Project: TMDb Movies project UDACITY

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Table of Contents

Introduction

This data set contains information about 10,000 movies collected from The Movie Database (TMDb), including user ratings and revenue. Certain columns, like ‘cast’ and ‘genres’, contain multiple values separated by pipe (|) characters. There are some odd characters in the ‘cast’ column. Don’t worry about cleaning them. You can leave them as is. The final two columns ending with “_adj” show the budget and revenue of the associated movie in terms of 2010 dollars, accounting for inflation over time.

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SOURCE TO DATASET https://d17h27t6h515a5.cloudfront.net/topher/2017/October/59dd1c4c_tmdb-movies/tmdb-movies.csv (https://d17h27t6h515a5.cloudfront.net/topher/2017/October/59dd1c4c_tmdb-movies/tmdb-movies.csv).

Questions:

1. Top 5 most expensive movies
2. What is the average runtime, budget, revenue of the movies
3. What is the movie with the highest andlowest profit
4. Which year had most profitable movies
5. The most popular movie before the movie with the highest profit was released
6. Is there a correlation between how popular a movie is and the profit?

In [1]:
```
# Use this cell to set up import statements for all of the packages that you
#   plan to use.

# Remember to include a 'magic word' so that your visualizations are plotted
#   inline with the notebook. See this page for more:
#   http://ipython.readthedocs.io/en/stable/interactive/magics.html

import pandas as pd
import numpy as np
from datetime import datetime
import matplotlib.pyplot as plt
%matplotlib inline
```

Data Wrangling

> The data wrangling process will be done using pandas. Some methods will be used to explore the dataset and draw intuition about the dataset to understand the shape, datatype and other parameters** First o all I will load my data and use several codes to draw insight as to the shape, datatypes, NAN values etc present in the data

In [2]:
```
df = pd.read_csv('tmdb-movies.csv')
# looking at null values and datatypes so I can know what cleanin techniques
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10866 entries, 0 to 10865
Data columns (total 21 columns):
 #   Column                Non-Null Count  Dtype  
---  ------                --------------  -----  
 0   id                    10866 non-null  int64  
 1   imdb_id               10856 non-null  object 
 2   popularity            10866 non-null  float64
 3   budget                10866 non-null  int64  
 4   revenue               10866 non-null  int64  
 5   original_title        10866 non-null  object 
 6   cast                  10790 non-null  object 
 7   homepage              2936 non-null   object 
 8   director              10822 non-null  object 
 9   tagline               8042 non-null   object 
 10  keywords              9373 non-null   object 
 11  overview              10862 non-null  object 
 12  runtime               10866 non-null  int64  
 13  genres                10843 non-null  object 
 14  production_companies  9836 non-null   object 
 15  release_date          10866 non-null  object 
 16  vote_count            10866 non-null  int64  
 17  vote_average          10866 non-null  float64
 18  release_year          10866 non-null  int64  
 19  budget_adj            10866 non-null  float64
 20  revenue_adj           10866 non-null  float64
dtypes: float64(4), int64(6), object(11)
memory usage: 1.7+ MB
```

In [3]:
```
#Exploring the shape of the dataset
df.shape
```

Out[3]:
```
(10866, 21)
```

observations

- The data set has "10866" rows and "21" columns
- There are some null values in the data set
- data type looks consistent but release_date is stored as a string
- budget and revenue are floats
- there are some 0 values in our data sets

In [4]:
```
# Confirming that release_date is stored as a string
type(df['release_date'][0])
```

Out[4]:
```
str
```

In [5]:
```
# exploring the frist 5 rows to have a sense of my data
df.head()
```

Out[5]:

	id	imdb_id	popularity	budget	revenue	original_title	cast	
0	135397	tt0369610	32.985763	150000000	1513528810	Jurassic World	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...	
1	76341	tt1392190	28.419936	150000000	378436354	Mad Max: Fury Road	Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...	
2	262500	tt2908446	13.112507	110000000	295238201	Insurgent	Shailene Woodley|Theo James|Kate Winslet|Ansel...	http://v
3	140607	tt2488496	11.173104	200000000	2068178225	Star Wars: The Force Awakens	Harrison Ford|Mark Hamill|Carrie Fisher|Adam D...	
4	168259	tt2820852	9.335014	190000000	1506249360	Furious 7	Vin Diesel|Paul Walker|Jason Statham|Michelle ...	

5 rows × 21 columns

In [6]:
```
# checking for duplicates in the data
sum(df.duplicated())
```

Out[6]: 1

In [7]:
```
df[df.duplicated()]
```

Out[7]:

	id	imdb_id	popularity	budget	revenue	original_title	cast	homepage
2090	42194	tt0411951	0.59643	30000000	967000	TEKKEN	Jon Foo|Kelly Overton|Cary-Hiroyuki Tagawa|Ian...	NaN

1 rows × 21 columns

Data Cleaning -

Thes list below showsthe different cleaning techniques that will be employed to make the dataset appropriate for Exploratory data Analysis

- Changing release date column from string to datetime data type.
- Removing the duplicated values.
- Changing format of budget and revenue columns.
- Remove unnecessary columns such as 'imdb_id', 'budget_adj', 'revenue_adj', 'homepage', production_company, 'keywords', 'overview', 'production_companies', 'vote_count' and 'vote_average'.
- replace all the values from '0' to NAN in 'budget' and 'revenue' columns, then removing them.

Changing release date column from string to date type data.

To change the release_date to datetime I will have to use the datetime function of pandas

In [8]:
```
df['release_date'] = pd.to_datetime(df['release_date'])
# checking to see that the datatypes has changed to timestamp for 'release_da
type(df['release_date'][0])
```

Out[8]:
```
pandas._libs.tslibs.timestamps.Timestamp
```

Now I need to confirm that my release_date is now a date datatype

In [9]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10866 entries, 0 to 10865
Data columns (total 21 columns):
 #   Column                Non-Null Count  Dtype         
---  ------                --------------  -----         
 0   id                    10866 non-null  int64         
 1   imdb_id               10856 non-null  object        
 2   popularity            10866 non-null  float64       
 3   budget                10866 non-null  int64         
 4   revenue               10866 non-null  int64         
 5   original_title        10866 non-null  object        
 6   cast                  10790 non-null  object        
 7   homepage              2936 non-null   object        
 8   director              10822 non-null  object        
 9   tagline               8042 non-null   object        
 10  keywords              9373 non-null   object        
 11  overview              10862 non-null  object        
 12  runtime               10866 non-null  int64         
 13  genres                10843 non-null  object        
 14  production_companies  9836 non-null   object        
 15  release_date          10866 non-null  datetime64[ns]
 16  vote_count            10866 non-null  int64         
 17  vote_average          10866 non-null  float64       
 18  release_year          10866 non-null  int64         
 19  budget_adj            10866 non-null  float64       
 20  revenue_adj           10866 non-null  float64       
dtypes: datetime64[ns](1), float64(4), int64(6), object(10)
memory usage: 1.7+ MB
```

Removing duplicate data

Before proceeding withthe analysis some duplicate values need to be dropped so they don't affect the outcome of the analysis

In [10]:
```
# removing duplicate data
df.drop_duplicates(keep ='first', inplace=True)
# checking for duplicated value
df.duplicated().sum()
```

Out[10]:
```
0
```

```
In [11]:  df.nunique()

Out[11]:  id                      10865
          imdb_id                 10855
          popularity              10814
          budget                    557
          revenue                  4702
          original_title          10571
          cast                    10719
          homepage                 2896
          director                 5067
          tagline                  7997
          keywords                 8804
          overview                10847
          runtime                   247
          genres                   2039
          production_companies     7445
          release_date             5909
          vote_count               1289
          vote_average               72
          release_year               56
          budget_adj               2614
          revenue_adj              4840
          dtype: int64
```

Changing format of budget and revenue columns.

In [12]:
```
change_type=['budget', 'revenue']

#changing data type
df[change_type]=df[change_type].applymap(np.int64)

#printing data types of the dataset to see the changed information
df.dtypes
```

Out[12]:
```
id                              int64
imdb_id                        object
popularity                    float64
budget                          int64
revenue                         int64
original_title                 object
cast                           object
homepage                       object
director                       object
tagline                        object
keywords                       object
overview                       object
runtime                         int64
genres                         object
production_companies           object
release_date           datetime64[ns]
vote_count                      int64
vote_average                  float64
release_year                    int64
budget_adj                    float64
revenue_adj                   float64
dtype: object
```

Removing unnecessary columns

Since I won't be using all columns in my analysis, I will be dropping the columns that I won't be needing at all throught the course of the EDA because they are not relevant to answering the posed questions

In [13]:
```
#list of columns I want to remove
col_to_del = ['imdb_id', 'budget_adj', 'revenue_adj', 'homepage', 'keywords',
#deleting the columns from the database
df = df.drop(col_to_del, 1)

# previewing the new dataset
df.head(3)
```

```
C:\Users\Simeon\AppData\Local\Temp\ipykernel_2248\2768113811.py:4: FutureWa
rning: In a future version of pandas all arguments of DataFrame.drop except
for the argument 'labels' will be keyword-only.
  df = df.drop(col_to_del, 1)
```

Out[13]:

	id	popularity	budget	revenue	original_title	cast	director	tagline
0	135397	32.985763	150000000	1513528810	Jurassic World	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...	Colin Trevorrow	The park is open
1	76341	28.419936	150000000	378436354	Mad Max: Fury Road	Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...	George Miller	What a Lovely Day
2	262500	13.112507	110000000	295238201	Insurgent	Shailene Woodley|Theo James|Kate Winslet|Ansel...	Robert Schwentke	One Choice Can Destroy You

Replacing the '0' in our column to NAN so we can drop it

After exploring the first and last few rows in budget and revenue columns, there are several entries have '0' value, so firstly I will convert those values to NAN then I will remove them from the dataset.

In [14]:
```

# creating a list of revenue and budget columns
temp_list=['budget', 'revenue']

#this will replace all the value from '0' to NAN in the list
df[temp_list] = df[temp_list].replace(0, np.NAN)

#Removing all the row which has NaN value in temp_list
df.dropna(subset = temp_list, inplace = True)
```

After removing them we ned to check to see the that the amount of columns have reduced to be sure the affected columns have beendropped

In [15]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3854 entries, 0 to 10848
Data columns (total 12 columns):
 #   Column          Non-Null Count  Dtype         
---  ------          --------------  -----         
 0   id              3854 non-null   int64         
 1   popularity      3854 non-null   float64       
 2   budget          3854 non-null   float64       
 3   revenue         3854 non-null   float64       
 4   original_title  3854 non-null   object        
 5   cast            3850 non-null   object        
 6   director        3853 non-null   object        
 7   tagline         3574 non-null   object        
 8   runtime         3854 non-null   int64         
 9   genres          3854 non-null   object        
 10  release_date    3854 non-null   datetime64[ns]
 11  release_year    3854 non-null   int64         
dtypes: datetime64[ns](1), float64(3), int64(3), object(5)
memory usage: 391.4+ KB
```

Exploratory Data Analysis

Research Question 1 (Top 5 most expensive movies)

To get the top 5 most expensive movies we need to sort the dataset based on budget in descending order. This will give us the list from most expensive to the least expensive

In [16]:
```
expensive_movies = df.sort_values(by='budget',ascending=False).head()
expensive_movies
```

Out[16]:

	id	popularity	budget	revenue	original_title	cast	director
2244	46528	0.250540	425000000.0	1.108757e+07	The Warrior's Way	Kate Bosworth|Jang Dong-gun|Geoffrey Rush|Dann...	Sngmoo Lee
3375	1865	4.955130	380000000.0	1.021683e+09	Pirates of the Caribbean: On Stranger Tides	Johnny Depp|PenÃ©lope Cruz|Geoffrey Rush|Ian M...	Rob Marshall
7387	285	4.965391	300000000.0	9.610000e+08	Pirates of the Caribbean: At World's End	Johnny Depp|Orlando Bloom|Keira Knightley|Geof...	Gore Verbinski
14	99861	5.944927	280000000.0	1.405036e+09	Avengers: Age of Ultron	Robert Downey Jr.|Chris Hemsworth|Mark Ruffalo...	Joss Whedon
6570	1452	1.957331	270000000.0	3.910812e+08	Superman Returns	Brandon Routh|Kevin Spacey|Kate Bosworth|James...	Bryan Singer

In [17]:
```
least_expensive  = df.sort_values(by='budget')
least_expensive.head()
```

Out[17]:

	id	popularity	budget	revenue	original_title	cast	director	tagline
3581	59296	0.520430	1.0	1378.0	Love, Wedding, Marriage	Mandy Moore|Kellan Lutz|Jessica Szohr|Autumn F...	Dermot Mulroney	Here comes the ride.
2618	39964	0.090186	1.0	100.0	Lost & Found	David Spade|Sophie Marceau|Ever Carradine|Step...	Jeff Pollack	A comedy about a guy who would do anything to ...
8944	14373	0.464188	2.0	16.0	Death Wish 2	Charles Bronson|Jill Ireland|Vincent Gardenia|...	Michael Winner	First His Wife. Now His Daughter. It's Time To...
10050	20701	0.317091	3.0	16.0	Tales from the Darkside: The Movie	Rae Dawn Chong|Christian Slater|Deborah Harry|...	John Harrison	From the depths of four twisted minds.
2398	39356	0.028456	3.0	43.0	Boy	James Rolleston|Craig Hall|Taika Waititi|Te Ah...	Taika Waititi	Summer, Girls, Gangs, Drugs ... its not easy b...

Movie ID 2244 The Warrior's Way shows the largest budget i.e 425000000

Whereas Love, Wedding, Marriage with id no. 3581 shows the smallest budget i.e 1 dollar

Research Question 2 (What is the average runtime, budget, revenue of the movies)

To avoid repetition I am going to create a simple function called avg i.e average to calculate the average runtime,budget and revenue. This will give us an idea of where majority of the movies fall in terms of budget, revenue and runtime.

In [18]:
```
# defining a function to find average of a column
def avg(column):
    return df[column].mean()
```

In [19]:
```
# calculating the average runtime
avg(['runtime'])
```

Out[19]:
```
runtime    109.220291
dtype: float64
```

No unit was given for runtime, budget and revenue so we would assume runtime is in minutes, revenue and budget are in dollars

In [20]:
```
# calculating the average budget. in this case a print function was added to
print(round(avg(['budget'])));
```

```
budget    37203697.0
dtype: float64
```

In [21]:
```
# calculating the average revenue
print(round(avg(['revenue'])));
```

```
revenue    107686616.0
dtype: float64
```

On the average the runtime, budget and revenue are 109.2 mins, 37203697 dollars, 107686616 dollars

Research Question 3 (What is the movie with the highest and lowest profit)

We don't have a column represents the total profits of the movies in our dataset to find the most and least profit movies so I will answer this question in two steps:

A. Calculating the profit of each movie

I'm going to add a new column to the dataset represents the total profit every movie in our dataset made by subtracting the revenue from the budget.

In [22]:
```
# Finding profit
df['profit'] = df['revenue']-df['budget']
```

B. From the profit column calculate movies with most and least profit¶

In [23]:
```
# Which movie has highest profit?
highest_profit_movie = df.sort_values(by='profit',ascending=False)
highest_profit_movie.iloc[0]
```

Out[23]:
```
id                                                              19995
popularity                                                   9.432768
budget                                                    237000000.0
revenue                                                  2781505847.0
original_title                                                 Avatar
cast                 Sam Worthington|Zoe Saldana|Sigourney Weaver|S...
director                                                James Cameron
tagline                                   Enter the World of Pandora.
runtime                                                           162
genres                        Action|Adventure|Fantasy|Science Fiction
release_date                                      2009-12-10 00:00:00
release_year                                                     2009
profit                                                   2544505847.0
Name: 1386, dtype: object
```

In [24]:
```
lowest_profit_movie = df.sort_values(by='profit')
lowest_profit_movie.iloc[0]
```

Out[24]:
```
id                                                              46528
popularity                                                    0.25054
budget                                                    425000000.0
revenue                                                    11087569.0
original_title                                       The Warrior's Way
cast                 Kate Bosworth|Jang Dong-gun|Geoffrey Rush|Dann...
director                                                   Sngmoo Lee
tagline                                      Assassin. Hero. Legend.
runtime                                                           100
genres                       Adventure|Fantasy|Action|Western|Thriller
release_date                                      2010-12-02 00:00:00
release_year                                                     2010
profit                                                   -413912431.0
Name: 2244, dtype: object
```

Movie Avatar with id 19995 shows the highest earned profit i.e 237000000.

WhereasThe Warrior's Way movie with id 46528 shows the lowest earned profit i.e -413912431

Research Question 4 (Which year had most profitable movies)

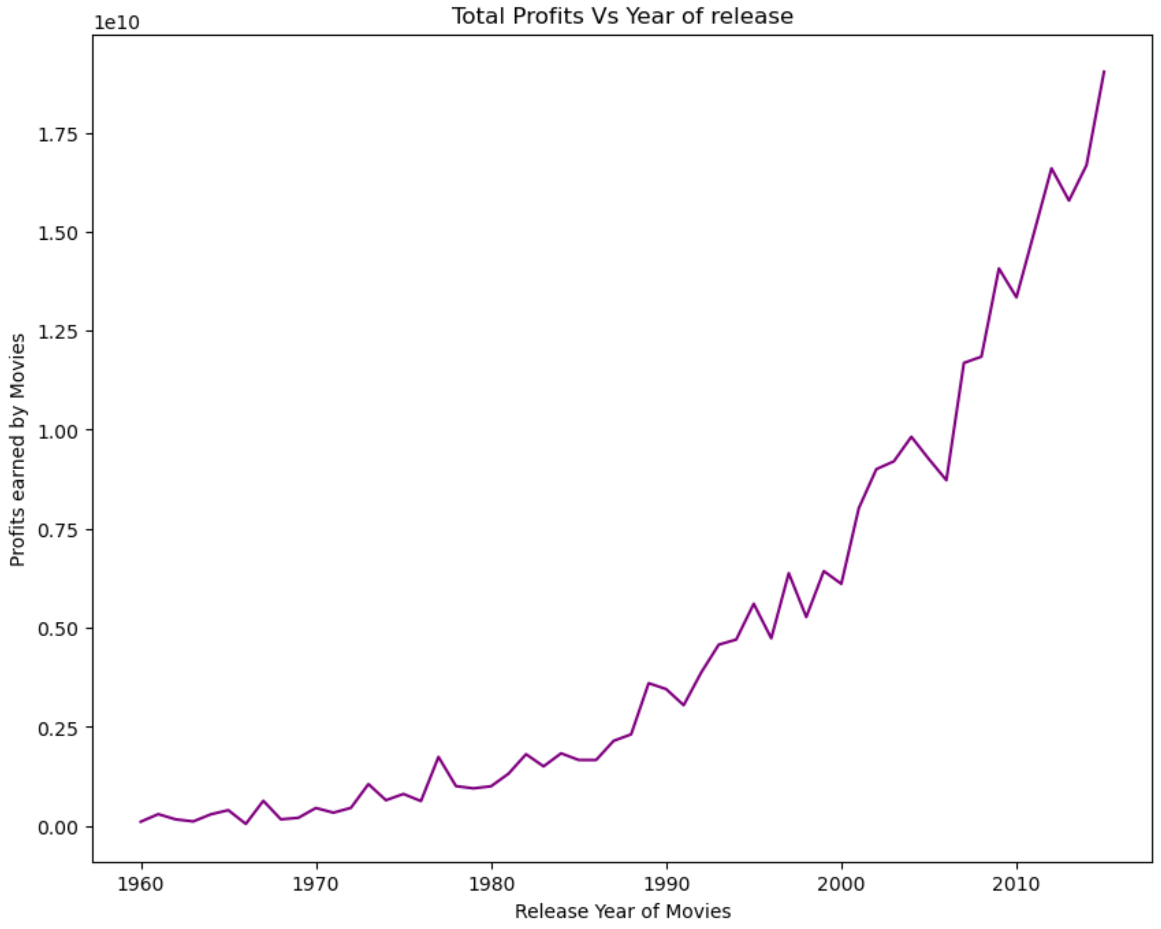
In [25]:
```
#We will be using Line plot for this analysis
#Since we want to know the profits of movies for every year therefore we have

profits_year = df.groupby('release_year')['profit'].sum()

#figure size(width, height)
plt.figure(figsize=(10,8), dpi = 100)

#labelling x-axis
plt.xlabel('Release Year of Movies')
#labelling  y-axis
plt.ylabel('Profits earned by Movies')
#title of the plot
plt.title('Total Profits Vs Year of release')

#plotting the graph
plt.plot(profits_year, color = 'purple')
plt.show()
```



In [26]:
```
#To find which year made the highest profit?
profits_year.idxmax()
```

Out[26]:
```
2015
```

Graphically we cannot easily spot that 2015 is the year with the highest profit but using the idxmax() helps confirm that . However an important observation from the graph is that we can see an upwards trend of profit Year on Year

Research Question 5 (The most popular movie before the movie with the highest profit was released)

Avatar was the movies with the highst profit in 2009 but before then what movie was the most popular?

In [27]:
```
# in this case the highest profit earning movie was Avatar released in 2009
popular_movie_2010_idx = df[df["release_year"]<=2009]["popularity"].idxmax()
df.loc[popular_movie_2010_idx]
```

Out[27]:
```
id                                                               11
popularity                                                12.037933
budget                                                   11000000.0
revenue                                                 775398007.0
original_title                                            Star Wars
cast              Mark Hamill|Harrison Ford|Carrie Fisher|Peter ...
director                                              George Lucas
tagline                A long time ago in a galaxy far, far away...
runtime                                                         121
genres                          Adventure|Action|Science Fiction
release_date                                    1977-03-20 00:00:00
release_year                                                   1977
profit                                                  764398007.0
Name: 1329, dtype: object
```

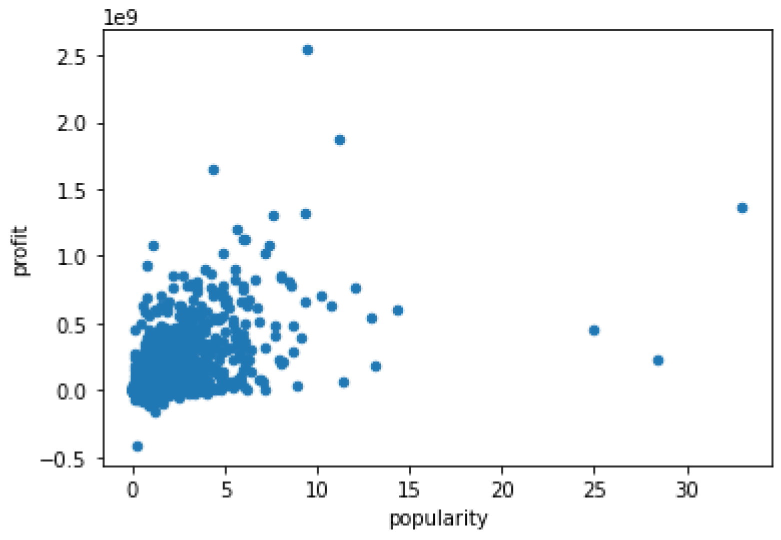
The most popular movie was Star Wars released in 1977 before Avatar

Research Question 5 (Is there a correlation between popularity and profit?)

We have looked at Avatar and Star Wars in previos sections but does the popularity of a movie affect how much profit is earned from it?

Firstly, I will create a scatter plot between popularity and profit to visually see the corelation and then use the corr() to get the exact value

In [28]:
```
# creating a scatterplot between popularity and profit
df.plot(x = 'popularity', y = 'profit', kind = 'scatter');
```



In [29]:
```
# getiing the quantitative value for the correlation between profit and popul
corr = df['popularity'].corr(df['profit'])
corr
```

Out[29]:
```
0.5962013674920571
```

Conclusions

To summarize the whole analysis:

- **SUMMARY**

  The top 5 most expensive movies are:
- The Warrior's Way
- Pirates of the Caribbean: On Stranger Tides
- Pirates of the Caribbean: At World's End
- Avengers: Age of Ultron
- Superman Returns

> The average:
> - runtime is 109.220291
> - budget is 37203697.0
> - revenue is 107686616.0

- Movie with the highest profit is 'Avatar', While Movie with the lowest profit is 'The Warrior's Way'

- The year with the most profit is 2015 While there is a 0.59 correllation between popularity and profit

CONCLUSION

- We can observe an ongoing upwards trend in Total profit of movies every year.
- There is a moderate relationship between popularity of a movie and profit made
- The most expensive movies made belong to the genres of Action|Adventure|Fantasy/Sci-Fi

LIMITATIONS

- Since the budget and revenue column do not have currency unit, it might be possible different movies have budget in different currency according to the country they were produced in. So an inconsistency appears here which can state the complete analysis wrong. Dropping the rows with missing values might have also affected the overall analysis.