TMDB Movie Analysis

April 24, 2020

1 Project: TMDb (The Movie Database) Analysis

The primary objective of this project is to explore the'TMDb Dataset' ([https://www.kaggle.com/tmdb/tmdb-movie-metadata]) by conducting suitable data-analysis using various tools and libraries like Jupyter Notebooks, IPython, Numpy, Pandas and Matplotlib. In order to make the findings more interpretable, project is further divided into the following four sections:

1.1 Table of Contents

1.2 Introduction

TMDd-Movie Dataset was genrated by 'The Movie Database API' [(https://www.kaggle.com/tmdb/themoviedb.org)] which contains metadata on ~5000 movies including cast, crew, budget and revenue of each film. Using this data, we can start digging in to questions like:

- What are the highest grossing films of all time?
- Which day of week has most number of releases?
- How does popularity influence revenue of films?

```
In [102]: # Importing required libraries like Numpy, Pandas and Matplotlib
          import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
```

## Data Wrangling

1.2.1 Wrangling and munging data from its raw format into a suitable form appropriate for analysis.

```
In [103]: # Loading the data into the DataFrame using pd.read_csv() function
          # There are 21 Columns and 10,866 entries in this dataset
          df = pd.read_csv('tmdb-movies.csv', header=0, parse_dates=True)
          df.head()
```

```
Out[103]:        id    imdb_id  popularity     budget     revenue  \
          0  135397  tt0369610   32.985763  150000000  1513528810
          1   76341  tt1392190   28.419936  150000000   378436354
          2  262500  tt2908446   13.112507  110000000   295238201
          3  140607  tt2488496   11.173104  200000000  2068178225
          4  168259  tt2820852    9.335014  190000000  1506249360

                          original_title  \
          0               Jurassic World
          1           Mad Max: Fury Road
          2                    Insurgent
          3 Star Wars: The Force Awakens
          4                    Furious 7

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

                                                    homepage          director  \
          0                        http://www.jurassicworld.com/   Colin Trevorrow
          1                          http://www.madmaxmovie.com/     George Miller
          2     http://www.thedivergentseries.movie/#insurgent  Robert Schwentke
          3  http://www.starwars.com/films/star-wars-episod...       J.J. Abrams
          4                             http://www.furious7.com/         James Wan

                                tagline  ...  \
          0            The park is open.  ...
          1           What a Lovely Day.  ...
          2       One Choice Can Destroy You  ...
          3  Every generation has a story.  ...
          4            Vengeance Hits Home  ...
```

```
                                            overview runtime  \
0  Twenty-two years after the events of Jurassic ...     124   
1  An apocalyptic story set in the furthest reach...     120   
2  Beatrice Prior must confront her inner demons ...     119   
3  Thirty years after defeating the Galactic Empi...     136   
4  Deckard Shaw seeks revenge against Dominic Tor...     137   

                                      genres  \
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 [104]: # Checking the data-types of various columns using df.dtypes function
          # Few datatypes are inconsistent like release_date and release_year
          df.dtypes
```

```
Out[104]: 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 [105]:
```
# Checking the shape of the dataset using the df.shape function
# Some columns are unnecessary for our analysis, should be excluded
df.shape
```

Out[105]:
```
(10866, 21)
```

In [106]:
```
# Printing summary of entire dataset using df.info() function
# There are missing values in few columns, must be repaired
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 [107]: # Generating descriptive statistics using df.describe() function
          # Summarizes shape, central tendency and dispersion
          df.describe()
```

```
Out[107]:                  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
```

```
In [108]: # Checking for unique values using df.nunique() function
          # There are multiple unique values in columns like Cast, Genre
          df.nunique()
```

```
Out[108]: 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
```

1.3 Data Cleaning

1.3.1 Detecting and cleaning data by getting rid of various inconsistencies or errors before reporting.

```
In [109]: # Dropping unecessary columns using df.drop() function
          df = df.drop(['id', 'imdb_id', 'homepage', 'tagline', 'keywords', 'overview', 'budget_
```

```
In [110]: # Dropping duplicate entries using drop_duplicates() function
          df.duplicated().sum()
          df.drop_duplicates()
```

```
Out[110]:        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
          ...           ...        ...         ...                           ...
          10861    0.080598          0           0            The Endless Summer
          10862    0.065543          0           0                    Grand Prix
          10863    0.065141          0           0          Beregis Avtomobilya
          10864    0.064317          0           0        What's Up, Tiger Lily?
          10865    0.035919      19000           0      Manos: The Hands of Fate

                                                              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
          ...                                                  ...                ...
          10861  Michael Hynson|Robert August|Lord 'Tally Ho' B...        Bruce Brown
          10862  James Garner|Eva Marie Saint|Yves Montand|Tosh...  John Frankenheimer
          10863  Innokentiy Smoktunovskiy|Oleg Efremov|Georgi Z...     Eldar Ryazanov
          10864  Tatsuya Mihashi|Akiko Wakabayashi|Mie Hama|Joh...        Woody Allen
          10865  Harold P. Warren|Tom Neyman|John Reynolds|Dian...   Harold P. Warren

                 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
          ...        ...                                        ...
          10861       95                                 Documentary
```

```
10862     176                    Action|Adventure|Drama
10863      94                           Mystery|Comedy
10864      80                            Action|Comedy
10865      74                                   Horror

                                  production_companies release_date  \
0      Universal Studios|Amblin Entertainment|Legenda...       6/9/15
1      Village Roadshow Pictures|Kennedy Miller Produ...      5/13/15
2      Summit Entertainment|Mandeville Films|Red Wago...      3/18/15
3              Lucasfilm|Truenorth Productions|Bad Robot     12/15/15
4      Universal Pictures|Original Film|Media Rights ...       4/1/15
...                                                  ...          ...
10861                                  Bruce Brown Films      6/15/66
10862  Cherokee Productions|Joel Productions|Douglas ...     12/21/66
10863                                            Mosfilm       1/1/66
10864                              Benedict Pictures Corp.    11/2/66
10865                                          Norm-Iris     11/15/66

       vote_count  vote_average  release_year
0            5562           6.5          2015
1            6185           7.1          2015
2            2480           6.3          2015
3            5292           7.5          2015
4            2947           7.3          2015
...           ...           ...           ...
10861          11           7.4          1966
10862          20           5.7          1966
10863          11           6.5          1966
10864          22           5.4          1966
10865          15           1.5          1966

[10865 rows x 13 columns]
```

```
In [111]: df.isnull().sum()
```

```
Out[111]: popularity                 0
          budget                     0
          revenue                    0
          original_title             0
          cast                      76
          director                  44
          runtime                    0
          genres                    23
          production_companies    1030
          release_date               0
          vote_count                 0
          vote_average               0
          release_year               0
          dtype: int64
```

```
In [112]: # Checking missing values across columns using df.isnull() function
          df.isnull().sum()
          # Filling missing values for budget/revenue with with df.fillna() function
          df['budget'].fillna(df['budget'].mean(), inplace=True)
          df['revenue'].fillna(df['revenue'].mean(), inplace=True)
          # Dropping null/NaN values in rows using df.dropna() function
          df.dropna(axis=0, inplace=True)
```

```
In [113]: # Converting datatypes of non-date columns using pd.to_datetime()
          df['release_date'] = pd.to_datetime(df['release_date'])
          df['release_year'] = pd.DatetimeIndex(df['release_year']).year
          df.head()
```

```
Out[113]:    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...   2015-06-09        5562
          1  Village Roadshow Pictures|Kennedy Miller Produ...   2015-05-13        6185
          2  Summit Entertainment|Mandeville Films|Red Wago...   2015-03-18        2480
          3          Lucasfilm|Truenorth Productions|Bad Robot   2015-12-15        5292
          4  Universal Pictures|Original Film|Media Rights ...   2015-04-01        2947

             vote_average  release_year
          0           6.5          1970
          1           7.1          1970
          2           6.3          1970
          3           7.5          1970
          4           7.3          1970
```

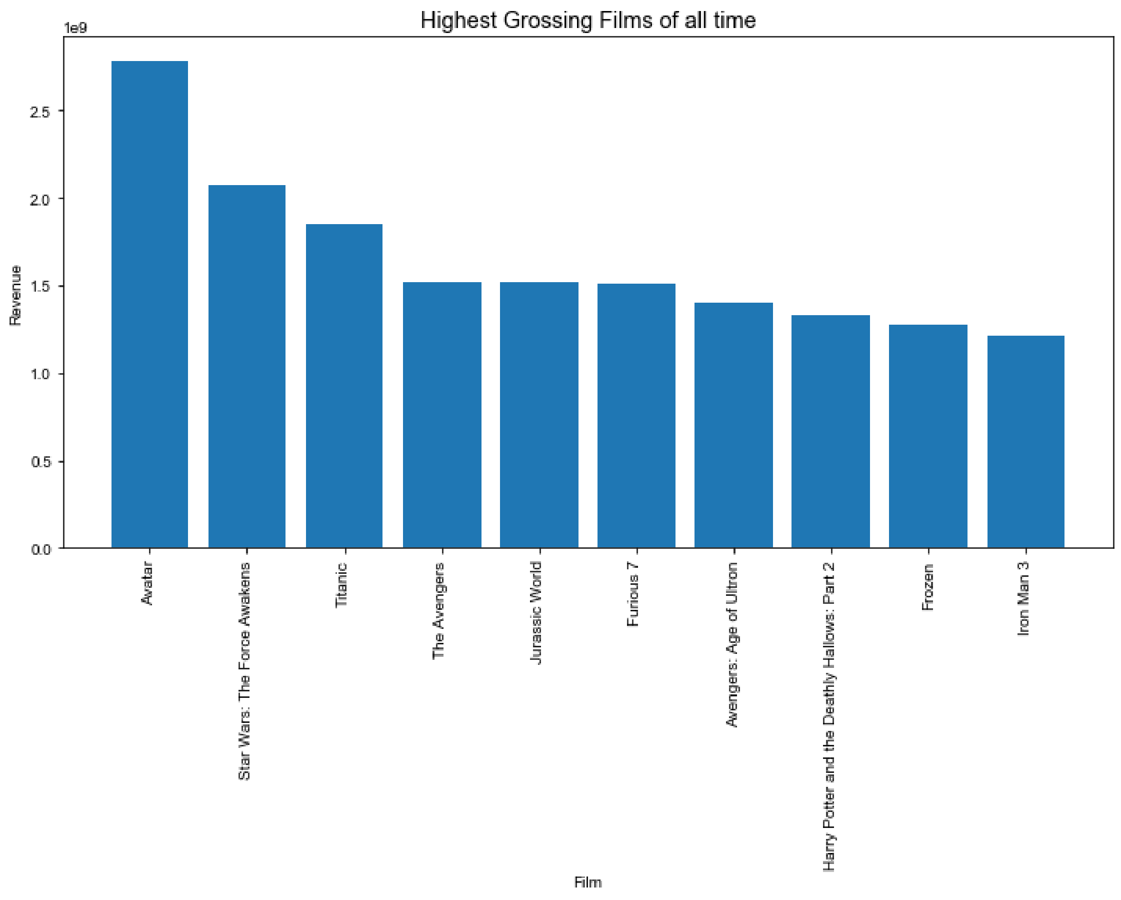
## Exploratory Data Analysis

Analyzing the dataset by summarising its main characteristics. Including, choice of various of graphical techniques that will aid in bird's eye view of the data to make some sense of it. Answering critical research questions along the way to supplement our findings.

### Question 1: What are the highest grossing films of all time?

Avatar(2.78B) was highest grossing film of all time, followed by Star Wars(2.06B) and Titanic(1.84B).

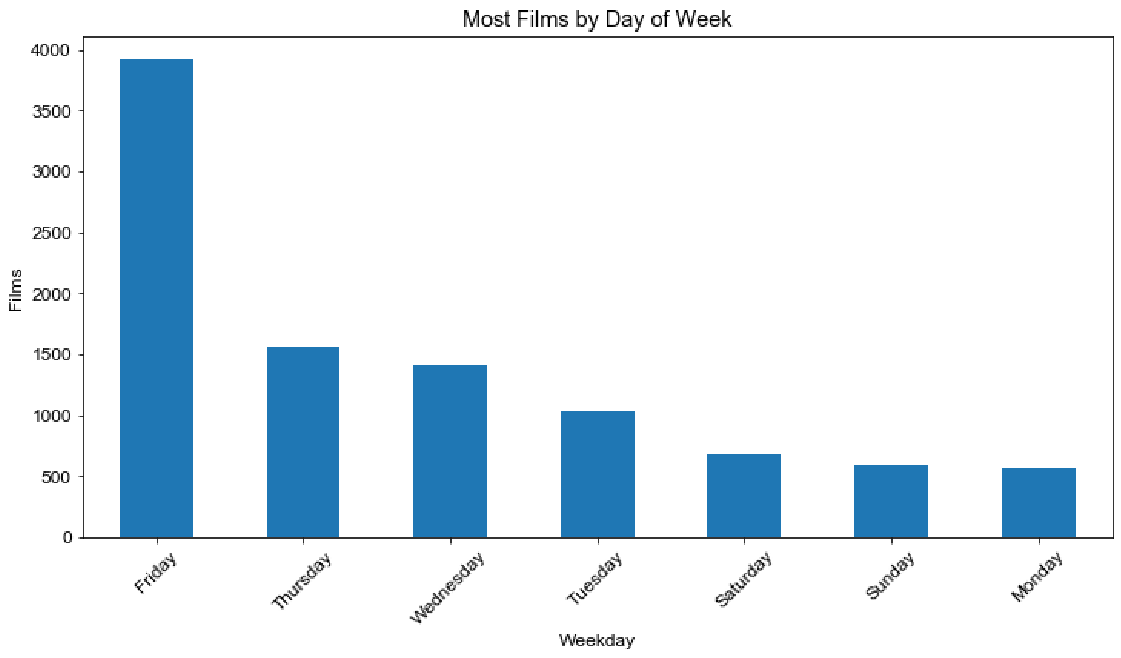
```
In [114]: fig, ax = plt.subplots(figsize = (12,6))
          plt.rcParams['font.sans-serif'] = 'Arial'
          plt.rcParams['font.family'] = 'sans-serif'
          plt.rcParams['font.size']=12
          high_gross = df.sort_values(by='revenue', ascending=False)[:10]
          plt.bar(high_gross['original_title'], high_gross['revenue'])
          plt.xlabel('Film')
          plt.ylabel('Revenue')
          plt.title('Highest Grossing Films of all time')
          plt.xticks(rotation=90)
          plt.show()
```



### Question 2: Which day of the week has most number of releases?
Friday seems to have the most number of releases, followed by Thursday and Wednesday.

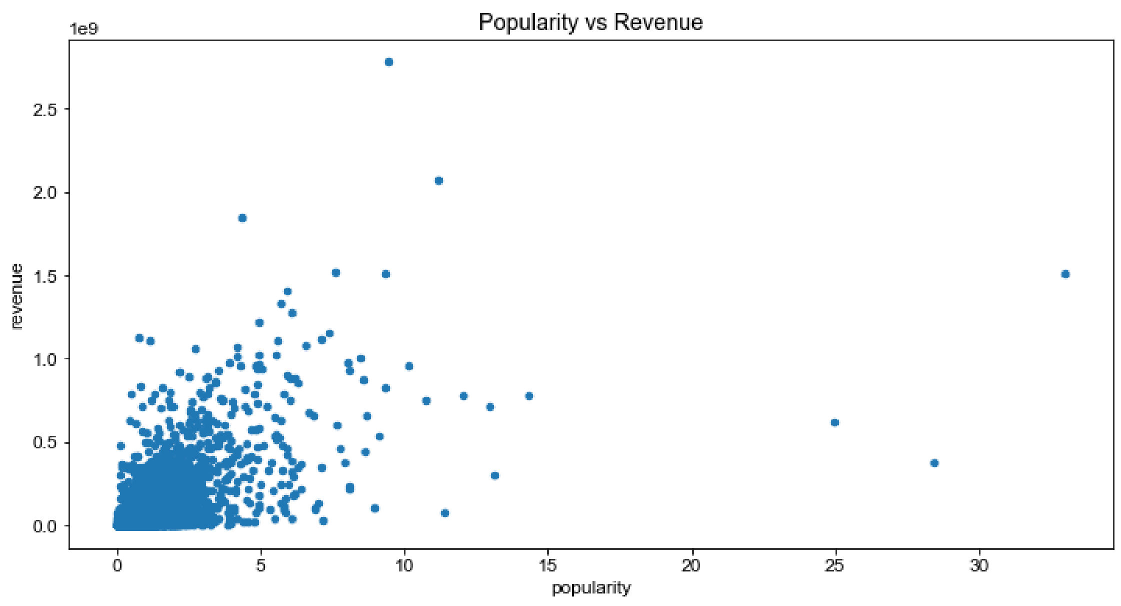
```
In [115]: fig, ax = plt.subplots(figsize = (12,6))
          plt.rcParams['font.sans-serif'] = 'Arial'
          plt.rcParams['font.family'] = 'sans-serif'
          plt.rcParams['font.size']=12
          day_week = df['release_date'].dt.day_name()
          day_week.value_counts().plot.bar()
          plt.xticks(rotation=45)
          plt.xlabel('Weekday')
          plt.ylabel('Films')
          plt.title('Most Films by Day of Week')
```

```
Out[115]: Text(0.5, 1.0, 'Most Films by Day of Week')
```



### Question 3: How does popularity influence revenue of a film?
General positive correlation among popularity and revenue with few outliers.

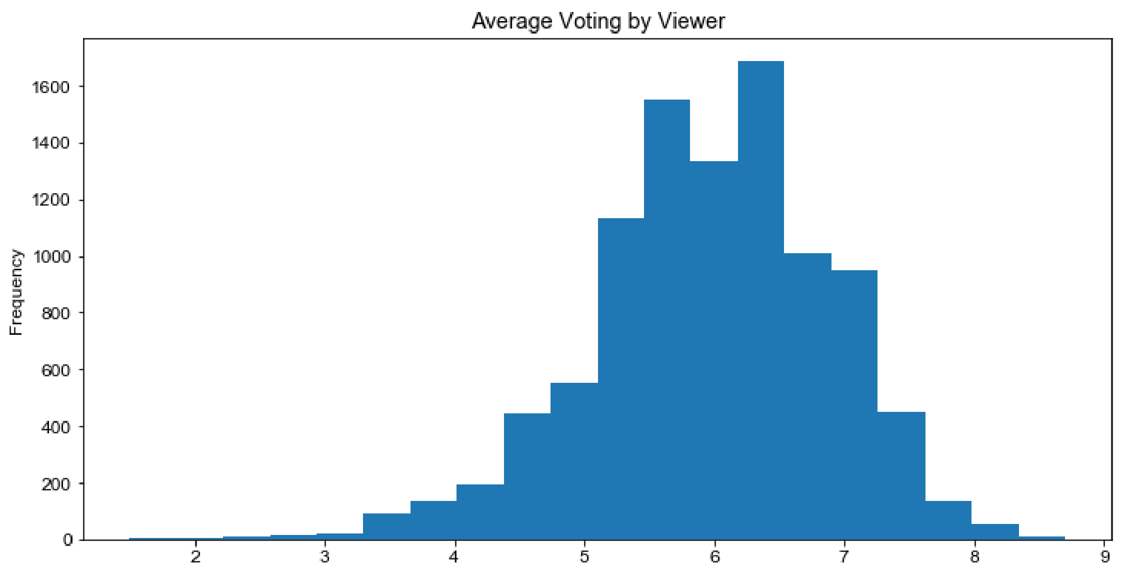
```
In [116]: plt.rcParams['font.sans-serif'] = 'Arial'
          plt.rcParams['font.family'] = 'sans-serif'
          plt.rcParams['font.size']=12
          df.plot(x='popularity', y='revenue', kind='scatter', figsize=(12,6))
          plt.title('Popularity vs Revenue')
          plt.show()
```



### Question 4: What does average voting among films look like?
In general viewers have rated the films in following range, with very few ratings above 8.

```
In [117]: plt.rcParams['font.sans-serif'] = 'Arial'
          plt.rcParams['font.family'] = 'sans-serif'
          plt.rcParams['font.size']=12
          df.vote_average.plot(kind='hist', bins = 20, figsize = (12,6), title='Average Voting b
```

```
Out[117]: <matplotlib.axes._subplots.AxesSubplot at 0x11ec2f890>
```



## Conclusions
Some of the meaningful insights extracted from the above analysis of data include:

- Avatar is highest grossing film of all time, followed by Star Wars: Force Awakens and Titanic.
- Friday saw the most number of film releases, followed by Thursday based on the day of week.
- Popularity has a positive affect on the success of a given film or its commercial revenue.
- Average vote among various films is around 6.0, with very few films having vote higher than 8.0.

### Limitations

- Extracted data may be incomplete, as there are several missing values. This affects its usability. (For example, missing values in columns like budget/revenue are replaced with their means).
- Data collected above varies in quality and format. Many unique values appear in individual columns. (For example, cast/genres columns have lots of unique values seperated by '|' operator).
- Such data needs lot of preprocessing before its ready for analysis. There may be incorect data types. (For example, release_date/release_year had to be transformed before using them in analysis).
- Such inconsistencies, must be treated with caution until making important decisions as it may produce biases.

## References

1. Python Plotting Basics [https://towardsdatascience.com/python-plotting-basics-simple-charts-with-matplotlib-seaborn-and-plotly-e36346952a3a]
2. Quick dive into Pandas [https://towardsdatascience.com/quick-dive-into-pandas-for-data-science-cc1c1a80d9c4]
3. Data Wrangling with Pandas [https://towardsdatascience.com/data-wrangling-with-pandas-5b0be151df4e]