investigate-movie-dataset

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1 Project: Investigate TMDb Movie Data

1.1 Table of Contents

Introduction

This data set contains information about 10,000 movies released between 1960 and 2015. Collected from The Movie Database (TMDb), it also includes user ratings and popularities. This report aims at conducting exploratory data analysis to answer the questions below:

1. What are the average popularities of movies according to budget levels?
2. What are the profit trends of movies from year to year?
3. What are the average runtimes of movies over the years?
4. Which are the 5 cheapest and most expensive profitable movies of all time?

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

import pandas as pd
import numpy as np
import csv
import matplotlib.pyplot as plt
% matplotlib inline
from datetime import datetime
import seaborn as sns

df = pd.read_csv('tmdb-movies.csv')
```

Data Wrangling

Key notes:: In this section of the report, the following work will be done: load the data; check for cleanliness; trim and clean dataset for analysis.

1.1.1 General Properties

In [2]:
```
# Load your data and print out a few lines. Perform operations to inspect data

df.head()
```

Out[2]:

	id	imdb_id	popularity	budget	revenue	original_title	cast	homepage	director	tagline	...	overview	runtime	genres
0	135397	tt0369610	32.985763	150000000	1513528810	Jurassic World	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...	http://www.jurassicworld.com/	Colin Trevorrow	The park is open.	...	Twenty-two years after the events of Jurassic ...	124	
1	76341	tt1392190	28.419936	150000000	378436354	Mad Max: Fury Road	Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...	http://www.madmaxmovie.com/	George Miller	What a Lovely Day.	...	An apocalyptic story set in the furthest reach...	120	
2	262500	tt2908446	13.112507	110000000	295238201	Insurgent	Shailene Woodley|Theo James|Kate Winslet|Ansel...	http://www.thedivergentseries.movie/#insurgent	Robert Schwentke	One Choice Can Destroy You	...	Beatrice Prior must confront her inner demons ...	119	
3	140607	tt2488496	11.173104	200000000	2068178225	Star Wars: The Force Awakens	Harrison Ford|Mark Hamill|Carrie Fisher|Adam D...	http://www.starwars.com/films/star-wars-episod...	J.J. Abrams	Every generation has a story.	...	Thirty years after defeating the Galactic Empi...	136	
4	168259	tt2820852	9.335014	190000000	1506249360	Furious 7	Vin Diesel|Paul Walker|Jason Statham|Michelle ...	http://www.furious7.com/	James Wan	Vengeance Hits Home	...	Deckard Shaw seeks revenge against Dominic Tor...	137	

```
0  Action|Adventure|Science Fiction|Thriller
1  Action|Adventure|Science Fiction|Thriller
2         Adventure|Science Fiction|Thriller
3   Action|Adventure|Science Fiction|Fantasy
4                       Action|Crime|Thriller

                                production_companies release_date vote_count  \
0  Universal Studios|Amblin Entertainment|Legenda...       6/9/15       5562
1  Village Roadshow Pictures|Kennedy Miller Produ...      5/13/15       6185
2  Summit Entertainment|Mandeville Films|Red Wago...      3/18/15       2480
3          Lucasfilm|Truenorth Productions|Bad Robot     12/15/15       5292
4  Universal Pictures|Original Film|Media Rights ...       4/1/15       2947

   vote_average  release_year    budget_adj   revenue_adj
0           6.5          2015  1.379999e+08  1.392446e+09
1           7.1          2015  1.379999e+08  3.481613e+08
2           6.3          2015  1.012000e+08  2.716190e+08
3           7.5          2015  1.839999e+08  1.902723e+09
4           7.3          2015  1.747999e+08  1.385749e+09

[5 rows x 21 columns]
```

In [3]:
```
# return a tuple of the dimensions of the dataframe

df.shape
```

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

In [4]:
```
# print the column labels in the dataframe

for i, v in enumerate(df.columns):
    print(i, v)
```

```
0 id
1 imdb_id
2 popularity
3 budget
4 revenue
5 original_title
6 cast
7 homepage
8 director
9 tagline
10 keywords
11 overview
12 runtime
13 genres
14 production_companies
15 release_date
```

```
16 vote_count
17 vote_average
18 release_year
19 budget_adj
20 revenue_adj
```

In [5]:
```
# return the datatypes of the columns

df.dtypes
```

Out[5]:
```
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           object
vote_count              int64
vote_average          float64
release_year            int64
budget_adj            float64
revenue_adj           float64
dtype: object
```

In [6]:
```
# check for duplicates in the data

sum(df.duplicated())
```

Out[6]:
```
1
```

In [7]:
```
#  check if any value is NaN in DataFrame and in how many columns

df.isnull().any().any(), sum(df.isnull().any())
```

Out[7]:
```
(True, 9)
```

In [8]:
```
# displays a concise summary of the dataframe
# including the number of non-null values in each column

df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10866 entries, 0 to 10865
Data columns (total 21 columns):
id                      10866 non-null int64
imdb_id                 10856 non-null object
popularity              10866 non-null float64
budget                  10866 non-null int64
revenue                 10866 non-null int64
original_title          10866 non-null object
cast                    10790 non-null object
homepage                2936 non-null object
director                10822 non-null object
tagline                 8042 non-null object
keywords                9373 non-null object
overview                10862 non-null object
runtime                 10866 non-null int64
genres                  10843 non-null object
production_companies    9836 non-null object
release_date            10866 non-null object
vote_count              10866 non-null int64
vote_average            10866 non-null float64
release_year            10866 non-null int64
budget_adj              10866 non-null float64
revenue_adj             10866 non-null float64
dtypes: float64(4), int64(6), object(11)
memory usage: 1.7+ MB
```

In [9]:
```
# Generates descriptive statistics, excluding NaN values

df.describe()
```

Out[9]:

	id	popularity	budget	revenue	runtime	\
count	10866.000000	10866.000000	1.086600e+04	1.086600e+04	10866.000000	
mean	66064.177434	0.646441	1.462570e+07	3.982332e+07	102.070863	
std	92130.136561	1.000185	3.091321e+07	1.170035e+08	31.381405	
min	5.000000	0.000065	0.000000e+00	0.000000e+00	0.000000	
25%	10596.250000	0.207583	0.000000e+00	0.000000e+00	90.000000	
50%	20669.000000	0.383856	0.000000e+00	0.000000e+00	99.000000	
75%	75610.000000	0.713817	1.500000e+07	2.400000e+07	111.000000	
max	417859.000000	32.985763	4.250000e+08	2.781506e+09	900.000000	

	vote_count	vote_average	release_year	budget_adj	revenue_adj
count	10866.000000	10866.000000	10866.000000	1.086600e+04	1.086600e+04
mean	217.389748	5.974922	2001.322658	1.755104e+07	5.136436e+07
std	575.619058	0.935142	12.812941	3.430616e+07	1.446325e+08
min	10.000000	1.500000	1960.000000	0.000000e+00	0.000000e+00
25%	17.000000	5.400000	1995.000000	0.000000e+00	0.000000e+00

```
50%       38.000000      6.000000   2006.000000  0.000000e+00  0.000000e+00
75%      145.750000      6.600000   2011.000000  2.085325e+07  3.369710e+07
max     9767.000000      9.200000   2015.000000  4.250000e+08  2.827124e+09
```

1.1.2 Data Cleaning

```
In [10]: # drop duplicates
         # confirm correction

         df.drop_duplicates(inplace=True)
         sum(df.duplicated())
```

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

Firstly, we will get rid of the columns that are not needed for our analysis. They are id, imdb_id, budget_adj, revenue_adj, homepage, tagline, keywords and overview.

```
In [11]: # list of columns that are to be deleted/dropped
         col = ['id', 'imdb_id', 'budget_adj', 'revenue_adj', 'homepage',  'tagline', 'keywords

         # deleting the columns
         df.drop(col, axis = 1, inplace = True)

         #checking to see if the columns have been deleted
         df.head()
```

```
Out[11]:    popularity     budget     revenue                original_title  \
         0   32.985763  150000000  1513528810                Jurassic World
         1   28.419936  150000000   378436354             Mad Max: Fury Road
         2   13.112507  110000000   295238201                      Insurgent
         3   11.173104  200000000  2068178225  Star Wars: The Force Awakens
         4    9.335014  190000000  1506249360                      Furious 7

                                                 cast           director  \
         0  Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...   Colin Trevorrow
         1  Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...     George Miller
         2  Shailene Woodley|Theo James|Kate Winslet|Ansel...  Robert Schwentke
         3  Harrison Ford|Mark Hamill|Carrie Fisher|Adam D...       J.J. Abrams
         4  Vin Diesel|Paul Walker|Jason Statham|Michelle ...         James Wan

            runtime                                     genres  \
         0      124  Action|Adventure|Science Fiction|Thriller
         1      120  Action|Adventure|Science Fiction|Thriller
         2      119         Adventure|Science Fiction|Thriller
         3      136   Action|Adventure|Science Fiction|Fantasy
         4      137                     Action|Crime|Thriller

                                      production_companies release_date  vote_count  \
         0  Universal Studios|Amblin Entertainment|Legenda...       6/9/15        5562
```

```
1  Village Roadshow Pictures|Kennedy Miller Produ...      5/13/15        6185
2  Summit Entertainment|Mandeville Films|Red Wago...      3/18/15        2480
3         Lucasfilm|Truenorth Productions|Bad Robot     12/15/15        5292
4  Universal Pictures|Original Film|Media Rights ...       4/1/15        2947

   vote_average  release_year
0           6.5          2015
1           7.1          2015
2           6.3          2015
3           7.5          2015
4           7.3          2015
```

```
In [12]: # Changing datatype of `release_date` column
         df['release_date'] = pd.to_datetime(df['release_date'])
```

```
In [13]: # check if the change has taken place successfully
         df.dtypes
```

```
Out[13]: popularity                    float64
         budget                          int64
         revenue                         int64
         original_title                 object
         cast                           object
         director                       object
         runtime                         int64
         genres                         object
         production_companies           object
         release_date           datetime64[ns]
         vote_count                      int64
         vote_average                  float64
         release_year                    int64
         dtype: object
```

```
In [14]: # Handling 0 values in `budget`, `revenue` and `runtime` columns
         # Making a list of the 3 columns
         temp_col = ['budget', 'revenue', 'runtime']

         # Replacing all the 0 values with NaN
         df[temp_col] = df[temp_col].replace(0, np.NAN)
```

```
In [15]: # Dropping/Deleting all the NaN values
         # Subset helps to define in which columns to look for missing values
         df.dropna(subset = temp_col, inplace = True)
         rows, col = df.shape
```

```
In [16]: #Changing format of budget and revenue column.

         change_type=['budget', 'revenue']
         #changing data type
```

```
df[change_type]=df[change_type].applymap(np.int64)
#printing the changed information
df.dtypes
```

```
Out[16]: popularity                    float64
         budget                          int64
         revenue                         int64
         original_title                 object
         cast                           object
         director                       object
         runtime                       float64
         genres                         object
         production_companies           object
         release_date            datetime64[ns]
         vote_count                      int64
         vote_average                  float64
         release_year                    int64
         dtype: object
```

1.2 Exploratory Data Analysis

Let's start with the exploration! :)

1.2.1 1. What are the average popularities of movies according to budget levels?

```
In [17]: # First we need to make columns for budget ranges
         # We use the cut methods of the pandas library to do so
         df['budget_ranges'] = pd.cut(df['budget'], df['budget'].describe()[3:8], labels = ['L
```

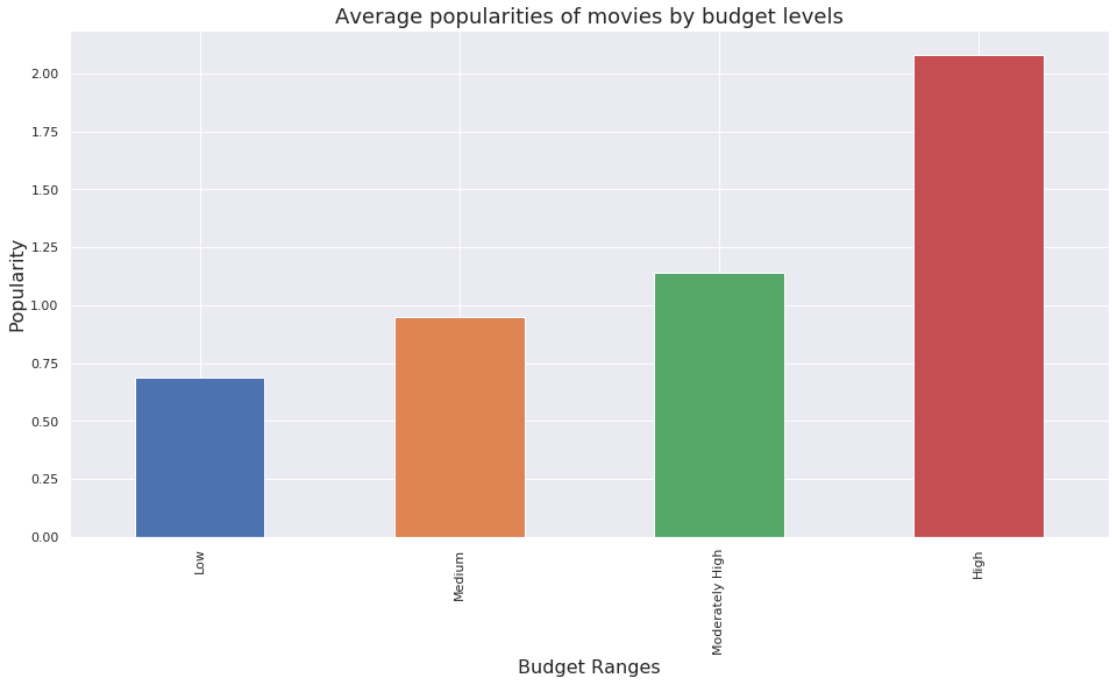
```
In [18]: # Now we find out the average popularities of each level
         df.groupby('budget_ranges')['popularity'].mean()
```

```
Out[18]: budget_ranges
         Low                0.686413
         Medium             0.951718
         Moderately High    1.142414
         High               2.080911
         Name: popularity, dtype: float64
```

```
In [19]: # Plotting the above information in a bar graph
         sns.set()
         df.groupby('budget_ranges')['popularity'].mean().plot(kind = 'bar', figsize = (16, 8))

         # Setting the title of the plot
         plt.title('Average popularities of movies by budget levels', fontsize = 18)

         # Setting the x and y axis labels
         plt.xlabel('Budget Ranges', fontsize = 16)
         plt.ylabel('Popularity', fontsize = 16);
```



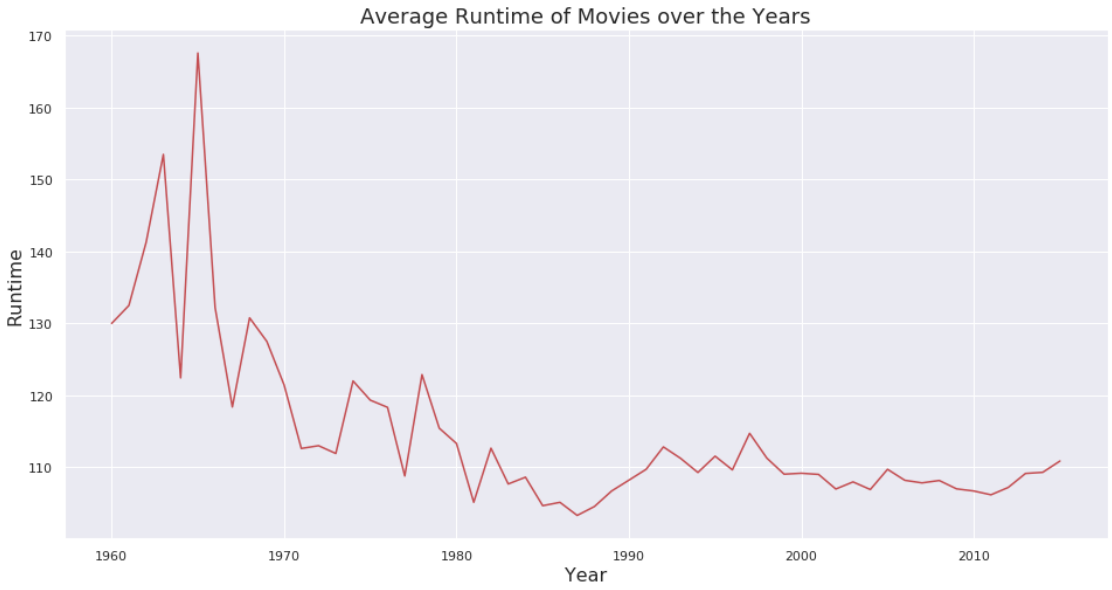
1.2.2 2. What are profit trends from year to year?

In [20]:
```
# First we need to insert a column for the profit/loss value of each movie
df.insert(3, 'profit_loss', df['revenue'] - df['budget'])
```

In [21]:
```
df.groupby('release_year')['profit_loss'].sum().plot(kind = 'line', figsize = (16, 8)
plt.title('Profit Trends from year to year', fontsize = 18)
plt.xlabel('Year', fontsize = 16)
plt.ylabel('Profit', fontsize = 16);
```

1.2.3 3. What are the average runtimes of movies over the years?

```
In [22]: df.groupby('release_year')['runtime'].mean().plot(kind='line', figsize = (16, 8), colo
         plt.title('Average Runtime of Movies over the Years', fontsize = 18)
         plt.xlabel('Year', fontsize = 16)
         plt.ylabel('Runtime', fontsize = 16);
```



1.2.4 4. Which are the 5 cheapest and most expensive profitable movies of all time?

For this we shall set a standard value of profit which has to be met, that value will be $50,000,000

```
In [23]: # creating a list of columns that will be viewed
         col = ['original_title', 'cast', 'director', 'budget', 'revenue', 'profit_loss']

         # Using query function to show records of movies which have a profit of more than $50
         # Also using sort_values function to make sure it is sorted according to the budget c

         df.query('profit_loss>50000000')[col].sort_values('budget', ascending = False).head(5)
```

```
Out[23]:                                  original_title  \
         3375  Pirates of the Caribbean: On Stranger Tides
         7387     Pirates of the Caribbean: At World's End
         14                        Avengers: Age of Ultron
         6570                             Superman Returns
```

```
1929                                        Tangled

                                                      cast  \
3375  Johnny Depp|PenÃ¯lope Cruz|Geoffrey Rush|Ian M...
7387  Johnny Depp|Orlando Bloom|Keira Knightley|Geof...
14    Robert Downey Jr.|Chris Hemsworth|Mark Ruffalo...
6570  Brandon Routh|Kevin Spacey|Kate Bosworth|James...
1929  Zachary Levi|Mandy Moore|Donna Murphy|Ron Perl...

                        director     budget     revenue  profit_loss
3375               Rob Marshall  380000000  1021683000    641683000
7387             Gore Verbinski  300000000   961000000    661000000
14                  Joss Whedon  280000000  1405035767   1125035767
6570               Bryan Singer  270000000   391081192    121081192
1929  Nathan Greno|Byron Howard  260000000   591794936    331794936
```

```
In [24]: df.query('profit_loss>50000000')[col].sort_values('budget', ascending = True).head(5)
```

```
Out[24]:                 original_title  \
10495  The Karate Kid, Part II
7447       Paranormal Activity
2449   The Blair Witch Project
7057                Open Water
10759               Halloween

                                                      cast  \
10495  Ralph Macchio|Pat Morita|Martin Kove|Charlie T...
7447   Katie Featherston|Micah Sloat|Mark Fredrichs|A...
2449   Heather Donahue|Michael C. Williams|Joshua Leo...
7057   Blanchard Ryan|Daniel Travis|Saul Stein|Michae...
10759  Donald Pleasence|Jamie Lee Curtis|P.J. Soles|N...

                             director  budget    revenue  profit_loss
10495               John G. Avildsen     113  115103979    115103866
7447                      Oren Peli   15000  193355800    193340800
2449   Daniel Myrick|Eduardo SÃąnchez   25000  248000000    247975000
7057                    Chris Kentis  130000   54667954     54537954
10759                 John Carpenter  300000   70000000     69700000
```

Conclusions

Question 1: It can be observed that movies with a higher budget range tend to be more popular with the audience.

Question 2: Profits have increased exponentially with each passing year especially after the beginning of the 21st century.

Question 3: The runtime of movies has decreased with each passsing year. It experienced a hike during the 60s but has then steadily decreased over the years. The lowest

was around 100-110 mintues. Presently, movies tend to last around the 110 minute mark.

Limitations: This analysis was done considering the movies which had a significant amount of profit of around 50 million dollar. This might not be completely error free but by following these suggestion one can increase the probability of a movie to become a hit. Moreover we are not sure if the data provided to us is completel corect and up-to-date. As mentioned before 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 are produce in. So a disparity arises here which can state the complete analysis wrong. Dropping the rows with missing values also affected the overall analysis.