Exploratory Data Analysis on Movie Data

Business Problem

Microsoft is looking to create a new movie studio that can distribute films to movie theaters. They are looking for tangible advice towards creating movies that can compete at the box office. Specefically, they would like to know 'what types of films are currently doing the best at the box office'. They have given me data on the film industry and tasked me with finding three actionable insights.

General Overview of the Industy

Before approcahing this problem, I wanted to familiarize myself as much as possible with the film industry. Three questions, I needed to understand in order to provide actionable recommendations were.

1) How do film studios make money (https://www.investopedia.com/articles/investing/093015/how-exactly-do-movies-make-money.asp). (investopedia.com)

2) What costs and revenue streams do film studios have (https://www.fticonsulting.com/emea/-/media/files/emea--files/insights/articles/2020/sep/economics-film-changing-dynamics-covid-19-world.pdf?rev=71d8d0ae3a2b413bb77950dd772bee74&hash=7B4F3893D68857623A232DCE9F062B1E). (fticonsulting.com)

3) What are some trends in the movie industry that a new company can capitalize on. (motionpictures.org)

One of the key takeaways from my preliminary research was that movie studios budgets are purposely misleading. The reported budget for movies is not reliable because it does not take into account marketing costs. Marketing and advertising costs for movies are oftentimes just as high as production budgets and that cost is not reported publicly.

This practice is so widespread that there is an entire wikipedia article on something called "Hollywood Accounting (https://en.wikipedia.org/wiki/Hollywood_accounting)". One of the most egregious examples of this is Star Wars Episode VI - Return of the Jedi, despite making 450 million dollars in 1983 (https://www.theatlantic.com/business/archive/2011/09/how-hollywood-accounting-can-make-a-450-million-movie-unprofitable/245134/) has yet to turn a profit according to LucasFilms.

Another key insight from my research was the average movie released from 2016-2019 did not recover its costs after its theatrical release. Most films only begin making a profit after the "home release" period of it's development. This insight whilst not valuable to answering the business problem could be a source for further data analysis moving forward.

The final conclusion I gleaned from my research was a general trend towards foreign markets. Whilst the U.S. and Canada are still the largest markets for theatrical releases, other countries made up 71% of the global box office. There is also a growing trend where some American made films to make more internationally than domestically. This is a new trend and one that I think Microsoft should exploit.

General Understanding Key Takeaways

1) Because the production cost is not reliable data uses gross revenue to identify which movies are doing best at the box office.

2) Test to see if foreign box office is connected to the total gross of the movie.

3) Use categorical data to identify some actionable insights Microsoft Film Studio can use.

Data Understanding

In [2]:

```python
# Import libraries and my data files

import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import sqlite3
tmdb_df = pd.read_csv('zippeddata/tmdb.movies.csv')
movie_gross_df = pd.read_csv('zippedData/bom.movie_gross.csv')
con = sqlite3.connect('zippeddata/im.db')
```

In [3]:

```
1 # Open The Movie Database File to see what information is available in i
2 tmdb_df
```

Out[3]:

	Unnamed: 0	genre_ids	id	original_language	original_title	popularity	release_
0	0	[12, 14, 10751]	12444	en	Harry Potter and the Deathly Hallows: Part 1	33.533	2010-1
1	1	[14, 12, 16, 10751]	10191	en	How to Train Your Dragon	28.734	2010-0
2	2	[12, 28, 878]	10138	en	Iron Man 2	28.515	2010-0
3	3	[16, 35, 10751]	862	en	Toy Story	28.005	1995-1
4	4	[28, 878, 12]	27205	en	Inception	27.920	2010-0
...	...	...	...	...	...	...	
26512	26512	[27, 18]	488143	en	Laboratory Conditions	0.600	2018-1
26513	26513	[18, 53]	485975	en	_EXHIBIT_84xxx_	0.600	2018-0
26514	26514	[14, 28, 12]	381231	en	The Last One	0.600	2018-1
26515	26515	[10751, 12, 28]	366854	en	Trailer Made	0.600	2018-0
26516	26516	[53, 27]	309885	en	The Church	0.600	2018-1

26517 rows × 10 columns

The Movie Database File appears to have information on the user reviews and some information on genres but would require information on the genre id codes

In [4]:

```
movie_gross_df
```

Out[4]:

	title	studio	domestic_gross	foreign_gross	year
0	Toy Story 3	BV	415000000.0	652000000	2010
1	Alice in Wonderland (2010)	BV	334200000.0	691300000	2010
2	Harry Potter and the Deathly Hallows Part 1	WB	296000000.0	664300000	2010
3	Inception	WB	292600000.0	535700000	2010
4	Shrek Forever After	P/DW	238700000.0	513900000	2010
...	...	...	...	...	...
3382	The Quake	Magn.	6200.0	NaN	2018
3383	Edward II (2018 re-release)	FM	4800.0	NaN	2018
3384	El Pacto	Sony	2500.0	NaN	2018
3385	The Swan	Synergetic	2400.0	NaN	2018
3386	An Actor Prepares	Grav.	1700.0	NaN	2018

3387 rows × 5 columns

The Box Office Mojo has information on the domestic and foreign gross as long as the title. This will make it possible to combine the dataframes on title into one comprehensive data frame

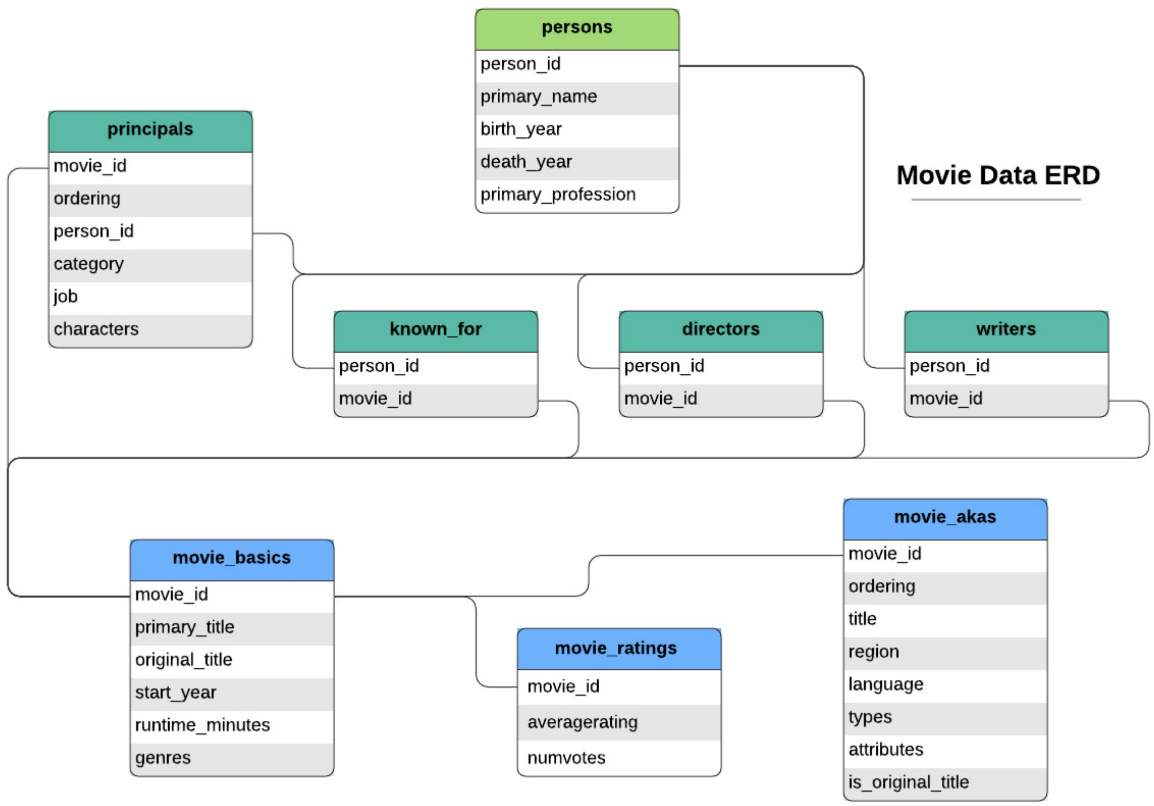
In [5]:

```
#Check out the tables for the IMDb data

table_name_query = """SELECT name
                      AS 'Table Names'
                      FROM sqlite_master
                      WHERE type='table';"""

pd.read_sql(table_name_query, con)
```

Out[5]:

	Table Names
0	movie_basics
1	directors
2	known_for
3	movie_akas
4	movie_ratings
5	persons
6	principals
7	writers

Here is the ERD for the database



The IMDb data is a .df file so I will have to run some SQL queries to get the data I need. I'm most interested in grabbing categorical data so I'm going to grab the director data. I'm also going to grab the run time length, genres, and average rating. Although I already have information on genres and average rating, it may be useful to compare it if I have time.

In [6]:

```
query_1 = '''
SELECT
        primary_name as Director,
        primary_title as Movie_Name,
        runtime_minutes as Length,
        genres,
        averagerating as AVG_Rating


FROM directors as d
    JOIN persons as p
        on p.person_id = d.person_id
            JOIN movie_basics as mb
                on d.movie_id = mb.movie_id
                    JOIN movie_ratings as mr
                        on mr.movie_id = mb.movie_id

'''

director_movie_genre_df = pd.read_sql(query_1, con)

director_movie_genre_df
```

Out[6]:

	Director	Movie_Name	Length	genres	AVG_Rating
0	Tony Vitale	Life's a Beach	100.0	Comedy	3.9
1	Bill Haley	Steve Phoenix: The Untold Story	110.0	Drama	5.5
2	Jay Chandrasekhar	The Babymakers	95.0	Comedy	5.0
3	Jay Chandrasekhar	The Babymakers	95.0	Comedy	5.0
4	Albert Pyun	Bulletface	82.0	Thriller	5.8
...	...	...	...	...	...
181382	Anne Sundberg	Reversing Roe	99.0	Documentary	7.4
181383	Mike Rohl	The Princess Switch	101.0	Romance	6.0
181384	Mike Rohl	The Princess Switch	101.0	Romance	6.0
181385	Richard Squires	Doozy	70.0	Animation,Comedy	6.7
181386	Fredrik Horn Akselsen	Syndebukken: Prosessen mot Harry Lindstrøm	NaN	Documentary	8.4

181387 rows × 5 columns

Now that I've taken a quick look at my data, I want to key in on the movie gross data. Total box office will be the key metric I judge success on so I want to look at that first

In [7]:

```
movie_gross_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3387 entries, 0 to 3386
Data columns (total 5 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   title           3387 non-null   object 
 1   studio          3382 non-null   object 
 2   domestic_gross  3359 non-null   float64
 3   foreign_gross   2037 non-null   object 
 4   year            3387 non-null   int64  
dtypes: float64(1), int64(1), object(3)
memory usage: 132.4+ KB
```

There are a lot of null values in the foreign gross column. But I wanted to see if that was a result of some movies not being released internationally. There is significantly less null values for the domestic gross so I can use a cutoff point to see if those null values are because the movie was unlikely and could not be sold to an international distributor.

In [8]:

```
# Use a loc statement to subset the dataframe to where domestic gross is
movie_gross_df.loc[movie_gross_df['domestic_gross'] > 10000000].info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1169 entries, 0 to 3226
Data columns (total 5 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   title           1169 non-null   object 
 1   studio          1169 non-null   object 
 2   domestic_gross  1169 non-null   float64
 3   foreign_gross   1116 non-null   object 
 4   year            1169 non-null   int64  
dtypes: float64(1), int64(1), object(3)
memory usage: 54.8+ KB
```

In [9]:

```
# Use a loc statement to subset the dataframe to where domestic gross is
movie_gross_df.loc[movie_gross_df['domestic_gross'] > 100000000].info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 284 entries, 0 to 3129
Data columns (total 5 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   title           284 non-null    object 
 1   studio          284 non-null    object 
 2   domestic_gross  284 non-null    float64
 3   foreign_gross   284 non-null    object 
 4   year            284 non-null    int64  
dtypes: float64(1), int64(1), object(3)
memory usage: 13.3+ KB
```

When I look only at the movies that cross a threshold of domestic gross, most of the null values go away. This reinforces my idea that most of the movies missing a foreign gross value were probably not released internationally. Because I want to keep as much data as possible, I'm going to use 10,000,000 dollars as my cut-off threshold for my analysis and drop any columns that have a null value for foreign_gross.

In [10]:
```
# Create a new dataset that only has movies that grossed over $10,000,000
movie_gross_over_ten_milly_df = movie_gross_df.loc[movie_gross_df['domest
```

In [11]:
```
# Drop null values
movie_gross_over_ten_milly_df = movie_gross_over_ten_milly_df.dropna(axi
movie_gross_over_ten_milly_df
```

Out[11]:

	title	studio	domestic_gross	foreign_gross	year
0	Toy Story 3	BV	415000000.0	652000000	2010
1	Alice in Wonderland (2010)	BV	334200000.0	691300000	2010
2	Harry Potter and the Deathly Hallows Part 1	WB	296000000.0	664300000	2010
3	Inception	WB	292600000.0	535700000	2010
4	Shrek Forever After	P/DW	238700000.0	513900000	2010
...	...	...	...	...	...
3203	If Beale Street Could Talk	Annapurna	14900000.0	5700000	2018
3207	Hell Fest	LGF	11100000.0	7100000	2018
3208	Chappaquiddick	ENTMP	17400000.0	591000	2018
3216	Upgrade	BH Tilt	12000000.0	2400000	2018
3219	Welcome to Marwen	Uni.	10800000.0	2100000	2018

1116 rows × 5 columns

Unfortunately some of the data for foreign gross is not an intenger or float so I need to clean it up by eliminating some of the problematic characters.

In [12]:
```
# Remove the commas from the dataset and then set it as float and then a
movie_gross_over_ten_milly_df["foreign_gross"] = movie_gross_over_ten_mi
movie_gross_over_ten_milly_df['foreign_gross'] = movie_gross_over_ten_mi
```

In [13]:
```
movie_gross_over_ten_milly_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1116 entries, 0 to 3219
Data columns (total 5 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   title           1116 non-null   object 
 1   studio          1116 non-null   object 
 2   domestic_gross  1116 non-null   float64
 3   foreign_gross   1116 non-null   int32  
 4   year            1116 non-null   int64  
dtypes: float64(1), int32(1), int64(1), object(2)
memory usage: 48.0+ KB
```

Now that foreign gross is an intenger type, I can create new columns by doing some math between domestic gross and foreign gross

In [14]:

```
# Create a total gross column which combines domestic and foreign gross
movie_gross_over_ten_milly_df['total_gross'] = movie_gross_over_ten_milly


# Create a new column that shows what percent domestic gross made up tota

movie_gross_over_ten_milly_df['domestic_gross_percentage'] = (movie_gros
                                                               / movie_gro
                                                              ) * 100

movie_gross_over_ten_milly_df
```

Out[14]:

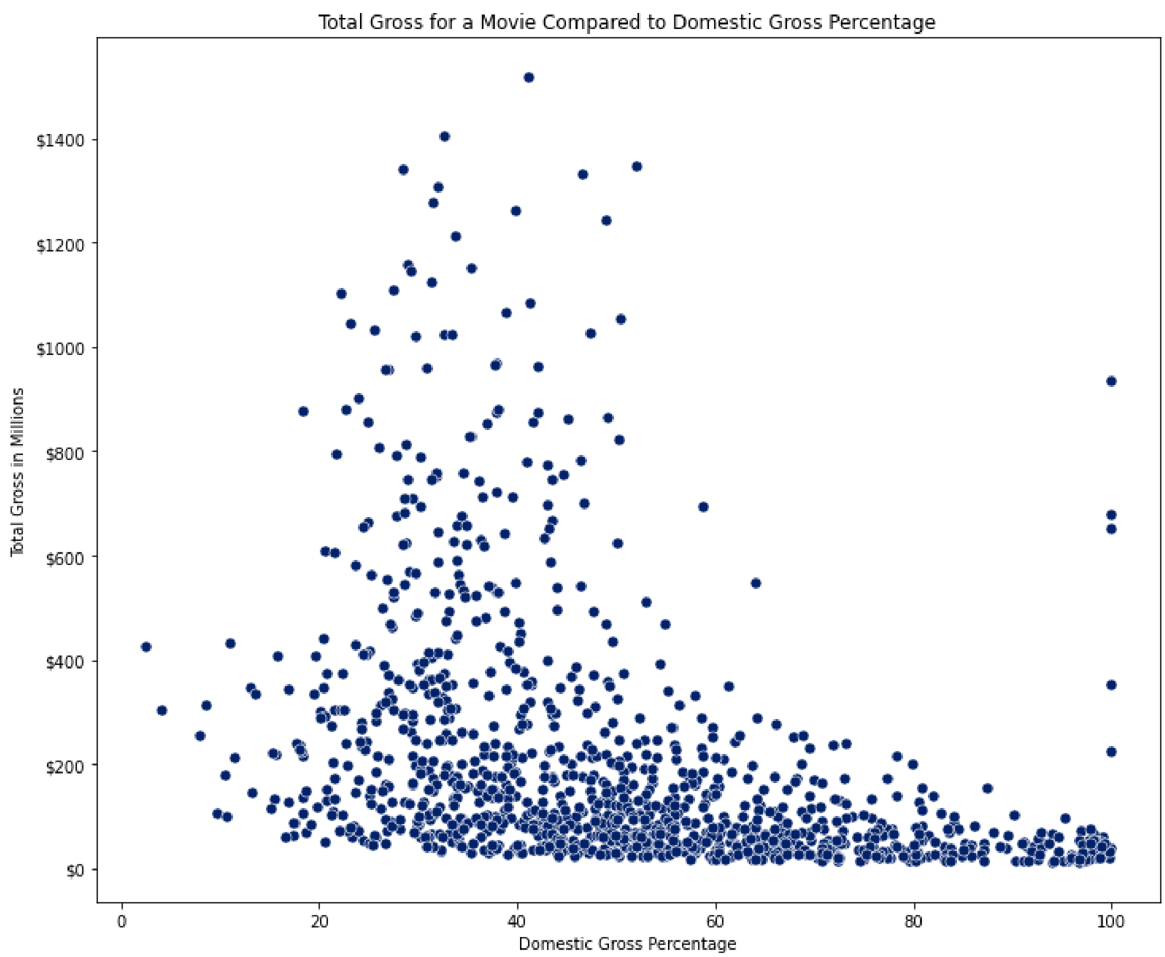
	title	studio	domestic_gross	foreign_gross	year	total_gross	dom
0	Toy Story 3	BV	415000000.0	652000000	2010	1.067000e+09	
1	Alice in Wonderland (2010)	BV	334200000.0	691300000	2010	1.025500e+09	
2	Harry Potter and the Deathly Hallows Part 1	WB	296000000.0	664300000	2010	9.603000e+08	
3	Inception	WB	292600000.0	535700000	2010	8.283000e+08	
4	Shrek Forever After	P/DW	238700000.0	513900000	2010	7.526000e+08	
...	...	...	...	...	...	...	
3203	If Beale Street Could Talk	Annapurna	14900000.0	5700000	2018	2.060000e+07	
3207	Hell Fest	LGF	11100000.0	7100000	2018	1.820000e+07	
3208	Chappaquiddick	ENTMP	17400000.0	591000	2018	1.799100e+07	
3216	Upgrade	BH Tilt	12000000.0	2400000	2018	1.440000e+07	
3219	Welcome to Marwen	Uni.	10800000.0	2100000	2018	1.290000e+07	

1116 rows × 7 columns

Now that I have some numerical data on domestic gross percentage and total gross I what to put that on a graph to see if I can glean anything from it

In [15]:

```
# Create a new column that is gross in millions so graphs are a bit easie
movie_gross_over_ten_milly_df['gross_in_millions'] = movie_gross_over_ten
plt.figure(figsize=(12, 10))
dg_percentage_scatter = sns.scatterplot(x ='domestic_gross_percentage', y
                                        s = 50, color = '#012169', data =

dg_percentage_scatter.set(xlabel ="Domestic Gross Percentage",
                       ylabel = "Total Gross in Millions",
                       title = 'Total Gross for a Movie Compared to Domes

dg_percentage_scatter.yaxis.set_major_formatter('${x:1.0f}')
```



It's tough to glean anything from this graph by itself, but I can create a

new subset to limit the data points. Because Microsoft is primarily interested in standing out in the box office. I'm going to create a "blockbuster" dataset that consists only of movies that made more than 100 Million Dollars domestically.

In [16]:

```
blockbuster_movie_gross_df = movie_gross_over_ten_milly_df.loc[movie_gro
blockbuster_movie_gross_df

```

Out[16]:

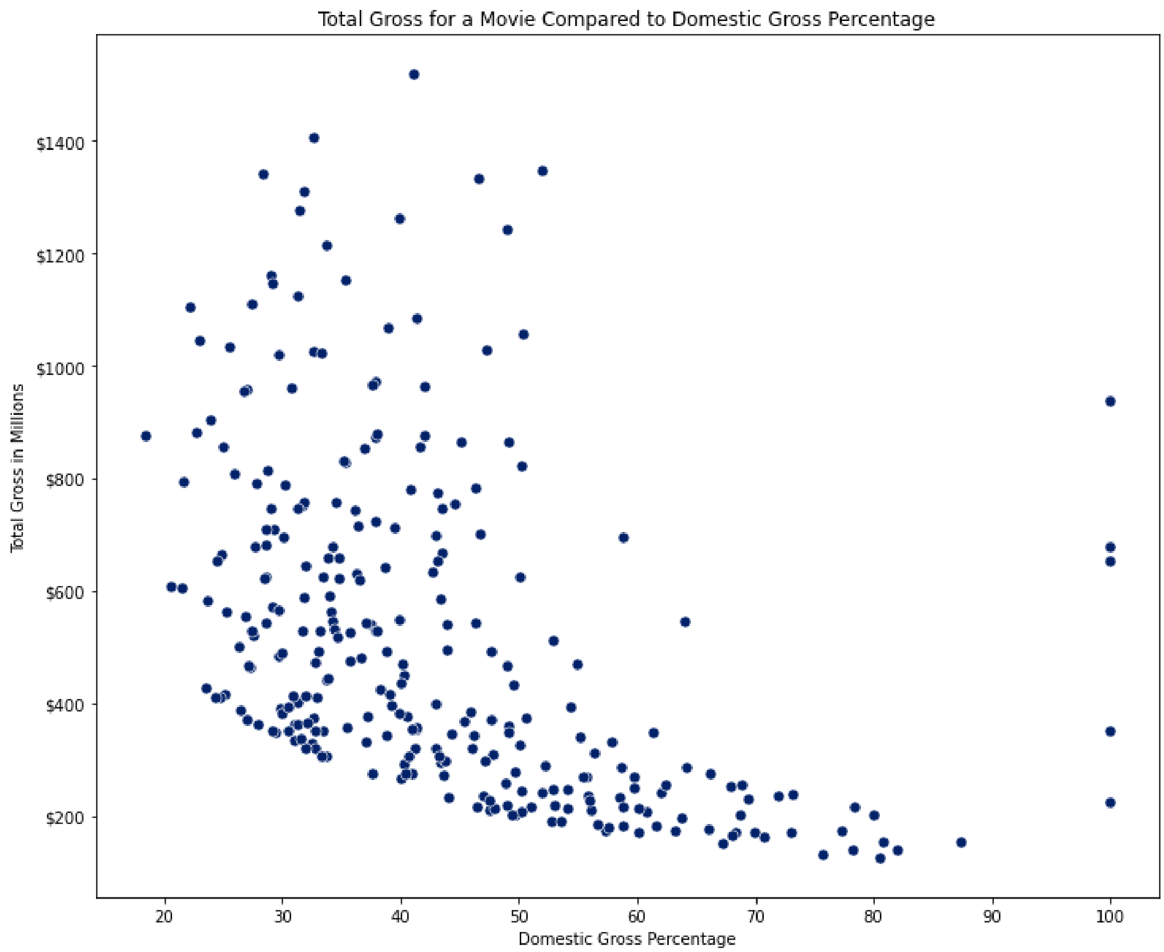
	title	studio	domestic_gross	foreign_gross	year	total_gross	domestic_gross_
0	Toy Story 3	BV	415000000.0	652000000	2010	1.067000e+09	
1	Alice in Wonderland (2010)	BV	334200000.0	691300000	2010	1.025500e+09	
2	Harry Potter and the Deathly Hallows Part 1	WB	296000000.0	664300000	2010	9.603000e+08	
3	Inception	WB	292600000.0	535700000	2010	8.283000e+08	
4	Shrek Forever After	P/DW	238700000.0	513900000	2010	7.526000e+08	
...	...	...	...	...	...	...	
3116	Crazy Rich Asians	WB	174500000.0	64000000	2018	2.385000e+08	
3119	Creed II	MGM	115700000.0	98300000	2018	2.140000e+08	
3121	The Equalizer 2	Sony	102100000.0	88300000	2018	1.904000e+08	
3123	The Mule	WB	103800000.0	68700000	2018	1.725000e+08	
3129	A Wrinkle in Time	BV	100500000.0	32200000	2018	1.327000e+08	

284 rows × 8 columns

Let's plot this data the same way and see if a trend emerges

In [17]:

```
plt.figure(figsize=(12, 10))
dg_percentage_scatter = sns.scatterplot(x ='domestic_gross_percentage', y
                                        color = '#012169', data = blockbu

dg_percentage_scatter.set(xlabel ="Domestic Gross Percentage",
                          ylabel = "Total Gross in Millions",
                          title = 'Total Gross for a Movie Compared to Domes

dg_percentage_scatter.yaxis.set_major_formatter('${x:1.0f}')
```



This graph shows a much clearer trend, but it looks like there are some outliers where domestic gross percentage is higher. I'm going to clean those up and add a trend line to the graph

In [18]:

```
1 blockbuster_movie_gross_df.sort_values('domestic_gross_percentage', ascen
```

Out[18]:

	title	studio	domestic_gross	foreign_gross	year	total_gross	domestic_gross_pe
1872	Star Wars: The Force Awakens	BV	936700000.0	1131	2015	936701131.0	9
1873	Jurassic World	Uni.	652300000.0	1019	2015	652301019.0	9
3079	Avengers: Infinity War	BV	678800000.0	1369	2018	678801369.0	9
1874	Furious 7	Uni.	353000000.0	1163	2015	353001163.0	9
2760	The Fate of the Furious	Uni.	226000000.0	1010	2017	226001010.0	9
1527	Ride Along	Uni.	134900000.0	19500000	2014	154400000.0	8
2819	Girls Trip	Uni.	115200000.0	25400000	2017	140600000.0	8
1176	Lone Survivor	Uni.	125100000.0	29700000	2013	154800000.0	8
1185	This is the End	Sony	101500000.0	24600000	2013	126100000.0	8
1910	Straight Outta Compton	Uni.	161200000.0	40400000	2015	201600000.0	7

It looks like when the data was converted, movies that grossed over a billion dollars in international markets were incorrectly accounted for. I can quickly fix those numbers using a lambda function

In [19]:

```
#Fix our first modified dataframe
movie_gross_over_ten_milly_df['foreign_gross'] = movie_gross_over_ten_mi
movie_gross_over_ten_milly_df.sort_values('domestic_gross_percentage', a

#Fix our second modified dataframe
blockbuster_movie_gross_df['foreign_gross'] = blockbuster_movie_gross_df
blockbuster_movie_gross_df.sort_values('domestic_gross_percentage', ascer

# Reset the Total Gross fro both dataframes

movie_gross_over_ten_milly_df['total_gross'] = movie_gross_over_ten_milly

blockbuster_movie_gross_df['total_gross'] = blockbuster_movie_gross_df['

# Reset the domestic gross percentage column for both dataframes
movie_gross_over_ten_milly_df['domestic_gross_percentage'] = (movie_gros
                                                               / movie_gr
                                                              ) * 100
blockbuster_movie_gross_df['domestic_gross_percentage'] = (blockbuster_m
                                                               / blockbus
                                                              ) * 100
```

```
<ipython-input-19-306458a7a27a>:6: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://p
andas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-vi
ew-versus-a-copy)
  blockbuster_movie_gross_df['foreign_gross'] = blockbuster_movie_gross_df
['foreign_gross'].apply(lambda x: x * 1000000 if x < 2000 else x)
<ipython-input-19-306458a7a27a>:13: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://p
andas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-vi
ew-versus-a-copy)
  blockbuster_movie_gross_df['total_gross'] = blockbuster_movie_gross_df['d
omestic_gross'] + blockbuster_movie_gross_df['foreign_gross']
<ipython-input-19-306458a7a27a>:19: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://p
andas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-vi
ew-versus-a-copy)
  blockbuster_movie_gross_df['domestic_gross_percentage'] = (blockbuster_mo
vie_gross_df['domestic_gross']
```

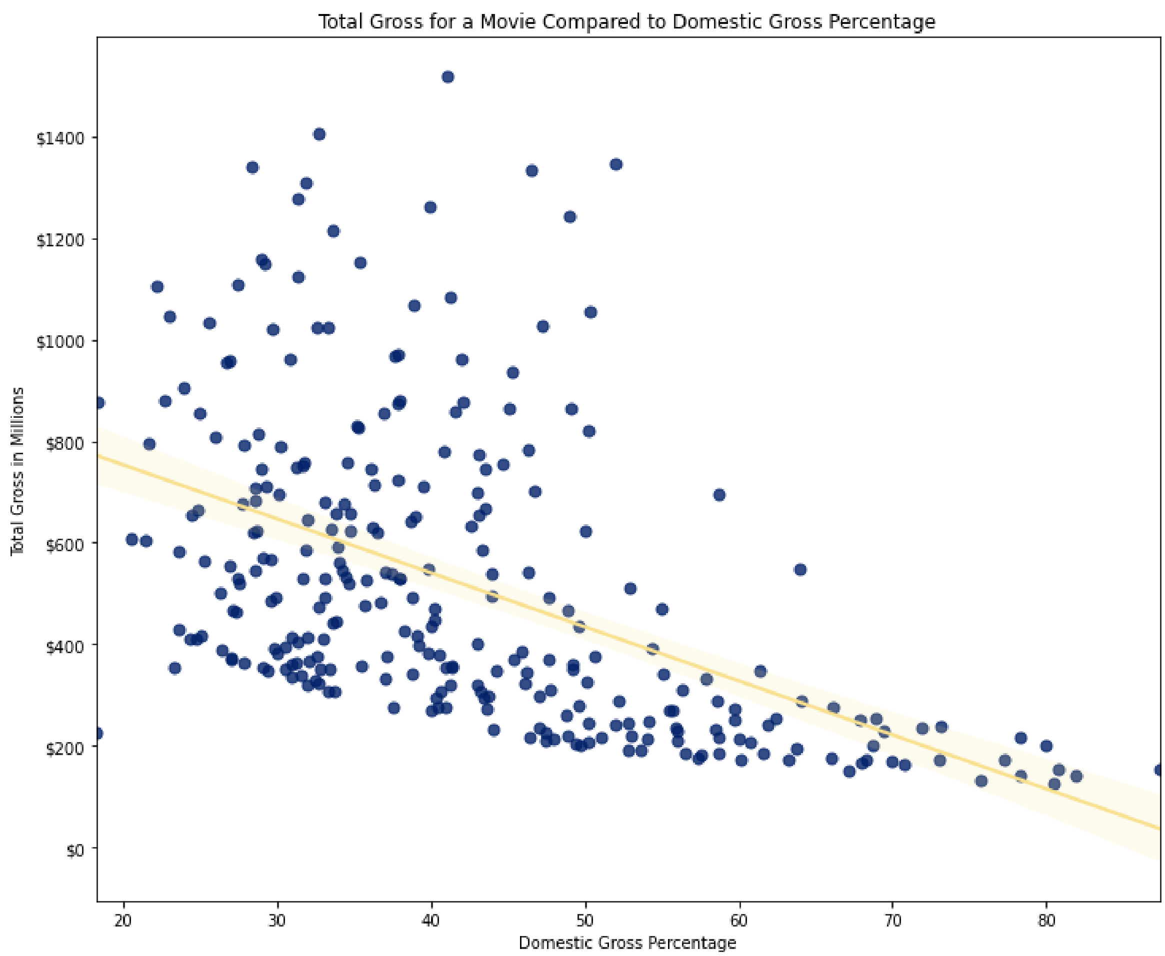
In [20]:
```
1 blockbuster_movie_gross_df.sort_values('domestic_gross_percentage', ascen
```

Out[20]:

	title	studio	domestic_gross	foreign_gross	year	total_gross	domestic_gross_p
1527	Ride Along	Uni.	134900000.0	19500000	2014	154400000.0	
2819	Girls Trip	Uni.	115200000.0	25400000	2017	140600000.0	
1176	Lone Survivor	Uni.	125100000.0	29700000	2013	154800000.0	
1185	This is the End	Sony	101500000.0	24600000	2013	126100000.0	
1910	Straight Outta Compton	Uni.	161200000.0	40400000	2015	201600000.0	
355	The Help	BV	169700000.0	46900000	2011	216600000.0	
1921	Trainwreck	Uni.	110200000.0	30600000	2015	140800000.0	
1172	Identity Thief	Uni.	134500000.0	39500000	2013	174000000.0	
3129	A Wrinkle in Time	BV	100500000.0	32200000	2018	132700000.0	
3116	Crazy Rich Asians	WB	174500000.0	64000000	2018	238500000.0	

In [21]:

```
plt.figure(figsize=(12, 10))
dg_percentage_plot = sns.regplot(x ='domestic_gross_percentage', y = 'gr
                                 fit_reg=True,
                                 data = blockbuster_movie_gross_df,
                                 scatter_kws={'s':50, "color": "#012169"
#                                  scatter_kws={"color": "#012169"},
                                 line_kws={"color": "#F8E08E"}

                                )
dg_percentage_plot.set(xlabel ="Domestic Gross Percentage",
                       ylabel = "Total Gross in Millions",
                       title = 'Total Gross for a Movie Compared to Dome

dg_percentage_plot.yaxis.set_major_formatter('${x:1.0f}')
```



This graph suggests there is a a negative correlation between total gross and the domestic gross percentage. Movies that make more money are less reliant on the domestic box office.

I also want to explore the review data from The Movie DataBase to see if I can glean any insights from that. In order to do that I will have to merge the two dataframes.

In [22]:

```
movie_gross_and_rating_df = tmdb_df[['title', 'vote_average', 'popularity
                                                left_on='title',
                                                right_on='title',
                                                   how='inner')
movie_gross_and_rating_df
```

Out[22]:

	title	vote_average	popularity	release_date	studio	domestic_gross	foreign_
0	How to Train Your Dragon	7.7	28.734	2010-03-26	P/DW	217600000.0	277
1	Iron Man 2	6.8	28.515	2010-05-07	Par.	312400000.0	311
2	Inception	8.3	27.920	2010-07-16	WB	292600000.0	535
3	Toy Story 3	7.7	24.445	2010-06-17	BV	415000000.0	652
4	Despicable Me	7.2	23.673	2010-07-09	Uni.	251500000.0	291
...	...	...	...	...	...	...	
1064	The 15:17 to Paris	5.3	11.576	2018-02-09	WB	36300000.0	20
1065	Uncle Drew	6.5	10.836	2018-06-29	LG/S	42500000.0	4
1066	Chappaquiddick	6.0	10.737	2018-04-06	ENTMP	17400000.0	
1067	Proud Mary	5.5	9.371	2018-01-12	SGem	20900000.0	
1068	Show Dogs	5.9	7.904	2018-05-18	Global Road	17900000.0	21

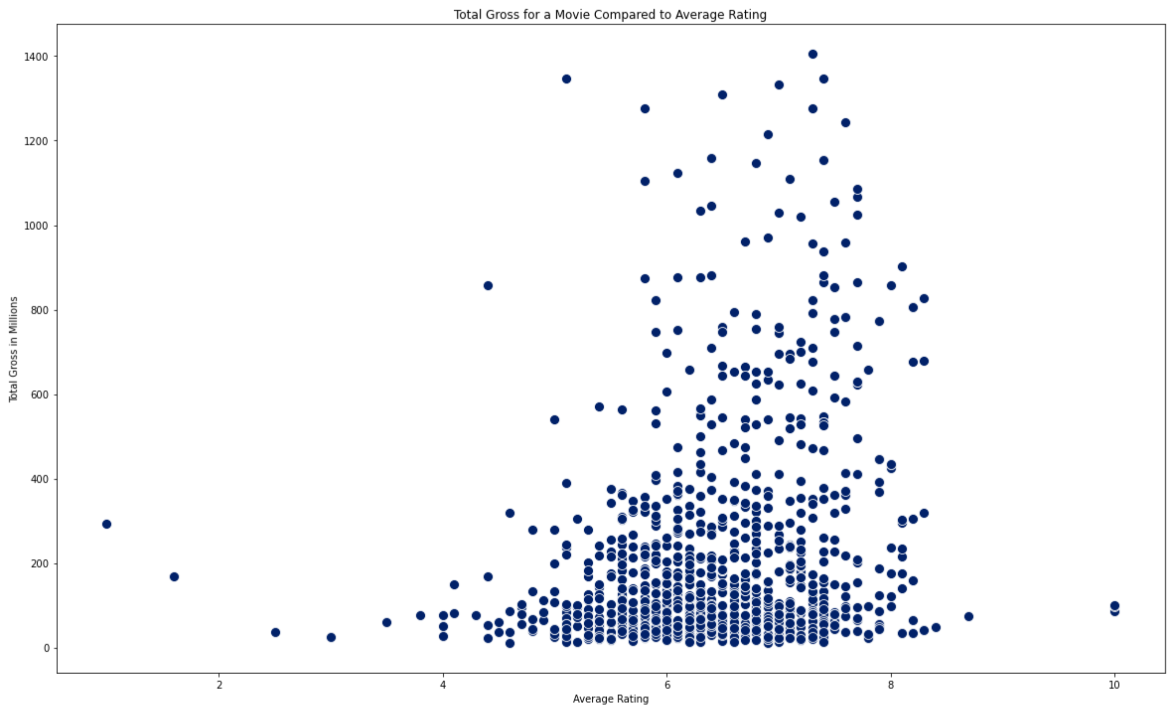
1069 rows × 11 columns

The merge appears to be sucessful as we only lost ~4% of the columns. It would be possible to further optimize this merge at a later date but I am confident it 'mostly worked'™ .

Let's plot a graph to see if we can glean anything

In [23]:

```
plt.figure(figsize=(20, 12))
vote_average_vs_gross_scatterplot = sns.scatterplot( x = 'vote_average',

vote_average_vs_gross_scatterplot.set(xlabel ="Average Rating",
                        ylabel = "Total Gross in Millions",
                        title = 'Total Gross for a Movie Compared to Avera
                                       )

dg_percentage_plot.yaxis.set_major_formatter('${x:1.0f}')
```



That plot looks like the first day of my statistics course!

It looks like a continuous uniform distribution. If I were to plot data with no correlation I would expect a graph like this. Though I can't necessarilyhelp build an actionable insight for Microsoft, but I can tell

them that fan ratings do not appear to be correlated with box office gross.

I do want to look at genres to see which genres perform best at the box office and see how those genres perform in international markets. In order to do that I'm going to add Directors and Genres to the dataframe with movies that exceeded 10 Million Dollars.

In [75]:

```
movie_gross_and_director = director_movie_genre_df.merge(movie_gross_ove
                                                         left_on='Movie_Name',
                                                         right_on='title',
                                                            how='inner')

movie_gross_and_director.head(5)
```

Out[75]:

	Director	Movie_Name	Length	genres	AVG_Rating	title	studio
0	Roger Michell	Morning Glory	107.0	Comedy,Drama,Romance	6.5	Morning Glory	Par.
1	Adam Shankman	Rock of Ages	123.0	Comedy,Drama,Musical	5.9	Rock of Ages	WB (NL)
2	Adam Shankman	Rock of Ages	123.0	Comedy,Drama,Musical	5.9	Rock of Ages	WB (NL)
3	Adam Shankman	Rock of Ages	123.0	Comedy,Drama,Musical	5.9	Rock of Ages	WB (NL)
4	Tim Hill	Hop	95.0	Adventure,Animation,Comedy	5.4	Hop	Uni.

In [76]:

```
movie_gross_and_director.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3403 entries, 0 to 3402
Data columns (total 13 columns):
 #   Column                     Non-Null Count  Dtype  
---  ------                     --------------  -----  
 0   Director                   3403 non-null   object 
 1   Movie_Name                 3403 non-null   object 
 2   Length                     3381 non-null   float64
 3   genres                     3397 non-null   object 
 4   AVG_Rating                 3403 non-null   float64
 5   title                      3403 non-null   object 
 6   studio                     3403 non-null   object 
 7   domestic_gross             3403 non-null   float64
 8   foreign_gross              3403 non-null   int64  
 9   year                       3403 non-null   int64  
 10  total_gross                3403 non-null   float64
 11  domestic_gross_percentage  3403 non-null   float64
 12  gross_in_millions          3403 non-null   float64
dtypes: float64(6), int64(2), object(5)
memory usage: 372.2+ KB
```

This dataframe returned more rows than movies we were looking at but we can tell from the preview there are some duplicates in there. So dropping the duplicates will most likely return something we can work with.

In [77]:

```
movie_gross_and_director.drop_duplicates(subset = "Movie_Name", inplace=
movie_gross_and_director
```

Out[77]:

	Director	Movie_Name	Length	genres	AVG_Rating	title	stu
0	Roger Michell	Morning Glory	107.0	Comedy,Drama,Romance	6.5	Morning Glory	F
1	Adam Shankman	Rock of Ages	123.0	Comedy,Drama,Musical	5.9	Rock of Ages	\ (I
4	Tim Hill	Hop	95.0	Adventure,Animation,Comedy	5.4	Hop	U
7	Darren Lynn Bousman	Mother's Day	112.0	Drama,Horror,Thriller	6.3	Mother's Day	O
15	Greg Strause	Skyline	92.0	Action,Sci-Fi,Thriller	4.4	Skyline	U
...	...	...	...	...	...	...	
3391	Frank Coraci	Here Comes the Boom	105.0	Action,Comedy,Sport	6.4	Here Comes the Boom	Sc
3394	Anne Fletcher	The Guilt Trip	95.0	Comedy,Drama	5.8	The Guilt Trip	F
3395	Scott Derrickson	Sinister	110.0	Horror,Mystery,Thriller	6.8	Sinister	LC
3397	Steve Pink	Hot Tub Time Machine 2	93.0	Comedy,Mystery,Sci-Fi	5.1	Hot Tub Time Machine 2	F
3399	James Wan	The Conjuring 2	134.0	Drama,Horror,Mystery	7.4	The Conjuring 2	\ (I

918 rows × 13 columns

This looks much better and even though we lost some of our results, we can still glean some information from this new dataframe. If I had more time I could further refine the join but it 'mostly worked'™.

I do want to seperate the genre category so the dataframe has a seperate column for each unique genre.

In [78]:

```
#Create a new dataframe that keeps the same index but splits the genre r
genres_df = movie_gross_and_director['genres'].str.split(',', expand = T
genres_df.columns =['Genre1', 'Genre2', 'Genre3']
genres_df
```

Out[78]:

	Genre1	Genre2	Genre3
0	Comedy	Drama	Romance
1	Comedy	Drama	Musical
4	Adventure	Animation	Comedy
7	Drama	Horror	Thriller
15	Action	Sci-Fi	Thriller
...	...	...	...
3391	Action	Comedy	Sport
3394	Comedy	Drama	None
3395	Horror	Mystery	Thriller
3397	Comedy	Mystery	Sci-Fi
3399	Drama	Horror	Mystery

918 rows × 3 columns

I can now merge the two dataframes together

In [79]:

```
movie_gross_and_director = movie_gross_and_director.merge(genres_df, rig
movie_gross_and_director
```

Out[79]:

	Director	Movie_Name	Length	genres	AVG_Rating	title	stu
0	Roger Michell	Morning Glory	107.0	Comedy,Drama,Romance	6.5	Morning Glory	F
1	Adam Shankman	Rock of Ages	123.0	Comedy,Drama,Musical	5.9	Rock of Ages	\ (I
4	Tim Hill	Hop	95.0	Adventure,Animation,Comedy	5.4	Hop	U
7	Darren Lynn Bousman	Mother's Day	112.0	Drama,Horror,Thriller	6.3	Mother's Day	O
15	Greg Strause	Skyline	92.0	Action,Sci-Fi,Thriller	4.4	Skyline	U
...	...	...	...	...	...	...	
3391	Frank Coraci	Here Comes the Boom	105.0	Action,Comedy,Sport	6.4	Here Comes the Boom	Sc
3394	Anne Fletcher	The Guilt Trip	95.0	Comedy,Drama	5.8	The Guilt Trip	F
3395	Scott Derrickson	Sinister	110.0	Horror,Mystery,Thriller	6.8	Sinister	LC
3397	Steve Pink	Hot Tub Time Machine 2	93.0	Comedy,Mystery,Sci-Fi	5.1	Hot Tub Time Machine 2	F
3399	James Wan	The Conjuring 2	134.0	Drama,Horror,Mystery	7.4	The Conjuring 2	\ (I

918 rows × 16 columns

I want to find a way to get the average movie gross for each genre. The first step is to get a list of genres.

In [80]:

```
# Create A New Dataframe where the genres are the columns
list_of_genres_df = genres_df[['Genre1', 'Genre2', 'Genre3']].apply(pd.S
list_of_genres_df = list_of_genres_df.transpose()
list_of_genres_df
```

Out[80]:

	Action	Adventure	Animation	Biography	Comedy	Crime	Documentary	Drama	Far
Genre1	308.0	129.0	7.0	67.0	178.0	33.0	14.0	126.0	N
Genre2	NaN	156.0	69.0	8.0	83.0	65.0	3.0	185.0	2
Genre3	NaN	NaN	12.0	2.0	85.0	30.0	NaN	79.0	3

3 rows × 21 columns

In [81]:

```
#Convert the Column Labels into a list
list_of_genres = list(list_of_genres_df.columns)
list_of_genres
```

Out[81]:

```
['Action',
 'Adventure',
 'Animation',
 'Biography',
 'Comedy',
 'Crime',
 'Documentary',
 'Drama',
 'Family',
 'Fantasy',
 'History',
 'Horror',
 'Music',
 'Musical',
 'Mystery',
 'Romance',
 'Sci-Fi',
 'Sport',
 'Thriller',
 'War',
 'Western']
```

First I am going to go through the dataframe and assert whether that movie contains the genres. I used the boolean True or False for the assertion.

In [82]:

```
for genre in list_of_genres:
    movie_gross_and_director[genre] = np.where((movie_gross_and_director
                                              (movie_gross_and_director[
                                              (movie_gross_and_director[
                                              True,
                                              False)
```

Now that I have a list of all the genres and have identified which movies contain which genres, I can create a loop that goest through the dataframe and gets the average gross and domestic box office percentage for those genres.

In [83]:

```
#Create a new empty list to put the average gross values for each genre
total_gross_genre = []
for genre in list_of_genres:
        #Add the mean value for all the columsn
        total_gross_genre.append(movie_gross_and_director.loc[movie_gros

#Create a new empty list to put the average gross values for each genre
total_gross_genre
```

Out[83]:

```
[318129301.9318182,
 394275140.32631576,
 387769318.14772725,
 129916064.92207792,
 184280297.37861273,
 138546617.1796875,
 107740294.05882353,
 127946916.13846155,
 197303761.9047619,
 277673285.70238096,
 137078249.9642857,
 131115088.8888889,
 132049440.0,
 208200000.0,
 125481520.0,
 105797566.64864865,
 434950744.43333334,
 157189993.33333334,
 188674780.63870966,
 123066666.66666667,
 256325000.0]
```

In [84]:
```
#Create a new empty list to put the domestic gross percentage values for

domestic_gross_percentage_genre = []
for genre in list_of_genres:
        domestic_gross_percentage_genre.append(movie_gross_and_director.

domestic_gross_percentage_genre
```

Out[84]:
```
[42.38097838612483,
 39.255730100079205,
 39.41045870997703,
 56.20198961639074,
 53.92797872090043,
 54.698373441845774,
 64.95473576658722,
 54.521062353888446,
 51.53358760392938,
 41.14422676675871,
 53.04935267573994,
 51.006193590898256,
 53.14174141717532,
 48.222498093369765,
 48.49637392226229,
 54.111280628072954,
 42.619232348624884,
 72.93264852727965,
 47.275360425770096,
 47.54061374917885,
 47.46483307992577]
```

Now that I have three seperate lists, I can create a new dataframe object with those three values.

In [85]:

```
zipped = list(zip(list_of_genres, total_gross_genre, domestic_gross_perc
genre_data_df = pd.DataFrame(zipped, columns=['Genre', 'Total_Gross_Genr
genre_data_df
# Sort the dataframe for easier analysis
genre_data_df = genre_data_df.sort_values('Total_Gross_Genre', ascending
# Create a new Column for Total_Gross in Millions
genre_data_df['Total_Gross_In_Mllions'] = genre_data_df['Total_Gross_Gen
genre_data_df
```

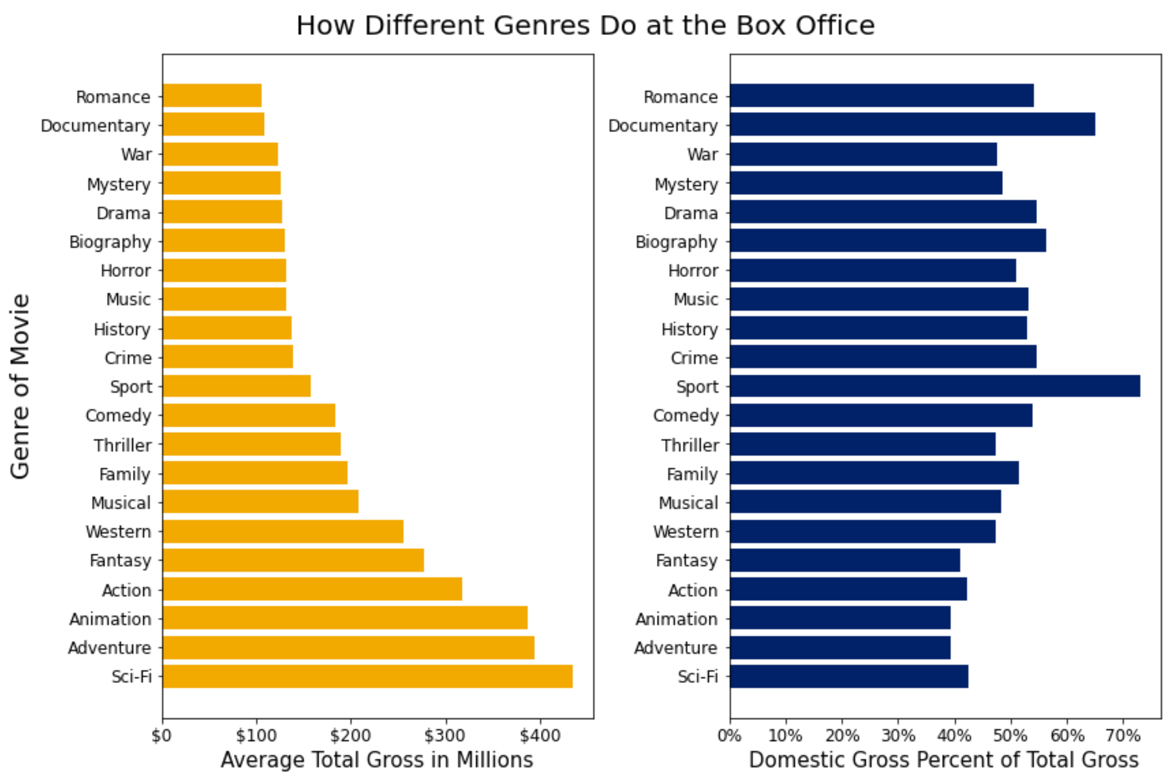
Out[85]:

	Genre	Total_Gross_Genre	Domestic Gross Percentage	Total_Gross_In_Mllions
16	Sci-Fi	4.349507e+08	42.619232	434.950744
1	Adventure	3.942751e+08	39.255730	394.275140
2	Animation	3.877693e+08	39.410459	387.769318
0	Action	3.181293e+08	42.380978	318.129302
9	Fantasy	2.776733e+08	41.144227	277.673286
20	Western	2.563250e+08	47.464833	256.325000
13	Musical	2.082000e+08	48.222498	208.200000
8	Family	1.973038e+08	51.533588	197.303762
18	Thriller	1.886748e+08	47.275360	188.674781
4	Comedy	1.842803e+08	53.927979	184.280297
17	Sport	1.571900e+08	72.932649	157.189993
5	Crime	1.385466e+08	54.698373	138.546617
10	History	1.370782e+08	53.049353	137.078250
12	Music	1.320494e+08	53.141741	132.049440
11	Horror	1.311151e+08	51.006194	131.115089
3	Biography	1.299161e+08	56.201990	129.916065
7	Drama	1.279469e+08	54.521062	127.946916
14	Mystery	1.254815e+08	48.496374	125.481520
19	War	1.230667e+08	47.540614	123.066667
6	Documentary	1.077403e+08	64.954736	107.740294
15	Romance	1.057976e+08	54.111281	105.797567

Now I want to visualize this data. I'm going to create two horizontal bar charts with the same y axis (genre).

In [86]:

```
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(12, 8))
fig.suptitle('How Different Genres Do at the Box Office', fontsize = 20)
ax1.barh(genre_data_df['Genre'], genre_data_df['Total_Gross_In_Mllions']
ax2.barh(genre_data_df['Genre'], genre_data_df['Domestic Gross Percentag

# Below code does very specefic formatting
ax1.set_xlabel('Average Total Gross in Millions', fontsize = 15)
ax2.set_xlabel('Domestic Gross Percent of Total Gross', fontsize = 15)
ax1.set_ylabel('Genre of Movie', fontsize = 18)
ax1.xaxis.set_major_formatter('${x:1.0f}')
ax2.xaxis.set_major_formatter('{x:1.0f}%')
ax1.tick_params(axis='x', labelsize=12)
ax1.tick_params(axis='y', labelsize=12)
ax2.tick_params(axis='x', labelsize=12)
ax2.tick_params(axis='y', labelsize=12)

plt.tight_layout()

```

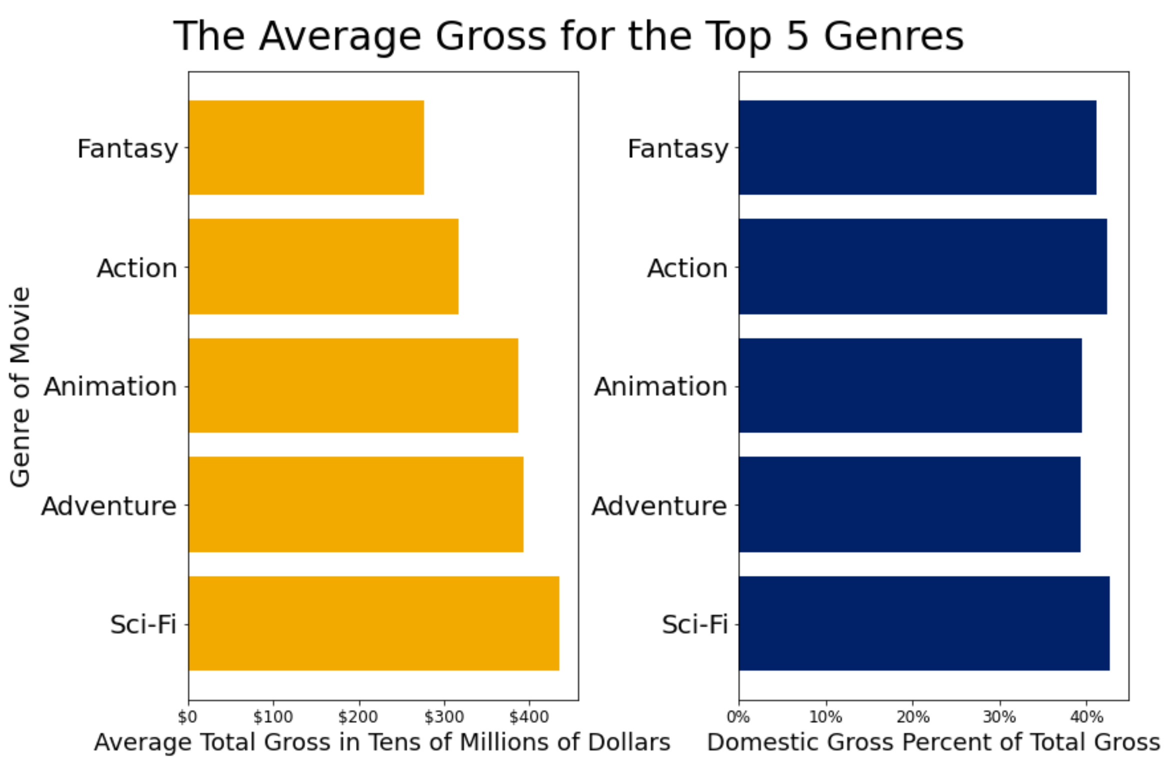


It appears that the genres with the most total gross are also less reliant on domestic revenue. This further supports my belief that making movies that can are just as appealing to an international audience is a

better strategy. It also allows me to give some actionable insights to Microsoft Film Studio about what type of movies they should make

In [87]:

```
fig, (ax1, ax2) = plt.subplots(1, 2, figsize=(12, 8))
fig.suptitle('The Average Gross for the Top 5 Genres', fontsize = 30)
ax1.barh(genre_data_df['Genre'].head(5), genre_data_df['Total_Gross_In_Mi
ax2.barh(genre_data_df['Genre'].head(5), genre_data_df['Domestic Gross Pe


# Below code does very specefic formatting
ax1.set_xlabel('Average Total Gross in Tens of Millions of Dollars', font
ax2.set_xlabel('Domestic Gross Percent of Total Gross', fontsize = 18)
ax1.set_ylabel('Genre of Movie', fontsize = 20)
ax1.xaxis.set_major_formatter('${x:1.0f}')
ax2.xaxis.set_major_formatter('{x:1.0f}%')
ax1.tick_params(axis='x', labelsize=12)
ax1.tick_params(axis='y', labelsize=20)
ax2.tick_params(axis='x', labelsize=12)
ax2.tick_params(axis='y', labelsize=20)
plt.tight_layout()

```



Sci-Fi, Adventure, Animation, Action, and Fantasy **movies make more money than other movies and also have international appeal. This is an actionable insight I can give to Microsoft Film Studios.**

I also want to recommend some directors to recommend hiring. I believe that hiring high-profile directors with a

history of making 'Blockbuster" movies will benefit Microsoft. In order to find the best directors for Microsoft to hire I'm going to segment my data again to only include films that grossed over 100 Million Dollars and find the directors who most appeal to international markets.

In [37]:

```
# Create a new dataframe using our combined
# Movie Gross, Director, and Genre DF where domestic gross is greater th
BB_gross_director_df = movie_gross_and_director.loc[movie_gross_and_dire
```

In [38]:

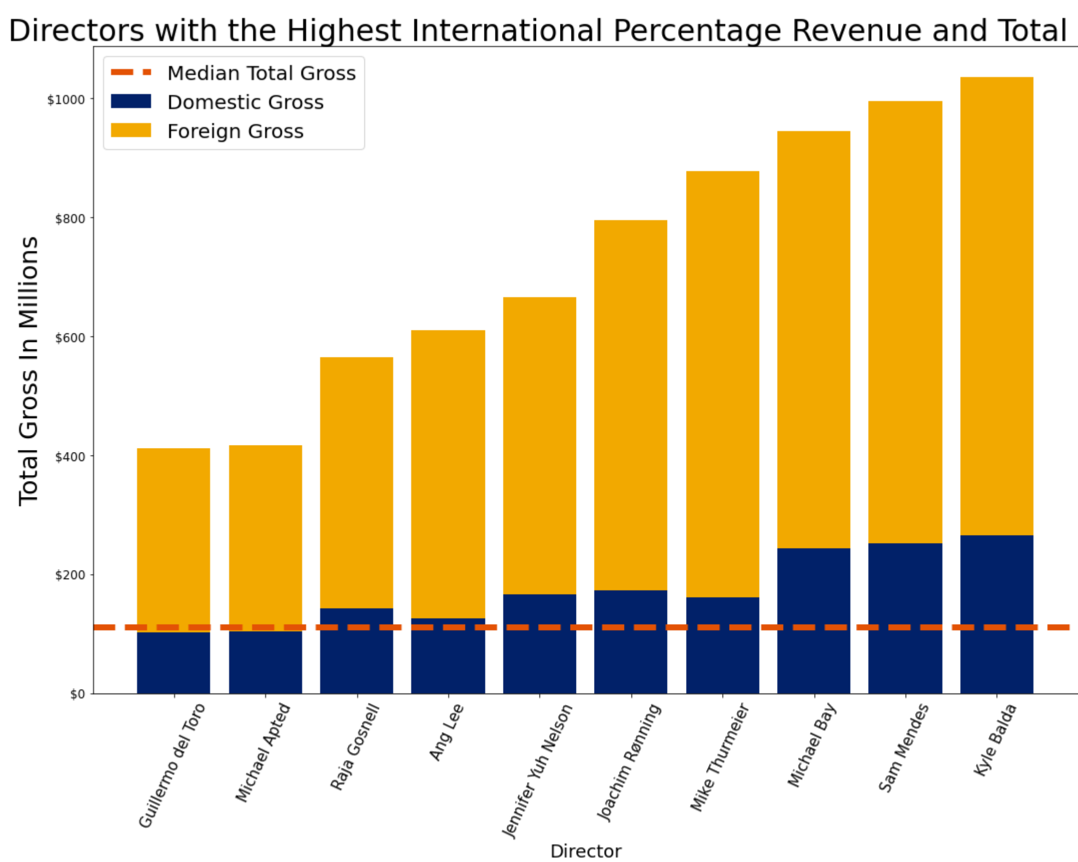
```
# Sort the new dataframe using a groupby method so every movie a directo
director_percentage_sorted_df = BB_gross_director_df.groupby('Director')
# Grab only the top 10 directors by International Gross Percentage
ten_lowest_dom_percentage_directors = director_percentage_sorted_df.head
#Sort the dataframe by total gross so the graph is prettier
ten_lowest_dom_percentage_directors = ten_lowest_dom_percentage_director
ten_lowest_dom_percentage_directors
```

Out[38]:

	Director	Length	AVG_Rating	domestic_gross	foreign_gross	year	total_gross
65	Guillermo del Toro	131.000000	6.9	1.018000e+08	3.092000e+08	2013.0	4.110000e+08
107	Michael Apted	113.000000	6.3	1.044000e+08	3.113000e+08	2010.0	4.157000e+08
132	Raja Gosnell	103.000000	5.5	1.426000e+08	4.211000e+08	2011.0	5.637000e+08
9	Ang Lee	127.000000	7.9	1.250000e+08	4.840000e+08	2012.0	6.090000e+08
78	Jennifer Yuh Nelson	90.000000	7.2	1.652000e+08	5.004000e+08	2011.0	6.656000e+08
79	Joachim Rønning	129.000000	6.6	1.726000e+08	6.223000e+08	2017.0	7.949000e+08
113	Mike Thurmeier	88.000000	6.6	1.613000e+08	7.159000e+08	2012.0	8.772000e+08
108	Michael Bay	157.666667	5.7	2.426667e+08	7.017667e+08	2014.0	9.444333e+08
146	Sam Mendes	145.500000	7.3	2.522500e+08	7.424000e+08	2013.5	9.946500e+08
94	Kyle Balda	89.000000	6.3	2.646000e+08	7.702000e+08	2017.0	1.034800e+09

In [49]:

```
#Find the median gross for all movies to see how much these directors exc
median_movie_gross = movie_gross_and_director['total_gross'].median()
#Create new columns to make the graph prettier
ten_lowest_dom_percentage_directors['Domestic_Gross_In_Millions'] = ten_l
ten_lowest_dom_percentage_directors['Foreign_Gross_In_Millions'] = ten_lo

fig, ax = plt.subplots(figsize=(15, 12))

# Plot both the doemstic gross and international gross on the same bar
ax.bar(ten_lowest_dom_percentage_directors['Director'], ten_lowest_dom_pe
       color = '#012169', label = 'Domestic Gross')
ax.bar(ten_lowest_dom_percentage_directors['Director'], ten_lowest_dom_pe
       bottom = ten_lowest_dom_percentage_directors['Domestic_Gross_In_Mi

# Below code does very specefic formatting
plt.axhline(y = median_movie_gross/1000000, color = '#E35205', linestyle
plt.xticks(rotation=65)
plt.legend(loc="upper left", fontsize = 20)
ax.set_title('Directors with the Highest International Percentage Revenue
ax.set_xlabel('Director', fontsize = 18)
ax.set_ylabel('Total Gross In Millions', fontsize = 25)
ax.yaxis.set_major_formatter('${x:1.0f}')
ax.tick_params(axis='x', labelsize=15)
ax.tick_params(axis='y', labelsize=12)

plt.tight_layout()
```



This graph shows 'Blockbuster" directors with the highest foreign gross percentage and what portion of their movie gross comes from the Domestic Box Office and the Foreign Box Office. These directors make movies that gross much more than average and would be a good hire for Microsoft Film Studios.

70 percent of them are non-american and three of the top four make animated movies. Animated movies translate very well for international audiences because film studios can hire different voice actors and not rely on dubs. Another key insight is that foreign directors are much better at making money over seas.

Recommendations

***Goal*: Prioritize revenue over other factors such as ROI or reviews.**

Higher total revenue is correlated with a higher international gross percentage.

Certain genres are more appealing to foreign markets.

1. Sci-Fi, Adventure, Action, Animation, and Fantasy are the highest grossing genres.
2. They also are genres that international audiences are keen to see.
3. This is most likely because they are plot-driven vs character-driven films. (NYBookEditors Article on the Difference (https://nybookeditors.com/2017/02/character-driven-vs-plot-driven-best/#:~:text=Character-driven%20stories%20can%20deal,arrives%20at%20a%20particular%20choice.))

Hire directors with a proven track record of releasing successfully outside the U.S./Canada.

1. International directors have a global perspective that helps to sell movies abroad.
2. In order to maximize the chances the movie will be high grossing, hire international directors who have a proven history of making "blockbuster" movies
3. Animation directors also have a lot of experience translating their movies internationally and can hire different voice actors for different regions.

Future Improvement Ideas

- Grab data from movies that were not released in the U.S.
    - Better understanding foreign markets will allow your studio to release more successfully abroad
- Adjust for Inflation.
- Refine my join statements so that I can keep more data.

- Create Director/Genre pairings so Microsoft can commission directors to make certain types of movies
- Look into the importance of sequels and movie franchises as it pertains to this data.

Other Resources and Places to Contact Me

Presentation Deck:

Work Notebook I used:

Acknowledgements

I want to thank my professors at Flatiron School who helped me to create this report. Specifically, **Lindsey Berlin** and **Mark Barbour**.

I also could not have done this without all the public information available on the websites I linked in this notebook and the datasets I used.

I also want to give a shoutout to my dog *Haley* who oversaw all of my work on this project. She kept me on task throughout and was willing to listen when my code did not work.

Most importantly, I want to thank you the reader.

If you have any questions or want to get in touch with me please feel free to reach out via these platforms.

Thanks, John Bruemmer

Email: Johnnybruemmer@gmail.com (mailto:Johnnybruemmer@gmail.com)

LinkedIn : John Bruemmer (https://www.linkedin.com/in/john-bruemmer-407a58a4/)

GitHub : Jbruemmer (https://github.com/Jbruemmer)

In [ ]:

```
1
```