Project - 2

May 26, 2021

[12]:
```
import numpy as np
import pandas as pd
import re
import matplotlib.pyplot as plt
from matplotlib import style
%matplotlib inline
```

[13]:
```
#Importing all 3 Datasets
users_data = pd.read_csv("users.dat",sep="::", header=None,␣
 ↪names=['UserID','Gender','Age','Occupation','Zip-code'],
            dtype={'UserID': np.int32, 'Gender': np.str, 'Age': np.int32,␣
 ↪'Occupation' : np.int32, 'Zip-code' : np.str},
            engine='python')
movie_data = pd.read_csv("movies.dat",
                         sep="::", header=None,␣
 ↪names=['MovieID','Title','Genres'],
                         dtype={'MovieID': np.int32, 'Title': np.str, 'Genres':␣
 ↪np.str}, engine='python')
ratings_data = pd.read_csv("ratings.dat",
                         sep="::", header=None,␣
 ↪names=['UserID','MovieID','Rating','Timestamp'],
                 dtype={'UserID': np.int32, 'MovieID': np.int32, 'Rating': np.
 ↪int32, 'Timestamp' : np.str}, engine='python')
```

[3]:
```
#Analysing the Datasets
#1) Users Data
users_data.head()
```

[3]:

	UserID	Gender	Age	Occupation	Zip-code
0	1	F	1	10	48067
1	2	M	56	16	70072
2	3	M	25	15	55117
3	4	M	45	7	02460
4	5	M	25	20	55455

[4]:
```
users_data.isnull().sum()
```

[4]:
```
UserID        0
Gender        0
Age           0
Occupation    0
Zip-code      0
dtype: int64
```

[5]:
```
users_data.shape
```

[5]:
```
(6040, 5)
```

[8]:
```
#2) Movie Data
movie_data.head()
```

[8]:

	MovieID	Title	Genres
0	1	Toy Story (1995)	Animation|Children's|Comedy
1	2	Jumanji (1995)	Adventure|Children's|Fantasy
2	3	Grumpier Old Men (1995)	Comedy|Romance
3	4	Waiting to Exhale (1995)	Comedy|Drama
4	5	Father of the Bride Part II (1995)	Comedy

[9]:
```
movie_data.isnull().sum()
```

[9]:
```
MovieID    0
Title      0
Genres     0
dtype: int64
```

[10]:
```
movie_data.shape
```

[10]:
```
(3883, 3)
```

[11]:
```
#3) Rating data
ratings_data.head()
```

[11]:

	UserID	MovieID	Rating	Timestamp
0	1	1193	5	978300760
1	1	661	3	978302109
2	1	914	3	978301968
3	1	3408	4	978300275
4	1	2355	5	978824291

[12]:
```
ratings_data.isnull().sum()
```

[12]:
```
UserID       0
MovieID      0
Rating       0
```

```
Timestamp    0
dtype: int64
```

[13]:
```
ratings_data.shape
```

[13]:
```
(1000209, 4)
```

[14]:
```
#Merging the Dataset and creating a Master Dataset
#Merging Users dataset and ratings dataset
Master_Data = pd.merge(users_data,ratings_data,on = 'UserID')
Master_Data.head()
```

[14]:

	UserID	Gender	Age	Occupation	Zip-code	MovieID	Rating	Timestamp
0	1	F	1	10	48067	1193	5	978300760
1	1	F	1	10	48067	661	3	978302109
2	1	F	1	10	48067	914	3	978301968
3	1	F	1	10	48067	3408	4	978300275
4	1	F	1	10	48067	2355	5	978824291

[15]:
```
#Merging Master Dataset and movie dataset
Master_Data=pd.merge(Master_Data,movie_data,on = 'MovieID')
Master_Data.head()
```

[15]:

	UserID	Gender	Age	Occupation	Zip-code	MovieID	Rating	Timestamp	\
0	1	F	1	10	48067	1193	5	978300760	
1	2	M	56	16	70072	1193	5	978298413	
2	12	M	25	12	32793	1193	4	978220179	
3	15	M	25	7	22903	1193	4	978199279	
4	17	M	50	1	95350	1193	5	978158471	

	Title	Genres
0	One Flew Over the Cuckoo's Nest (1975)	Drama
1	One Flew Over the Cuckoo's Nest (1975)	Drama
2	One Flew Over the Cuckoo's Nest (1975)	Drama
3	One Flew Over the Cuckoo's Nest (1975)	Drama
4	One Flew Over the Cuckoo's Nest (1975)	Drama

[16]:
```
#Preparing the Master datset as required
Master_Data = Master_Data.drop(['Zip-code'],axis=1)
Master_Data = Master_Data.drop(['Timestamp'],axis=1)
```

[17]:
```
Master_Data =␣
↪Master_Data[['UserID','Gender','Age','Occupation','MovieID','Title','Genres','Rating']]
Master_Data.head()
```

[17]:

	UserID	Gender	Age	Occupation	MovieID	\
0	1	F	1	10	1193	

```
1       2      M   56          16     1193
2      12      M   25          12     1193
3      15      M   25           7     1193
4      17      M   50           1     1193

                                    Title Genres  Rating
0  One Flew Over the Cuckoo's Nest (1975)  Drama       5
1  One Flew Over the Cuckoo's Nest (1975)  Drama       5
2  One Flew Over the Cuckoo's Nest (1975)  Drama       4
3  One Flew Over the Cuckoo's Nest (1975)  Drama       4
4  One Flew Over the Cuckoo's Nest (1975)  Drama       5
```

[57]:
```
#Data Visualizations
#1) User Age Distribution
```

[18]:
```
Age_count = users_data['Age'].value_counts()
Age_count
```

[18]:
```
25    2096
35    1193
18    1103
45     550
50     496
56     380
1      222
Name: Age, dtype: int64
```

[19]:
```
Age_Category = ('Under 18','18-24','25-34','35-44','45-49','50-55','56+')
x_position = np.arange(len(Age_Category))
x_position
```

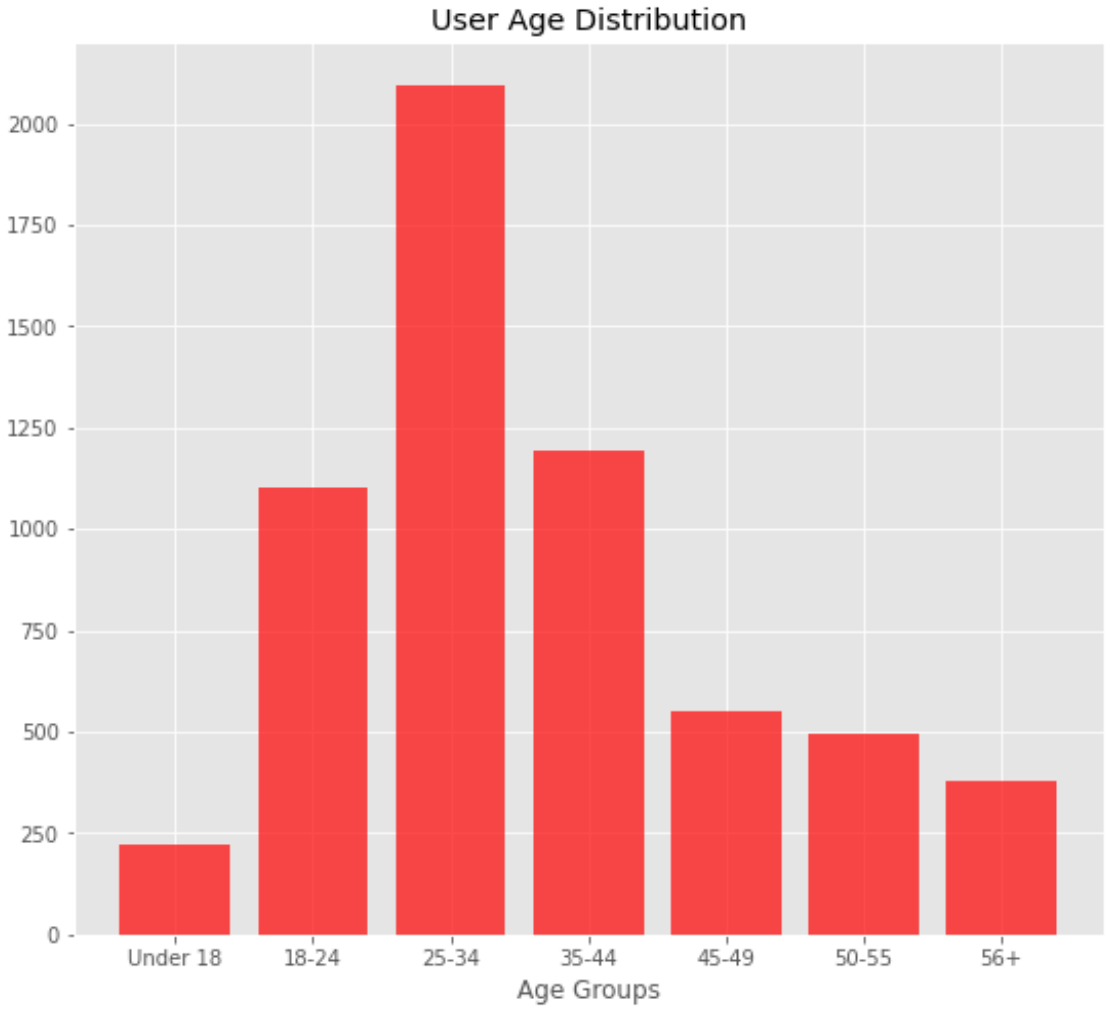
[19]:
```
array([0, 1, 2, 3, 4, 5, 6])
```

[20]:
```
Age_Values =␣
 ↪[Age_count[1],Age_count[18],Age_count[25],Age_count[35],Age_count[45],Age_count[50],Age_cou
Age_Values
```

[20]:
```
[222, 1103, 2096, 1193, 550, 496, 380]
```

[10]:
```
#plotting bar chart
style.use('ggplot')
plt.figure(figsize=(9,8))
plt.bar(x_position,Age_Values,align='center',color='r',alpha=0.7)
#set the y axis lable
plt.xlabel('Age Groups')
#set the bar value
plt.xticks(x_position,Age_Category)
```

```
#set the title
plt.title('User Age Distribution')
plt.show()
```



[142]:
```
#The above age distribution shows that most of the users are 25-34 years old
```

[1]:
```
#2) User ratings of movie Toy Story
```

[21]:
```
#Fetching thr Movie ID of Toy Story
movie_data.MovieID[movie_data.Title=='Toy Story (1995)']
```

[21]:
```
0    1
Name: MovieID, dtype: int32
```

[22]:
```
toystory_data = ratings_data[ratings_data.MovieID==1]
toystory_data.head(10)
```

[22]:

	UserID	MovieID	Rating	Timestamp
40	1	1	5	978824268
469	6	1	4	978237008
581	8	1	4	978233496
711	9	1	5	978225952
837	10	1	5	978226474
1966	18	1	4	978154768
2276	19	1	5	978555994
2530	21	1	3	978139347
2870	23	1	4	978463614
3405	26	1	3	978130703

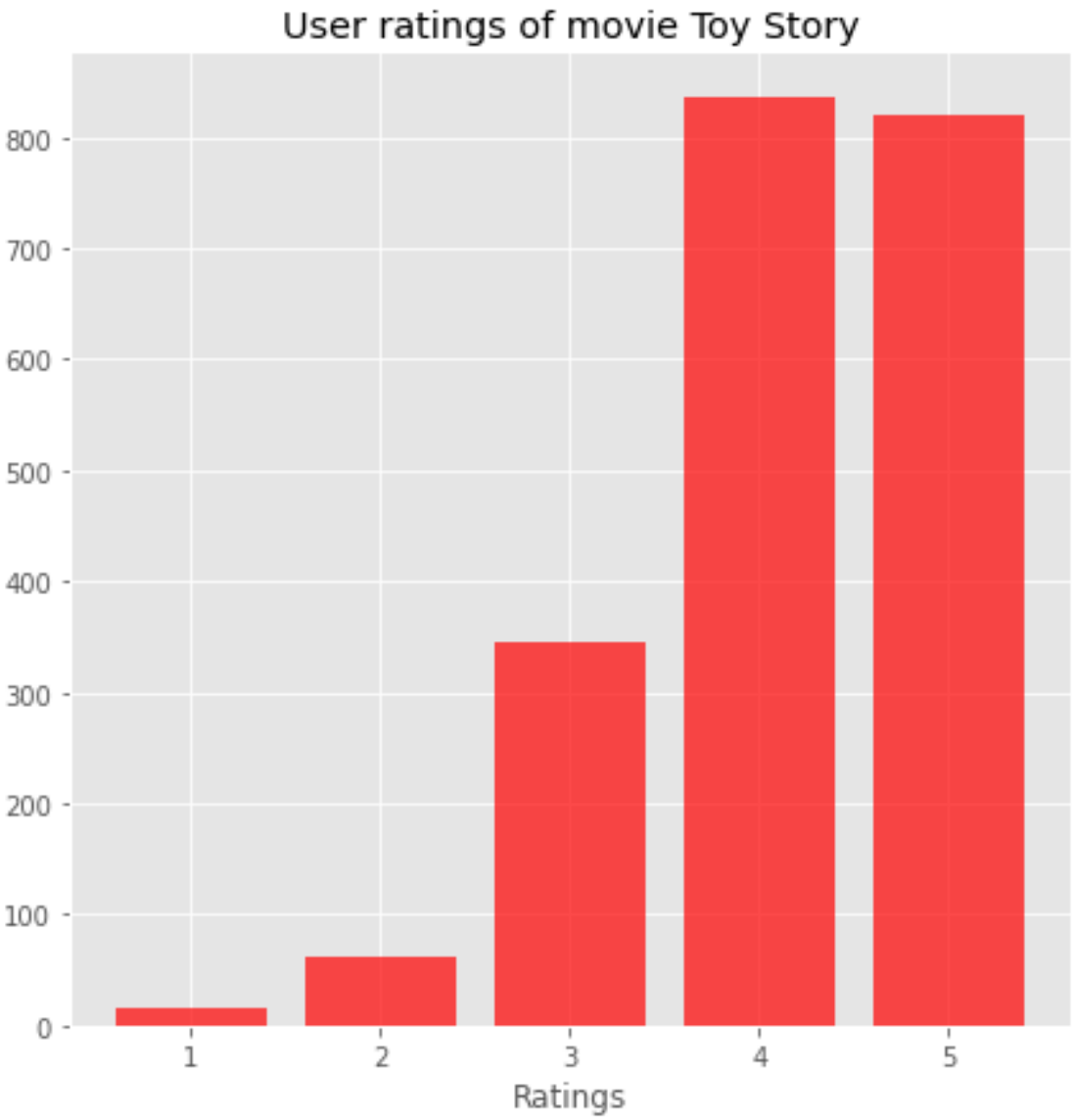
[23]:
```
movie_ratings_toystory = toystory_data.groupby('Rating').size()
movie_ratings_toystory
```

[23]:
```
Rating
1     16
2     61
3    345
4    835
5    820
dtype: int64
```

[24]:
```
ratings_type = ('1','2','3','4','5')
x_pos = np.arange(len(ratings_type))
x_pos
```

[24]:
```
array([0, 1, 2, 3, 4])
```

[15]:
```
#plotting bar chart
style.use('ggplot')
plt.figure(figsize=(7,7))
plt.bar(x_pos,movie_ratings_toystory,align='center',color='r',alpha=0.7)
#set the y axis lable
plt.xlabel('Ratings')
#set the bar value
plt.xticks(x_pos,ratings_type)
#set the title
plt.title('User ratings of movie Toy Story')
plt.show()
```



[53]:
```
#The above plot shows that the movie 'Toystory' has got 4 ** (stars) maximum
```

[20]:
```
#3) Top 25 movies by viewership rating
```

[25]:
```
#Fetching the Data and ratings of each movie by aggrega
movie_rating = Master_Data.groupby(['Title'], as_index=False)
average_movie_ratings = movie_rating.agg({'Rating':'mean'})
average_movie_ratings.head(25)
```

[25]:

	Title	Rating
0	$1,000,000 Duck (1971)	3.027027
1	'Night Mother (1986)	3.371429

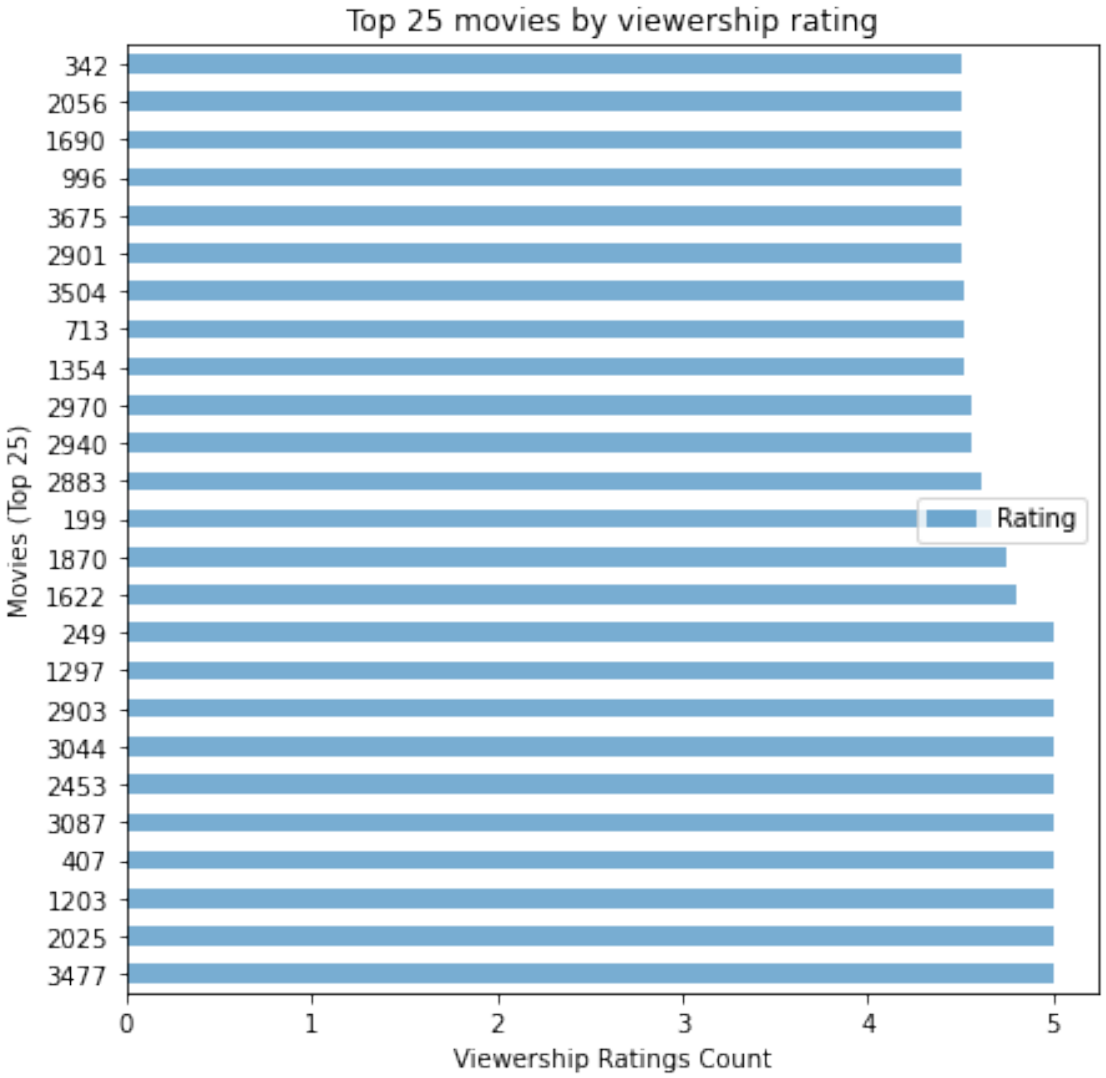
```
2                     'Til There Was You (1997)  2.692308
3                           'burbs, The (1989)  2.910891
4                …And Justice for All (1979)  3.713568
5                                1-900 (1994)  2.500000
6          10 Things I Hate About You (1999)  3.422857
7                       101 Dalmatians (1961)  3.596460
8                       101 Dalmatians (1996)  3.046703
9                         12 Angry Men (1957)  4.295455
10                  13th Warrior, The (1999)  3.158667
11                               187 (1997)  2.745455
12                2 Days in the Valley (1996)  3.283217
13                             20 Dates (1998)  2.856115
14       20,000 Leagues Under the Sea (1954)  3.702609
15                     200 Cigarettes (1999)  2.883978
16             2001: A Space Odyssey (1968)  4.068765
17                             2010 (1984)  3.417021
18            24 7: Twenty Four Seven (1997)  4.000000
19                      24-hour Woman (1998)  1.777778
20                           28 Days (2000)  3.065347
21  3 Ninjas: High Noon On Mega Mountain (1998)  1.361702
22                          3 Strikes (2000)  2.750000
23                           301, 302 (1995)  2.888889
24                      39 Steps, The (1935)  4.075099
```

[26]:
```
top_25_movies = average_movie_ratings.sort_values('Rating', ascending=False).
↪head(25)
top_25_movies
```

[26]:
```
                                                 Title    Rating
3477                          Ulysses (Ulisse) (1954)  5.000000
2025                                   Lured (1947)  5.000000
1203                          Follow the Bitch (1998)  5.000000
407                          Bittersweet Motel (2000)  5.000000
3087                           Song of Freedom (1936)  5.000000
2453                          One Little Indian (1973)  5.000000
3044                              Smashing Time (1967)  5.000000
2903          Schlafes Bruder (Brother of Sleep) (1995)  5.000000
1297                Gate of Heavenly Peace, The (1995)  5.000000
249                                  Baby, The (1973)  5.000000
1622               I Am Cuba (Soy Cuba/Ya Kuba) (1964)  4.800000
1870                                 Lamerica (1994)  4.750000
199                           Apple, The (Sib) (1998)  4.666667
2883                                  Sanjuro (1962)  4.608696
2940  Seven Samurai (The Magnificent Seven) (Shichin…  4.560510
2970                  Shawshank Redemption, The (1994)  4.554558
1354                               Godfather, The (1972)  4.524966
713                                Close Shave, A (1995)  4.520548
```

```
3504                          Usual Suspects, The (1995)  4.517106
2901                             Schindler's List (1993)  4.510417
3675                          Wrong Trousers, The (1993)  4.507937
996                Dry Cleaning (Nettoyage  sec) (1997)  4.500000
1690          Inheritors, The (Die Siebtelbauern) (1998)  4.500000
2056                                    Mamma Roma (1962)  4.500000
342                                     Bells, The (1926)  4.500000
```

[91]:
```
top_25_movies.plot(kind='barh',alpha=0.6,figsize=(7,7))
plt.xlabel("Viewership Ratings Count")
plt.ylabel("Movies (Top 25)")
plt.title("Top 25 movies by viewership rating")
plt.show()
```

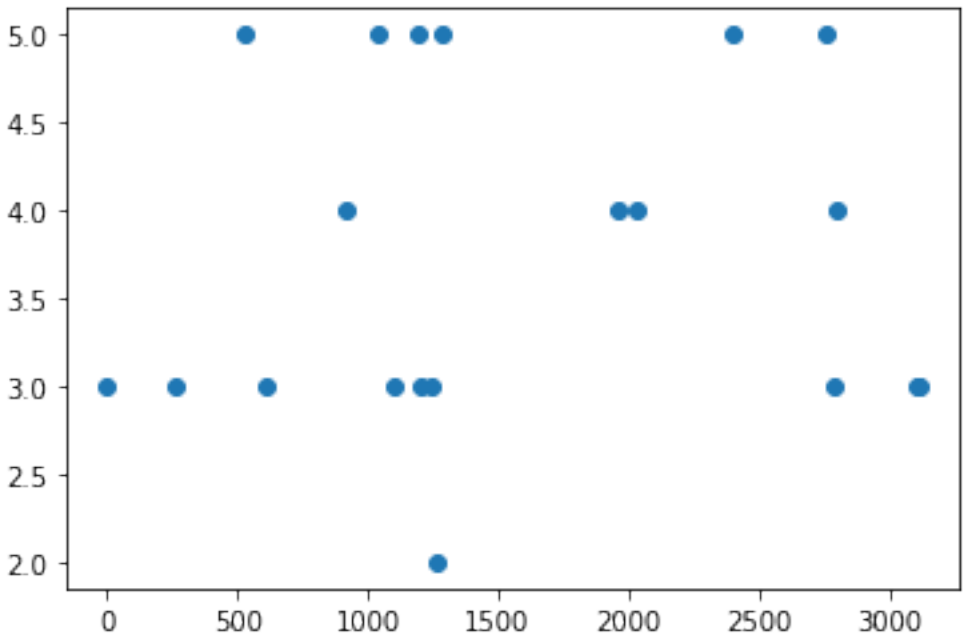


[27]:
```
#Ratings for all the movies reviewed by for a particular user of user id = 2696
user_rating_data = Master_Data[Master_Data['UserID']==2496]
user_rating_data = user_rating_data[['UserID','MovieID','Title','Rating']]
user_rating_data.head(10)
```

[27]:

	UserID	MovieID	Title	Rating
668	2496	1193	One Flew Over the Cuckoo's Nest (1975)	5
2518	2496	914	My Fair Lady (1964)	4
8506	2496	1287	Ben-Hur (1959)	5
9492	2496	2804	Christmas Story, A (1983)	4
14173	2496	2398	Miracle on 34th Street (1947)	5
16319	2496	1035	Sound of Music, The (1965)	5
17581	2496	2791	Airplane! (1980)	3
19798	2496	3105	Awakenings (1990)	3
24263	2496	1270	Back to the Future (1985)	2
26818	2496	527	Schindler's List (1993)	5

[96]:
```
# plotting the above data
plt.scatter(x=user_rating_data['MovieID'].head(20),␣
 ↪y=user_rating_data['Rating'].head(20))
plt.show()
```



[19]:
```
#Feature Engineering
# 1) Find out all the unique genres
```

[28]:
```
genres = Master_Data['Genres'].str.split("|")
genres
```

[28]:
```
0                            [Drama]
1                            [Drama]
2                            [Drama]
3                            [Drama]
4                            [Drama]
                        …
1000204                [Documentary]
1000205                      [Drama]
1000206                      [Drama]
1000207    [Comedy, Drama, Western]
1000208                [Documentary]
Name: Genres, Length: 1000209, dtype: object
```

[29]:
```
unique_genres = set()
for gen in genres:
    unique_genres = unique_genres.union(set(gen))
```

[33]:
```
unique_genres
```

[33]:
```
{'Action',
 'Adventure',
 'Animation',
 "Children's",
 'Comedy',
 'Crime',
 'Documentary',
 'Drama',
 'Fantasy',
 'Film-Noir',
 'Horror',
 'Musical',
 'Mystery',
 'Romance',
 'Sci-Fi',
 'Thriller',
 'War',
 'Western'}
```

[35]:
```
# 2) Create a separate column for each genre category with a one-hot encoding (␣
 ↪1 and 0)
```

[30]:
```
oneHotGenre = Master_Data["Genres"].str.get_dummies("|")
oneHotGenre.head()
```

[30]:

	Action	Adventure	Animation	Children's	Comedy	Crime	Documentary
0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0

	Drama	Fantasy	Film-Noir	Horror	Musical	Mystery	Romance	Sci-Fi
0	1	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0
3	1	0	0	0	0	0	0	0
4	1	0	0	0	0	0	0	0

	Thriller	War	Western
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0

[31]:
```
oneHotGenre = pd.concat([Master_Data,oneHotGenre],axis=1)
oneHotGenre.head()
```

[31]:

	UserID	Gender	Age	Occupation	MovieID	Title	Genres	Rating	Action	Adventure
0	1	F	1	10	1193	One Flew Over the Cuckoo's Nest (1975)	Drama	5	0	0
1	2	M	56	16	1193	One Flew Over the Cuckoo's Nest (1975)	Drama	5	0	0
2	12	M	25	12	1193	One Flew Over the Cuckoo's Nest (1975)	Drama	4	0	0
3	15	M	25	7	1193	One Flew Over the Cuckoo's Nest (1975)	Drama	4	0	0
4	17	M	50	1	1193	One Flew Over the Cuckoo's Nest (1975)	Drama	5	0	0

	…	Fantasy	Film-Noir	Horror	Musical	Mystery	Romance	Sci-Fi
0	…	0	0	0	0	0	0	0
1	…	0	0	0	0	0	0	0
2	…	0	0	0	0	0	0	0
3	…	0	0	0	0	0	0	0
4	…	0	0	0	0	0	0	0

	Thriller	War	Western
0	0	0	0

```
1         0    0        0
2         0    0        0
3         0    0        0
4         0    0        0

[5 rows x 26 columns]
```

[49]:
```
oneHotGenre.columns
```

[49]:
```
Index(['UserID', 'Gender', 'Age', 'Occupation', 'MovieID', 'Title', 'Genres',
       'Rating', 'UserID', 'Gender', 'Age', 'Occupation', 'MovieID', 'Title',
       'Genres', 'Rating', 'UserID', 'Gender', 'Age', 'Occupation', 'MovieID',
       'Title', 'Genres', 'Rating', 'UserID', 'Gender', 'Age', 'Occupation',
       'MovieID', 'Title', 'Genres', 'Rating', 'UserID', 'Gender', 'Age',
       'Occupation', 'MovieID', 'Title', 'Genres', 'Rating', 'Action',
       'Adventure', 'Animation', 'Children's', 'Comedy', 'Crime',
       'Documentary', 'Drama', 'Fantasy', 'Film-Noir', 'Horror', 'Musical',
       'Mystery', 'Romance', 'Sci-Fi', 'Thriller', 'War', 'Western'],
      dtype='object')
```

[17]:
```
# 3) Determine the features affecting the ratings of any particular movie
```

[32]:
```
Features_Data =Master_Data.copy()
Features_Data
```

[32]:
```
         UserID Gender  Age  Occupation  MovieID  \
0             1      F    1          10     1193
1             2      M   56          16     1193
2            12      M   25          12     1193
3            15      M   25           7     1193
4            17      M   50           1     1193
…           …    …  …          …       …
1000204    5949      M   18          17     2198
1000205    5675      M   35          14     2703
1000206    5780      M   18          17     2845
1000207    5851      F   18          20     3607
1000208    5938      M   25           1     2909

                                          Title                Genres  \
0            One Flew Over the Cuckoo's Nest (1975)                 Drama
1            One Flew Over the Cuckoo's Nest (1975)                 Drama
2            One Flew Over the Cuckoo's Nest (1975)                 Drama
3            One Flew Over the Cuckoo's Nest (1975)                 Drama
4            One Flew Over the Cuckoo's Nest (1975)                 Drama
…                                                …                    …
1000204                        Modulations (1998)           Documentary
1000205                      Broken Vessels (1998)                 Drama
```

```
1000206                            White Boys (1999)                 Drama
1000207                      One Little Indian (1973)  Comedy|Drama|Western
1000208  Five Wives, Three Secretaries and Me (1998)           Documentary

         Rating
0             5
1             5
2             4
3             4
4             5
…           …
1000204       5
1000205       3
1000206       1
1000207       5
1000208       4

[1000209 rows x 8 columns]
```

[35]:
```
#Fetching the year ehich the movie was released
Features_Data[["Title","Year"]] = Features_Data.Title.str.extract("(.)\s\((.
 ↪\d+)",expand=True)
Features_Data = Features_Data.drop(['Title'],axis=1)
Features_Data
```

[35]:
```
         UserID Gender  Age  Occupation  MovieID                 Genres  \
0             1      F    1          10     1193                  Drama
1             2      M   56          16     1193                  Drama
2            12      M   25          12     1193                  Drama
3            15      M   25           7     1193                  Drama
4            17      M   50           1     1193                  Drama
…          …    …  …          …       …                    …
1000204    5949      M   18          17     2198           Documentary
1000205    5675      M   35          14     2703                 Drama
1000206    5780      M   18          17     2845                 Drama
1000207    5851      F   18          20     3607  Comedy|Drama|Western
1000208    5938      M   25           1     2909           Documentary

         Rating  Year
0             5  1975
1             5  1975
2             4  1975
3             4  1975
4             5  1975
…           …    …
1000204       5  1998
1000205       3  1998
```

```
1000206       1  1999
1000207       5  1973
1000208       4  1998

[1000209 rows x 8 columns]
```

[36]:
```
#Calculating the age of movies
Features_Data['Year'] = Features_Data.Year.astype(int)
Features_Data['Movie_Age'] = 2000 -Features_Data['Year']
Features_Data
```

[36]:
```
          UserID Gender  Age  Occupation  MovieID                Genres  \
0              1      F    1          10     1193                 Drama
1              2      M   56          16     1193                 Drama
2             12      M   25          12     1193                 Drama
3             15      M   25           7     1193                 Drama
4             17      M   50           1     1193                 Drama
…            …    …  …          …       …                     …
1000204    5949      M   18          17     2198           Documentary
1000205    5675      M   35          14     2703                 Drama
1000206    5780      M   18          17     2845                 Drama
1000207    5851      F   18          20     3607  Comedy|Drama|Western
1000208    5938      M   25           1     2909           Documentary

          Rating  Year  Movie_Age
0              5  1975         25
1              5  1975         25
2              4  1975         25
3              4  1975         25
4              5  1975         25
…            …    …        …
1000204        5  1998          2
1000205        3  1998          2
1000206        1  1999          1
1000207        5  1973         27
1000208        4  1998          2

[1000209 rows x 9 columns]
```

[37]:
```
#Creating Gender variable as integer type
Features_Data['Gender'] = Features_Data.Gender.replace('F',1)
Features_Data['Gender'] = Features_Data.Gender.replace('M',0)
Features_Data['Gender'] = Features_Data.Gender.astype(int)
Features_Data.head()
```

[37]:
```
   UserID  Gender  Age  Occupation  MovieID Genres  Rating  Year  Movie_Age
0       1       1    1          10     1193  Drama       5  1975         25
```

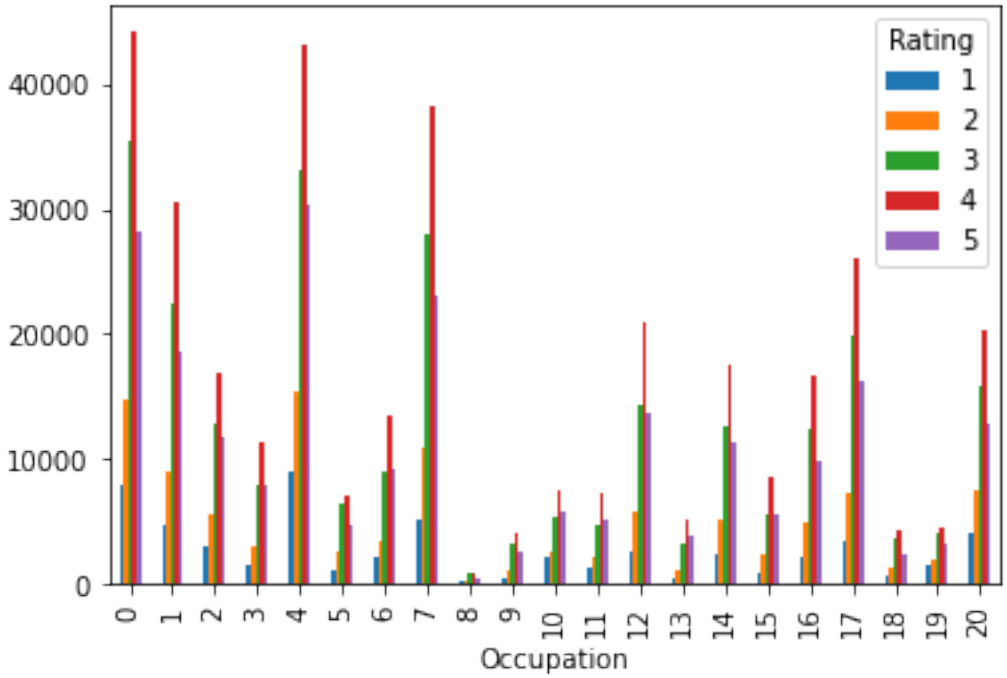
1	2	0	56	16	1193	Drama	5	1975	25
2	12	0	25	12	1193	Drama	4	1975	25
3	15	0	25	7	1193	Drama	4	1975	25
4	17	0	50	1	1193	Drama	5	1975	25

[38]:
```
#Checking the correlation of features with Rating
Features_Data[['Gender','Occupation', 'Age', 'Movie_Age']].
 ↪corrwith(Features_Data['Rating'])
```

[38]:
```
Gender        0.019861
Occupation    0.006753
Age           0.056869
Movie_Age     0.156946
dtype: float64
```

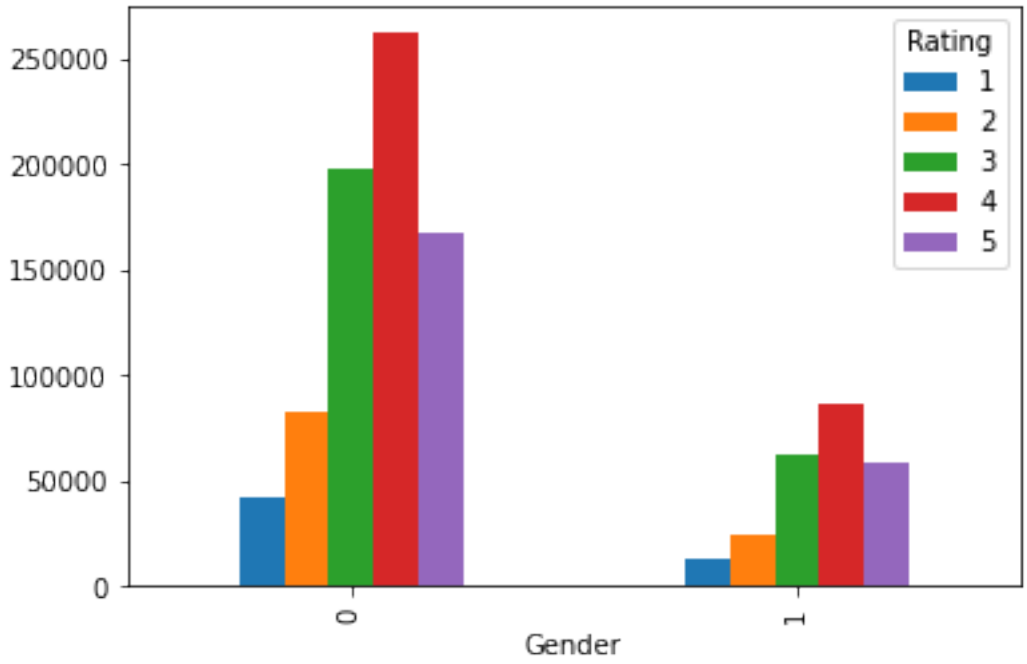
[103]:
```
#Movie_Age has the most positive relationship with Rating
```

[105]:
```
#Occupation relationship with Rating
Features_Data.groupby(["Occupation","Rating"]).size().unstack().
 ↪plot(kind='bar',stacked=False,legend=True)
plt.show()
```

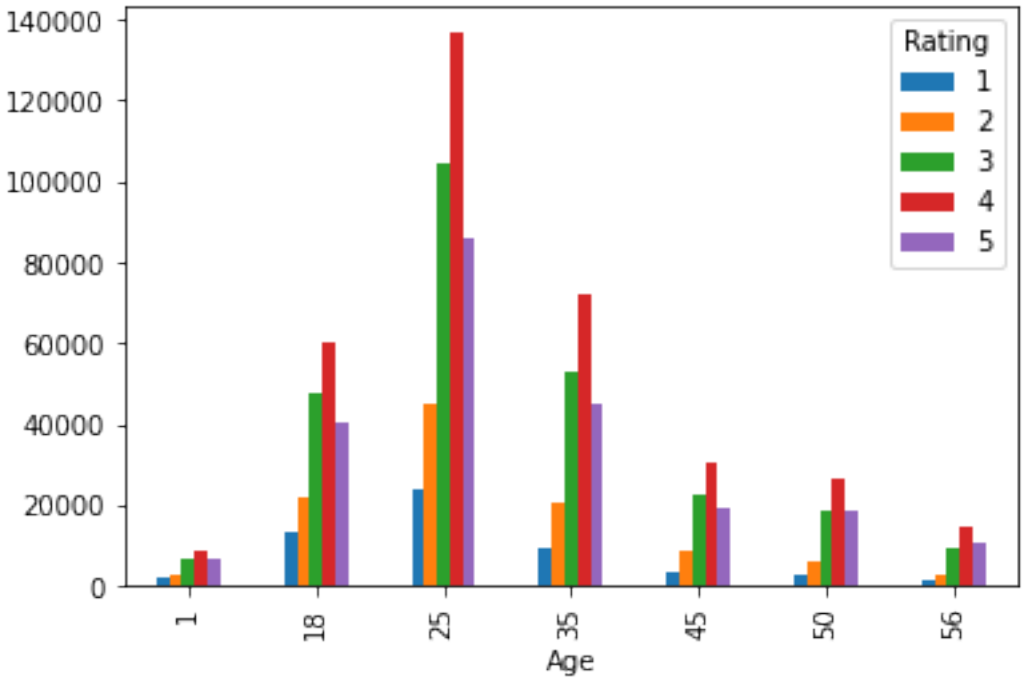


[107]:
```
#Gender relationship with Rating
#1 -> Male, 0 -> Female
```

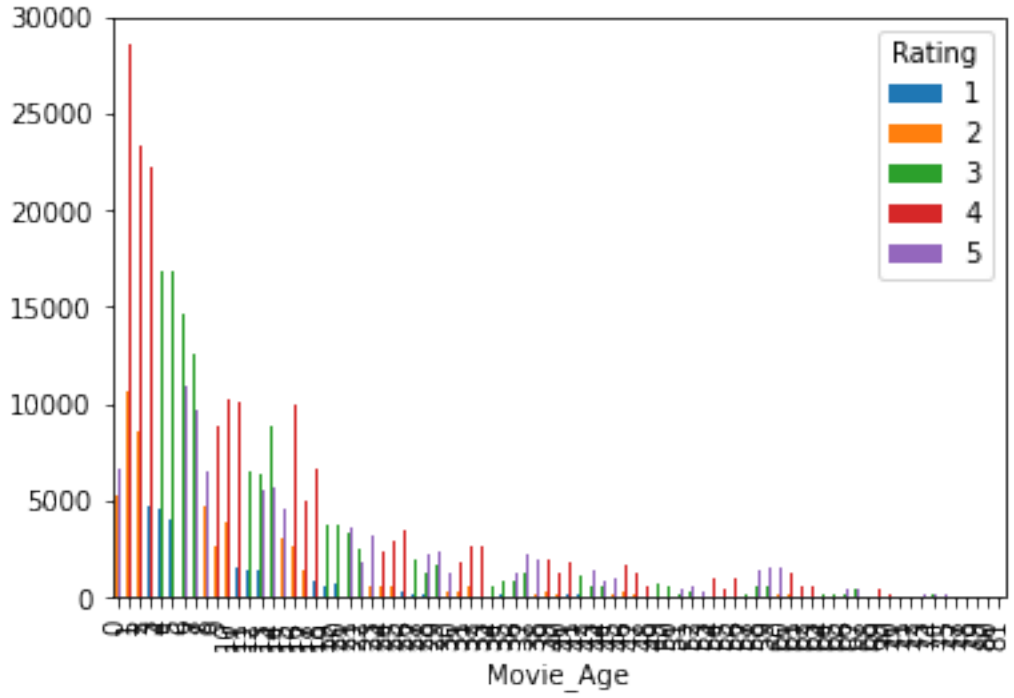
```
Features_Data.groupby(["Gender","Rating"]).size().unstack().
 ↪plot(kind='bar',stacked=False,legend=True)
plt.show()
```



[108]:
```
#Age relationship with Rating
Features_Data.groupby(["Age","Rating"]).size().unstack().
 ↪plot(kind='bar',stacked=False,legend=True)
plt.show()
```



[109]:
```
#Movie_Age relationship with Rating
Features_Data.groupby(["Movie_Age","Rating"]).size().unstack().
 ↪plot(kind='bar',stacked=False,legend=True)
plt.show()
```



[39]:
```
#To Predict the values of rating we are using Logistic regression
```

[75]:
```
# Assign independent variables to X dataset
X = Master_Data[['Age','Occupation','MovieID']].head(500)
X
```

[75]:

	Age	Occupation	MovieID
0	1	10	1193
1	56	16	1193
2	25	12	1193
3	25	7	1193
4	50	1	1193
..	…	…	…
495	25	2	1193
496	18	4	1193
497	25	12	1193
498	18	4	1193
499	45	14	1193

[500 rows x 3 columns]

[76]:
```
# Assign dependent variables to Y dataset
Y = Master_Data['Rating'].head(500)
Y
```

[76]:
```
0      5
1      5
2      4
3      4
4      5
      ..
495    4
496    5
497    5
498    5
499    5
Name: Rating, Length: 500, dtype: int32
```

[77]:
```
# view the shape for both axes
print (X.shape)
print (Y.shape)
```

```
(500, 3)
(500,)
```

[78]:
```
# Splitting the data into training & testing datasets(70:30)
import sklearn
from sklearn.model_selection import train_test_split
X_train, X_test, Y_train, Y_test = sklearn.model_selection.
↪train_test_split(X,Y,random_state=2,test_size=0.3)
```

[79]:
```
# use the Logistic regression estimator
from sklearn.linear_model import LogisticRegression
logReg = LogisticRegression()
```

[81]:
```
# fit data into the Logistic regression estimator
logReg.fit(X_train,Y_train)
```

```
/usr/local/lib/python3.7/site-packages/sklearn/linear_model/_logistic.py:940:
ConvergenceWarning: lbfgs failed to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-
regression
  extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
```

[81]:
```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='auto', n_jobs=None, penalty='l2',
                   random_state=None, solver='lbfgs', tol=0.0001, verbose=0,
                   warm_start=False)
```

[82]:
```
#Model Evaluation
# predict the outcoome using Logistic regression estimator
y_predict=logReg.predict(X_test)
```

[83]:
```
y_predict
```

[83]:
```
array([5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,
       5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5], dtype=int32)
```

[84]:
```
# Calculate the accuracy of the model
from sklearn.metrics import accuracy_score
accuracy_score(y_predict,Y_test)
```

[84]:
```
0.5866666666666667
```

[85]:
```
#Check model performance on new dataset
# create Example object with new values for prediction
X_new = [[25,7,1193],[18,17,2198]]
```

[86]:
```
logReg.predict(X_new)
```

[86]:
```
array([5, 5], dtype=int32)
```

[89]:
```
from sklearn import metrics
print (metrics.confusion_matrix(Y_test, y_predict))
print (metrics.classification_report(Y_test, y_predict))
```

```
[[ 0  0  0  0  1]
 [ 0  0  0  0  2]
 [ 0  0  0  0  9]
 [ 0  0  0  0 50]
 [ 0  0  0  0 88]]
              precision    recall  f1-score   support

           1       0.00      0.00      0.00         1
           2       0.00      0.00      0.00         2
           3       0.00      0.00      0.00         9
           4       0.00      0.00      0.00        50
           5       0.59      1.00      0.74        88

    accuracy                           0.59       150
   macro avg       0.12      0.20      0.15       150
weighted avg       0.34      0.59      0.43       150


/usr/local/lib/python3.7/site-packages/sklearn/metrics/_classification.py:1272:
UndefinedMetricWarning: Precision and F-score are ill-defined and being set to
0.0 in labels with no predicted samples. Use `zero_division` parameter to
control this behavior.
  _warn_prf(average, modifier, msg_start, len(result))
```

[ ]:
```
```