Data Set Title
Exploratory Analysis

Jacob Redmon, jredmon@bellarmine.edu

I. INTRODUCTION

This data set contains some basic data from movies in the Internet Movie Database. It contains information about the number of Facebook likes the director and starring actors have, which will provide some interesting analysis. The data set can be found at https://www.kaggle.com/carolzhangdc/imdb-5000-movie-dataset.

II. DATA SET DESCRIPTION

This data set contains 5043 samples with 27 columns with various data types. A complete listing is shown in **Table 1**.

Table 1: Data Types and Missing Data

Variable Name	*Data Type*	*Missing Data (%)*
movie_title	nominal/object	0%
title_year	interval/int64	2%
country	nominal/object	0.09%
language	nominal/object	0.2%
budget	ratio/float64	9.7%
gross	ratio/float64	17.5%
imdb_score	ratio/float64	0%
duration	ratio/float64	0.3%
genres	nominal/object	0%
plot_keywords	nominal/object	3%
color	nominal/object	0.3%
content_rating	nominal/object	6%
facenumber_in_poster	ratio/float64	2.5%
num_critic_for_reviews	ratio/float64	0.9%
num_user_for_reviews	ratio/float64	0.4%
num_voted_users	ratio/int64	0%
director_name	nominal/object	2%
actor_1_name	nominal/object	1.4%
actor_2_name	nominal/object	0.2%
actor_3_name	nominal/object	4.5%
director_facebook_likes	ratio/int64	2%
actor_1_facebook_likes	ratio/int64	0.1%
actor_2_facebook_likes	ratio/int64	0.2%
actor_3_facebook_likes	ratio/int64	0.4%
cast_total_facebook_likes	ratio/int64	0%
movie_facebook_likes	ratio/int64	0%
movie_imdb_link	nominal/object	0%
first_genre	nominal/object	0%

III. Data Set Summary Statistics

After cleaning up the data by removing any rows with null values and adding an additional column called `first_genre` that captures just the first genre listed in the `genre` column, looking at summary statistics can help us draw some conclusions about the movies included in the data set. The summary statistics are located in **Table 2** displays some general statistics about the continuous variables. **Tables 3a-3e** showcase the proportions for the categorical variables; the larger tables (the director and actor names, as well as genre and plot keywords contain 1000+ categories) are shown in CSV files in the project folder as they were too large for this document. The

correlation matrix (which is too large to fit in this document accurately, so a CSV file is located in the project folder as well) in **Table 4**, and the following heatmap, displays how the continuous data points are correlated with each other. We see a large amount of correlation between a movies gross sales and the amount of reviews it has on IMDB. Additionally, there is significant correlation between actors' and directors' Facebook likes, with the highest degree of correlation between the lead actors' and the movies' total number of Facebook likes, which is expected.

Table 2: Summary Statistics for Movie Metadata

Variable Name	*Count*	*Mean*	*Standard Deviation*	*Min*
title_year	3756	2002.977	9.888108	1927
budget	3756	46236850	2.26E+08	218
gross	3756	52612824	70317867	162
imdb_score	3756	6.465282	1.056247	1.6
duration	3756	110.258	22.64672	37
facenumber_in_poster	3756	1.377263	2.041541	0
num_critic_for_reviews	3756	167.3783	123.452	2
num_user_for_reviews	3756	336.8432	411.2274	4
num_voted_users	3756	105826.7	152035.4	91
director_facebook_likes	3756	807.3365	3068.172	0
actor_1_facebook_likes	3756	7751.339	15519.34	0
actor_2_facebook_likes	3756	2021.776	4544.908	0
actor_3_facebook_likes	3756	771.2796	1894.25	0
cast_total_facebook_likes	3756	11527.1	19122.18	0
movie_facebook_likes	3756	9353.829	21462.89	0

Variable Name	*25th*	*50th*	*75th*	*Max*
title_year	1999	2004	2010	2016
budget	10000000	25000000	50000000	1.22E+10
gross	8270233	30093107	66881941	7.61E+08
imdb_score	5.9	6.6	7.2	9.3
duration	96	106	120	330
facenumber_in_poster	0	1	2	43
num_critic_for_reviews	77	138.5	224	813
num_user_for_reviews	110	210	398.25	5060
num_voted_users	19667	53973.5	128602	1689764
director_facebook_likes	11	64	235	23000
actor_1_facebook_likes	745	1000	13000	640000
actor_2_facebook_likes	384.75	685.5	976	137000
actor_3_facebook_likes	194	436	691	23000
cast_total_facebook_likes	1919.75	4059.5	16240	656730
movie_facebook_likes	0	227	11000	349000

Table 3a: Proportions for Country (n=45)

Category	*Frequency*	*Proportion (%)*
Afghanistan	1	0.026624
Argentina	3	0.079872

Aruba	1	0.026624
Australia	39	1.038339
Belgium	1	0.026624
Brazil	5	0.133120
Canada	59	1.570820
Chile	1	0.026624
China	13	0.346113
Colombia	1	0.026624
Czech Republic	3	0.079872
Denmark	8	0.212993
Finland	1	0.026624
France	101	2.689031
Georgia	1	0.026624
Germany	80	2.129925
Greece	1	0.026624
Hong Kong	13	0.346113
Hungary	2	0.053248
Iceland	1	0.026624
India	5	0.133120
Indonesia	1	0.026624
Iran	4	0.106496
Ireland	7	0.186368
Israel	1	0.026624
Italy	11	0.292865
Japan	15	0.399361
Mexico	6	0.159744
Netherlands	3	0.079872
New Line	1	0.026624
New Zealand	11	0.292865
Norway	4	0.106496
Official site	1	0.026624
Peru	1	0.026624
Poland	1	0.026624
Romania	2	0.053248
Russia	3	0.079872
South Africa	3	0.079872
South Korea	8	0.212993
Spain	21	0.559105
Taiwan	2	0.053248
Thailand	4	0.106496
UK	318	8.466454
USA	2987	79.526092
West Germany	1	0.026624

Table 3b: Proportions for Language (n=34)

Category	*Frequency*	*Proportion (%)*
Aboriginal	2	0.053248
Arabic	1	0.026624
Aramaic	1	0.026624
Bosnian	1	0.026624
Cantonese	7	0.186368
Czech	1	0.026624
Danish	3	0.079872

Dari	2	0.053248
Dutch	3	0.079872
English	3598	95.793397
Filipino	1	0.026624
French	34	0.905218
German	10	0.266241
Hebrew	1	0.026624
Hindi	5	0.133120
Hungarian	1	0.026624
Indonesian	2	0.053248
Italian	7	0.186368
Japanese	10	0.266241
Kazakh	1	0.026624
Korean	5	0.133120
Mandarin	15	0.399361
Maya	1	0.026624
Mongolian	1	0.026624
None	1	0.026624
Norwegian	4	0.106496
Persian	3	0.079872
Portuguese	5	0.133120
Romanian	1	0.026624
Russian	1	0.026624
Spanish	23	0.612354
Thai	3	0.079872
Vietnamese	1	0.026624
Zulu	1	0.026624

Table 3c: Proportions for Color (n=2)

Category	*Frequency*	*Proportion (%)*
Black and White	124	3.301384
Color	3632	96.698616

Table 3d: Proportions for Content Rating (n=12)

Category	*Frequency*	*Proportion (%)*
Approved	17	0.452609
G	87	2.316294
GP	1	0.026624
M	2	0.053248
NC-17	6	0.159744
Not Rated	34	0.905218
PG	566	15.069223
PG-13	1308	34.824281
Passed	3	0.079872
R	1700	45.260916
Unrated	22	0.585729
X	10	0.266241

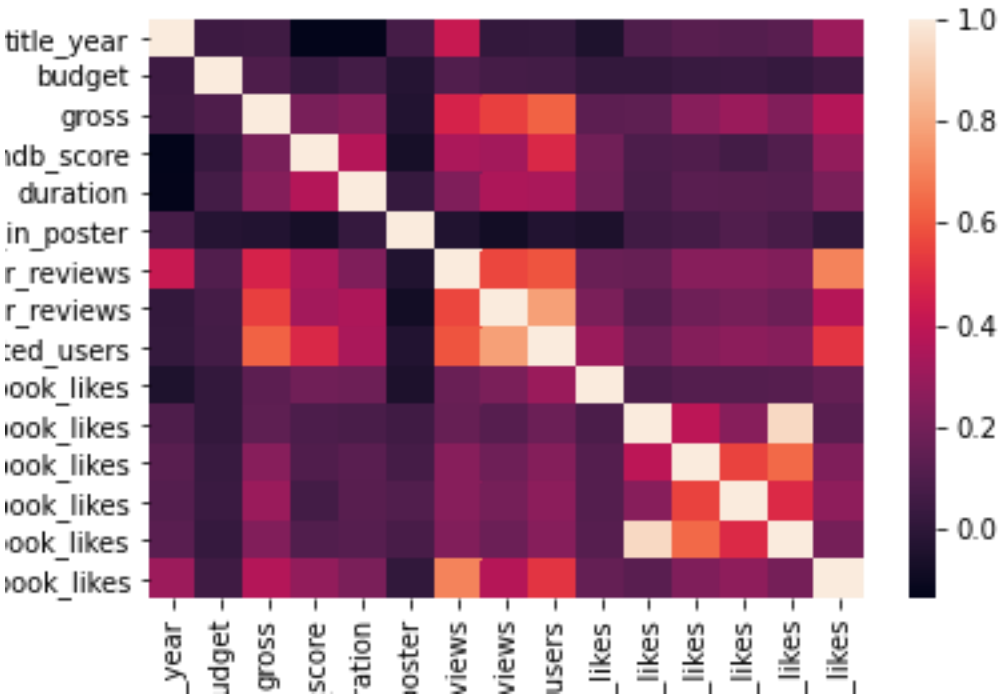
Table 3e: Proportions for First Genre (n=17)

Category	*Frequency*	*Proportion (%)*
Action	959	25.53248
Adventure	369	9.824281
Animation	45	1.198083

Biography	205	5.457934
Comedy	989	26.3312
Crime	255	6.789137
Documentary	26	0.692226
Drama	668	17.78488
Family	3	0.079872
Fantasy	37	0.985091
Horror	164	4.366347
Musical	2	0.053248
Mystery	23	0.612354
Romance	1	0.026624
Sci-Fi	7	0.186368
Thriller	1	0.026624
Western	2	0.053248

Table 4: Correlation Table/Tables

	title_year	budget	gross	imdb_score	duration	facenumber_in_poster	nur
title_year	1	0.047138	0.054808	-0.13498	-0.13021	0.070093	0.4
budget	0.047138	1	0.099496	0.02919	0.068012	-0.02167	0.1
gross	0.054808	0.099496	1	0.21474	0.245726	-0.03202	0.4
imdb_score	-0.13498	0.02919	0.21474	1	0.366221	-0.06549	0.3
duration	-0.13021	0.068012	0.245726	0.366221	1	0.026919	0.2
facenumber_in_poster	0.070093	-0.02167	-0.03202	-0.06549	0.026919	1	-0.0
num_critic_for_reviews	0.420202	0.104717	0.464187	0.347886	0.228631	-0.03436	1
num_user_for_reviews	0.01947	0.070372	0.544674	0.325003	0.351595	-0.08097	0.5
num_voted_users	0.023687	0.065927	0.624949	0.48243	0.339592	-0.03221	0.5
director_facebook_likes	-0.04466	0.018167	0.138351	0.192314	0.180644	-0.04807	0.1
actor_1_facebook_likes	0.096194	0.016418	0.14401	0.093597	0.083632	0.057387	0.1
actor_2_facebook_likes	0.12241	0.035715	0.252842	0.102372	0.128935	0.073098	0.2
actor_3_facebook_likes	0.117475	0.039966	0.299864	0.065544	0.125797	0.106189	0.2
cast_total_facebook_likes	0.127045	0.028682	0.235601	0.106803	0.120179	0.080687	0.2
movie_facebook_likes	0.306987	0.05249	0.366933	0.281155	0.215303	0.015185	0.7



IV. DATA SET GRAPHICAL EXPLORATION

This section contains a graphical exploration of the data set, taking a look at various distributions of the data, scatter plots, and bar charts.

A. Distributions

The first look at distributions of the data in **Figure 1** was using Pandas `dataframe.hist()` function to generate histograms of all the continuous variables in the data set. Here, I noticed a significant skew to zero for many variables, most notably `budget` looking empty other than ~98% of the data falling into the first bin, as it caps to nearly 12 billion. Similar disparities are seen in all columns with Facebook like data, and also the numbers of faces in movie posters (which is mainly zero). It should be noted that most movies in this data set seem to be successful since the `gross` column is skewed to zero way less than the `budget` column.

The next distribution I looked, **Figure 2**, at was what that first bin of `budget` actually looks like. I generated a Kernel Density Plot for the budget of movies that had a budget less than $100,000,000, which shows a better look at that column.

Figure 3 shows another Kernel Density Plot of the `content_rating` column for non-English movies. Looking at the data for non-English movies, which is also done later on in the report, is interesting as it cuts out a large portion of the data set (what the Oscars label “foreign” films).

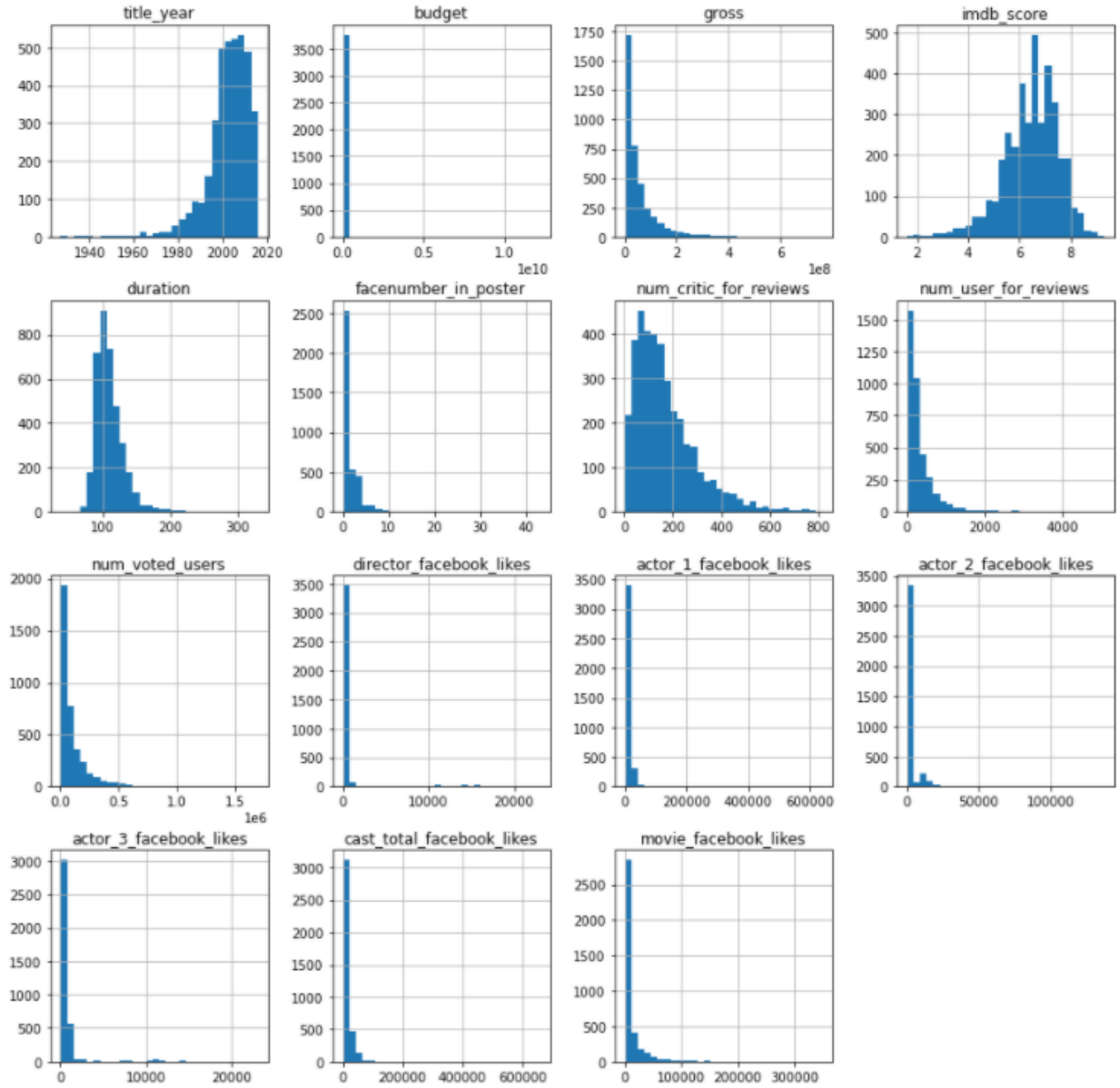


Figure 1: Histograms of all continuous variables (multiple plots)

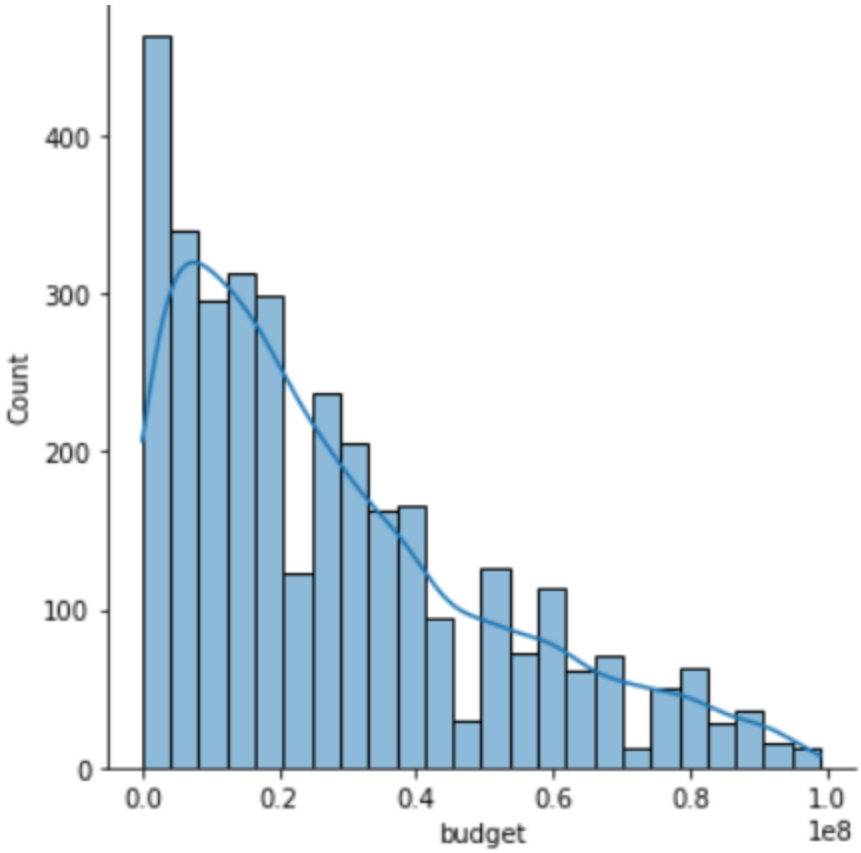


Figure 2: Kernel Density Plot for movies with a budget under $100,000,000

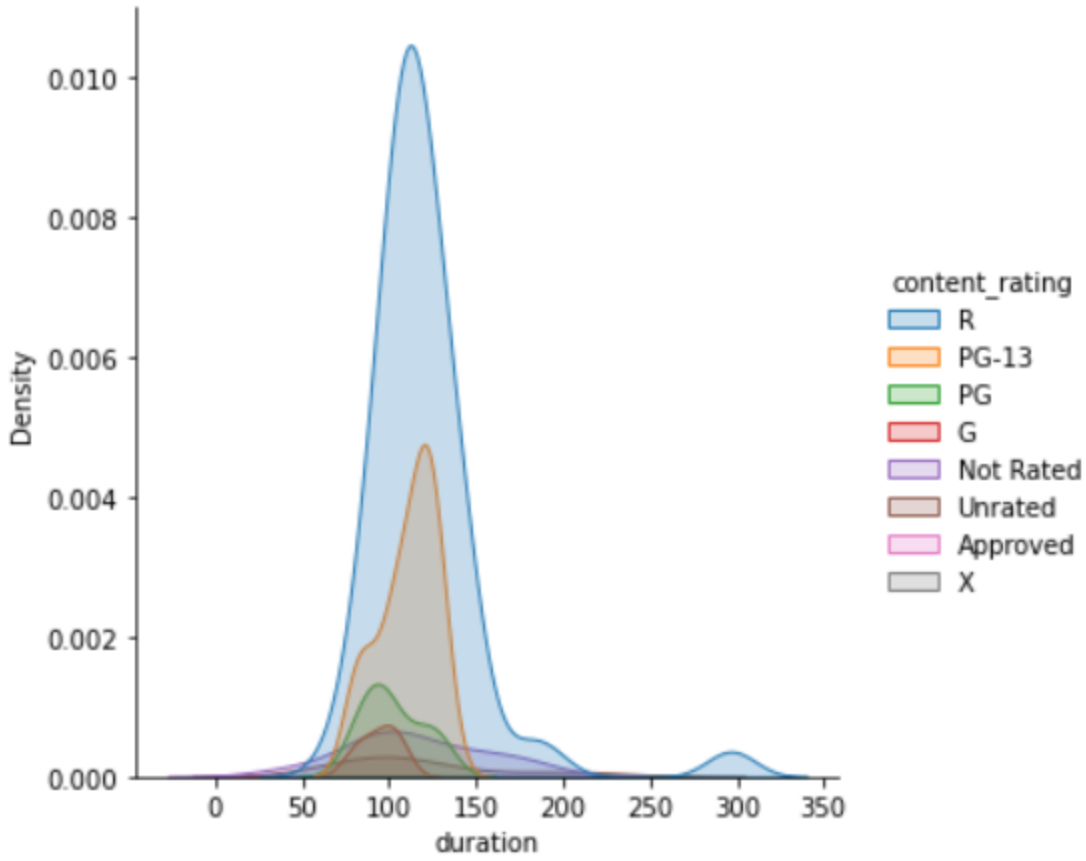


Figure 3: Kernel Density Plot for content rating compared to duration

B. Scatter Plots / Pairwise Plots (continuous variables)

I was most interested in seeing how different variables were distributed with respect to IMDB scores, so many of the following graphs contain data compared to the `imdb_score` column. **Figure 4** shows a scatter plot of IMDB scores compared to the duration of a movie, where I noticed that duration does not have a significant effect on rating, and that there are, thankfully, few movies longer than three hours.

Figure 5 shows a scatter plot comparing budget to gross for movies with less than a $100,000,000 budget, which shows just the slightest trend to a larger budget making more money, and some notable outliers that made the most money with a (relatively) smaller budget.

Figure 6 shows a scatter plot comparing IMDB score to number of Facebook likes for movies with greater than a $100,000,000 budget, which shows the expected trend of a large amount of Facebook likes means the movie is better rated.

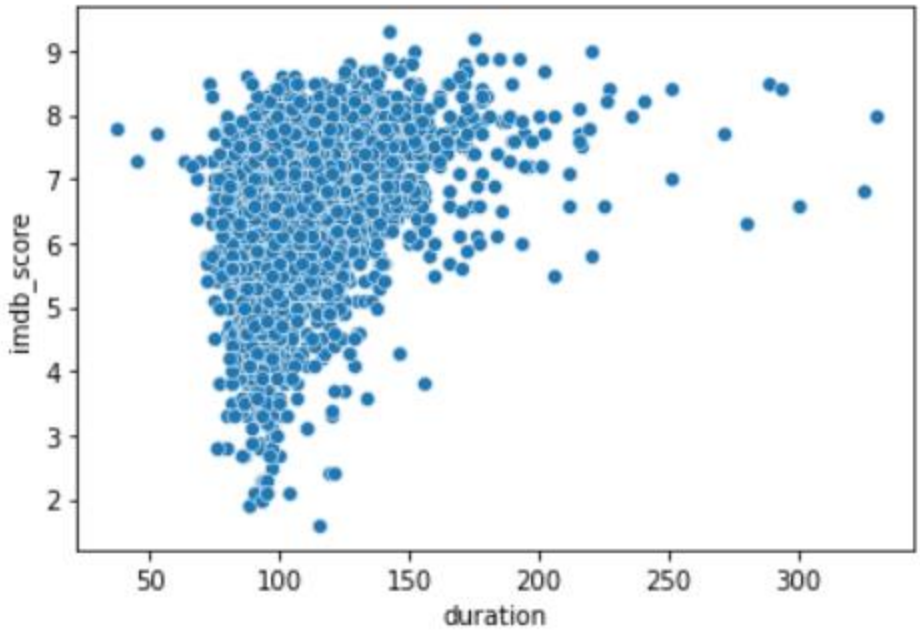


Figure 4: Scatter plot comparing IMDB score to duration

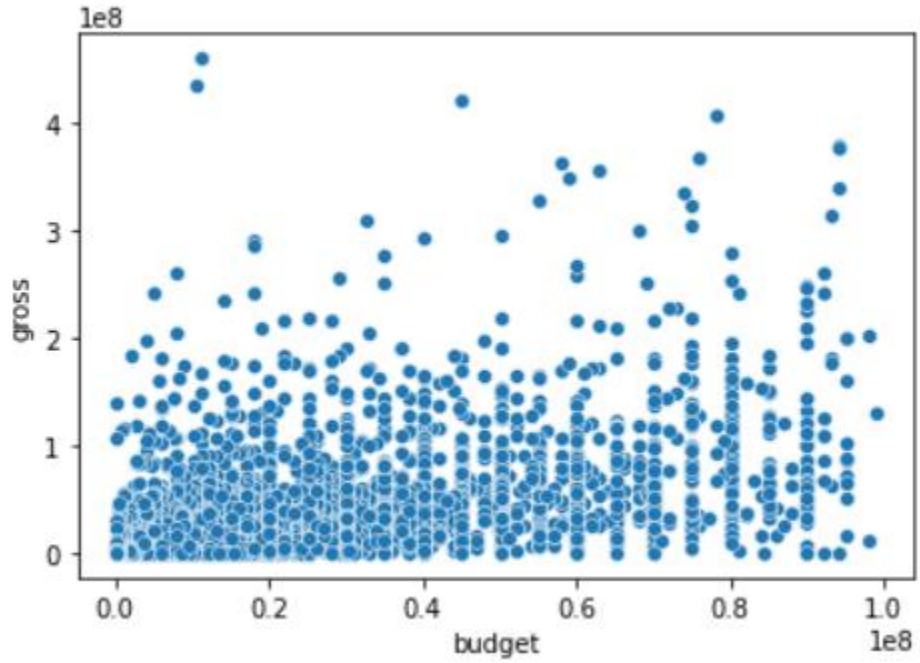


Figure 5: Scatter plot comparing budget to gross for movies with < $100,000,000 budget

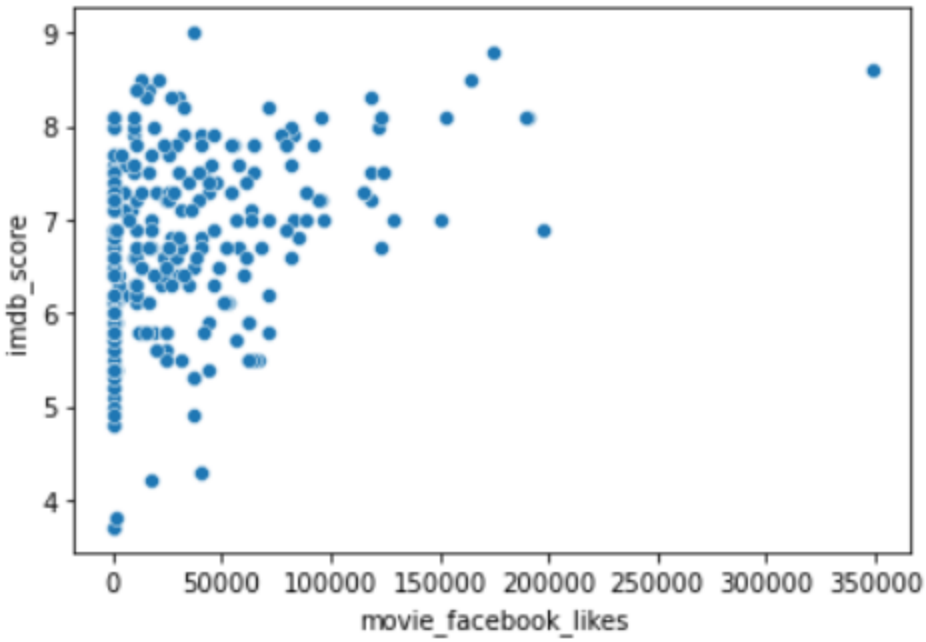


Figure 4: Scatter plot comparing IMDB score to number of Facebook likes for movies with >$100,000,000 budget

C. Bar charts (categorical variables)

Unfortunately, most of the data set's categorical variables had many categories, which made it difficult to look at spreads of all the data. I graphed each country's average IMDB score for and displayed the top ten in **Figure 7**. I was surprised to see these ten countries at the top since I cannot name a movie from any of them (which might show more about my movie knowledge than the actual data).

Figure 8 shows the genres ranked by average IMDB score, and I was unsurprised to see thrillers rated the lowest because they are generally not good (but so entertaining). Westerns were significantly the highest rated genre, but I am curious if that is accurate and if the data set was not skewed with the best westerns.

Figure 9 shows the top ten years ranked by average IMDB score. I was incredibly surprised to see the latest year was 1975 at fifth place, which makes me think if the sheer volume of recent movies brings down the ratings for newer years.

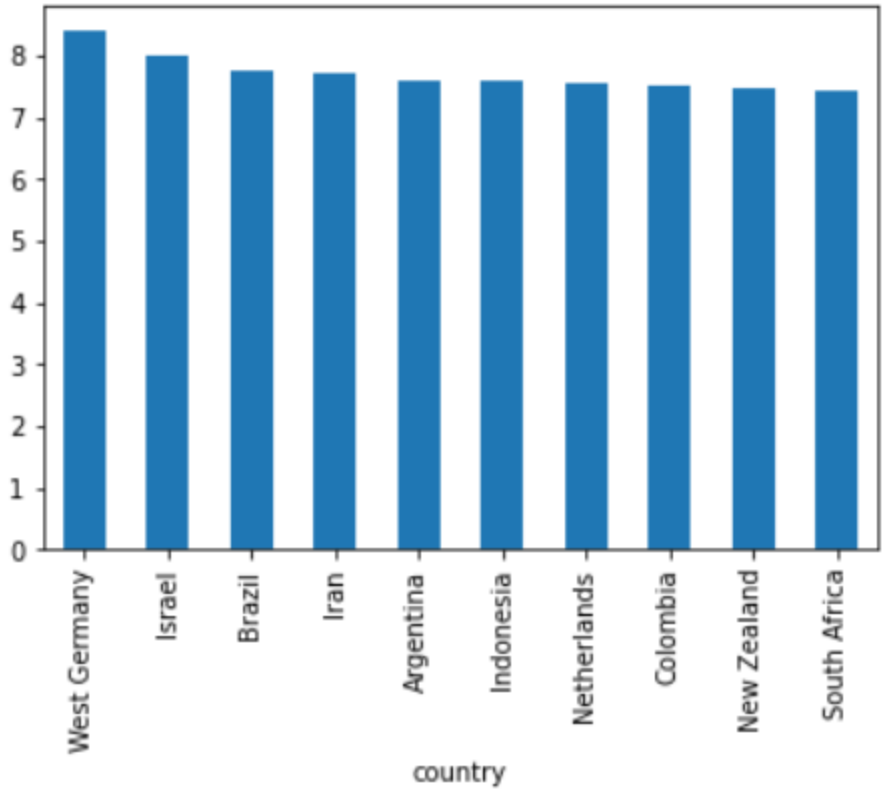


Figure 7: Bar chart showing the top 10 countries with the highest average IMDB scores

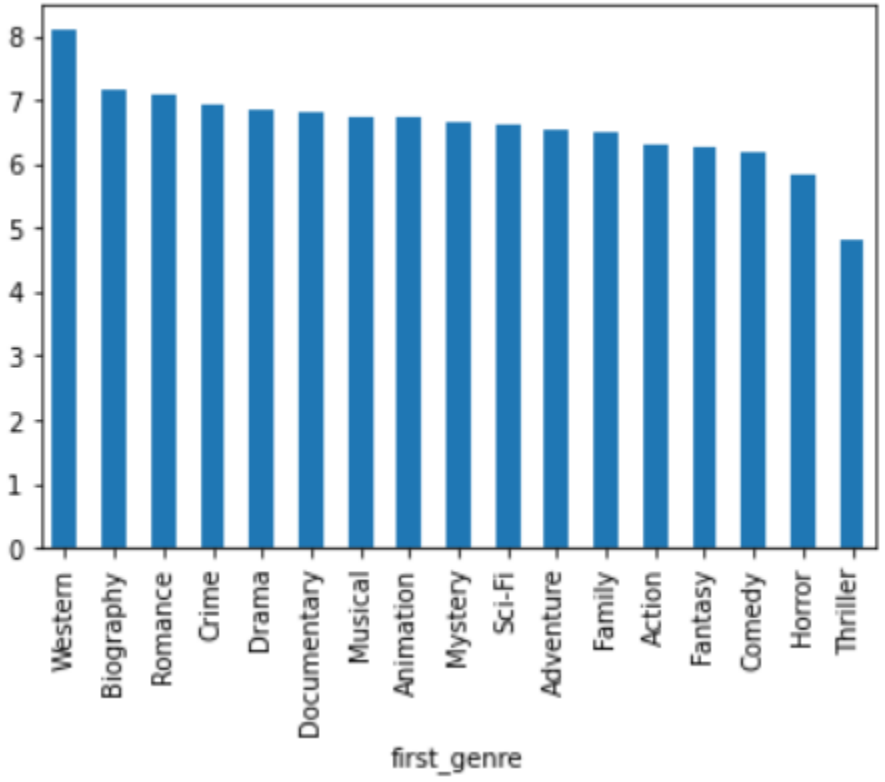


Figure 8: Bar chart showing the genres ranked by average IMDB score

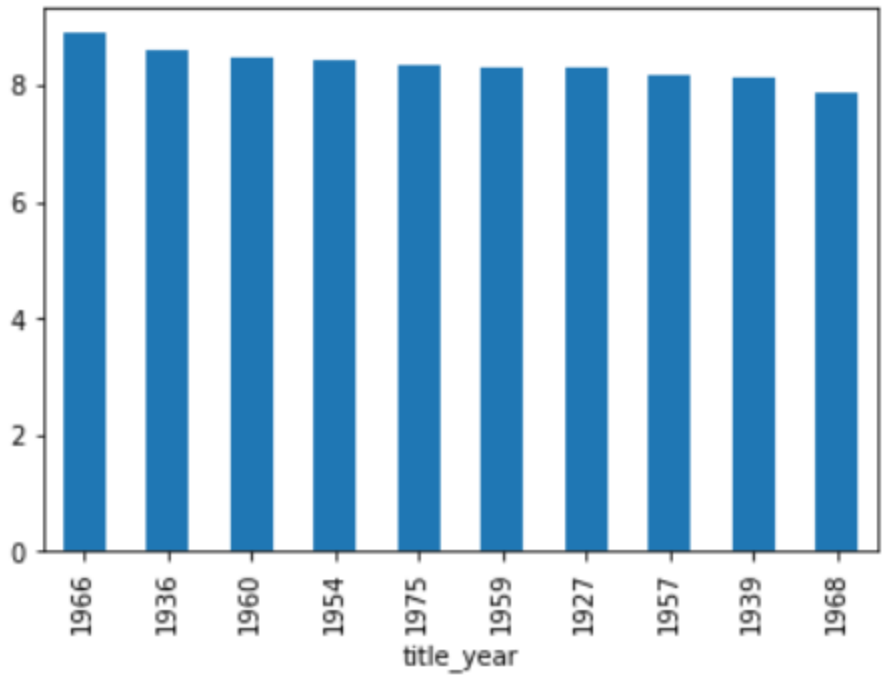


Figure 9: Bar chart showing the top 10 years ranked by average IMDB score

D. Other Plots

Out of curiosity, I made a pair plot for the entire data set (not included in this report) which showed some interesting trends though it was far too zoomed out to be useful. I wanted to look at a box-and-whisker plot for the scores to see how they were distributed and found that most movies in this data set were ranked between 6 and 7 on IMDB, with very few approaching a perfect score, seen in **Figure 10**.

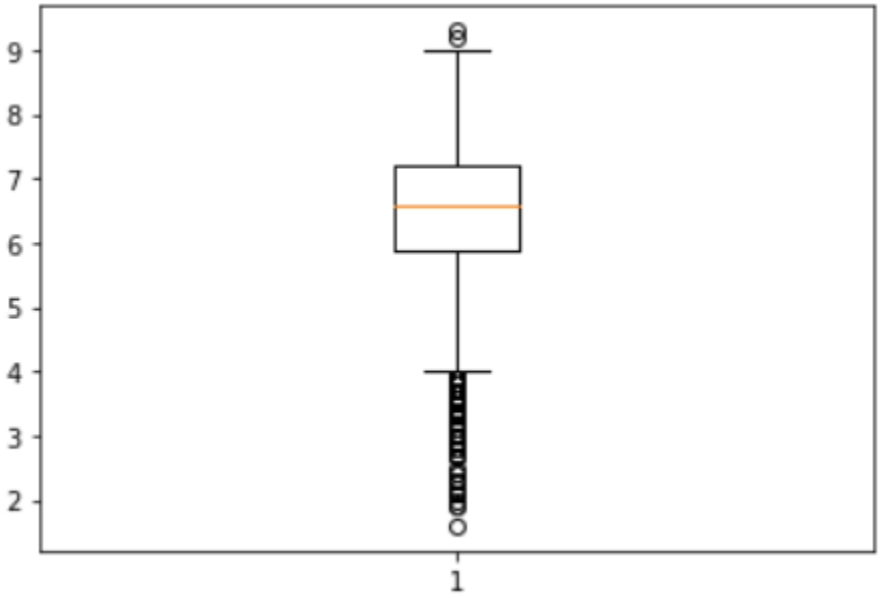


Figure 10: Box-and-whisker plot for IMDB scores

V. SUMMARY OF FINDINGS

This data set showed largely expected results with some movie metadata. Generally, the more Facebook likes a movie, its director, or its actors had, the better the movie both performed financially and was rated on IMDB. This finding is a good argument for the effectiveness of advertising for financial success of movies. That is not to say, however, that that is necessarily the rule. Many movies, usually older movies, performed perfectly fine with their zero likes on a social media platform that did not exist when it was released. Looking at subsets of the data, mainly excluding either movies made in the United States or performed in English, gave a more clear look on how movies performed globally, as both those factors outweigh all other categories by an extremely vast majority.