project-pdf

November 1, 2023

1 Complete the steps given below:

1.1 1. Perform necessary EDA on the data

1.2 2. Use machine learning to create clusters of similar projects.

1.3 3. Create a regression model to predict the budget

1.4 4. Create a classification model to predict the value of the Type column.

[1]:

```python
import pandas as pd

df = pd.read_csv('Freelance_Platform_Projects[1].csv') # reading csv file
df.head() # display first five rows
```

[1]:

```
                                   Title         Category Name    Experience  \
0  Banner images for web desgin websites                Design     Entry ($)   
1    Make my picture a solid silhouette   Video, Photo & Image     Entry ($)   
2                      Bookkeeper needed              Business     Entry ($)   
3                     Accountant needed               Business     Entry ($)   
4          Guest Post on High DA Website     Digital Marketing  Expert ($$$)   

           Sub Category Name Currency   Budget Location  \
0             Graphic Design      EUR     60.0   remote   
1              Image Editing      GBP     20.0   remote   
2       Finance & Accounting      GBP     12.0   remote   
3  Tax Consulting & Advising      GBP     14.0   remote   
4                        SEO      USD  10000.0   remote   

  Freelancer Preferred From         Type          Date Posted  \
0                       ALL  fixed_price  2023-04-29 18:06:39   
1                       ALL  fixed_price  2023-04-29 17:40:28   
2                       ALL  fixed_price  2023-04-29 17:40:06   
3                       ALL  fixed_price  2023-04-29 17:32:01   
4                       ALL  fixed_price  2023-04-29 17:09:36   

                                         Description Duration  \
0  We are looking to improve the banner images on…      NaN   
1  Hello \n\nI need a quick designer to make 4 pi…      NaN   
```

```
2  Hi - I need a bookkeeper to assist with bookke…      NaN
3  Hi - I need an accountant to assist me with un…      NaN
4  Hi, I am currently running a project where I w…      NaN

  Client Registration Date Client City  Client Country Client Currency  \
0               2010-11-03      Dublin         Ireland             EUR
1               2017-02-21      London  United Kingdom             GBP
2               2023-04-09      London  United Kingdom             GBP
3               2023-04-09      London  United Kingdom             GBP
4               2016-07-01      Mumbai           India             USD

    Client Job Title
0     PPC Management
1     Office manager
2          Paralegal
3          Paralegal
4  Guest posts buyer
```

```
[2]: df.tail() # display last five rows
```

```
[2]:                                                    Title  \
12217  Published Travel Writer required for content c…
12218  Shopify - Filtering Work (Product Selection/No…
12219                                   Simple SQL Query
12220  Create a Carbon, Water, Waste Calculating plat…
12221                                  COMPANY REGISTERS

                  Category Name         Experience         Sub Category Name  \
12217     Writing & Translation          Entry ($)           Content Writing
12218                    Design  Intermediate ($$)                Web Design
12219  Technology & Programming          Entry ($)   Data Science & Analysis
12220                    Design       Expert ($$$)                Web Design
12221                  Business       Expert ($$$)  Administration Assistance

      Currency  Budget        Location Freelancer Preferred From         Type  \
12217      GBP    50.0          remote                       ALL  fixed_price
12218      GBP    65.0  remote_country                        GB  fixed_price
12219      GBP    50.0          remote                       ALL  fixed_price
12220      USD    39.0          remote                       ALL       hourly
12221      GBP    75.0          remote                       ALL  fixed_price

               Date Posted                                        Description  \
12217  2023-01-18 19:23:01  I am looking for a published travel writer to …
12218  2023-01-18 19:18:48  On our website www.juicebitz.co.uk we have add…
12219  2023-01-18 19:18:48  I need someone to write a quick SQL query on a…
12220  2023-01-18 19:18:47  I am seeking a full stack web developer who sp…
12221  2023-01-18 19:18:47  Hi, the following administrative task would be…
```

```
            Duration Client Registration Date Client City  Client Country  \
12217            NaN               2011-06-06   Amsterdam     Netherlands
12218  1 day or less               2022-03-23       Filey  United Kingdom
12219            NaN               2022-03-14      London  United Kingdom
12220            NaN               2013-07-21       Noida           India
12221            NaN               2020-09-21       Grays  United Kingdom

      Client Currency                                   Client Job Title
12217             GBP                                   Wordpress Expert
12218             GBP                                           Director
12219             GBP                                                NaN
12220             USD  Google Adwords, Pay Per Click, Google Shopping…
12221             GBP                                                NaN
```

[3]:

```python
df.size # no of total elements
```

[3]:

```
207774
```

[4]:

```python
df.shape # no of rows = 12222 , no of column = 17
```

[4]:

```
(12222, 17)
```

[5]:

```python
df.info() # detailed info of your data

# Number of rows = 12222
# Number of columns = 17
# For every column
# => Name of column
# => Number of not null values
# => Number of null value = Total rows - Not null values
# => Data type
# Number of columns for each data type
# Memory usage
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 12222 entries, 0 to 12221
Data columns (total 17 columns):
 #   Column                     Non-Null Count  Dtype
---  ------                     --------------  -----
 0   Title                      12222 non-null  object
 1   Category Name              12222 non-null  object
 2   Experience                 12222 non-null  object
 3   Sub Category Name          12222 non-null  object
 4   Currency                   12222 non-null  object
 5   Budget                     12222 non-null  float64
 6   Location                   12222 non-null  object
 7   Freelancer Preferred From  12222 non-null  object
 8   Type                       12222 non-null  object
 9   Date Posted                12222 non-null  object
 10  Description                12222 non-null  object
 11  Duration                   1602 non-null   object
 12  Client Registration Date   12222 non-null  object
 13  Client City                12222 non-null  object
 14  Client Country             12222 non-null  object
 15  Client Currency            12222 non-null  object
 16  Client Job Title           4588 non-null   object
dtypes: float64(1), object(16)
memory usage: 1.6+ MB
```

```
[6]: df.drop(['Date Posted', 'Client Registration Date'], axis = 1, inplace = True)␣
      ↪# droping unnecessary columns
```

2 1) EDA

Perform necessary EDA on the data

2.1 Handling Missing Values

```
[7]: df.isnull().sum() # total no of missing values in each column
```

```
[7]: Title                            0
     Category Name                    0
     Experience                       0
     Sub Category Name                0
     Currency                         0
     Budget                           0
     Location                         0
     Freelancer Preferred From        0
     Type                             0
     Description                      0
     Duration                     10620
     Client City                      0
     Client Country                   0
     Client Currency                  0
     Client Job Title              7634
     dtype: int64
```

Here, we have 2 option to deal with this: 1) Deletion : removal of data or records from a dataset. 2) Imputation : process of filling in missing values with estimated or substituted data.

```
[8]: # display the rows in which the 'Duration' column has missing values.

     missing_rows = df.index[df['Duration'].isna()==True]
```

```
df.loc[missing_rows,'Duration']
```

```
[8]: 0        NaN
     1        NaN
     2        NaN
     3        NaN
     4        NaN
             …
     12216    NaN
     12217    NaN
     12219    NaN
     12220    NaN
     12221    NaN
     Name: Duration, Length: 10620, dtype: object
```

```
[9]: # Imputation (Maximum values are missing so we can't delete it because after␣
      ↪deletion we will have very less data)

     df['Duration'].fillna("Not Available", inplace=True)
     df.loc[missing_rows,:]
```

```
[9]:                                              Title  \
     0                 Banner images for web desgin websites
     1                   Make my picture a solid silhouette
     2                                     Bookkeeper needed
     3                                    Accountant needed
     4                           Guest Post on High DA Website
     …                                                   …
     12216                                  Simple SQL Query
     12217  Published Travel Writer required for content c…
     12219                                  Simple SQL Query
     12220  Create a Carbon, Water, Waste Calculating plat…
     12221                                 COMPANY REGISTERS

                      Category Name    Experience          Sub Category Name  \
     0                       Design     Entry ($)            Graphic Design
     1         Video, Photo & Image     Entry ($)             Image Editing
     2                     Business     Entry ($)       Finance & Accounting
     3                     Business     Entry ($)  Tax Consulting & Advising
     4            Digital Marketing   Expert ($$$)                       SEO
     …                          …           …                         …
     12216  Technology & Programming     Entry ($)                 Databases
     12217     Writing & Translation     Entry ($)           Content Writing
     12219  Technology & Programming     Entry ($)    Data Science & Analysis
     12220                    Design   Expert ($$$)                Web Design
     12221                  Business   Expert ($$$)  Administration Assistance
```

```
      Currency   Budget Location Freelancer Preferred From         Type  \
0          EUR     60.0   remote                       ALL  fixed_price
1          GBP     20.0   remote                       ALL  fixed_price
2          GBP     12.0   remote                       ALL  fixed_price
3          GBP     14.0   remote                       ALL  fixed_price
4          USD  10000.0   remote                       ALL  fixed_price
…        …      …      …                       …          …
12216      GBP     30.0   remote                       ALL  fixed_price
12217      GBP     50.0   remote                       ALL  fixed_price
12219      GBP     50.0   remote                       ALL  fixed_price
12220      USD     39.0   remote                       ALL       hourly
12221      GBP     75.0   remote                       ALL  fixed_price

                                             Description       Duration  \
0      We are looking to improve the banner images on…  Not Available
1      Hello \n\nI need a quick designer to make 4 pi…  Not Available
2      Hi - I need a bookkeeper to assist with bookke…  Not Available
3      Hi - I need an accountant to assist me with un…  Not Available
4      Hi, I am currently running a project where I w…  Not Available
…                                                  …             …
12216  I need someone to write a quick SQL query base…  Not Available
12217  I am looking for a published travel writer to …  Not Available
12219  I need someone to write a quick SQL query on a…  Not Available
12220  I am seeking a full stack web developer who sp…  Not Available
12221  Hi, the following administrative task would be…  Not Available

      Client City  Client Country Client Currency  \
0          Dublin         Ireland             EUR
1          London  United Kingdom             GBP
2          London  United Kingdom             GBP
3          London  United Kingdom             GBP
4          Mumbai           India             USD
…            …             …             …
12216      London  United Kingdom             GBP
12217   Amsterdam     Netherlands             GBP
12219      London  United Kingdom             GBP
12220       Noida           India             USD
12221       Grays  United Kingdom             GBP

                                        Client Job Title
0                                         PPC Management
1                                         Office manager
2                                              Paralegal
3                                              Paralegal
4                                      Guest posts buyer
…                                                  …
12216                                                NaN
```

```
12217                                   Wordpress Expert
12219                                                NaN
12220  Google Adwords, Pay Per Click, Google Shopping…
12221                                                NaN

[10620 rows x 15 columns]
```

[10]:

```
# display the rows in which the 'Client Job Title' column has missing values.

missing_rows = df.index[df['Client Job Title'].isna()==True]
df.loc[missing_rows,'Client Job Title']
```

[10]:

```
6        NaN
8        NaN
9        NaN
11       NaN
15       NaN
        …
12213    NaN
12214    NaN
12216    NaN
12219    NaN
12221    NaN
Name: Client Job Title, Length: 7634, dtype: object
```

[11]:

```
# Imputation

df['Client Job Title'].fillna("Not Available", inplace=True)
df.loc[missing_rows,:]
```

[11]:

```
                                                   Title  \
6                     Make web site for Tutoring company
8                                             E-learning
9      19 sentences recording. native english speaker…
11          Looking for someone to configure AWS server
15                                    Logo colour change
…                                                  …
12213   Need someone with Clickhouse Database expertise
12214                            modify existing flyer
12216                                   Simple SQL Query
12219                                   Simple SQL Query
12221                                  COMPANY REGISTERS

                  Category Name         Experience          Sub Category Name  \
6                        Design          Entry ($)                 Web Design
8                        Design  Intermediate ($$)     Illustration & Drawing
9                 Music & Audio          Entry ($)                 Voice-Over
```

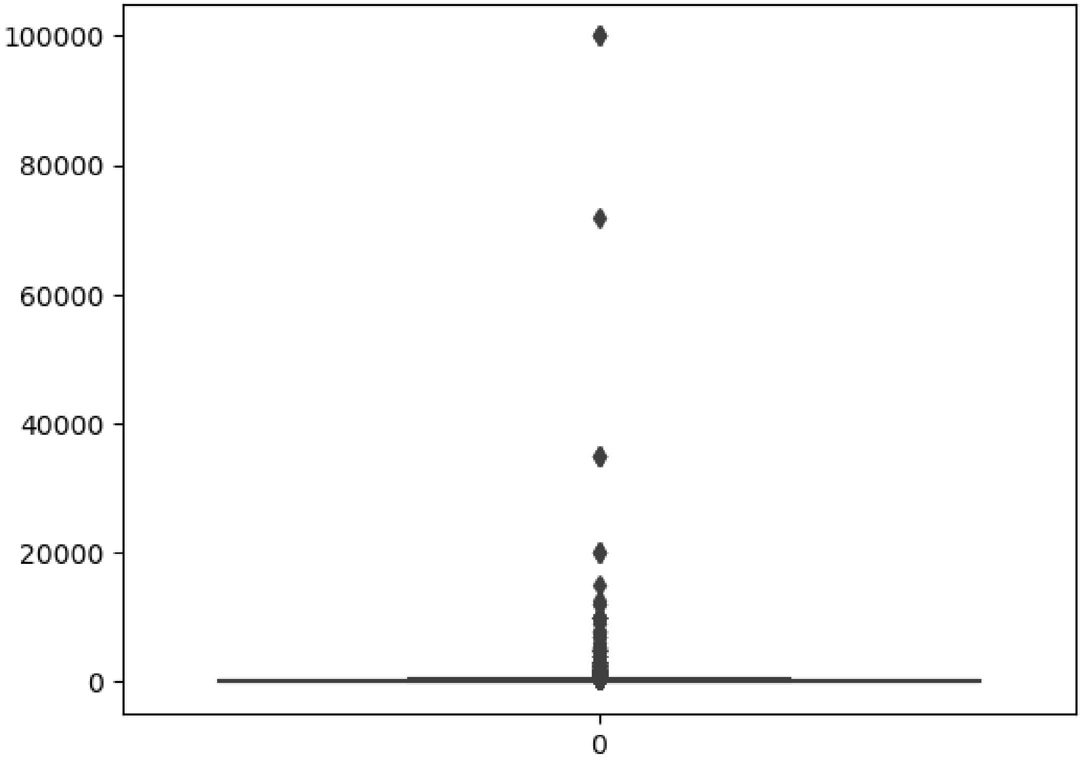
```
11     Technology & Programming       Expert ($$$)        Website Development
15                       Design          Entry ($)                Logo Design
…                         …                …                         …
12213  Technology & Programming          Entry ($)                  Databases
12214                    Design          Entry ($)             Graphic Design
12216  Technology & Programming          Entry ($)                  Databases
12219  Technology & Programming          Entry ($)    Data Science & Analysis
12221                  Business       Expert ($$$)  Administration Assistance

      Currency  Budget Location Freelancer Preferred From         Type  \
6          USD    10.0   remote                       ALL  fixed_price
8          GBP     0.0   remote                       ALL  fixed_price
9          USD    10.0   remote                       ALL  fixed_price
11         EUR    31.0   remote                       ALL       hourly
15         USD    10.0   remote                       ALL  fixed_price
…        …     …      …                       …          …
12213      USD   120.0   remote                       ALL  fixed_price
12214      USD    15.0   remote                       ALL  fixed_price
12216      GBP    30.0   remote                       ALL  fixed_price
12219      GBP    50.0   remote                       ALL  fixed_price
12221      GBP    75.0   remote                       ALL  fixed_price

                                             Description       Duration  \
6      I need to build web site for my tutoring compa…    1 - 2 weeks
8      Looking for a quote for an introductory e-lear…  Not Available
9      1.  need native speaker from US or UK or CA\n2…  Not Available
11     Hi we are looking to deploy our domain from go…  Not Available
15     Very easy job, I literally just need my logo c…  Not Available
…                                                  …            …
12213  I want to do a clickhouse database project whi…  Not Available
12214  i would like to modify a existing flyer which …  Not Available
12216  I need someone to write a quick SQL query base…  Not Available
12219  I need someone to write a quick SQL query on a…  Not Available
12221  Hi, the following administrative task would be…  Not Available

      Client City  Client Country Client Currency Client Job Title
6          London  United Kingdom             USD    Not Available
8         Glasgow  United Kingdom             GBP    Not Available
9          Sydney       Australia             GBP    Not Available
11       Budapest         Hungary             USD    Not Available
15          Menai       Australia             USD    Not Available
…           …             …             …              …
12213     Fremont   United States             USD    Not Available
12214     Dieburg         Germany             EUR    Not Available
12216      London  United Kingdom             GBP    Not Available
12219      London  United Kingdom             GBP    Not Available
12221       Grays  United Kingdom             GBP    Not Available
```

```
[7634 rows x 15 columns]
```

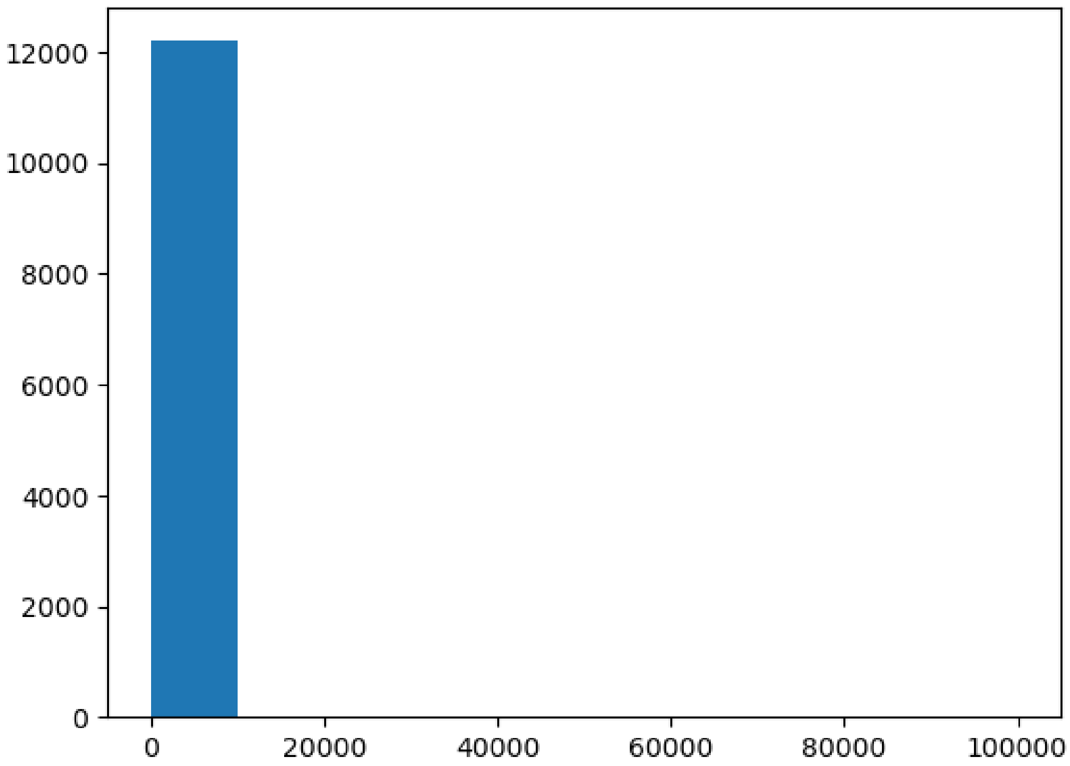
2.2 Handling Outliers

[12]:
```
import seaborn as sns

sns.boxplot(df['Budget']) # checking outliers(we are using 'Budget' column␣
↪because it is only numeric column we have)
```

[12]:
```
<Axes: >
```



[13]:
```
import matplotlib.pyplot as plt

plt.hist(df['Budget']) # Create a histogram of the 'Budget' column in the␣
↪DataFrame 'df'
plt.show()
```



[14]:

```
# probably the reason of so many outliers is 'skewness'

df['Budget'].skew() # >5 is considered as high
```

[14]:

```
42.455398395555996
```

[15]:

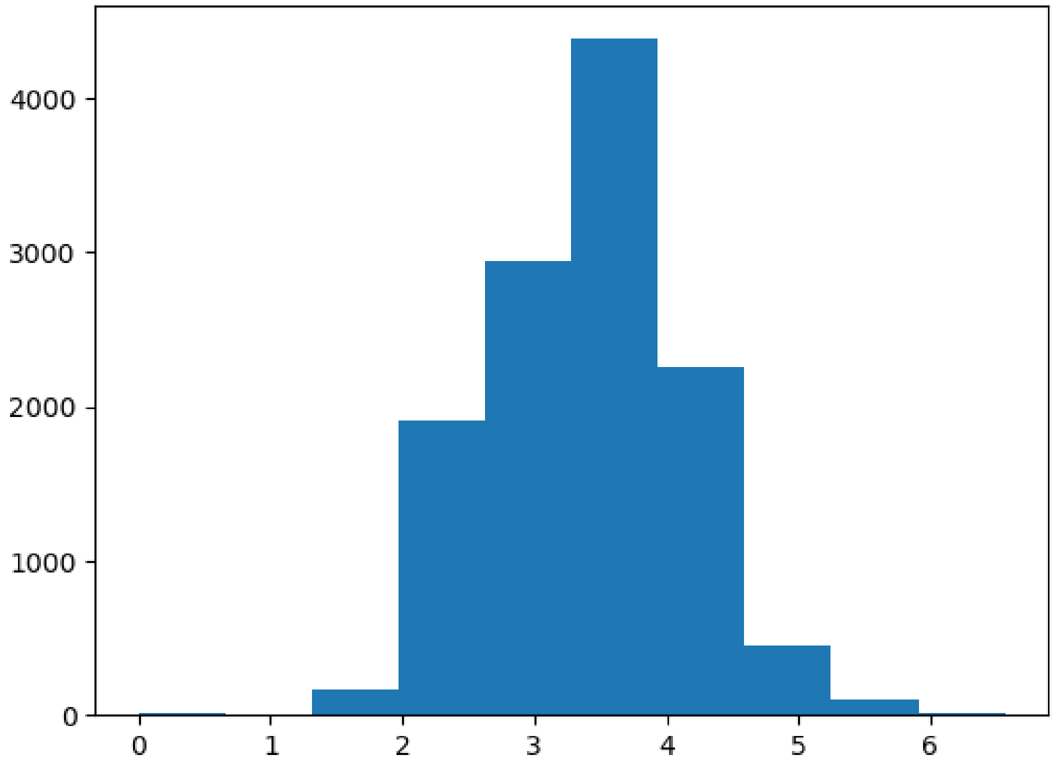
```
# to handle skewness we use boxcox

from scipy.stats import boxcox

df['Budget'] = df['Budget'] + 1  # Adding 1 to make values positive
df['Budget'] = boxcox(df['Budget'])[0]
df['Budget'].skew()
```

[15]:

```
-0.021454219174626175
```

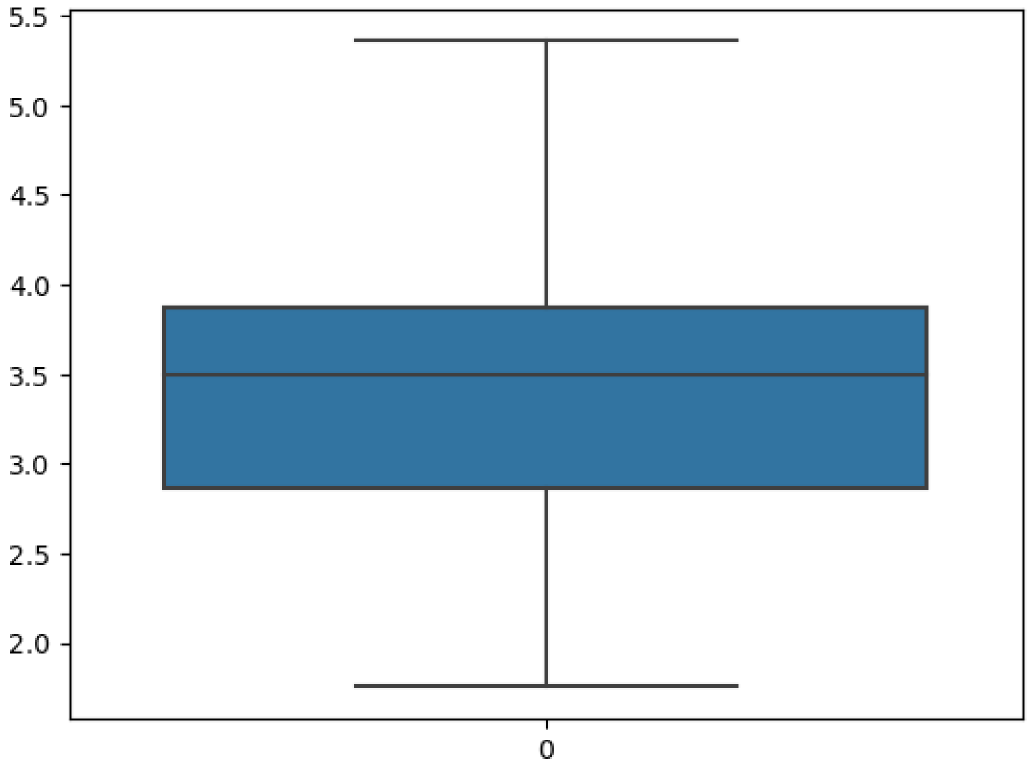
[16]:

```
plt.hist(df['Budget'])
plt.show()
```



[17]:
```
# Calculate the IQR, lower, and upper bounds

Q1 = df['Budget'].quantile(0.25)
Q3 = df['Budget'].quantile(0.75)
IQR = Q3 - Q1
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

# Identify and remove outliers
outliers = df[(df['Budget'] < lower_bound) | (df['Budget'] > upper_bound)]
df = df[(df['Budget'] >= lower_bound) & (df['Budget'] <= upper_bound)]

# Create the box plot
sns.boxplot(df['Budget'])
```

[17]:
```
<Axes: >
```



2.3 Categorical Data Encoding

[18]:
```
df.dtypes
```

[18]:
```
Title                           object
Category Name                   object
Experience                      object
Sub Category Name               object
Currency                        object
Budget                         float64
Location                        object
Freelancer Preferred From       object
Type                            object
Description                     object
Duration                        object
Client City                     object
Client Country                  object
Client Currency                 object
Client Job Title                object
dtype: object
```

[19]:

```
# Label Encoding (Label encoding is used to represent categorical data as␣
 ↪ordinal integers)

from sklearn.preprocessing import LabelEncoder

def label_encode_columns(df, columns):
    for col in columns:
        encoder = LabelEncoder()
        encoding = encoder.fit_transform(df[col])
        df[col] = encoding
        var = df[col].head()
        print(var)

# List of columns to label encode
columns_to_encode = ['Title', 'Category Name', 'Experience', 'Sub Category␣
 ↪Name', 'Currency',
                     'Location', 'Freelancer Preferred From', 'Type',␣
 ↪'Description', 'Duration',
                     'Client City', 'Client Country', 'Client Currency',␣
 ↪'Client Job Title']

# Call the function to label encode the specified columns
label_encode_columns(df, columns_to_encode)
```

```
0     956
1    6335
2    1094
3     461
5    1800
Name: Title, dtype: int32
0    1
1    7
2    0
3    0
5    6
Name: Category Name, dtype: int32
0    0
1    0
2    0
3    0
5    1
Name: Experience, dtype: int32
0    42
1    45
2    37
3    90
5    26
```

```
Name: Sub Category Name, dtype: int32
0    0
1    1
2    1
3    1
5    0
Name: Currency, dtype: int32
0    1
1    1
2    1
3    1
5    1
Name: Location, dtype: int32
0    1
1    1
2    1
3    1
5    1
Name: Freelancer Preferred From, dtype: int32
0    0
1    0
2    0
3    0
5    0
Name: Type, dtype: int32
0    10364
1     1236
2     2161
3     2163
5      564
Name: Description, dtype: int32
0    21
1    21
2    21
3    21
5    21
Name: Duration, dtype: int32
0    489
1    936
2    936
3    936
5    488
Name: Client City, dtype: int32
0     61
1    129
2    129
3    129
5    128
```

```
Name: Client Country, dtype: int32
0    0
1    1
2    1
3    1
5    0
Name: Client Currency, dtype: int32
0    1177
1    1127
2    1194
3    1194
5     149
Name: Client Job Title, dtype: int32
```

Scaling : Scaling improve the performance and interpretability of various machine learning algorithms. Types - 1) StandardScaler 2) MinMaxScaler

[20]:

```
# we are using SS because it is suitable for a wide range of data and models

from sklearn.preprocessing import StandardScaler

scaler = StandardScaler()
df['Budget'] = scaler.fit_transform(df[['Budget']]) # fit - calculating mean␣
 ↪and sd of data & transform - value after scaling
df['Budget'][:5]
```

[20]:

```
0   -0.123392
1   -1.141924
2   -1.639954
3   -1.488617
5    1.571911
Name: Budget, dtype: float64
```

[21]:

```
df['Budget'].mean() # Calculate the mean value of the 'result' data
```

[21]:

```
8.809324647310018e-16
```

[22]:

```
import numpy as np
median_value = np.median(df['Budget']) # Calculate the median value of the␣
 ↪'result' data using numpy
median_value
```

[22]:

```
0.12815933375328264
```

[23]:

```
from scipy import stats
mode_value = stats.mode(df['Budget']) # Calculate the mode value of the␣
 ↪'result' data using scipy's mode function
mode_value
```

```
C:\Users\Sapna\AppData\Local\Temp\ipykernel_10196\2282642316.py:2:
FutureWarning: Unlike other reduction functions (e.g. `skew`, `kurtosis`), the
default behavior of `mode` typically preserves the axis it acts along. In SciPy
1.11.0, this behavior will change: the default value of `keepdims` will become
False, the `axis` over which the statistic is taken will be eliminated, and the
value None will no longer be accepted. Set `keepdims` to True or False to avoid
this warning.
  mode_value = stats.mode(df['Budget']) # Calculate the mode value of the
'result' data using scipy's mode function
```

[23]:
```
ModeResult(mode=array([0.31861116]), count=array([743]))
```

[24]:
```
df['Budget'].std() # Calculate the standard deviation of the 'result' data
```

[24]:
```
1.0000412056781718
```

[25]:
```
df['Budget'].min() # Find the minimum value in the 'Budget' column of the␣
 ↪DataFrame 'df'
```

[25]:
```
-2.322457346222455
```

[26]:
```
df['Budget'].max() # Find the maximum value in the 'Budget' column of the␣
 ↪DataFrame 'df'
```

[26]:
```
2.7526630506423064
```

Unsupervised Learning : a type of machine learning where the algorithm is trained on data without explicit supervision or labeled outcomes.(most common way of doing UL is 'Clustering')

3 2) Cluster

Use machine learning to create clusters of similar projects. Data points within one cluster are expected to be similar to each other.

Data points in different clusters are expected to be different from each other.

k-mean clustering : It aims to partition the n observation into k (<=n) sets so as to minimize the within cluster sum of squares(wcss)

[27]:
```
x = df.iloc[:, [0,1,2,3,4]]
x.head()
```

[27]:
```
   Title  Category Name  Experience  Sub Category Name  Currency
0    956              1           0                 42         0
1   6335              7           0                 45         1
2   1094              0           0                 37         1
3    461              0           0                 90         1
5   1800              6           1                 26         0
```

[28]:
```python
from sklearn.cluster import KMeans

wcss_list = []
# Loop through a range of cluster numbers from 1 to 10
for i in range(1,11):
    model = KMeans(n_clusters=i)
    model.fit(x)
    wcss = model.inertia_ # Calculate the WCSS for the current number of␣
 ↪clusters
    wcss_list.append(wcss) # Append the WCSS value to the list

wcss_list # Display the list of WCSS values for different cluster numbers
```

```
C:\Users\Sapna\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\Sapna\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\Sapna\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\Sapna\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\Sapna\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
C:\Users\Sapna\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
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```

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  super()._check_params_vs_input(X, default_n_init=10)
```

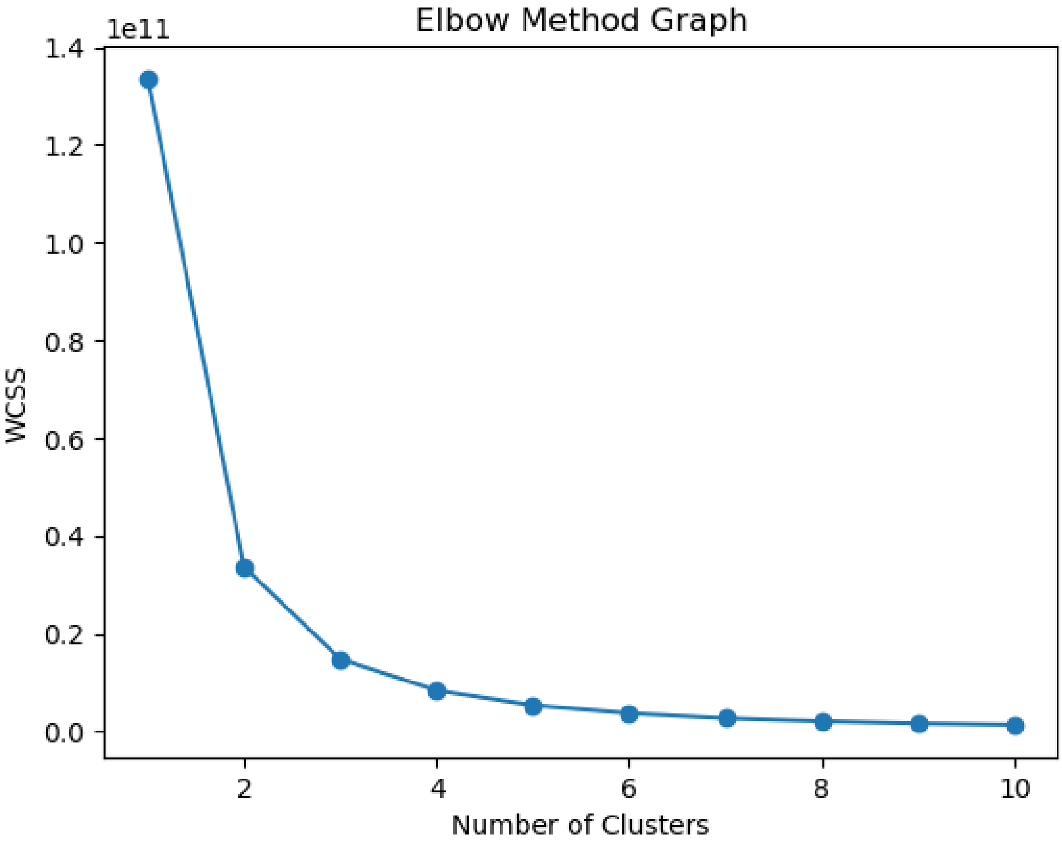
[28]:

```
[133590593098.89883,
 33673762370.248634,
 14790098656.414959,
 8401938819.139595,
 5352760997.224634,
 3756407150.835943,
 2727560227.2335005,
 2106972434.0767555,
 1655536457.5855198,
 1357347335.5917444]
```

[29]:

```python
import matplotlib.pyplot as plt

plt.plot(range(1,11), wcss_list,'-o') # Create a line plot of the WCSS values␣
 ↪for different numbers of clusters
plt.title('Elbow Method Graph') # Set the title of the plot
plt.xlabel('Number of Clusters') # Set the label for the x-axis
plt.ylabel('WCSS') # Set the label for the y-axis
plt.show() # Display the plot
```



[30]:
```
kmeans = KMeans(n_clusters=3)
kmeans.fit(x) # no 'y' because it's unsupervised
pred = kmeans.predict(x)
pred[:3]
```

```
C:\Users\Sapna\anaconda3\Lib\site-packages\sklearn\cluster\_kmeans.py:1412:
FutureWarning: The default value of `n_init` will change from 10 to 'auto' in
1.4. Set the value of `n_init` explicitly to suppress the warning
  super()._check_params_vs_input(X, default_n_init=10)
```

[30]:
```
array([0, 2, 0])
```

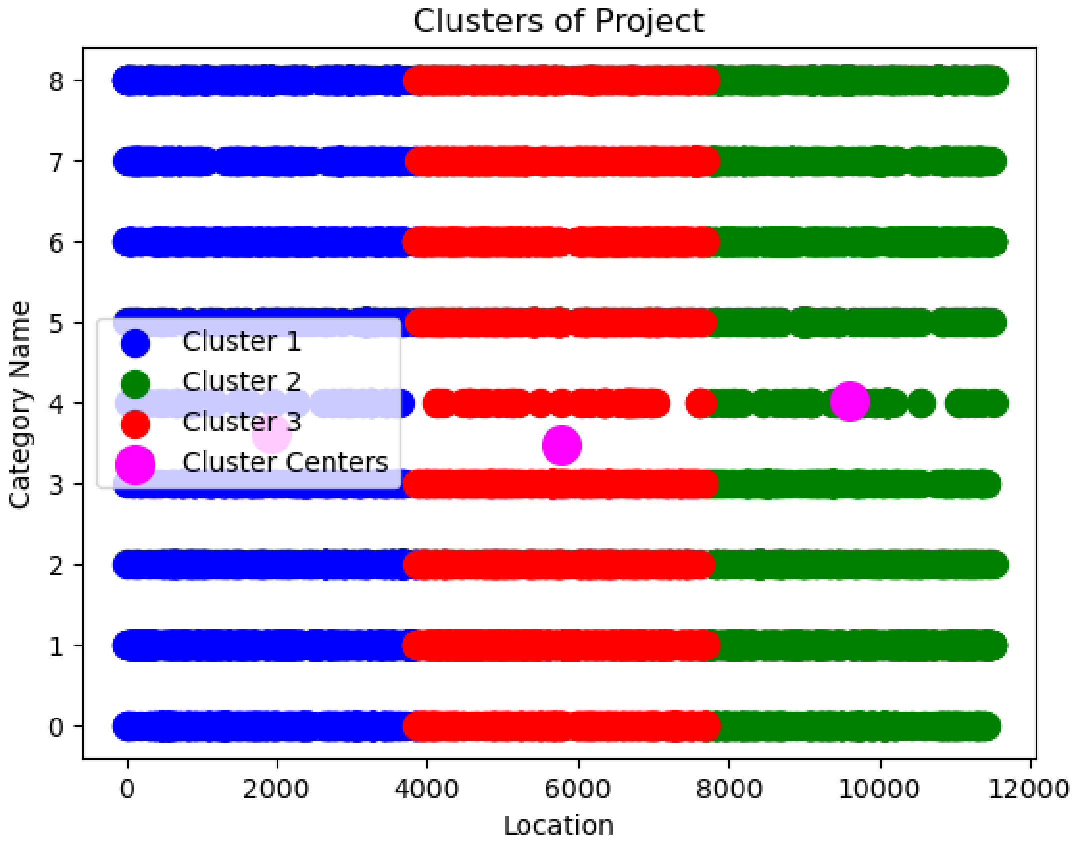
[31]:
```
kmeans.cluster_centers_
```

[31]:
```
array([[1.92603392e+03, 3.61252785e+00, 7.01658826e-01, 5.25768755e+01,
        1.17504333e+00],
       [9.60057880e+03, 4.03201787e+00, 6.54753040e-01, 6.25624224e+01,
        1.17175478e+00],
       [5.78141775e+03, 3.47848537e+00, 6.95106958e-01, 5.51703959e+01,
        1.20752397e+00]])
```

[32]:

```
# Create scatter plots for each cluster and cluster centers

plt.scatter(x.iloc[pred==0, 0], x.iloc[pred==0, 1],
            s=100, c='blue', label='Cluster 1')
plt.scatter(x.iloc[pred==1, 0], x.iloc[pred==1, 1],
            s=100, c='green', label='Cluster 2')
plt.scatter(x.iloc[pred==2, 0], x.iloc[pred==2, 1],
            s=100, c='red', label='Cluster 3')
plt.scatter(kmeans.cluster_centers_[:,0],
            kmeans.cluster_centers_[:, 1],
            s=200, c='magenta', label='Cluster Centers')
plt.title('Clusters of Project') # Set the title of the plot
plt.xlabel('Location') # Set the label for the x-axis
plt.ylabel('Category Name') # Set the label for the y-axis
plt.legend() # Add a legend to the plot to distinguish data points and cluster␣
 ↪centers
plt.show() # Display the plot
```



4 3) Regression

Create a regression model to predict the ‘budget’. Target variable is continuous(’Budget’)

[33]:
```
df.head()
```

[33]:
```
   Title  Category Name  Experience  Sub Category Name  Currency    Budget  \
0    956              1           0                 42         0 -0.123392
1   6335              7           0                 45         1 -1.141924
2   1094              0           0                 37         1 -1.639954
3    461              0           0                 90         1 -1.488617
5   1800              6           1                 26         0  1.571911

   Location  Freelancer Preferred From  Type  Description  Duration  \
0         1                          1     0        10364        21
1         1                          1     0         1236        21
2         1                          1     0         2161        21
3         1                          1     0         2163        21
5         1                          1     0          564        21

   Client City  Client Country  Client Currency  Client Job Title
0          489              61                0              1177
1          936             129                1              1127
2          936             129                1              1194
3          936             129                1              1194
5          488             128                0               149
```

[34]:
```
# split the data into x and y

x = df.drop(columns=['Budget'])
y = df['Budget']
```

[35]:
```
# Split the data into training and testing

from sklearn.model_selection import train_test_split

xtrain, xtest, ytrain, ytest=train_test_split(x,y,
                                              train_size=0.7,
                                             random_state=1)
```

4.0.1 XGBoost Regression

[36]:
```
!pip install xgboost
```

```
Requirement already satisfied: xgboost in c:\users\sapna\anaconda3\lib\site-
packages (2.0.0)
Requirement already satisfied: numpy in c:\users\sapna\anaconda3\lib\site-
packages (from xgboost) (1.24.3)
```

```
Requirement already satisfied: scipy in c:\users\sapna\anaconda3\lib\site-
packages (from xgboost) (1.10.1)
```

```
[37]: import xgboost as xgb

      model = xgb.XGBRegressor() # Create an instance of the XGBRegressor model
      model.fit(xtrain, ytrain) # Fit the model to the training data
      trainpred = model.predict(xtrain) # Make predictions on the training data
      trainpred[:5] # Display the first 5 predictions
```

```
[37]: array([ 1.3640537 ,  1.3072898 , -1.5222318 ,  0.99022496, -0.66387075],
            dtype=float32)
```

```
[38]: testpred = model.predict(xtest) # Make predictions on the test data using the␣
        ↪trained model
      testpred # Display the test predictions
```

```
[38]: array([-0.7291285 ,  0.70003724, -1.0932764 , …, -0.944017  ,
             -0.6009989 , -1.0011668 ], dtype=float32)
```

```
[39]: from sklearn.metrics import mean_squared_error

      mean_squared_error(ytrain, trainpred) # Calculate the mean squared error for␣
        ↪training data
```

```
[39]: 0.13185775409381667
```

```
[40]: mean_squared_error(ytest, testpred) # Calculate the mean squared error for test␣
        ↪data
```

```
[40]: 0.3316048886167132
```

```
[41]: from sklearn.metrics import mean_absolute_error

      # Calculate the mean absolute error (MAE) for the training predictions and true␣
        ↪training labels
      mae_train = mean_absolute_error(ytrain,trainpred)
      mae_train
```

```
[41]: 0.25981870039243443
```

```
[42]: # Calculate the mean absolute error (MAE) for the testing predictions and true␣
        ↪testing labels
      mae_test = mean_absolute_error(ytest,testpred)
      mae_test
```

```
[42]: 0.42899353652810474
```

5 4) Classification

Create a classification model to predict the value of the ‘Type’ column.

[43]:
```
# split the data into x and y

x = df.drop(columns=['Type'])
y = df['Type']
```

[44]:
```
from sklearn.model_selection import train_test_split

xtrain, xtest, ytrain, ytest = train_test_split(x,y,
                                                train_size=0.7,
                                                random_state=1)
```

5.0.1 Random Forest Classification

[45]:
```
from sklearn.ensemble import RandomForestClassifier

model = RandomForestClassifier(n_estimators=100) # Create a Random Forest␣
 ↪Classifier model with 100 trees (n_estimators)
model.fit(xtrain, ytrain) # Fit the model to the training data
trainpred = model.predict(xtrain) # Make predictions on the training data
trainpred[:5]  # Display the first 5 predictions
```

[45]:
```
array([0, 0, 1, 0, 1])
```

[46]:
```
model.predict_proba(xtrain)[:5] # Predict probabilities for training data
```

[46]:
```
array([[1.  , 0.  ],
       [1.  , 0.  ],
       [0.1 , 0.9 ],
       [1.  , 0.  ],
       [0.08, 0.92]])
```

[47]:
```
from sklearn.metrics import classification_report

# Generate a classification report to evaluate the model's performance on the␣
 ↪training data
print(classification_report(ytrain, trainpred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00      7241
           1       1.00      1.00      1.00      1253

    accuracy                           1.00      8494
   macro avg       1.00      1.00      1.00      8494
```

```
weighted avg       1.00      1.00      1.00      8494
```

[48]:

```python
# Generate a classification report to evaluate the model's performance on the test data
testpred = model.predict(xtest)
print(classification_report(ytest, testpred))
```

```
              precision    recall  f1-score   support

           0       0.96      0.98      0.97      3109
           1       0.88      0.75      0.81       532

    accuracy                           0.95      3641
   macro avg       0.92      0.87      0.89      3641
weighted avg       0.95      0.95      0.95      3641
```