Investigate_a_Dataset

November 23, 2022

1 Project: Investigate a Dataset - TMDb movie data

1.1 Table of Contents

1.1.1 Dataset Description

In this project, we will be analzing TMDb movie data 1960 - 2015 (cleaned from original data on Kaggle). This data set contains information about 10,000 movies collected from The Movie Database (TMDb), including user ratings and revenue.

1.1.2 Question(s) for Analysis

Some questions we will be analyzing include: 1. Which movie has the highest all-time polularity? 2. Which movie has the highest all-time budget? 3. Which movie generated more revenue, per year, and overall? 4. Does movie genre determine revenue? 5. What is the best production company doing differently? 6. Which genres are most popular from year to year? 7. What kinds of properties are associated with movies that have high revenues? 8. Which stars are the most prominent casts?

```
In [1]: import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
        import seaborn as sns
        import matplotlib as mpl

        % matplotlib inline
```

```
In [2]: # Pandas upgrade (to access dataframe.explode() method)
        !pip install --upgrade pandas==0.25.0
```

```
Requirement already up-to-date: pandas==0.25.0 in /opt/conda/lib/python3.6/site-packages (0.25.0
Requirement already satisfied, skipping upgrade: numpy>=1.13.3 in /opt/conda/lib/python3.6/site-
Requirement already satisfied, skipping upgrade: pytz>=2017.2 in /opt/conda/lib/python3.6/site-p
Requirement already satisfied, skipping upgrade: python-dateutil>=2.6.1 in /opt/conda/lib/python
Requirement already satisfied, skipping upgrade: six>=1.5 in /opt/conda/lib/python3.6/site-packa
```

```
In [3]: #load dataset
        df = pd.read_csv("Database_TMDb_movie_data/tmdb-movies.csv")
        #first five observations
        df.head()
```

```
Out[3]:        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 [4]: #A quick insight into the data
        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
```

All the features seem to have appropriate data types assigned to them. However will will do a recast on **release_date** from string to pandas datetime format

```
In [5]: #convert release_date to pandas datetime
        df["release_date"] = pd.to_datetime(df["release_date"])
```

```
In [6]: #check conversion result
        df.release_date.dtype
```

```
Out[6]: dtype('<M8[ns]')
```

Let's examine all the features/columns and draft and out possible questions for analysis.

This will help us in removing columns that won't help in answering our questions

```
In [7]: df.columns
```

```
Out[7]: Index(['id', 'imdb_id', 'popularity', 'budget', 'revenue', 'original_title',
               'cast', 'homepage', 'director', 'tagline', 'keywords', 'overview',
               'runtime', 'genres', 'production_companies', 'release_date',
               'vote_count', 'vote_average', 'release_year', 'budget_adj',
               'revenue_adj'],
              dtype='object')
```

1. Which movie has the highest all-time polularity?
2. Which movie has the highest all-time budget?
3. Which movie generated more revenue, per year, and overall?
4. Does movie genre determine revenue?
5. What is the best production company doing differently?
6. Which genres are most popular from year to year?
7. What kinds of properties are associated with movies that have high revenues?
8. Which stars are the most prominent casts?

We will get rid of the following columns as they are not needful for the analysis/answering above questions

"id", "imdb_id", "original_title", "keywords", "overview", "homepage", "tagline",

```
In [8]: #Drop unneccessary columns
        df.drop(columns = ["id","imdb_id", "keywords", "overview", "homepage", "tagline"], inpla
```

1.2 Checking for missing values

```
In [9]: #Now let's check for missing values
        df.isnull().sum()
```

```
Out[9]: 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
        budget_adj                 0
        revenue_adj                0
        dtype: int64
```

cast - we will delete affected observations **director** - we will delete affected observations **genres** - we will delete affected observations **production_companies**we will delete affected observations ~~we ignore this and only use it if we want to do any analysis that relates to it~~

```
In [10]: #Drop null values
         df.dropna(inplace = True)
```

```
In [11]: #Let's check that everything worked as expected
         df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 9773 entries, 0 to 10865
Data columns (total 15 columns):
popularity              9773 non-null float64
budget                  9773 non-null int64
revenue                 9773 non-null int64
original_title          9773 non-null object
cast                    9773 non-null object
director                9773 non-null object
runtime                 9773 non-null int64
genres                  9773 non-null object
production_companies    9773 non-null object
release_date            9773 non-null datetime64[ns]
vote_count              9773 non-null int64
vote_average            9773 non-null float64
release_year            9773 non-null int64
budget_adj              9773 non-null float64
```

```
revenue_adj             9773 non-null float64
dtypes: datetime64[ns](1), float64(4), int64(5), object(5)
memory usage: 1.2+ MB
```

```
In [12]: #Let's check for duplicate values
         df.duplicated().sum()
```

```
Out[12]: 1
```

We have 1 duplicate record that has to be dropped

```
In [13]: df.drop_duplicates(inplace = True)
         df.duplicated().sum()
```

```
Out[13]: 0
```

Duplicate row has been removed

1.2.1 Data Cleaning

> **Tip**: Make sure that you keep your reader informed on the steps that you are taking in your investigation. Follow every code cell, or every set of related code cells, with a markdown cell to describe to the reader what was found in the preceding cell(s). Try to make it so that the reader can then understand what they will be seeing in the following cell(s).

1.3 Let's Explore

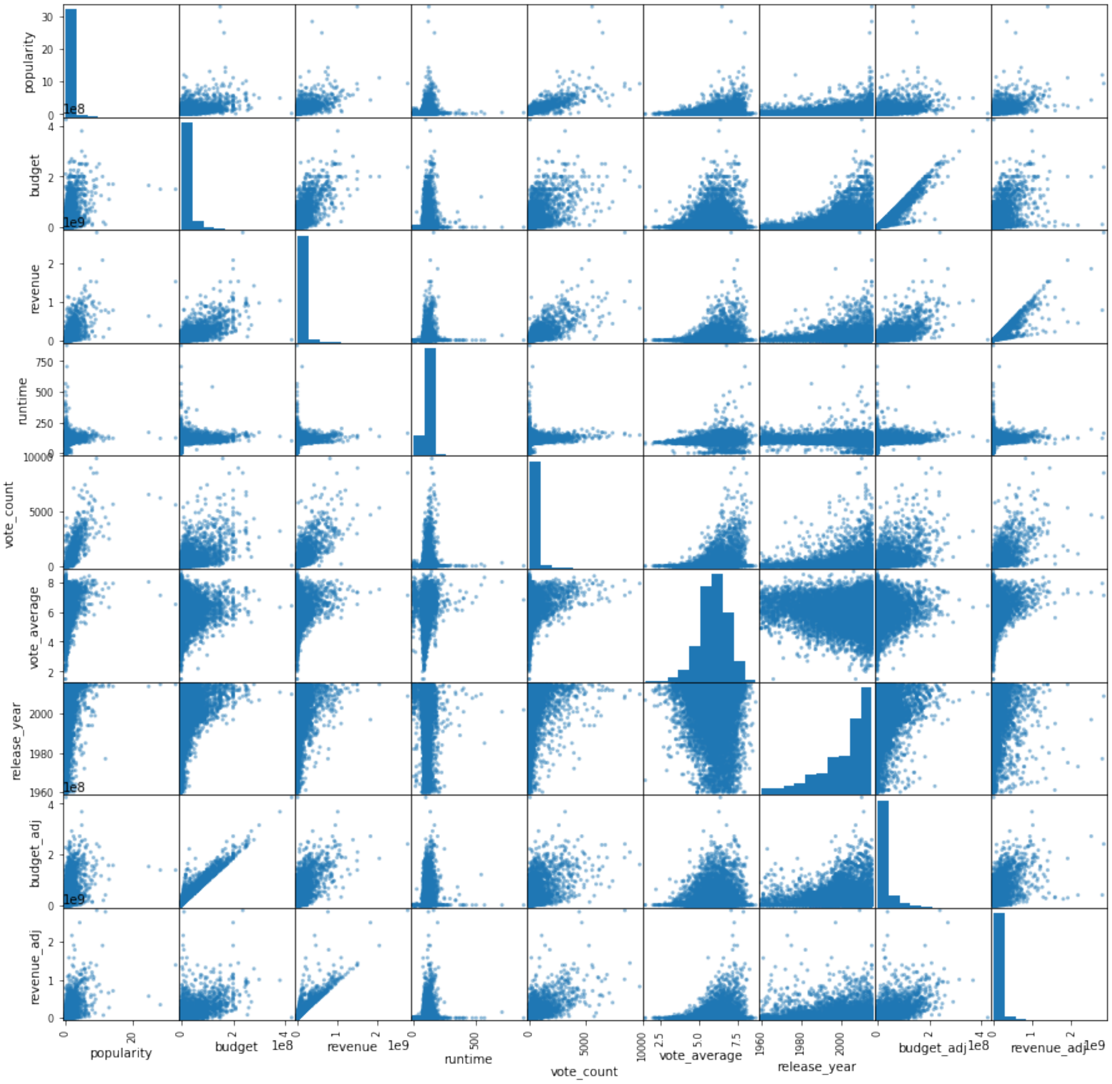
```
In [14]: #Statistical overview
         df.describe()
```

```
Out[14]:         popularity        budget       revenue      runtime   vote_count  \
         count  9772.000000  9.772000e+03  9.772000e+03  9772.000000  9772.000000
         mean      0.694721  1.617967e+07  4.423121e+07   102.926627   239.312014
         std       1.036931  3.221074e+07  1.225889e+08    27.877432   603.011504
         min       0.000188  0.000000e+00  0.000000e+00     0.000000    10.000000
         25%       0.232710  0.000000e+00  0.000000e+00    90.000000    18.000000
         50%       0.419762  2.000000e+05  0.000000e+00   100.000000    46.000000
         75%       0.776408  1.928750e+07  3.104729e+07   112.000000   173.000000
         max      32.985763  4.250000e+08  2.781506e+09   877.000000  9767.000000

                vote_average  release_year    budget_adj   revenue_adj
         count   9772.000000   9772.000000  9.772000e+03  9.772000e+03
         mean       5.963528   2000.878428  1.941599e+07  5.705309e+07
         std        0.913174     13.036794  3.566634e+07  1.514499e+08
         min        1.500000   1960.000000  0.000000e+00  0.000000e+00
         25%        5.400000   1994.000000  0.000000e+00  0.000000e+00
         50%        6.000000   2005.000000  3.061342e+05  0.000000e+00
         75%        6.600000   2011.000000  2.464268e+07  4.311848e+07
         max        8.700000   2015.000000  4.250000e+08  2.827124e+09
```

From this statistics: 1. For the given period of years (1960 - 2015), there been an average revenue of 44231208.89 in the movie industry 2. There has been an average budget of 16179667.921715105 in the movie industry 3. Looking at vote count, there's a wide gap between maximum and minimum vote count which could either mean there are outliers or that some movies actually had very low vote count

Let's see some generalized plots

```
In [15]: pd.plotting.scatter_matrix(df, figsize = (15,15));
```

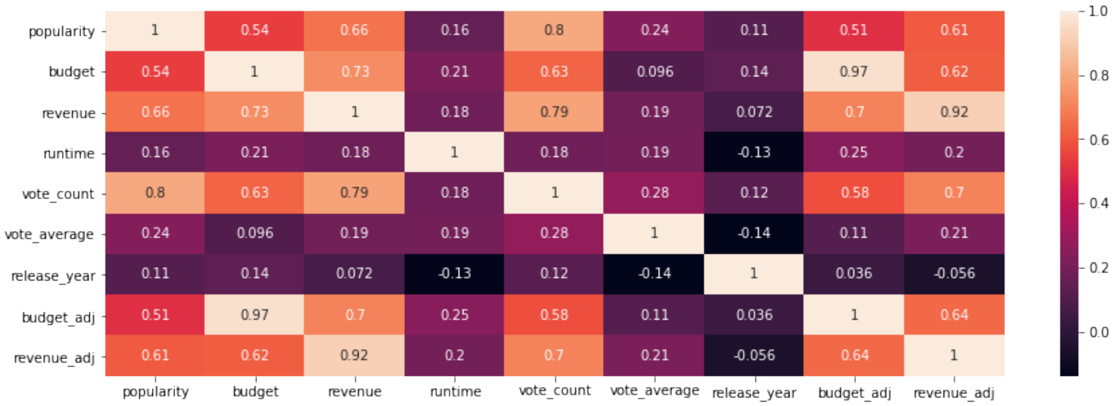


The above plot shows a general relationship between all of the features using scattered plot and histogram. Some key findings from the plots are: 1. Very obviously and as expected, revenue and revenue_adj have very strong correlation 2. Likwise, budget and budget_adj also have very strong correlation 3. Other features that show some level of correlation include: --popularity and revenue_adj --popularity and budget_adj --revenue and budget_adj --revenue_adj and budget_adj

--budget and vote_count --budget and revenue 4. Most of the charts are right-skewed, except for vote average that is almost normalized but tends towards left-skew

We can use seaborn to make a correlation chart to view the correlations better

```
In [16]: plt.figure(figsize = (15, 5))
         sns.heatmap(df.corr(), annot = True);
```



We have used default colors for this chart. The lighter colors reveal strong correlations while the the darker the color gets, the less correlated they actually are. For example it is very easy to see that popularity and vote_count go hand in hand.

1.3.1 Research Question 1 (Which movie has the highest all-time polularity)

```
In [17]: df.head()

Out[17]:    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    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
```

```
In [18]: #Highest popularity
         df[df["popularity"] == df["popularity"].max()]
```

```
Out[18]:    popularity     budget     revenue  original_title  \
         0   32.985763  150000000  1513528810  Jurassic World

                                                       cast         director  \
         0  Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...  Colin Trevorrow

            runtime                                     genres  \
         0      124  Action|Adventure|Science Fiction|Thriller

                                         production_companies release_date  vote_count  \
         0  Universal Studios|Amblin Entertainment|Legenda...   2015-06-09        5562

            vote_average  release_year    budget_adj   revenue_adj
         0           6.5          2015  1.379999e+08  1.392446e+09
```

Jurassic World release 2015 has the highest popularity

Let’s get the top ten popular movies

```
In [19]: pop_10 = df.sort_values("popularity", ascending = False).head(10)
         pop_10
```

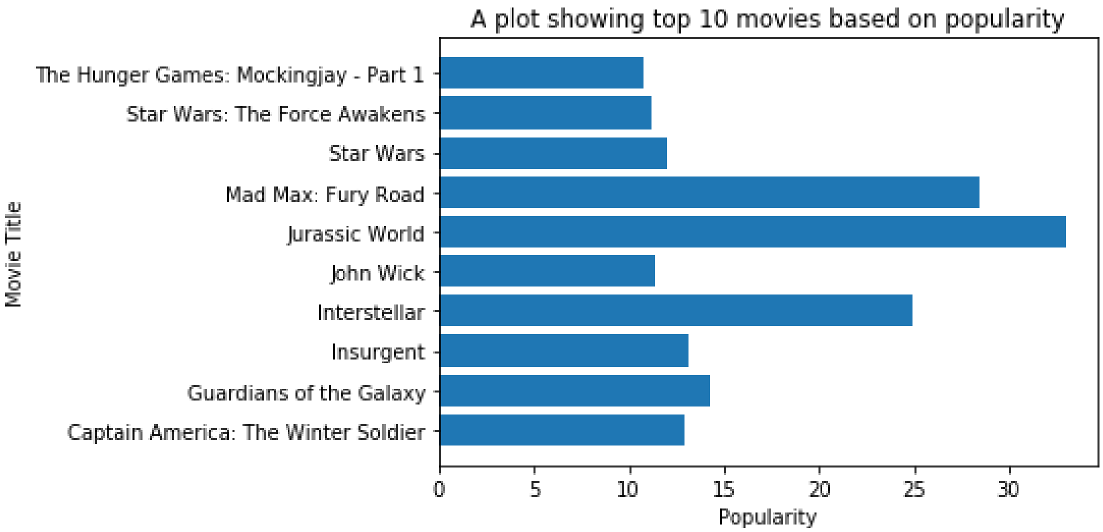
```
Out[19]:       popularity     budget     revenue  \
         0       32.985763  150000000  1513528810
         1       28.419936  150000000   378436354
         629     24.949134  165000000   621752480
         630     14.311205  170000000   773312399
         2       13.112507  110000000   295238201
         631     12.971027  170000000   714766572
         1329    12.037933   11000000   775398007
```

```
632    11.422751   20000000    78739897
3      11.173104  200000000  2068178225
633    10.739009  125000000   752100229

                             original_title  \
0                            Jurassic World
1                        Mad Max: Fury Road
629                            Interstellar
630                 Guardians of the Galaxy
2                                 Insurgent
631      Captain America: The Winter Soldier
1329                              Star Wars
632                               John Wick
3              Star Wars: The Force Awakens
633   The Hunger Games: Mockingjay - Part 1

                                                   cast  \
0     Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...
1     Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...
629   Matthew McConaughey|Jessica Chastain|Anne Hath...
630   Chris Pratt|Zoe Saldana|Dave Bautista|Vin Dies...
2     Shailene Woodley|Theo James|Kate Winslet|Ansel...
631   Chris Evans|Scarlett Johansson|Sebastian Stan|...
1329  Mark Hamill|Harrison Ford|Carrie Fisher|Peter ...
632   Keanu Reeves|Michael Nyqvist|Alfie Allen|Wille...
3     Harrison Ford|Mark Hamill|Carrie Fisher|Adam D...
633   Jennifer Lawrence|Josh Hutcherson|Liam Hemswor...

                         director  runtime  \
0                 Colin Trevorrow      124
1                   George Miller      120
629             Christopher Nolan      169
630                    James Gunn      121
2                Robert Schwentke      119
631       Joe Russo|Anthony Russo      136
1329                 George Lucas      121
632   Chad Stahelski|David Leitch      101
3                     J.J. Abrams      136
633              Francis Lawrence      123

                                         genres  \
0     Action|Adventure|Science Fiction|Thriller
1     Action|Adventure|Science Fiction|Thriller
629             Adventure|Drama|Science Fiction
630            Action|Science Fiction|Adventure
2            Adventure|Science Fiction|Thriller
631            Action|Adventure|Science Fiction
1329           Adventure|Action|Science Fiction
```

```
632                                 Action|Thriller
3       Action|Adventure|Science Fiction|Fantasy
633           Science Fiction|Adventure|Thriller

                                       production_companies release_date  \
0     Universal Studios|Amblin Entertainment|Legenda...   2015-06-09
1     Village Roadshow Pictures|Kennedy Miller Produ...   2015-05-13
629   Paramount Pictures|Legendary Pictures|Warner B...   2014-11-05
630   Marvel Studios|Moving Picture Company (MPC)|Bu...   2014-07-30
2     Summit Entertainment|Mandeville Films|Red Wago...   2015-03-18
631                                      Marvel Studios   2014-03-20
1329   Lucasfilm|Twentieth Century Fox Film Corporation   1977-03-20
632   Thunder Road Pictures|Warner Bros.|87Eleven|De...   2014-10-22
3             Lucasfilm|Truenorth Productions|Bad Robot   2015-12-15
633                                 Lionsgate|Color Force   2014-11-18

      vote_count  vote_average  release_year    budget_adj   revenue_adj
0           5562           6.5          2015  1.379999e+08  1.392446e+09
1           6185           7.1          2015  1.379999e+08  3.481613e+08
629         6498           8.0          2014  1.519800e+08  5.726906e+08
630         5612           7.9          2014  1.565855e+08  7.122911e+08
2           2480           6.3          2015  1.012000e+08  2.716190e+08
631         3848           7.6          2014  1.565855e+08  6.583651e+08
1329        4428           7.9          1977  3.957559e+07  2.789712e+09
632         2712           7.0          2014  1.842182e+07  7.252661e+07
3           5292           7.5          2015  1.839999e+08  1.902723e+09
633         3590           6.6          2014  1.151364e+08  6.927528e+08
```

In [20]:
```
# plt.bar(x = pop_10.original_title, height = pop_10.popularity)
# plt.xticks(rotation=90);

plt.barh(y = pop_10.original_title, width = pop_10.popularity);
plt.ylabel("Movie Title")
plt.xlabel("Popularity")
plt.title("A plot showing top 10 movies based on popularity")
```

Out[20]:
```
Text(0.5,1,'A plot showing top 10 movies based on popularity')
```



The chart above easily shows the top 10 popular movies as of 1960 to 2015.
`Mad Max: Fury Road` coming after `Jurassic World`
Let's see what genre of movie they are and their year of release

```
In [21]: pop_10[["popularity", "genres", "release_year", "original_title"]].sort_values("popular
```

```
Out[21]:       popularity                                    genres  release_year  \
         0      32.985763  Action|Adventure|Science Fiction|Thriller          2015
         1      28.419936  Action|Adventure|Science Fiction|Thriller          2015
         629    24.949134            Adventure|Drama|Science Fiction          2014
         630    14.311205           Action|Science Fiction|Adventure          2014
         2      13.112507         Adventure|Science Fiction|Thriller          2015
         631    12.971027           Action|Adventure|Science Fiction          2014
         1329   12.037933           Adventure|Action|Science Fiction          1977
         632    11.422751                            Action|Thriller          2014
         3      11.173104   Action|Adventure|Science Fiction|Fantasy          2015
         633    10.739009         Science Fiction|Adventure|Thriller          2014

                                      original_title
         0                            Jurassic World
         1                        Mad Max: Fury Road
         629                            Interstellar
         630                 Guardians of the Galaxy
         2                                 Insurgent
         631     Captain America: The Winter Soldier
         1329                              Star Wars
         632                               John Wick
         3              Star Wars: The Force Awakens
         633   The Hunger Games: Mockingjay - Part 1
```

There appears to be something perculiar to all of them. They're Action, Adventure, Thriller Sci-Fi movies

Now I'm curious to know about the 10 least polular movies

In [22]:
```
#10 least popular movies
least_pop_10 = df.sort_values("popularity", ascending = False).tail(10)
least_pop_10
```

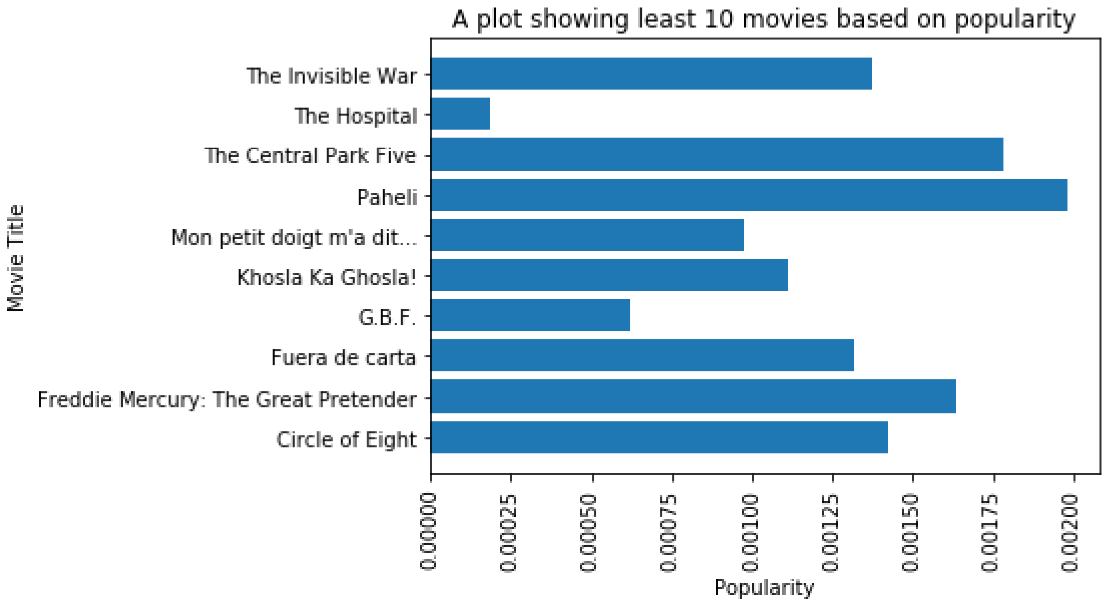
Out[22]:
```
      popularity  budget  revenue                      original_title  \
6553    0.001983       0        0                              Paheli
4947    0.001783       0   273747               The Central Park Five
4919    0.001635       0        0  Freddie Mercury: The Great Pretender
1918    0.001423       0        0                     Circle of Eight
4948    0.001372       0        0                   The Invisible War
3370    0.001317       0        0                      Fuera de carta
6961    0.001115       0        0                   Khosla Ka Ghosla!
6551    0.000973       0        0          Mon petit doigt m'a dit...
6080    0.000620       0        0                              G.B.F.
9977    0.000188       0        0                        The Hospital

                                                    cast  \
6553        Shah Rukh Khan|Rani Mukerji|Naseeruddin Shah
4947  Antron McCray|Kevin Richardson|Yusef Salaam|Ra...
4919  Freddie Mercury|Roger Taylor|Brian May|Luciano...
1918  Austin Highsmith|Jesse Johnson|Ryan Doom|Josh ...
4948  Kori Cioca|Jessica Hinves|Ariana Klay|Elle Hel...
3370  Javier CÃąmara|Lola DueÃśas|Fernando Tejero|Be...
6961  Anupam Kher|Boman Irani|Parvin Dabas|Tara Shar...
6551  Catherine Frot|AndrÃľ Dussollier|GeneviÃĺve Bu...
6080  Michael J. Willett|Paul Iacono|Sasha Pieterse|...
9977  George C. Scott|Diana Rigg|Richard Dysart|Barn...

                   director  runtime  \
6553           Amol Palekar      141
4947  Sarah Burns|Ken Burns      119
4919           Rhys Thomas      107
1918         Stephen Cragg       84
4948             Kirby Dick       93
3370       Nacho G. Velilla      111
6961       Dibakar Banerjee      135
6551          Pascal Thomas      105
6080           Darren Stein       92
9977         Arthur Hiller      103

                                              genres  \
6553  Drama|Thriller|Science Fiction|Romance|Foreign
4947                                     Documentary
4919                               Music|Documentary
```

```
1918                                  Mystery|Horror
4948                 Crime|Drama|History|Documentary
3370                                          Comedy
6961                                          Comedy
6551                                  Comedy|Mystery
6080                                          Comedy
9977                            Mystery|Comedy|Drama

                                   production_companies release_date  \
6553                         Red Chillies Entertainment   2005-06-24
4947                              Florentine Films|WETA   2012-05-24
4919                      Arte|Eagle Rock Entertainment   2012-09-25
1918  Bronson Avenue|Paramount Pictures Digital Ente...   2009-10-27
4948  Canal+|Chain Camera Pictures|ITVS|Rise Films|G...   2012-01-20
3370                                      TLA Releasing   2008-04-11
6961                                UTV Motion Pictures   2006-09-22
6551               RhÃťne-Alpes CinÃľma|France2 CinÃľma   2005-04-13
6080  School Pictures|Parting Shots Media|Logolite E...   2013-10-20
9977                                 Simcha Productions   2071-12-14

      vote_count  vote_average  release_year  budget_adj    revenue_adj
6553          13           6.2          2005         0.0       0.000000
4947          22           6.4          2012         0.0  259989.647787
4919          10           7.2          2012         0.0       0.000000
1918          11           4.3          2009         0.0       0.000000
4948          17           7.0          2012         0.0       0.000000
3370          13           5.3          2008         0.0       0.000000
6961          10           6.8          2006         0.0       0.000000
6551          13           5.7          2005         0.0       0.000000
6080          82           6.1          2013         0.0       0.000000
9977          10           6.4          1971         0.0       0.000000
```

Something is really obvious here. These movies had 0 budget and 0 revenue. Interesting.

```
In [23]: #Let's pull  a chart for them
         plt.barh(y = least_pop_10.original_title, width = least_pop_10.popularity)
         plt.xticks(rotation = 90);
         plt.ylabel("Movie Title")
         plt.xlabel("Popularity")
         plt.title("A plot showing least 10 movies based on popularity")
```

```
Out[23]: Text(0.5,1,'A plot showing least 10 movies based on popularity')
```



Let's see what genre of movie they are and their year of release

```
In [24]: least_pop_10[["popularity", "genres", "release_year", "original_title"]].sort_values("p
```

```
Out[24]:       popularity                                          genres  \
         6553    0.001983  Drama|Thriller|Science Fiction|Romance|Foreign
         4947    0.001783                                     Documentary
         4919    0.001635                               Music|Documentary
         1918    0.001423                                  Mystery|Horror
         4948    0.001372                 Crime|Drama|History|Documentary
         3370    0.001317                                          Comedy
         6961    0.001115                                          Comedy
         6551    0.000973                                  Comedy|Mystery
         6080    0.000620                                          Comedy
         9977    0.000188                            Mystery|Comedy|Drama

               release_year                        original_title
         6553          2005                                Paheli
         4947          2012                 The Central Park Five
         4919          2012  Freddie Mercury: The Great Pretender
         1918          2009                       Circle of Eight
         4948          2012                     The Invisible War
         3370          2008                        Fuera de carta
         6961          2006                     Khosla Ka Ghosla!
         6551          2005            Mon petit doigt m'a dit...
         6080          2013                                G.B.F.
         9977          1971                          The Hospital
```

Most of these movies are comedy, documentary or horror movies Although `Paheli` falls in the Thriller|Science Fiction category we saw that it had 0 zero budget.

So genre and budget can play a vital role in a movie's popularity.

1.3.2 Research Question 2 (Which movie has the highest all-time budget?)

But does that mean Jurassic World had the highest budget? Let's check!

```
In [25]: df.sort_values("budget", ascending = False).head(10)
```

```
Out[25]:
      popularity     budget     revenue  \
2244    0.250540  425000000    11087569
3375    4.955130  380000000  1021683000
7387    4.965391  300000000   961000000
14      5.944927  280000000  1405035767
6570    1.957331  270000000   391081192
4411    1.588457  260000000   284139100
1929    2.865684  260000000   591794936
7394    2.520912  258000000   890871626
5508    1.214510  255000000    89289910
4367    4.218933  250000000  1017003568

                                   original_title  \
2244                              The Warrior's Way
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
4411                                     John Carter
1929                                         Tangled
7394                                     Spider-Man 3
5508                                 The Lone Ranger
4367               The Hobbit: An Unexpected Journey

                                                   cast  \
2244  Kate Bosworth|Jang Dong-gun|Geoffrey Rush|Dann...
3375  Johnny Depp|PenÃľlope 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...
4411  Taylor Kitsch|Lynn Collins|Mark Strong|Willem ...
1929  Zachary Levi|Mandy Moore|Donna Murphy|Ron Perl...
7394  Tobey Maguire|Kirsten Dunst|James Franco|Thoma...
5508  Johnny Depp|Armie Hammer|William Fichtner|Hele...
4367  Ian McKellen|Martin Freeman|Richard Armitage|A...

                       director  runtime  \
2244                 Sngmoo Lee      100
```

```
3375               Rob Marshall      136
7387             Gore Verbinski      169
14                  Joss Whedon      141
6570               Bryan Singer      154
4411             Andrew Stanton      132
1929  Nathan Greno|Byron Howard      100
7394                  Sam Raimi      139
5508             Gore Verbinski      149
4367              Peter Jackson      169

                                    genres  \
2244  Adventure|Fantasy|Action|Western|Thriller
3375                 Adventure|Action|Fantasy
7387                 Adventure|Fantasy|Action
14           Action|Adventure|Science Fiction
6570   Adventure|Fantasy|Action|Science Fiction
4411   Action|Adventure|Fantasy|Science Fiction
1929                           Animation|Family
7394                 Fantasy|Action|Adventure
5508                 Action|Adventure|Western
4367                 Adventure|Fantasy|Action

                                production_companies release_date  \
2244                           Boram Entertainment Inc.   2010-12-02
3375  Walt Disney Pictures|Jerry Bruckheimer Films|M...   2011-05-11
7387  Walt Disney Pictures|Jerry Bruckheimer Films|S...   2007-05-19
14    Marvel Studios|Prime Focus|Revolution Sun Studios   2015-04-22
6570  DC Comics|Legendary Pictures|Warner Bros.|Bad ...   2006-06-28
4411                               Walt Disney Pictures   2012-03-07
1929  Walt Disney Pictures|Walt Disney Animation Stu...   2010-11-24
7394  Columbia Pictures|Laura Ziskin Productions|Mar...   2007-05-01
5508  Walt Disney Pictures|Jerry Bruckheimer Films|I...   2013-07-03
4367  WingNut Films|New Line Cinema|Metro-Goldwyn-Ma...   2012-11-26

      vote_count  vote_average  release_year    budget_adj   revenue_adj
2244          74           6.4          2010  4.250000e+08  1.108757e+07
3375        3180           6.3          2011  3.683713e+08  9.904175e+08
7387        2626           6.8          2007  3.155006e+08  1.010654e+09
14          4304           7.4          2015  2.575999e+08  1.292632e+09
6570         834           5.3          2006  2.920507e+08  4.230205e+08
4411        1479           6.0          2012  2.469335e+08  2.698595e+08
1929        2019           7.3          2010  2.600000e+08  5.917949e+08
7394        2083           5.8          2007  2.713305e+08  9.369017e+08
5508        1607           6.0          2013  2.386885e+08  8.357833e+07
4367        6417           6.9          2012  2.374361e+08  9.658933e+08
```

Well, on the contrary, Jurassic world does not fall in the top 10 most expensive movies. `The Warrior's Way` had the highest budget but had popularity of `0.250540` What could be resposible for this? perhaps the casts or the director or company? We have to keep checking.

1.3.3 Research Question 3 (Which movie generated more revenue, per year, and overall?)

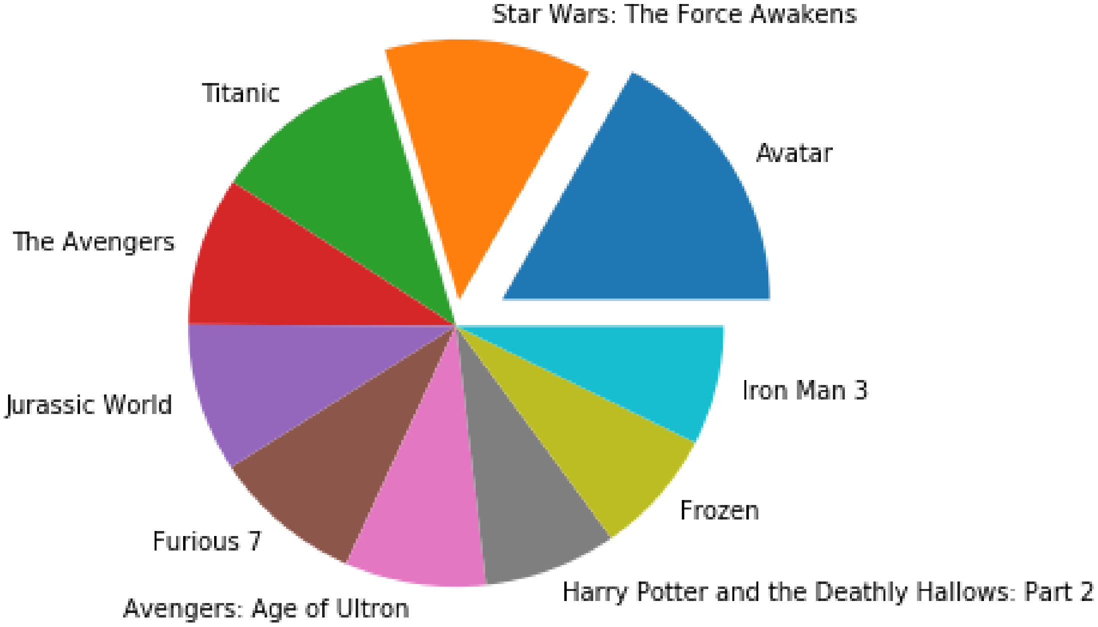
```
In [26]: rev = df.sort_values("revenue", ascending = False).head(10)
         rev
```

```
Out[26]:       popularity     budget     revenue  \
         1386    9.432768  237000000  2781505847
         3      11.173104  200000000  2068178225
         5231    4.355219  200000000  1845034188
         4361    7.637767  220000000  1519557910
         0      32.985763  150000000  1513528810
         4       9.335014  190000000  1506249360
         14      5.944927  280000000  1405035767
         3374    5.711315  125000000  1327817822
         5422    6.112766  150000000  1274219009
         5425    4.946136  200000000  1215439994

                                             original_title  \
         1386                                        Avatar
         3                     Star Wars: The Force Awakens
         5231                                       Titanic
         4361                                  The Avengers
         0                                   Jurassic World
         4                                        Furious 7
         14                         Avengers: Age of Ultron
         3374  Harry Potter and the Deathly Hallows: Part 2
         5422                                        Frozen
         5425                                    Iron Man 3

                                                            cast   \
         1386  Sam Worthington|Zoe Saldana|Sigourney Weaver|S...
         3     Harrison Ford|Mark Hamill|Carrie Fisher|Adam D...
         5231  Kate Winslet|Leonardo DiCaprio|Frances Fisher|...
         4361  Robert Downey Jr.|Chris Evans|Mark Ruffalo|Chr...
         0     Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...
         4     Vin Diesel|Paul Walker|Jason Statham|Michelle ...
         14    Robert Downey Jr.|Chris Hemsworth|Mark Ruffalo...
         3374  Daniel Radcliffe|Rupert Grint|Emma Watson|Alan...
         5422  Kristen Bell|Idina Menzel|Jonathan Groff|Josh ...
         5425  Robert Downey Jr.|Gwyneth Paltrow|Guy Pearce|D...

                              director  runtime  \
         1386            James Cameron      162
         3                 J.J. Abrams      136
         5231            James Cameron      194
         4361              Joss Whedon      143
```

```
0                Colin Trevorrow      124
4                      James Wan      137
14                   Joss Whedon      141
3374                 David Yates      130
5422  Chris Buck|Jennifer Lee      102
5425                 Shane Black      130

                                         genres  \
1386   Action|Adventure|Fantasy|Science Fiction
3      Action|Adventure|Science Fiction|Fantasy
5231                     Drama|Romance|Thriller
4361           Science Fiction|Action|Adventure
0     Action|Adventure|Science Fiction|Thriller
4                         Action|Crime|Thriller
14             Action|Adventure|Science Fiction
3374                   Adventure|Family|Fantasy
5422                 Animation|Adventure|Family
5425           Action|Adventure|Science Fiction

                                   production_companies release_date  \
1386  Ingenious Film Partners|Twentieth Century Fox ...   2009-12-10
3             Lucasfilm|Truenorth Productions|Bad Robot   2015-12-15
5231  Paramount Pictures|Twentieth Century Fox Film ...   1997-11-18
4361                                     Marvel Studios   2012-04-25
0     Universal Studios|Amblin Entertainment|Legenda...   2015-06-09
4     Universal Pictures|Original Film|Media Rights ...   2015-04-01
14    Marvel Studios|Prime Focus|Revolution Sun Studios   2015-04-22
3374  Warner Bros.|Heyday Films|Moving Picture Compa...   2011-07-07
5422  Walt Disney Pictures|Walt Disney Animation Stu...   2013-11-27
5425                                     Marvel Studios   2013-04-18

      vote_count  vote_average  release_year    budget_adj   revenue_adj
1386        8458           7.1          2009  2.408869e+08  2.827124e+09
3           5292           7.5          2015  1.839999e+08  1.902723e+09
5231        4654           7.3          1997  2.716921e+08  2.506406e+09
4361        8903           7.3          2012  2.089437e+08  1.443191e+09
0           5562           6.5          2015  1.379999e+08  1.392446e+09
4           2947           7.3          2015  1.747999e+08  1.385749e+09
14          4304           7.4          2015  2.575999e+08  1.292632e+09
3374        3750           7.7          2011  1.211748e+08  1.287184e+09
5422        3369           7.5          2013  1.404050e+08  1.192711e+09
5425        6882           6.9          2013  1.872067e+08  1.137692e+09
```

```
In [27]: x = np.array(rev.revenue)

         exp = [0.2, 0.1, 0, 0, 0,0,0,0,0,0]
```

```
In [28]: plt.figure(figsize = (5, 5))
         plt.pie(x = x, labels = rev.original_title, explode = exp);
```



Considering that it was 2009, the producers of `Avatar` did a good job gaining that much revenue from the movie. We also see a pattern of some popular company on top of this dataframe

1.3.4 Research Question 4 (Does movie genre determine revenue?)

We have seen that movie genre influences popularity which in turn affects revenue

1.3.5 Research Question 5 (What is the best production company doing differently?)

This may seem a bit ambigous. But we will use some parameters/features to determine the best production company

```
In [29]: df.columns
```

```
Out[29]: Index(['popularity', 'budget', 'revenue', 'original_title', 'cast', 'director',
                'runtime', 'genres', 'production_companies', 'release_date',
                'vote_count', 'vote_average', 'release_year', 'budget_adj',
                'revenue_adj'],
               dtype='object')
```

We shall use popularity, vote_count and revenue to determine the best companies

```
In [30]: best_comp = df.sort_values(['revenue','vote_count','popularity'],  ascending = False).h
         best_comp.loc[:,['production_companies','budget','revenue','vote_count','popularity', '
         # best_comp
```

```
Out[30]:                                    production_companies     budget  \
         1386  Ingenious Film Partners|Twentieth Century Fox ...  237000000
         3             Lucasfilm|Truenorth Productions|Bad Robot  200000000
         5231  Paramount Pictures|Twentieth Century Fox Film ...  200000000
         4361                                     Marvel Studios  220000000
         0     Universal Studios|Amblin Entertainment|Legenda...  150000000
         4     Universal Pictures|Original Film|Media Rights ...  190000000
         14    Marvel Studios|Prime Focus|Revolution Sun Studios  280000000
         3374  Warner Bros.|Heyday Films|Moving Picture Compa...  125000000
         5422  Walt Disney Pictures|Walt Disney Animation Stu...  150000000
         5425                                     Marvel Studios  200000000

                  revenue  vote_count  popularity  \
         1386  2781505847        8458    9.432768
         3     2068178225        5292   11.173104
         5231  1845034188        4654    4.355219
         4361  1519557910        8903    7.637767
         0     1513528810        5562   32.985763
         4     1506249360        2947    9.335014
         14    1405035767        4304    5.944927
         3374  1327817822        3750    5.711315
         5422  1274219009        3369    6.112766
         5425  1215439994        6882    4.946136

                                             original_title  runtime  \
         1386                                        Avatar      162
         3                     Star Wars: The Force Awakens      136
         5231                                       Titanic      194
         4361                                  The Avengers      143
         0                                   Jurassic World      124
         4                                        Furious 7      137
         14                         Avengers: Age of Ultron      141
         3374  Harry Potter and the Deathly Hallows: Part 2      130
         5422                                        Frozen      102
         5425                                    Iron Man 3      130

                                                  genres
         1386   Action|Adventure|Fantasy|Science Fiction
         3      Action|Adventure|Science Fiction|Fantasy
         5231                     Drama|Romance|Thriller
         4361           Science Fiction|Action|Adventure
         0     Action|Adventure|Science Fiction|Thriller
         4                         Action|Crime|Thriller
         14             Action|Adventure|Science Fiction
         3374                   Adventure|Family|Fantasy
         5422                 Animation|Adventure|Family
         5425           Action|Adventure|Science Fiction
```

In [31]:
```
best_comp.runtime.mean()
```

Out[31]:
```
139.9
```

We see a trend here: 1. high budget 2. average runtime of 139.9 3. Action | Adventure | Science Fiction | Thriller

Let's see if there is a trend in casts

In [32]:
```
topcast = pd.DataFrame()
topcast[['cast1', 'cast2', 'cast3', 'cast4', 'cast5']] = best_comp.cast.str.split("|",
topcast
```

Out[32]:
```
                   cast1                cast2             cast3  \
1386    Sam Worthington          Zoe Saldana  Sigourney Weaver
3         Harrison Ford          Mark Hamill     Carrie Fisher
5231       Kate Winslet    Leonardo DiCaprio    Frances Fisher
4361  Robert Downey Jr.          Chris Evans      Mark Ruffalo
0           Chris Pratt  Bryce Dallas Howard       Irrfan Khan
4            Vin Diesel          Paul Walker     Jason Statham
14    Robert Downey Jr.      Chris Hemsworth      Mark Ruffalo
3374   Daniel Radcliffe         Rupert Grint       Emma Watson
5422       Kristen Bell         Idina Menzel    Jonathan Groff
5425  Robert Downey Jr.      Gwyneth Paltrow        Guy Pearce

                   cast4               cast5
1386        Stephen Lang  Michelle Rodriguez
3            Adam Driver        Daisy Ridley
5231          Billy Zane         Kathy Bates
4361     Chris Hemsworth  Scarlett Johansson
0      Vincent D'Onofrio       Nick Robinson
4     Michelle Rodriguez      Dwayne Johnson
14           Chris Evans  Scarlett Johansson
3374        Alan Rickman        Maggie Smith
5422            Josh Gad     Santino Fontana
5425         Don Cheadle        Ben Kingsley
```

We can't say there is a pattern in casts for sure. We only see `Robert Downey Jr.` feature in 3 movies of the top 10 movies as a majo cast

Let us get the list of all casts

Firstly we need to reset the index column because they now have the wrong values after dropping columns

In [33]:
```
#Let's reset index since some rows were deleted
df.reset_index(inplace = True)
df.drop(columns = ["index"], inplace = True)
df.head()
```

Out[33]:
```
   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    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
```

1.3.6 Research Question 6 (Which genres are most popular from year to year?)

```
In [34]: genres_df = df.assign(genres_=df['genres'].str.split('|')).explode('genres_')
         genres_df['genres_'].value_counts()
```

```
Out[34]: Drama              4364
         Comedy             3433
         Thriller           2746
         Action             2235
         Romance            1570
         Horror             1526
         Adventure          1384
         Crime              1299
         Science Fiction    1136
         Family             1095
```

```
Fantasy            840
Mystery            773
Animation          617
Music              339
Documentary        317
History            306
War                258
Western            160
TV Movie           132
Foreign            120
Name: genres_, dtype: int64
```

Without doubt, `Drama` genre has more popularity from year to year with a total 4364

1.3.7 Research Question 7 (What kinds of properties are associated with movies that have high revenues?)

```
In [35]: #             ax.get_yaxis().get_major_formatter().set_useOffset(False)
         #             ax.get_yaxis().get_major_formatter().set_scientific(False)
```

```
In [36]: desc = ["This shows some level positive correlation between popularity and revenue. Imp
         "This is showing us that budget can also tremendously affect a movie's revenue as we se
         "Again we see a yet stron correlation between vote_count and revenue; meaning, working
         "Likewise, release year shows almost no correlation with revenue. So year of production
```

```
In [ ]: def plot_scatter(df):
            n = 0
            sp = 1
            for x in df.columns:
                if df[f"{x}"].dtypes == float or df[f"{x}"].dtypes == int:
                    plt.subplot(3, 3, sp)
                    plt.scatter(df[f'{x}'], df["revenue"], s = 1, alpha = 0.1)
                    plt.figtext(0.5, -0.1, desc[n], wrap=True, horizontalalignment='center', fon
                    ax = plt.gca()
                    ax.yaxis.set_major_formatter(mpl.ticker.StrMethodFormatter('{x:,.0f}'))
                    plt.draw()
                    plt.title(f'A scatter plot showing {x} and revenue')
                    ax.legend()

                    n += 1
                    sp += 1

        #              for tick in ax.get_xticklabels():
        #                  tick.set_rotation(360)

        plt.figure(figsize=(20,10))
        plot_scatter(df)
```

The figures show that `budget`, `popularity`, and `vote count` are strongly related to revenue

1.3.8 Research Question 8 (Which stars are the most prominent casts?)

Let's retunrn the 10 casts from the variable `all_cast`

```
In [38]: cast_df = df.assign(cast_=df['cast'].str.split('|')).explode('cast_')
         cast_df['cast_'].value_counts()[:10]

Out[38]: Robert De Niro        72
         Samuel L. Jackson     70
         Bruce Willis          62
         Nicolas Cage          61
         Michael Caine         52
         Robin Williams        51
         Morgan Freeman        49
         John Goodman          48
         John Cusack           48
         Susan Sarandon        47
         Name: cast_, dtype: int64
```

From the above analysis we see the top 10 casts from 1960 - 2015 with `Robert De Niro` appearing in 72 movies and `Alec Baldwin` featuring in 47 movies

## Conclusions

We have been able to see that budget and genre plays a vital role in movie quality and revenue. Other inconclusive factors are casts, company, director and perhaps title

We also saw consistent pattern of drama movie genre from year to year.

Limitations The popularity column is confusing. For example Jurassic World recives popularity of 32.98, whereas Avatar, Dark Knight have a popularity of less than 10 Similarly, the dataset does not include movies from other regions like Nollywood and Bollywood. More recently movie called Baahubali by director SS Rajamouli has been well received world wide and he is in the league of Nolan, Cameron.. but his movies are absent from this list.

```
In [39]: from subprocess import call
         call(['python', '-m', 'nbconvert', 'Investigate_a_Dataset.ipynb'])

Out[39]: 0

In [ ]:
```