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- Student pace: **Full Time Online**
- Scheduled project review date/time: **May 4, 2021 11 AM**
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- Blog post URL: https://danielmsmith1.medium.com/pivot-vs-pivottable-vs-groupby-2d8723beb782 (https://danielmsmith1.medium.com/pivot-vs-pivottable-vs-groupby-2d8723beb782)

Daniel M. Smith
Movie Studio Project Phase 1 Flatiron School

1 Business Understanding

Microsoft sees all the big companies creating original video content and they want to get in on the fun. They have decided to create a new movie studio, but they don't know anything about creating movies. You are charged with exploring what types of films are currently doing the best at the box office. You must then translate those findings into actionable insights that the head of Microsoft's new movie studio can use to help decide what type of films to create.

2 Data Mining

Initial data was provided and can be downloaded here (https://github.com/learn-co-curriculum/dsc-phase-1-project/tree/master/zippedData).

3 Data Cleaning

In this workbook we:

1. Load the data into pandas DataFrames
2. Inspect and observe the DataFrames
3. Clean and convert the data into appropriate types

3.1 Initial Reading of data files

In [254]:
```
import pandas as pd
import numpy as nm
from os import listdir
import seaborn as sns
import matplotlib.pyplot as plt
import matplotlib.ticker as mticker

path = './data/zippedData/'
```
executed in 9ms, finished 18:13:04 2021-05-04

In [255]:
```
#helper to list all csv or type files in a dir
def find_csv_filenames( path_to_dir, suffix=".csv"):
    filenames = listdir(path_to_dir)
    return [ filename for filename in filenames if filename.endswith( suffix ) ]

#creates dataframes for type specified
def create_dfs(filelist, suffix=".csv" ):
    #Read all the files and store in a dataFrame
    # the data Frames for each file will be listed in a dict
    # where key is the name and value is the df
    dict_csv_files = {}

    for filename in csvfiles:
        filename_cleaned = filename.replace(".csv", "").replace(".","_")#cleaning
        filename_df = pd.read_csv(path + filename, index_col = 0, encoding='utf8')
        dict_csv_files[filename_cleaned] = filename_df
    return dict_csv_files
```
executed in 13ms, finished 18:13:04 2021-05-04

In [256]:
```
#Create csvfiles, tsvfiles and call createdfs dict
csvfiles = find_csv_filenames(path)
tsvfiles = find_csv_filenames(path,'.tsv')
dict_dfs = create_dfs(csvfiles, suffix=".csv" )
```
executed in 3.37s, finished 18:13:07 2021-05-04

In [257]:
```
dict_dfs.keys()
```
executed in 14ms, finished 18:13:07 2021-05-04

Out[257]:
```
dict_keys(['bom_movie_gross', 'imdb_name_basics', 'imdb_title_akas', 'imdb_title_basics', 'imdb_title_cre
w', 'imdb_title_principals', 'imdb_title_ratings', 'tmdb_movies', 'tn_movie_budgets', 'tn_movie_budgets_cha
nged'])
```

In [258]:
```
##Create Working DataFrames
df_bom = dict_dfs['bom_movie_gross']
df_imdb_name = dict_dfs['imdb_name_basics']
df_imdb_akas = dict_dfs['imdb_title_akas']
df_imdbbasics = dict_dfs['imdb_title_basics']
df_imdb_crew = dict_dfs['imdb_title_crew']
df_imdb_principals = dict_dfs['imdb_title_principals']
df_imdb_ratings = dict_dfs['imdb_title_ratings']
df_tmb = dict_dfs['tmdb_movies']
df_tn_movie_budget = dict_dfs['tn_movie_budgets']
#Excluding rott.tsvfiles  df_rott_info = dict_dfs(' pd.read_csv('zippedData/rt.movie_info.tsv', sep='\t')
#df_rott_rev = dict_dfs(' pd.read_csv('zippedData/rt.reviews.tsv',encoding= 'unicode_escape', sep='\t')
```
executed in 15ms, finished 18:13:07 2021-05-04

3.2 Inspect DataFrames

Inspecting the dfs, Noting observations about the data, describing the data types.
We have 9 DataFrames from the 9 files:
df_bom
df_imdb_name
df_imdb_akas
df_imdbbasics
df_imdb_crew
df_imdb_principals
df_imdb_ratings
df_tmb
df_tn_movie_budget

3.2.1 Box Office Mojo-df_bom

In [259]:
```
df_bom.info()
```
executed in 15ms, finished 18:13:07 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 3387 entries, Toy Story 3 to An Actor Prepares
Data columns (total 4 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   studio          3382 non-null   object 
 1   domestic_gross  3359 non-null   float64
 2   foreign_gross   2037 non-null   object 
 3   year            3387 non-null   int64  
dtypes: float64(1), int64(1), object(2)
memory usage: 132.3+ KB
```

In [260]:
```
df_bom.head(3)
```
executed in 15ms, finished 18:13:07 2021-05-04

Out[260]:

title	studio	domestic_gross	foreign_gross	year
Toy Story 3	BV	415000000.0	652000000	2010
Alice in Wonderland (2010)	BV	334200000.0	691300000	2010
Harry Potter and the Deathly Hallows Part 1	WB	296000000.0	664300000	2010

3.2.1.1 Observation df_bom (Box office Mojo)

It looks as if the data is for 2010 to 2018 movies of domestic and foreign gross in dollars. Foreign gross needs to be converted to int datatype.

3.2.2 IMDB name basics-df_imdb_name

In [261]:
```
df_imdb_name.info()
```
executed in 77ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 606648 entries, nm0061671 to nm9993380
Data columns (total 5 columns):
 #   Column             Non-Null Count   Dtype  
---  ------             --------------   -----  
 0   primary_name       606648 non-null  object 
 1   birth_year         82736 non-null   float64
 2   death_year         6783 non-null    float64
 3   primary_profession  555308 non-null  object 
 4   known_for_titles   576444 non-null  object 
dtypes: float64(2), object(3)
memory usage: 27.8+ MB
```

In [262]:
```
df_imdb_name.head(3)
```
executed in 14ms, finished 18:13:08 2021-05-04

Out[262]:

nconst	primary_name	birth_year	death_year	primary_profession	known_for_titles
nm0061671	Mary Ellen Bauder	NaN	NaN	miscellaneous,production_manager,producer	tt0837562,tt2398241,tt0844471,tt0118553
nm0061865	Joseph Bauer	NaN	NaN	composer,music_department,sound_department	tt0896534,tt6791238,tt0287072,tt1682940
nm0062070	Bruce Baum	NaN	NaN	miscellaneous,actor,writer	tt1470654,tt0363631,tt0104030,tt0102898

3.2.2.1 Observation df_imdb_name

It looks as if the data is a name and profession and known for these movie titles.
The birth year and death year can be dropped as there is a high percentage of data missing from those columns.

3.2.3 IMDB akas-df_imdb_akas

In [263]:
```
df_imdb_akas.info()
```
executed in 62ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 331703 entries, tt0369610 to tt9880178
Data columns (total 7 columns):
 #   Column             Non-Null Count   Dtype  
---  ------             --------------   -----  
 0   ordering           331703 non-null  int64  
 1   title              331703 non-null  object 
 2   region             278410 non-null  object 
 3   language           41715 non-null   object 
 4   types              168447 non-null  object 
 5   attributes         14925 non-null   object 
 6   is_original_title  331678 non-null  float64
dtypes: float64(1), int64(1), object(5)
memory usage: 20.2+ MB
```

In [264]:
```
df_imdb_akas.head(3)
```
executed in 15ms, finished 18:13:08 2021-05-04

Out[264]:

title_id	ordering	title	region	language	types	attributes	is_original_title
tt0369610	10	Джурасик свят	BG	bg	NaN	NaN	0.0
tt0369610	11	Jurashikku warudo	JP	NaN	imdbDisplay	NaN	0.0
tt0369610	12	Jurassic World: O Mundo dos Dinossauros	BR	NaN	imdbDisplay	NaN	0.0

3.2.3.1 Observation df_imdb_akas

This data looks to be aka movie names in non domestic markets. There are lots of NaNs. Should we just look at isoriginal title as 1? Where does the title_id link to? Is ok to leave NaNs alone?

3.2.4 IMDBTitle basics-df_imdbbasics

In [265]:
```
df_imdbbasics.info()
```
executed in 31ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 146144 entries, tt0063540 to tt9916754
Data columns (total 5 columns):
 #   Column           Non-Null Count   Dtype  
---  ------           --------------   -----  
 0   primary_title    146144 non-null  object 
 1   original_title   146123 non-null  object 
 2   start_year       146144 non-null  int64  
 3   runtime_minutes  114405 non-null  float64
 4   genres           140736 non-null  object 
dtypes: float64(1), int64(1), object(3)
memory usage: 6.7+ MB
```

In [266]:
```
df_imdbbasics.tail(3)
```
executed in 15ms, finished 18:13:08 2021-05-04

Out[266]:

tconst	primary_title	original_title	start_year	runtime_minutes	genres
tt9916706	Dankyavar Danka	Dankyavar Danka	2013	NaN	Comedy
tt9916730	6 Gunn	6 Gunn	2017	116.0	NaN
tt9916754	Chico Albuquerque - Revelações	Chico Albuquerque - Revelações	2013	NaN	Documentary

In [ ]:
```

```

3.2.4.1 Observation df_df_imdbbasics

This data has primary title and original title and year and genre of the movie. Many missing runtime minutes can set to 90 mins? Main point here is the genre and year and title.

3.2.5 IMDB Crew-df_imfb_crew

In [267]:
```
df_imdb_crew.info()
```
executed in 31ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 146144 entries, tt0285252 to tt9010172
Data columns (total 2 columns):
 #   Column     Non-Null Count   Dtype 
---  ------     --------------   ----- 
 0   directors  140417 non-null  object
 1   writers    110261 non-null  object
dtypes: object(2)
memory usage: 3.3+ MB
```

In [268]:
```
df_imdb_crew.head(3)
```
executed in 13ms, finished 18:13:08 2021-05-04

Out[268]:

tconst	directors	writers
tt0285252	nm0899854	nm0899854
tt0438973	NaN	nm0175726,nm1802864
tt0462036	nm1940585	nm1940585

3.2.5.1 Observation df_df_imdb_crew

This df matches directors and writers to tconst which is primary key in df_imdbbasics and df_imdb_principals.

3.2.6 IMDB principals - df_imfb_principals

In [269]:
```
df_imdb_principals.info()
```
executed in 143ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 1028186 entries, tt0111414 to tt9692684
Data columns (total 5 columns):
 #   Column      Non-Null Count    Dtype 
---  ------      --------------    ----- 
 0   ordering    1028186 non-null  int64 
 1   nconst      1028186 non-null  object
 2   category    1028186 non-null  object
 3   job         177684 non-null   object
 4   characters  393360 non-null   object
dtypes: int64(1), object(4)
memory usage: 47.1+ MB
```

In [270]:
```
df_imdb_principals.head(3)
```
executed in 15ms, finished 18:13:08 2021-05-04

Out[270]:

tconst	ordering	nconst	category	job	characters
tt0111414	1	nm0246005	actor	NaN	["The Man"]
tt0111414	2	nm0398271	director	NaN	NaN
tt0111414	3	nm3739909	producer	producer	NaN

3.2.6.1 Observation df_imdb_principals

This data lists the roles of principals in movies(tconst) to categories and job and characters if they act.
Links to df_imdb_crew, df_imdbbasics, df_imdb_name, df_imdb_ratings.
nconst links to values in the df_imdb_crew and df_imdb_name listing the directors and writers.

3.2.7 IMDB ratings-df_imfb_ratings

In [271]:
```
df_imdb_ratings.info()
```
executed in 13ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 73856 entries, tt10356526 to tt9894098
Data columns (total 2 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   averagerating  73856 non-null  float64
 1   numvotes       73856 non-null  int64  
dtypes: float64(1), int64(1)
memory usage: 1.7+ MB
```

In [272]:
```
df_imdb_ratings.head(3)
```
executed in 13ms, finished 18:13:08 2021-05-04

Out[272]:

tconst	averagerating	numvotes
tt10356526	8.3	31
tt10384606	8.9	559
tt1042974	6.4	20

3.2.7.1 Observation df_imdb_ratings

Pretty straightforward rating and number of votes. title tconst links to tconst(title) in other imdb tables.

3.2.8 TMB-df_tmb

In [273]:
```
##The Movie DB
df_tmb.info()
```
executed in 15ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 26517 entries, 0 to 26516
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   genre_ids          26517 non-null  object 
 1   id                 26517 non-null  int64  
 2   original_language  26517 non-null  object 
 3   original_title     26517 non-null  object 
 4   popularity         26517 non-null  float64
 5   release_date       26517 non-null  object 
 6   title              26517 non-null  object 
 7   vote_average       26517 non-null  float64
 8   vote_count         26517 non-null  int64  
dtypes: float64(2), int64(2), object(5)
memory usage: 2.0+ MB
```

In [274]:
```
df_tmb.tail(3)
```
executed in 15ms, finished 18:13:08 2021-05-04

Out[274]:

	genre_ids	id	original_language	original_title	popularity	release_date	title	vote_average	vote_count
26514	[14, 28, 12]	381231	en	The Last One	0.6	2018-10-01	The Last One	0.0	1
26515	[10751, 12, 28]	366854	en	Trailer Made	0.6	2018-06-22	Trailer Made	0.0	1
26516	[53, 27]	309885	en	The Church	0.6	2018-10-05	The Church	0.0	1

3.2.8.1 Observation df_tmb

There are no Nans. This looks to be good data about the movies and genres.
Release date is an object and may be converted to a datatime if to be used. Where to look up genre_ids?

3.2.9 TN The Numbers-df_tn_movie_budget

In [275]:
```
##The Numbers
df_tn_movie_budget.info()
```
executed in 12ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 5782 entries, 1 to 82
Data columns (total 5 columns):
 #   Column             Non-Null Count  Dtype 
---  ------             --------------  ----- 
 0   release_date       5782 non-null   object
 1   movie              5782 non-null   object
 2   production_budget  5782 non-null   object
 3   domestic_gross     5782 non-null   object
 4   worldwide_gross    5782 non-null   object
dtypes: object(5)
memory usage: 271.0+ KB
```

In [276]:
```
df_tn_movie_budget.head(10)
```
executed in 12ms, finished 18:13:08 2021-05-04

Out[276]:

id	release_date	movie	production_budget	domestic_gross	worldwide_gross
1	Dec 18, 2009	Avatar	$425,000,000	$760,507,625	$2,776,345,279
2	May 20, 2011	Pirates of the Caribbean: On Stranger Tides	$410,600,000	$241,063,875	$1,045,663,875
3	Jun 7, 2019	Dark Phoenix	$350,000,000	$42,762,350	$149,762,350
4	May 1, 2015	Avengers: Age of Ultron	$330,600,000	$459,005,868	$1,403,013,963
5	Dec 15, 2017	Star Wars Ep. VIII: The Last Jedi	$317,000,000	$620,181,382	$1,316,721,747
6	Dec 18, 2015	Star Wars Ep. VII: The Force Awakens	$306,000,000	$936,662,225	$2,053,311,220
7	Apr 27, 2018	Avengers: Infinity War	$300,000,000	$678,815,482	$2,048,134,200
8	May 24, 2007	Pirates of the Caribbean: At Worldâ□□s End	$300,000,000	$309,420,425	$963,420,425
9	Nov 17, 2017	Justice League	$300,000,000	$229,024,295	$655,945,209
10	Nov 6, 2015	Spectre	$300,000,000	$200,074,175	$879,620,923

3.2.9.1 Observation df_tn_movie_budget

There are no Nans. This data is the movies, release date and worldwide gross with production budget. Money data should be converted to int and dollas signs removed Release date is an object and may be converted to a datatime if to be used.

3.3 Data Cleaning and Typing

Removing the NanNs, dropping columns which have no importance or too many nans, converting object datatypes to be useful.

3.3.1 Clean df_bom data

In [277]:
```
df_bom.isna().sum()
```
executed in 15ms, finished 18:13:08 2021-05-04

Out[277]:
```
studio              5
domestic_gross     28
foreign_gross    1350
year                0
dtype: int64
```

In [278]:
```
df_bom.shape
```
executed in 15ms, finished 18:13:08 2021-05-04

Out[278]:
```
(3387, 4)
```

In [279]:
```
df_bom.info()
```
executed in 15ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 3387 entries, Toy Story 3 to An Actor Prepares
Data columns (total 4 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   studio          3382 non-null   object 
 1   domestic_gross  3359 non-null   float64
 2   foreign_gross   2037 non-null   object 
 3   year            3387 non-null   int64  
dtypes: float64(1), int64(1), object(2)
memory usage: 132.3+ KB
```

In [280]:
```
#If NaN setting to 0..
df_bom.fillna(0, inplace=True)
```
executed in 15ms, finished 18:13:08 2021-05-04

In [281]:
```
df_bom.isna().sum()
```
executed in 15ms, finished 18:13:08 2021-05-04

Out[281]:
```
studio            0
domestic_gross    0
foreign_gross     0
year              0
dtype: int64
```

In [282]:
```
df_bom.info()
#Need to convert the foreign gross to float
```
executed in 15ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 3387 entries, Toy Story 3 to An Actor Prepares
Data columns (total 4 columns):
 #   Column          Non-Null Count  Dtype 
---  ------          --------------  ----- 
 0   studio          3387 non-null   object
 1   domestic_gross  3387 non-null   float64
 2   foreign_gross   3387 non-null   object
 3   year            3387 non-null   int64 
dtypes: float64(1), int64(1), object(2)
memory usage: 132.3+ KB
```

A Few values needed to be converted to billions

In [283]:
```
# When converting to numeric foreign gross at line numbers 1872,1873,1874,2760,
#3079 were in a shorthand billions
# ie 1,131.6 for 1131600000.
# this is the quick fix
df_bom.iloc[[1872],[2]] =1131600000.0
df_bom.iloc[[1873],[2]] =1019400000.0
df_bom.iloc[[1874],[2]] =1163000000.0
df_bom.iloc[[2760],[2]] =1010000000.0
df_bom.iloc[[3079],[2]] =1369500000.0
```
executed in 15ms, finished 18:13:08 2021-05-04

Convert the object number of foreign gross to numeric

In [284]:
```
#Convert string to numeric values...5 or so of the billions needed to be converted
df_bom['foreign_gross'] = pd.to_numeric(df_bom['foreign_gross'])
```
executed in 15ms, finished 18:13:08 2021-05-04

In [285]:
```
df_bom.info()
```
executed in 15ms, finished 18:13:08 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 3387 entries, Toy Story 3 to An Actor Prepares
Data columns (total 4 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   studio          3387 non-null   object 
 1   domestic_gross  3387 non-null   float64
 2   foreign_gross   3387 non-null   float64
 3   year            3387 non-null   int64  
dtypes: float64(2), int64(1), object(1)
memory usage: 132.3+ KB
```

In [286]:
```
#creating the worldwide_gross column from the dommestic and foreign gross
df_bom['worldwide_gross'] = df_bom['domestic_gross'] + df_bom['foreign_gross']
```
executed in 15ms, finished 18:13:08 2021-05-04

In [287]:
```
df_bom.head()
```
executed in 15ms, finished 18:13:08 2021-05-04

Out[287]:

title	studio	domestic_gross	foreign_gross	year	worldwide_gross
Toy Story 3	BV	415000000.0	652000000.0	2010	1.067000e+09
Alice in Wonderland (2010)	BV	334200000.0	691300000.0	2010	1.025500e+09
Harry Potter and the Deathly Hallows Part 1	WB	296000000.0	664300000.0	2010	9.603000e+08
Inception	WB	292600000.0	535700000.0	2010	8.283000e+08
Shrek Forever After	P/DW	238700000.0	513900000.0	2010	7.526000e+08

Observation Set Foreign gross to 0 if NaN. If we need we can use the movie budget to look up. Converted money columns to floats. Created worldwide_gross from domestc and foreign.

3.3.2 Clean imdb_name data

In [288]:
```
df_imdb_name.shape
```
executed in 14ms, finished 18:13:08 2021-05-04

Out[288]:
```
(606648, 5)
```

In [289]:
```
df_imdb_name.isna().sum()
```
executed in 78ms, finished 18:13:08 2021-05-04

Out[289]:
```
primary_name             0
birth_year          523912
death_year          599865
primary_profession   51340
known_for_titles     30204
dtype: int64
```

In [290]:
```
#Can drop birth_year and death year
df_imdb_name = df_imdb_name.drop(columns=['birth_year','death_year'])
```
executed in 31ms, finished 18:13:08 2021-05-04

drop if both primary_profession and known_for_titles are both Nan

In [291]:
```
df_imdb_name.isna().sum()
```
executed in 77ms, finished 18:13:08 2021-05-04

Out[291]:
```
primary_name             0
primary_profession   51340
known_for_titles     30204
dtype: int64
```

In [292]:
```
#drop if both primary_profession and known_for_titles are both Nan
col_lst = ['primary_profession', 'known_for_titles']
df_imdb_name.dropna(axis = 0, subset = col_lst, how = 'all', inplace = True)
```
executed in 123ms, finished 18:13:08 2021-05-04

In [293]:
```
df_imdb_name.isna().sum()
```
executed in 63ms, finished 18:13:09 2021-05-04

Out[293]:
```
primary_name             0
primary_profession    41307
known_for_titles      20171
dtype: int64
```

Observation lots of NaNs but are supposed to be blank if non applicable. put in holder value(NA, or job or characters? or 0? Dropped 'birth_year','death_year'. If NAN for known_for can drop? Final decision to fill na with 'unknown'

In [294]:
```
df_imdb_name[df_imdb_name['known_for_titles'].isna()].head()
```
executed in 45ms, finished 18:13:09 2021-05-04

Out[294]:

nconst	primary_name	primary_profession	known_for_titles
nm10108345	Jiaxi Li	actor	NaN
nm10113099	Greg Quibell	actor	NaN
nm10114259	Vera Prifatamasari	actress	NaN
nm10115487	Laurette De Haan	director,writer,cinematographer	NaN
nm10115788	Sustraida's Band	composer	NaN

In [295]:
```
#if there is a Nan in remaining data fill in with unknown
df_imdb_name['known_for_titles'].fillna(value='unknown', inplace=True)
df_imdb_name['primary_profession'].fillna(value='unknown', inplace=True)
```
executed in 62ms, finished 18:13:09 2021-05-04

In [296]:
```
df_imdb_name.isna().sum()
```
executed in 63ms, finished 18:13:09 2021-05-04

Out[296]:
```
primary_name          0
primary_profession    0
known_for_titles      0
dtype: int64
```

In [297]:
```
df_imdb_name.shape
```
executed in 14ms, finished 18:13:09 2021-05-04

Out[297]:
```
(596615, 3)
```

3.3.3 Clean imdb_akas data

In [298]:
```
df_imdb_akas.shape
```
executed in 14ms, finished 18:13:09 2021-05-04

Out[298]:
```
(331703, 7)
```

In [299]:
```
df_imdb_akas.info()
```
executed in 63ms, finished 18:13:09 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 331703 entries, tt0369610 to tt9880178
Data columns (total 7 columns):
 #   Column             Non-Null Count   Dtype  
---  ------             --------------   -----  
 0   ordering           331703 non-null  int64  
 1   title              331703 non-null  object 
 2   region             278410 non-null  object 
 3   language           41715 non-null   object 
 4   types              168447 non-null  object 
 5   attributes         14925 non-null   object 
 6   is_original_title  331678 non-null  float64
dtypes: float64(1), int64(1), object(5)
memory usage: 20.2+ MB
```

In [300]:
```
#Unsure if this data is useful
#df_imdb_akas = df_imdb_akas[df_imdb_akas['is_original_title'] == 1.0]
```
executed in 15ms, finished 18:13:09 2021-05-04

In [301]:
```
df_imdb_akas.isna().sum()
```
executed in 60ms, finished 18:13:09 2021-05-04

Out[301]:
```
ordering                0
title                   0
region              53293
language           289988
types              163256
attributes         316778
is_original_title      25
dtype: int64
```

In [302]:
```
df_imdb_akas.head(3)
```
executed in 15ms, finished 18:13:09 2021-05-04

Out[302]:

title_id	ordering	title	region	language	types	attributes	is_original_title
tt0369610	10	Джурасик свят	BG	bg	NaN	NaN	0.0
tt0369610	11	Jurashikku warudo	JP	NaN	imdbDisplay	NaN	0.0
tt0369610	12	Jurassic World: O Mundo dos Dinossauros	BR	NaN	imdbDisplay	NaN	0.0

In [303]:
```
set(df_imdb_akas['types'])
```
executed in 46ms, finished 18:13:09 2021-05-04

Out[303]:
```
{'alternative',
 'dvd',
 'dvd\x02imdbDisplay',
 'festival',
 'festival\x02working',
 'imdbDisplay',
 nan,
 'original',
 'tv',
 'video',
 'working'}
```

In [304]:
```
#for NaNs in these columns set to unknown
col_list = ['region','language','types','attributes']
for col in col_list:

    df_imdb_akas[col].fillna(value='unknown', inplace=True)
```

executed in 61ms, finished 18:13:09 2021-05-04

In [305]:
```
df_imdb_akas.isna().sum()
```

executed in 77ms, finished 18:13:09 2021-05-04

Out[305]:
```
ordering             0
title                0
region               0
language             0
types                0
attributes           0
is_original_title    25
dtype: int64
```

In [306]:
```
df_imdb_akas = df_imdb_akas[df_imdb_akas['is_original_title'].notna()]
```

executed in 30ms, finished 18:13:09 2021-05-04

In [307]:
```
df_imdb_akas.shape
```

executed in 15ms, finished 18:13:09 2021-05-04

Out[307]:
```
(331678, 7)
```

Actions In columns 'region','language','types','attributes'set Nan to 'unknown
removed is_original title id Nan

3.3.4 Clean imdb_basics data

In [308]:
```
df_imdbbasics.shape
```

executed in 15ms, finished 18:13:09 2021-05-04

Out[308]:
```
(146144, 5)
```

In [309]:
```
df_imdbbasics.isna().sum()
```
executed in 30ms, finished 18:13:09 2021-05-04

Out[309]:
```
primary_title          0
original_title        21
start_year             0
runtime_minutes    31739
genres              5408
dtype: int64
```

In [310]:
```
df_imdbbasics.tail(10)
```
executed in 15ms, finished 18:13:09 2021-05-04

Out[310]:

tconst	primary_title	original_title	start_year	runtime_minutes	genres
tt9916160	Drømmeland	Drømmeland	2019	72.0	Documentary
tt9916170	The Rehearsal	O Ensaio	2019	51.0	Drama
tt9916186	Illenau - die Geschichte einer ehemaligen Heil...	Illenau - die Geschichte einer ehemaligen Heil...	2017	84.0	Documentary
tt9916190	Safeguard	Safeguard	2019	90.0	Drama,Thriller
tt9916428	The Secret of China	The Secret of China	2019	NaN	Adventure,History,War
tt9916538	Kuambil Lagi Hatiku	Kuambil Lagi Hatiku	2019	123.0	Drama
tt9916622	Rodolpho Teóphilo - O Legado de um Pioneiro	Rodolpho Teóphilo - O Legado de um Pioneiro	2015	NaN	Documentary
tt9916706	Dankyavar Danka	Dankyavar Danka	2013	NaN	Comedy
tt9916730	6 Gunn	6 Gunn	2017	116.0	NaN
tt9916754	Chico Albuquerque - Revelações	Chico Albuquerque - Revelações	2013	NaN	Documentary

In [311]:
```
df_imdbbasics.info()
```
executed in 28ms, finished 18:13:09 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 146144 entries, tt0063540 to tt9916754
Data columns (total 5 columns):
 #   Column           Non-Null Count   Dtype  
---  ------           --------------   -----  
 0   primary_title    146144 non-null  object 
 1   original_title   146123 non-null  object 
 2   start_year       146144 non-null  int64  
 3   runtime_minutes  114405 non-null  float64
 4   genres           140736 non-null  object 
dtypes: float64(1), int64(1), object(3)
memory usage: 6.7+ MB
```

In [312]:
```
#for NaNs in these columns set to unknown
col_list = ['genres','original_title']
for col in col_list:

    df_imdbbasics[col].fillna(value='unknown', inplace=True)
```
executed in 15ms, finished 18:13:09 2021-05-04

In [313]:
```
#If runtime minutes missing set to 89.5 minutes
df_imdbbasics['runtime_minutes'].fillna(89.5,inplace=True)
```
executed in 14ms, finished 18:13:09 2021-05-04

In [314]:
```
df_imdbbasics.isna().sum()
```
executed in 30ms, finished 18:13:09 2021-05-04

Out[314]:
```
primary_title      0
original_title     0
start_year         0
runtime_minutes    0
genres             0
dtype: int64
```

Actions In columns 'genres','original_title' set Nan to 'unknown
if runtime minutes set to 89.5 if Nan

3.3.5 Clean imdb_crew data

In [315]:
```
df_imdb_crew.shape
```
executed in 14ms, finished 18:13:09 2021-05-04

Out[315]:
```
(146144, 2)
```

In [316]:
```
df_imdb_crew.isna().sum()
```
executed in 31ms, finished 18:13:09 2021-05-04

Out[316]:
```
directors     5727
writers      35883
dtype: int64
```

In [317]:
```
df_imdb_crew.head(5)
```
executed in 20ms, finished 18:13:09 2021-05-04

Out[317]:

tconst	directors	writers
tt0285252	nm0899854	nm0899854
tt0438973	NaN	nm0175726,nm1802864
tt0462036	nm1940585	nm1940585
tt0835418	nm0151540	nm0310087,nm0841532
tt0878654	nm0089502,nm2291498,nm2292011	nm0284943

In [318]:
```
df_imdb_crew.shape
```
executed in 12ms, finished 18:13:09 2021-05-04

Out[318]:
```
(146144, 2)
```

In [319]:
```
df_imdb_crew = df_imdb_crew[df_imdb_crew['directors'].notna()
                            | df_imdb_crew['writers'].notna()]
```
executed in 31ms, finished 18:13:09 2021-05-04

In [320]:
```
#for NaNs in these columns set to unknown
col_list = ['directors','writers']
for col in col_list:
    df_imdb_crew[col].fillna(value='unknown', inplace=True)
```
executed in 30ms, finished 18:13:09 2021-05-04

```
C:\Users\dsmith\anaconda3\envs\learn-env\lib\site-packages\pandas\core\series.py:4517: SettingWithCopyWarni
ng:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html
#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#retu
rning-a-view-versus-a-copy)
  return super().fillna(
```

In [321]:
```
df_imdb_crew.info()
```
executed in 29ms, finished 18:13:09 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 141670 entries, tt0285252 to tt9010172
Data columns (total 2 columns):
 #   Column     Non-Null Count   Dtype
---  ------     --------------   -----
 0   directors  141670 non-null  object
 1   writers    141670 non-null  object
dtypes: object(2)
memory usage: 3.2+ MB
```

Actions If directors and writers are NaN drop row(4474 rows). If then if directors is Nan replace with holder 'unknown'. If writers is Nan replace with unknown.

3.3.6 Clean imdb_principals data

In [322]:
```
df_imdb_principals.shape
```
executed in 15ms, finished 18:13:09 2021-05-04

Out[322]: (1028186, 5)

In [323]:
```
df_imdb_principals.tail()
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[323]:

tconst	ordering	nconst	category	job	characters
tt9692684	1	nm0186469	actor	NaN	["Ebenezer Scrooge"]
tt9692684	2	nm4929530	self	NaN	["Herself","Regan"]
tt9692684	3	nm10441594	director	NaN	NaN
tt9692684	4	nm6009913	writer	writer	NaN
tt9692684	5	nm10441595	producer	producer	NaN

In [324]:
```
df_imdb_principals.isna().sum()
```
executed in 139ms, finished 18:13:10 2021-05-04

Out[324]:
```
ordering           0
nconst             0
category           0
job           850502
characters    634826
dtype: int64
```

In [325]:
```
#for NaNs in these columns set to unknown
col_list = ['job','characters']
for col in col_list:
    df_imdb_principals[col].fillna(value='unknown', inplace=True)
```
executed in 92ms, finished 18:13:10 2021-05-04

In [326]:
```
df_imdb_principals.info()
```
executed in 141ms, finished 18:13:10 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 1028186 entries, tt0111414 to tt9692684
Data columns (total 5 columns):
 #   Column      Non-Null Count    Dtype 
---  ------      --------------    ----- 
 0   ordering    1028186 non-null  int64 
 1   nconst      1028186 non-null  object
 2   category    1028186 non-null  object
 3   job         1028186 non-null  object
 4   characters  1028186 non-null  object
dtypes: int64(1), object(4)
memory usage: 47.1+ MB
```

Actions replaced columns job and characters if Nan to 'unknown'

3.3.7 Clean imdb_ratings data

In [327]:
```
df_imdb_ratings.shape
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[327]:
```
(73856, 2)
```

In [328]:
```
df_imdb_ratings.isna().sum()
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[328]:
```
averagerating    0
numvotes         0
dtype: int64
```

In [329]:
```
df_imdb_ratings.head()
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[329]:

tconst	averagerating	numvotes
tt10356526	8.3	31
tt10384606	8.9	559
tt1042974	6.4	20
tt1043726	4.2	50352
tt1060240	6.5	21

In [330]:
```
df_imdb_ratings.info()
```
executed in 15ms, finished 18:13:10 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Index: 73856 entries, tt10356526 to tt9894098
Data columns (total 2 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   averagerating  73856 non-null  float64
 1   numvotes       73856 non-null  int64  
dtypes: float64(1), int64(1)
memory usage: 1.7+ MB
```

Actions All Clean. No missing data in this lookup table

3.3.8 Clean df_tmb data

In [331]:
```
df_tmb.shape
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[331]:
```
(26517, 9)
```

In [332]:
```
df_tmb.isna().sum()
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[332]:
```
genre_ids            0
id                   0
original_language    0
original_title       0
popularity           0
release_date         0
title                0
vote_average         0
vote_count           0
dtype: int64
```

In [333]:
```
df_tmb.info()
```
executed in 15ms, finished 18:13:10 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 26517 entries, 0 to 26516
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   genre_ids          26517 non-null  object 
 1   id                 26517 non-null  int64  
 2   original_language  26517 non-null  object 
 3   original_title     26517 non-null  object 
 4   popularity         26517 non-null  float64
 5   release_date       26517 non-null  object 
 6   title              26517 non-null  object 
 7   vote_average       26517 non-null  float64
 8   vote_count         26517 non-null  int64  
dtypes: float64(2), int64(2), object(5)
memory usage: 2.0+ MB
```

In [334]:
```
df_tmb.head(3)
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[334]:

	genre_ids	id	original_language	original_title	popularity	release_date	title	vote_average	vote_count
0	[12, 14, 10751]	12444	en	Harry Potter and the Deathly Hallows: Part 1	33.533	2010-11-19	Harry Potter and the Deathly Hallows: Part 1	7.7	10788
1	[14, 12, 16, 10751]	10191	en	How to Train Your Dragon	28.734	2010-03-26	How to Train Your Dragon	7.7	7610
2	[12, 28, 878]	10138	en	Iron Man 2	28.515	2010-05-07	Iron Man 2	6.8	12368

In [ ]:
```

```
executed in 6ms, finished 20:37:04 2021-04-27

In [ ]:
```

```

In [ ]:
```

```

Actions: Clean Data Note: Convert release date to datetime when using

### 3.3.9 Clean df_tn_movie_budget data

In [335]:
```
df_tn_movie_budget.shape
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[335]: (5782, 5)

In [336]:
```
df_tn_movie_budget.isna().sum()
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[336]:
```
release_date   0
movie   0
production_budget   0
domestic_gross   0
worldwide_gross   0
dtype: int64
```

In [337]:
```
df_tn_movie_budget.head(50)
```
executed in 30ms, finished 18:13:10 2021-05-04

Out[337]:

id	release_date	movie	production_budget	domestic_gross	worldwide_gross
1	Dec 18, 2009	Avatar	$425,000,000	$760,507,625	$2,776,345,279
2	May 20, 2011	Pirates of the Caribbean: On Stranger Tides	$410,600,000	$241,063,875	$1,045,663,875
3	Jun 7, 2019	Dark Phoenix	$350,000,000	$42,762,350	$149,762,350
4	May 1, 2015	Avengers: Age of Ultron	$330,600,000	$459,005,868	$1,403,013,963
5	Dec 15, 2017	Star Wars Ep. VIII: The Last Jedi	$317,000,000	$620,181,382	$1,316,721,747
6	Dec 18, 2015	Star Wars Ep. VII: The Force Awakens	$306,000,000	$936,662,225	$2,053,311,220
7	Apr 27, 2018	Avengers: Infinity War	$300,000,000	$678,815,482	$2,048,134,200
8	May 24, 2007	Pirates of the Caribbean: At Worldâ□□s End	$300,000,000	$309,420,425	$963,420,425
9	Nov 17, 2017	Justice League	$300,000,000	$229,024,295	$655,945,209
10	Nov 6, 2015	Spectre	$300,000,000	$200,074,175	$879,620,923
11	Jul 20, 2012	The Dark Knight Rises	$275,000,000	$448,139,099	$1,084,439,099
12	May 25, 2018	Solo: A Star Wars Story	$275,000,000	$213,767,512	$393,151,347
13	Jul 2, 2013	The Lone Ranger	$275,000,000	$89,302,115	$260,002,115
14	Mar 9, 2012	John Carter	$275,000,000	$73,058,679	$282,778,100
15	Nov 24, 2010	Tangled	$260,000,000	$200,821,936	$586,477,240
16	May 4, 2007	Spider-Man 3	$258,000,000	$336,530,303	$894,860,230
17	May 6, 2016	Captain America: Civil War	$250,000,000	$408,084,349	$1,140,069,413
18	Mar 25, 2016	Batman v Superman: Dawn of Justice	$250,000,000	$330,360,194	$867,500,281
19	Dec 14, 2012	The Hobbit: An Unexpected Journey	$250,000,000	$303,003,568	$1,017,003,568
20	Jul 15, 2009	Harry Potter and the Half-Blood Prince	$250,000,000	$302,089,278	$935,213,767
21	Dec 13, 2013	The Hobbit: The Desolation of Smaug	$250,000,000	$258,366,855	$960,366,855
22	Dec 17, 2014	The Hobbit: The Battle of the Five Armies	$250,000,000	$255,119,788	$945,577,621
23	Apr 14, 2017	The Fate of the Furious	$250,000,000	$225,764,765	$1,234,846,267

id	release_date	movie	production_budget	domestic_gross	worldwide_gross
24	Jun 28, 2006	Superman Returns	$232,000,000	$200,120,000	$374,085,065
25	May 26, 2017	Pirates of the Caribbean: Dead Men Tell No Tales	$230,000,000	$172,558,876	$788,241,137
26	Nov 14, 2008	Quantum of Solace	$230,000,000	$169,368,427	$591,692,078
27	May 4, 2012	The Avengers	$225,000,000	$623,279,547	$1,517,935,897
28	Jul 7, 2006	Pirates of the Caribbean: Dead Manâ□□s Chest	$225,000,000	$423,315,812	$1,066,215,812
29	Jun 14, 2013	Man of Steel	$225,000,000	$291,045,518	$667,999,518
30	May 16, 2008	The Chronicles of Narnia: Prince Caspian	$225,000,000	$141,621,490	$417,341,288
31	Jul 3, 2012	The Amazing Spider-Man	$220,000,000	$262,030,663	$757,890,267
32	May 18, 2012	Battleship	$220,000,000	$65,233,400	$313,477,717
33	Jun 21, 2017	Transformers: The Last Knight	$217,000,000	$130,168,683	$602,893,340
34	Jun 12, 2015	Jurassic World	$215,000,000	$652,270,625	$1,648,854,864
35	May 25, 2012	Men in Black 3	$215,000,000	$179,020,854	$654,213,485
36	Jun 24, 2009	Transformers: Revenge of the Fallen	$210,000,000	$402,111,870	$836,519,699
37	Jun 27, 2014	Transformers: Age of Extinction	$210,000,000	$245,439,076	$1,104,039,076
38	May 26, 2006	X-Men: The Last Stand	$210,000,000	$234,362,462	$459,260,946
39	May 14, 2010	Robin Hood	$210,000,000	$105,487,148	$322,459,006
40	Dec 14, 2005	King Kong	$207,000,000	$218,080,025	$550,517,357
41	Dec 7, 2007	The Golden Compass	$205,000,000	$70,107,728	$367,262,558
42	Feb 16, 2018	Black Panther	$200,000,000	$700,059,566	$1,348,258,224
43	Dec 19, 1997	Titanic	$200,000,000	$659,363,944	$2,208,208,395
44	Jun 15, 2018	Incredibles 2	$200,000,000	$608,581,744	$1,242,520,711
45	Dec 16, 2016	Rogue One: A Star Wars Story	$200,000,000	$532,177,324	$1,049,102,856
46	Jun 17, 2016	Finding Dory	$200,000,000	$486,295,561	$1,021,215,193
47	Jun 18, 2010	Toy Story 3	$200,000,000	$415,004,880	$1,068,879,522
48	May 3, 2013	Iron Man 3	$200,000,000	$408,992,272	$1,215,392,272
49	May 5, 2017	Guardians of the Galaxy Vol 2	$200,000,000	$389,813,101	$862,316,233

id	release_date	movie	production_budget	domestic_gross	worldwide_gross
50	Jun 30, 2004	Spider-Man 2	$200,000,000	$373,524,485	$795,110,670

In [338]:
```
for col in df_tn_movie_budget:
    print(col)
    print(df_tn_movie_budget[col].value_counts(normalize = True)[:5])
    print("====================================")
```

executed in 31ms, finished 18:13:10 2021-05-04

```
release_date
Dec 31, 2014    0.004151
Dec 31, 2015    0.003978
Dec 31, 2010    0.002594
Dec 31, 2008    0.002421
Dec 31, 2013    0.002248
Name: release_date, dtype: float64
====================================
movie
Halloween       0.000519
Home            0.000519
King Kong       0.000519
Pet Sematary    0.000346
The Square      0.000346
Name: movie, dtype: float64
====================================
production_budget
$20,000,000    0.039952
$10,000,000    0.036666
$30,000,000    0.030612
$15,000,000    0.029920
$25,000,000    0.029575
Name: production_budget, dtype: float64
====================================
domestic_gross
$0             0.094777
$8,000,000     0.001557
$7,000,000     0.001211
$2,000,000     0.001211
$10,000,000    0.001038
Name: domestic_gross, dtype: float64
====================================
worldwide_gross
$0             0.063473
$8,000,000     0.001557
$7,000,000     0.001038
$2,000,000     0.001038
```

```
$15,000,000    0.000692
Name: worldwide_gross, dtype: float64
==================================
```

Domectic gross has 9.4 % of zero values. Similiar to worldwide gross.

Will need to address.

look at budget data in bom, rott, tn df_tn_movie_budget[df_tn_movie_budget['domestic_gross'] > 500000000.0]

In [339]:
```
#Convert the object columns to ints where we can manipulate mathematically
#money string to ints
def money_to_float(df,col):
    df[col] = df[col].astype(str).str.replace("$", "").str.replace(",", "").astype('float')
    return df
```

executed in 13ms, finished 18:13:10 2021-05-04

In [340]:
```
money_cols = ['production_budget','domestic_gross', 'worldwide_gross']

for col in money_cols:
    df_tn_movie_budget = money_to_float(df_tn_movie_budget,col)
```

executed in 31ms, finished 18:13:10 2021-05-04

In [341]:
```
df_tn_movie_budget.head(10)
```
executed in 15ms, finished 18:13:10 2021-05-04

Out[341]:

id	release_date	movie	production_budget	domestic_gross	worldwide_gross
1	Dec 18, 2009	Avatar	425000000.0	760507625.0	2.776345e+09
2	May 20, 2011	Pirates of the Caribbean: On Stranger Tides	410600000.0	241063875.0	1.045664e+09
3	Jun 7, 2019	Dark Phoenix	350000000.0	42762350.0	1.497624e+08
4	May 1, 2015	Avengers: Age of Ultron	330600000.0	459005868.0	1.403014e+09
5	Dec 15, 2017	Star Wars Ep. VIII: The Last Jedi	317000000.0	620181382.0	1.316722e+09
6	Dec 18, 2015	Star Wars Ep. VII: The Force Awakens	306000000.0	936662225.0	2.053311e+09
7	Apr 27, 2018	Avengers: Infinity War	300000000.0	678815482.0	2.048134e+09
8	May 24, 2007	Pirates of the Caribbean: At Worldâ□□s End	300000000.0	309420425.0	9.634204e+08
9	Nov 17, 2017	Justice League	300000000.0	229024295.0	6.559452e+08
10	Nov 6, 2015	Spectre	300000000.0	200074175.0	8.796209e+08

In [342]:
```
df_tn_movie_budget.info()
```
executed in 15ms, finished 18:13:10 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 5782 entries, 1 to 82
Data columns (total 5 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   release_date       5782 non-null   object 
 1   movie              5782 non-null   object 
 2   production_budget  5782 non-null   float64
 3   domestic_gross     5782 non-null   float64
 4   worldwide_gross    5782 non-null   float64
dtypes: float64(3), object(2)
memory usage: 271.0+ KB
```

Actions Converted string currrency to float values. Convert release date to datetime when using

3.3.10 Save cleaned files as tidy files

Action: For each of the cleaned DataFrames save the df tidy.csv.
Will not have to keep the original .gz files and can load the cleaned files in EDA.

In [343]:
```
#dicts of dfname and df
def create_df_dict(namelist,dflist):
    dict_df_names = dict(zip(namelist, dflist))
    return dict_df_names

#takes a dict and saves all to csvs per savepath
def save_dict_tocsv(savepath, dict_dfs, suffix):
    for key,value in dict_dfs.items():
        value.to_csv(path_or_buf = savepath
                     + key +'_tidy' + suffix, encoding='utf8')
```
executed in 15ms, finished 18:13:10 2021-05-04

In [344]:
```
##List of Cleaned dfs
dfs_tidy_dict = [df_bom,df_imdb_name,df_imdb_akas,df_imdbbasics,df_imdb_crew,
       df_imdb_principals,df_imdb_ratings,df_tmb,df_tn_movie_budget]
dfs_names = ['df_bom','df_imdb_name','df_imdb_akas','df_imdbbasics','df_imdb_crew',
       'df_imdb_principals','df_imdb_ratings','df_tmb','df_tn_movie_budget']
savepath = './data/'

dict_cleaned_dfs = create_df_dict(dfs_names, dfs_tidy_dict)
save_dict_tocsv('./data/', dict_cleaned_dfs,'.csv' )
```

executed in 5.07s, finished 18:13:15 2021-05-04

EDA in eda_notebook.ipynb

In [ ]:

In [ ]:

4 Data Exploration

In this workbook we:

1. Reload the cleaned data to DataFrames
2. Perform EDA(Exploraory Data Analysis) to Answer Questions about the business problem
3. Summarize the EDA

4.1 Reload Cleaned data

In [345]:
```
#helper to list all csv or type files in a dir
def find_csv_filenames( path_to_dir, suffix=".csv"):
    filenames = listdir(path_to_dir)
    return [ filename for filename in filenames if filename.endswith( suffix ) ]

#creates dataframes for type specified
def create_dfs(path, filelist, suffix=".csv"):
    #Read all the files and store in a dataFrame
    # the data Frames for each file will be listed in a dict
    # where key is the name and value is the df
    dict_csv_files = {}

    for filename in csvfiles:
        filename_cleaned = filename.replace("_tidy.csv", "").replace(".","_")#cleaning
        filename_df = pd.read_csv(path + filename, index_col = 0, encoding='utf8')
        dict_csv_files[filename_cleaned] = filename_df
    return dict_csv_files

#dicts of dfname and df
def create_df_dict(namelist,dflist):
    dict_df_names = dict(zip(namelist, dflist))
    return dict_df_names

#takes a dict and saves all to csvs per savepath
def save_dict_tocsv(savepath, dict_dfs, suffix):
    for key,value in dict_dfs.items():
        value.to_csv(path_or_buf = savepath
                     + key +'_tidy' + suffix, encoding='utf8')
```

executed in 14ms, finished 18:13:15 2021-05-04

In [346]:
```
#Create csvfiles, tsvfiles and call createdfs dict
path = './data/'
csvfiles = find_csv_filenames(path)
dict_dfs = create_dfs(path, csvfiles, suffix=".csv" )
```

executed in 3.53s, finished 18:13:19 2021-05-04

In [347]:
```
dict_dfs.keys()
```

executed in 14ms, finished 18:13:19 2021-05-04

Out[347]:
```
dict_keys(['df_bom', 'df_imdbbasics', 'df_imdb_akas', 'df_imdb_crew', 'df_imdb_name', 'df_imdb_principals',
'df_imdb_ratings', 'df_tmb', 'df_tn_movie_budget', 'tn_moviesource_csv', 'tn_mpaa_ratings_csv'])
```

In [348]:
```
##Create Working DataFrames
df_bom = dict_dfs['df_bom']
df_imdbbasics = dict_dfs['df_imdbbasics']
df_imdb_akas = dict_dfs['df_imdb_akas']
df_imdb_name = dict_dfs['df_imdb_name']
df_imdb_crew = dict_dfs['df_imdb_crew']
df_imdb_principals = dict_dfs['df_imdb_principals']
df_imdb_ratings = dict_dfs['df_imdb_ratings']
df_tmb = dict_dfs['df_tmb']
df_tn_movie_budget = dict_dfs['df_tn_movie_budget']
```

executed in 14ms, finished 18:13:19 2021-05-04

4.2 Data Exploration

In the EDA (Exploratory Data Analysis) phase, we will work to answer the following question about the business problem by visually answering the data. Our business problem is to deliver actionable insights about the movie industry, specifically types of movies. I approached this Business Problem as defining a movie studio business strategy which leads me to these

Questions:

1. What is success for a feature film? This educates and defines expectations
2. At what level of production budget will we be comfortable investing?
3. What types of feature films genres are we going to make?
4. When should we most optimally release our movies? Are there better months for our releases?
5. How many feature films should we release per year? ie drives initial investment
6. Any correlation to MPA Rating?
7. Who in the industry would be good to work with as producers and directors?
8. Other factors to consider.

4.2.1 What is success for a feature film?

To answer this we should look to analyse data for movies we might consider making.

In industry terms there are four types of production level movies.

1. High Budget: Production budget(PB) is greater than 80 Million US Dollars
2. Medium Budget: PB is between 2 to 80 Million USD
3. Low Bugdet: PB is between 10K and 2 Million USD
4. Micro Budget: PB is under 10K

As a first run in the movie business Microscoft would not want to take a chance on high budget features so we will look at returns in the Medium budget. The average PB(production budget) is right around $65 Million. We will start with that as our cap. Best Return on Investment of Medium budget movies

Lets look at the df_tn_movie_budget data focusing at worldwide gross.

In [349]:
```
df_tn_movie_budget.info()
```

executed in 14ms, finished 18:13:19 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 5782 entries, 1 to 82
Data columns (total 5 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   release_date       5782 non-null   object 
 1   movie              5782 non-null   object 
 2   production_budget  5782 non-null   float64
 3   domestic_gross     5782 non-null   float64
 4   worldwide_gross    5782 non-null   float64
dtypes: float64(3), object(2)
memory usage: 271.0+ KB
```

Lets create a feature for difference between worldwide gross and prod budget
Business terms: Profit = Returned - Investment
Our Data: profit_over_pb = worldwide_gross - production_budget

Let's Calculate percent returned for movies with budgets below $65Mill
Business terms: ROI = Profit / Cost of the investment * 100
Our Data: roi_percent= profit_over_pb / production_budget *100

In [350]:
```
df_tn_movie_budget['profit_over_pb'] = df_tn_movie_budget['worldwide_gross'] - \
df_tn_movie_budget['production_budget']
```

executed in 14ms, finished 18:13:19 2021-05-04

In [351]:
```
df_tn_movie_budget['roi_percent'] = round((df_tn_movie_budget['profit_over_pb'] / \
df_tn_movie_budget['production_budget'])*100,1)#round to 1 digit
```

executed in 14ms, finished 18:13:19 2021-05-04

In [352]:
```
#Sort on roi_percent
df_tn_movie_budget.sort_values(by='roi_percent',ascending = False).head(50)
```

executed in 30ms, finished 18:13:19 2021-05-04

Out[352]:

id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent
46	Jun 30, 1972	Deep Throat	25000.0	45000000.0	45000000.0	44975000.0	179900.0
14	Mar 21, 1980	Mad Max	200000.0	8750000.0	99750000.0	99550000.0	49775.0
93	Sep 25, 2009	Paranormal Activity	450000.0	107918810.0	194183034.0	193733034.0	43051.8
80	Jul 10, 2015	The Gallows	100000.0	22764410.0	41656474.0	41556474.0	41556.5
7	Jul 14, 1999	The Blair Witch Project	600000.0	140539099.0	248300000.0	247700000.0	41283.3
10	May 7, 2004	Super Size Me	65000.0	11529368.0	22233808.0	22168808.0	34105.9
47	Aug 13, 1942	Bambi	858000.0	102797000.0	268000000.0	267142000.0	31135.4
74	Feb 26, 1993	El Mariachi	7000.0	2040920.0	2041928.0	2034928.0	29070.4
77	Oct 1, 1968	Night of the Living Dead	114000.0	12087064.0	30087064.0	29973064.0	26292.2
11	Nov 21, 1976	Rocky	1000000.0	117235147.0	225000000.0	224000000.0	22400.0
37	Oct 17, 1978	Halloween	325000.0	47000000.0	70000000.0	69675000.0	21438.5
16	Aug 9, 1995	The Brothers McMullen	50000.0	10426506.0	10426506.0	10376506.0	20753.0
66	Oct 18, 1974	The Texas Chainsaw Massacre	140000.0	26572439.0	26572439.0	26432439.0	18880.3
73	Aug 11, 1973	American Graffiti	777000.0	115000000.0	140000000.0	139223000.0	17918.0
82	Aug 5, 2005	My Date With Drew	1100.0	181041.0	181041.0	179941.0	16358.3
57	May 16, 2007	Once	150000.0	9445857.0	23323631.0	23173631.0	15449.1
43	Oct 19, 1994	Clerks	27000.0	3073428.0	3894240.0	3867240.0	14323.1
13	Jul 25, 1969	The Stewardesses	200000.0	13500000.0	25000000.0	24800000.0	12400.0
18	Dec 21, 1937	Snow White and the Seven Dwarfs	1488000.0	184925486.0	184925486.0	183437486.0	12327.8
58	Jan 1, 1971	Billy Jack	800000.0	98000000.0	98000000.0	97200000.0	12150.0
75	Oct 8, 2004	Primer	7000.0	424760.0	841926.0	834926.0	11927.5
47	Aug 1, 1997	In the Company of Men	25000.0	2883661.0	2883661.0	2858661.0	11434.6
8	Jun 11, 2004	Napoleon Dynamite	400000.0	44540956.0	46122713.0	45722713.0	11430.7

id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent
31	Aug 6, 2004	Open Water	500000.0	30500882.0	55518641.0	55018641.0	11003.7
25	May 9, 1980	Friday the 13th	550000.0	39754601.0	59754601.0	59204601.0	10764.5
81	Sep 29, 2006	Facing the Giants	100000.0	10178331.0	10243159.0	10143159.0	10143.2
12	Jan 6, 2012	The Devil Inside	1000000.0	53262945.0	101759490.0	100759490.0	10075.9
56	Jan 1, 1971	Sweet Sweetback's Baad Asssss Song	150000.0	15200000.0	15200000.0	15050000.0	10033.3
68	Dec 15, 1939	Gone with the Wind	3900000.0	198680470.0	390525192.0	386625192.0	9913.5
78	Feb 8, 1915	The Birth of a Nation	110000.0	10000000.0	11000000.0	10890000.0	9900.0
69	May 1, 1981	Graduation Day	250000.0	23894000.0	23894000.0	23644000.0	9457.6
76	Feb 15, 1950	Cinderella	2900000.0	85000000.0	263591415.0	260691415.0	8989.4
7	Nov 19, 1925	The Big Parade	245000.0	11000000.0	22000000.0	21755000.0	8879.6
60	Apr 23, 2009	Home	500000.0	15433.0	44793168.0	44293168.0	8858.6
57	Oct 29, 2004	Saw	1200000.0	55968727.0	103880027.0	102680027.0	8556.7
26	Apr 15, 1983	The Evil Dead	375000.0	2400000.0	29400000.0	29025000.0	7740.0
26	Jun 11, 1982	ET: The Extra-Terrestrial	10500000.0	435110554.0	792965326.0	782465326.0	7452.1
48	Apr 19, 2002	My Big Fat Greek Wedding	5000000.0	241438208.0	374890034.0	369890034.0	7397.8
90	Aug 13, 1997	The Full Monty	3500000.0	45950122.0	261249383.0	257749383.0	7364.3
65	May 25, 1977	Star Wars Ep. IV: A New Hope	11000000.0	460998007.0	786598007.0	775598007.0	7050.9
82	Jan 1, 1977	Eraserhead	100000.0	7000000.0	7014590.0	6914590.0	6914.6
7	Jul 10, 1998	Pi	68000.0	3221152.0	4678513.0	4610513.0	6780.2
66	Mar 9, 2001	Dayereh	10000.0	673780.0	673780.0	663780.0	6637.8
29	Sep 26, 2008	Fireproof	500000.0	33456317.0	33473297.0	32973297.0	6594.7
63	Apr 1, 2011	Insidious	1500000.0	54009150.0	99870886.0	98370886.0	6558.1
13	Jun 16, 1978	Grease	6000000.0	181813770.0	387510179.0	381510179.0	6358.5
14	Apr 17, 2015	Unfriended	1000000.0	32789645.0	64364198.0	63364198.0	6336.4
30	Nov 15, 1974	Benji	500000.0	31559560.0	31559560.0	31059560.0	6211.9

id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent
85	Oct 9, 1998	The Mighty	100000.0	2652246.0	6121582.0	6021582.0	6021.6
70	Apr 4, 1997	Chasing Amy	250000.0	12006514.0	15155095.0	14905095.0	5962.0

Lets filter to look at movies where budget is less than=$65 mill

In [353]:
```
df_budget_sub65m = df_tn_movie_budget[df_tn_movie_budget['production_budget'] \
                   <= 65000000.0].sort_values(by='roi_percent', ascending = False)
```
executed in 13ms, finished 18:13:19 2021-05-04

In [354]:
```
df_budget_sub65m.info()#Note 5012 movies
```
executed in 14ms, finished 18:13:19 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 5012 entries, 46 to 63
Data columns (total 7 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   release_date       5012 non-null   object 
 1   movie              5012 non-null   object 
 2   production_budget  5012 non-null   float64
 3   domestic_gross     5012 non-null   float64
 4   worldwide_gross    5012 non-null   float64
 5   profit_over_pb     5012 non-null   float64
 6   roi_percent        5012 non-null   float64
dtypes: float64(5), object(2)
memory usage: 313.2+ KB
```

In [355]:
```
df_budget_sub65m.reset_index(inplace =True)
```
executed in 14ms, finished 18:13:19 2021-05-04

In [356]:
```
#filer movies greater than 2 Mil
df_budg_2to65mil = df_budget_sub65m[df_budget_sub65m['production_budget'] \
                   >= 2000000.0].sort_values(by='roi_percent', ascending = False)
```
executed in 14ms, finished 18:13:19 2021-05-04

In [357]:
```
df_budg_2to65mil.info()#note 4231 movies
```
executed in 14ms, finished 18:13:19 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 4231 entries, 28 to 5010
Data columns (total 8 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   id                 4231 non-null   int64  
 1   release_date       4231 non-null   object 
 2   movie              4231 non-null   object 
 3   production_budget  4231 non-null   float64
 4   domestic_gross     4231 non-null   float64
 5   worldwide_gross    4231 non-null   float64
 6   profit_over_pb     4231 non-null   float64
 7   roi_percent        4231 non-null   float64
dtypes: float64(5), int64(1), object(2)
memory usage: 297.5+ KB
```

In [358]:
```
df_budg_2to65mil.reset_index(inplace =True)
```
executed in 14ms, finished 18:13:19 2021-05-04

Lets create a easy human readable feature called **x_times_invest**.
This is equal to our worldwide_gross / PB where as ROI percent is the profit / PB * 100.

In [359]:
```
df_budg_2to65mil['x_times_invest'] = round(df_budg_2to65mil['worldwide_gross']/df_budg_2to65mil['production_
```
executed in 15ms, finished 18:13:19 2021-05-04

In [360]:
```
df_budg_2to65mil.head(20)
```
executed in 30ms, finished 18:13:19 2021-05-04

Out[360]:

	index	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_tim
0	28	68	Dec 15, 1939	Gone with the Wind	3900000.0	198680470.0	390525192.0	386625192.0	9913.5	
1	31	76	Feb 15, 1950	Cinderella	2900000.0	85000000.0	263591415.0	260691415.0	8989.4	
2	36	26	Jun 11, 1982	ET: The Extra-Terrestrial	10500000.0	435110554.0	792965326.0	782465326.0	7452.1	
3	37	48	Apr 19, 2002	My Big Fat Greek Wedding	5000000.0	241438208.0	374890034.0	369890034.0	7397.8	
4	38	90	Aug 13, 1997	The Full Monty	3500000.0	45950122.0	261249383.0	257749383.0	7364.3	
5	39	65	May 25, 1977	Star Wars Ep. IV: A New Hope	11000000.0	460998007.0	786598007.0	775598007.0	7050.9	
6	45	13	Jun 16, 1978	Grease	6000000.0	181813770.0	387510179.0	381510179.0	6358.5	
7	52	65	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1	
8	54	50	Jan 20, 2017	Split	5000000.0	138141585.0	278964806.0	273964806.0	5479.3	
9	56	25	Mar 9, 1994	Four Weddings and a Funeral	4500000.0	52700832.0	242895809.0	238395809.0	5297.7	
10	60	49	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4	
11	62	64	Jul 28, 1978	National Lampoon's Animal House	3000000.0	141600000.0	141600000.0	138600000.0	4620.0	
12	64	1	Feb 7, 1974	Blazing Saddles	2600000.0	119500000.0	119500000.0	116900000.0	4496.2	
13	65	18	May 25, 2012	Les Intouchables	10800000.0	13182281.0	484873045.0	474073045.0	4389.6	
14	68	68	Dec 22, 1964	Goldfinger	3000000.0	51100000.0	124900000.0	121900000.0	4063.3	

	index	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_tim
15	69	51	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8	
16	71	99	Feb 9, 2007	Das Leben der Anderen	2000000.0	11284657.0	81197047.0	79197047.0	3959.9	
17	74	84	Oct 3, 2014	Annabelle	6500000.0	84273813.0	256862920.0	250362920.0	3851.7	
18	75	88	Apr 8, 1964	From Russia With Love	2000000.0	24800000.0	78900000.0	76900000.0	3845.0	
19	76	41	Jun 20, 1975	Jaws	12000000.0	260000000.0	470700000.0	458700000.0	3822.5	

It makes sense to only focus on recent movies. Lets look at the movies from 2010 onward.

In [361]:
```
df_budg_2to65mil_11yr = df_budg_2to65mil[pd.to_datetime(df_budg_2to65mil['release_date']).dt.year >= 2010]
```
executed in 548ms, finished 18:13:20 2021-05-04

In [362]:
```
df_budg_2to65mil_11yr.reset_index(inplace =True)
```
executed in 15ms, finished 18:13:20 2021-05-04

In [363]:
```
df_budg_2to65mil_11yr.describe()
```
executed in 45ms, finished 18:13:20 2021-05-04

Out[363]:

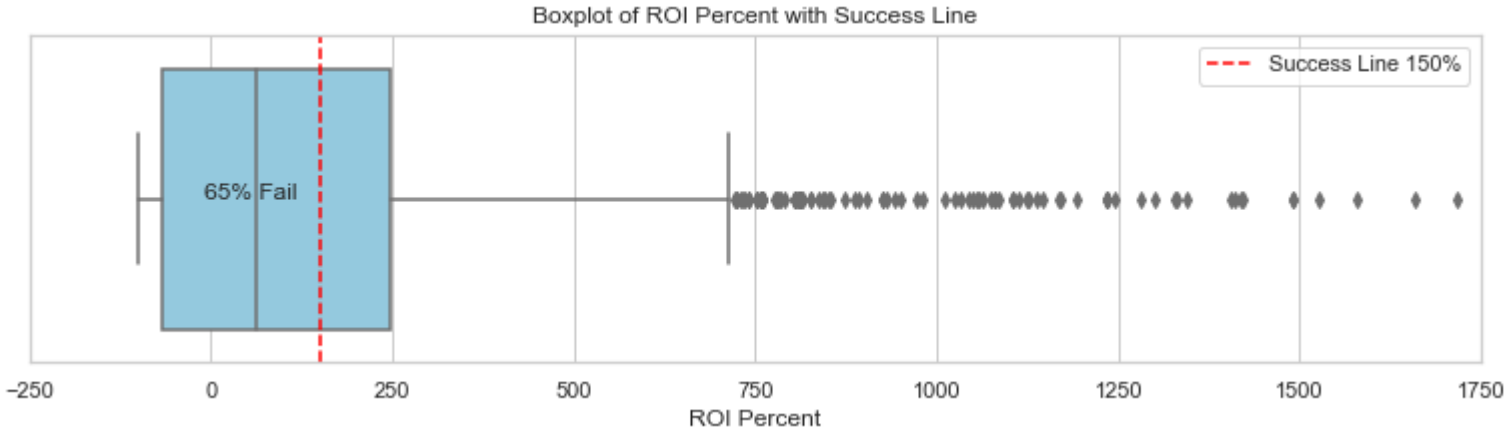
	level_0	index	id	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_
count	1485.000000	1485.000000	1485.000000	1.485000e+03	1.485000e+03	1.485000e+03	1.485000e+03	1485.000000	
mean	2207.599327	2542.965657	51.546128	2.082116e+07	2.718077e+07	5.767083e+07	3.684966e+07	200.663569	
std	1280.861844	1423.621413	28.217390	1.654820e+07	3.899086e+07	8.573114e+07	7.879218e+07	502.658395	
min	7.000000	52.000000	1.000000	2.000000e+06	0.000000e+00	0.000000e+00	-6.448372e+07	-100.000000	
25%	1132.000000	1369.000000	28.000000	7.000000e+06	3.100070e+05	3.721988e+06	-4.412809e+06	-67.800000	
50%	2142.000000	2439.000000	52.000000	1.600000e+07	1.254598e+07	2.638704e+07	9.867665e+06	61.500000	
75%	3415.000000	3822.000000	76.000000	3.000000e+07	3.912359e+07	7.634739e+07	4.940194e+07	246.200000	
max	4230.000000	5010.000000	100.000000	6.500000e+07	3.630707e+08	8.949853e+08	8.399853e+08	5817.100000	

4.2.1.1 What is our target?

Based on industry research, movies dont truly turn a profit until the 2.0 to 2.5 times PB mark due to marketing and distributors.
Note: The **median** value of medium budget movies (2-65mil) is **61.5% ROI or 1.6 x the investment.**
Lets set our target and define success as movies with 150% ROI_percent or wwgross 2.5 times the investment.
Example:PB is 5000000, **2.5** times is 12,500,000 for worldwide_gross
Profit would be 7500000 ROI%=7500000 /5000000 *100 =**150%**
Note: There are many outlers in this data. These movies are extremly successful. Graph only to 1750%. Max was 6000% ROI%

In [364]:
```
#Insert graph of all movies roi with red line at 2.5xPB or 150% roi

sns.set(style="whitegrid")
fig, ax1 = plt.subplots(figsize=(13,3),)

boxplot = sns.boxplot(ax=ax1, x=df_budg_2to65mil_11yr["roi_percent"],color='skyblue')
#sns.stripplot(ax=ax1, x=df_budg_2to65mil_11yr["roi_percent"],color='skyblue')
ax1.set(xlabel = 'ROI Percent', title='Boxplot of ROI Percent with Success Line')
ax1.axvline(150, ls='--',color='red',label='Success Line 150%')
ax1.set_xlim(xmin=-250,xmax=1750)
ax1.legend(loc='upper right')
ax1.text(x=-10,y=0,s="65% Fail")
plt.show();
```

executed in 234ms, finished 18:13:20 2021-05-04



Note: How many movies with roi_percent at >=150% ? Only 533 from 1485. Only **35% were successful. 65% fail**.

In [365]:
```
#Lets only analyze the movies with >=150% ROI(533 movies)
df_budg_success_11yrs = df_budg_2to65mil_11yr[df_budg_2to65mil_11yr['roi_percent'] >= 150]
```

executed in 14ms, finished 18:13:20 2021-05-04

533 successful movies INSERT graph of top 10

In [366]:
```
df_budg_success_11yrs.head(10)
```

executed in 30ms, finished 18:13:20 2021-05-04

Out[366]:

	level_0	index	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent
0	7	52	65	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1
1	8	54	50	Jan 20, 2017	Split	5000000.0	138141585.0	278964806.0	273964806.0	5479.3
2	10	60	49	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4
3	13	65	18	May 25, 2012	Les Intouchables	10800000.0	13182281.0	484873045.0	474073045.0	4389.6
4	15	69	51	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8
5	17	74	84	Oct 3, 2014	Annabelle	6500000.0	84273813.0	256862920.0	250362920.0	3851.7
6	29	96	53	Sep 13, 2013	Insidious Chapter 2	5000000.0	83586447.0	161921515.0	156921515.0	3138.4
7	31	98	56	Dec 21, 2016	Dangal	9500000.0	12391761.0	294654618.0	285154618.0	3001.6
8	35	104	67	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2
9	37	107	55	Jul 22, 2016	Lights Out	5000000.0	67268835.0	148806510.0	143806510.0	2876.1

In [367]:
```
df_budg_success_11yrs = df_budg_success_11yrs.drop(columns=['level_0','index'])
```

executed in 13ms, finished 18:13:20 2021-05-04

In [368]:
```
df_budg_success_11yrs.describe()
```
executed in 30ms, finished 18:13:20 2021-05-04

Out[368]:

	id	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_invest
count	533.000000	5.330000e+02	5.330000e+02	5.330000e+02	5.330000e+02	533.000000	533.000000
mean	55.587242	2.263056e+07	5.674026e+07	1.231468e+08	1.005162e+08	586.596998	6.863227
std	29.401908	1.712939e+07	4.938324e+07	1.112654e+08	1.014964e+08	678.787104	6.790683
min	1.000000	2.000000e+06	0.000000e+00	5.941994e+06	3.941994e+06	150.000000	2.500000
25%	33.000000	8.500000e+06	2.150269e+07	4.701145e+07	3.678539e+07	227.800000	3.300000
50%	59.000000	1.800000e+07	4.629074e+07	9.405095e+07	7.049704e+07	364.000000	4.600000
75%	82.000000	3.500000e+07	7.546858e+07	1.625028e+08	1.292782e+08	679.200000	7.800000
max	100.000000	6.500000e+07	3.630707e+08	8.949853e+08	8.399853e+08	5817.100000	59.200000

In [369]:
```
#save successful movies to file
df_budg_success_11yrs.to_csv(path_or_buf = path + 'budg_success_11yrs')
```
executed in 15ms, finished 18:13:20 2021-05-04

Conclusion: The Percent RoI for movies in the medium budget range from 2 - 65 M USD has a mean of 586% return but median is 61.5%. The mean is skewed due to the number of outliers. Most movies do not succeed. In this data, **65%** do not succeed. Considering marketing and distribution, A successful movie should return at least 2.5 times the production budget, ie 150% Roi. Going forward we will only look at those movies.

4.2.2 Question: What level of production budget will we be comfortable investing?

Of the 533 Successful Films in medium budget range since 2010, lets look into the production budgets of those.

In [370]:
```
df_budg_success_11yrs.describe()
```
executed in 43ms, finished 18:13:20 2021-05-04

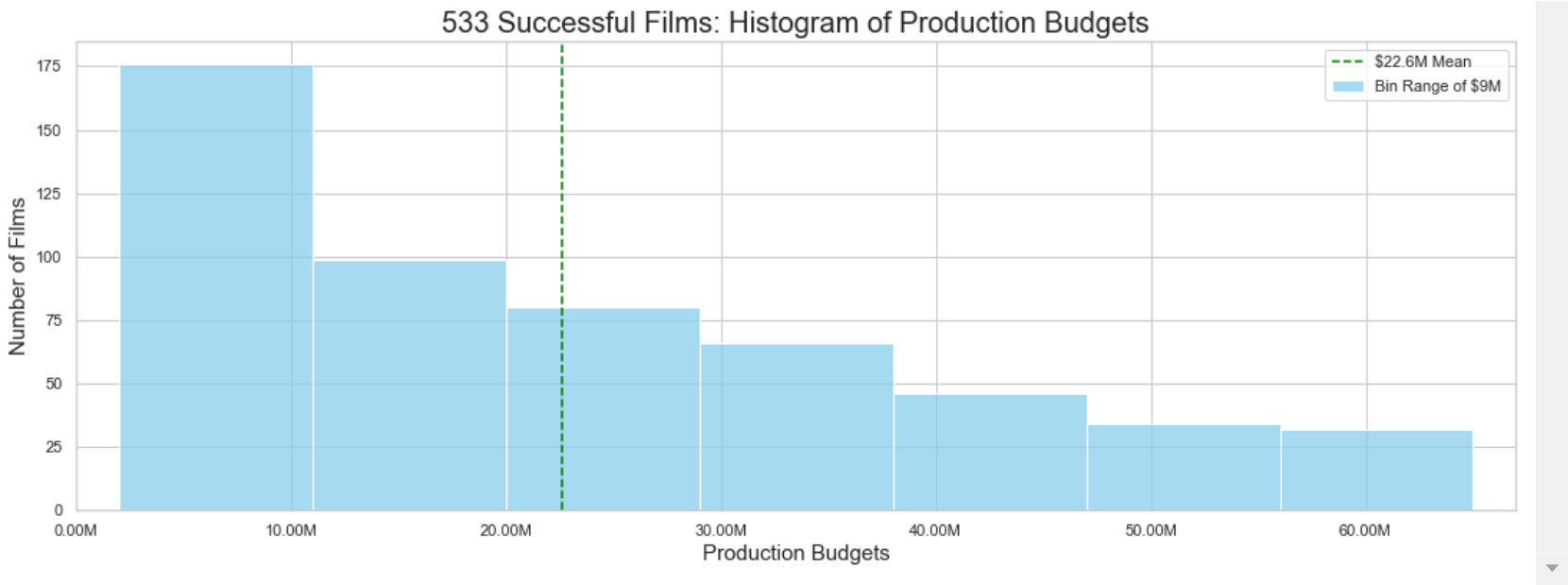
Out[370]:

	id	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_invest
count	533.000000	5.330000e+02	5.330000e+02	5.330000e+02	5.330000e+02	533.000000	533.000000
mean	55.587242	2.263056e+07	5.674026e+07	1.231468e+08	1.005162e+08	586.596998	6.863227
std	29.401908	1.712939e+07	4.938324e+07	1.112654e+08	1.014964e+08	678.787104	6.790683
min	1.000000	2.000000e+06	0.000000e+00	5.941994e+06	3.941994e+06	150.000000	2.500000
25%	33.000000	8.500000e+06	2.150269e+07	4.701145e+07	3.678539e+07	227.800000	3.300000
50%	59.000000	1.800000e+07	4.629074e+07	9.405095e+07	7.049704e+07	364.000000	4.600000
75%	82.000000	3.500000e+07	7.546858e+07	1.625028e+08	1.292782e+08	679.200000	7.800000
max	100.000000	6.500000e+07	3.630707e+08	8.949853e+08	8.399853e+08	5817.100000	59.200000

In [371]:

```
#Histogram of Production budget bins

sns.set(style="whitegrid")
fig, ax1 = plt.subplots(figsize=(18,6),sharex=True ,sharey=True)

histplot = sns.histplot(ax=ax1, x=df_budg_success_11yrs["production_budget"],
                        color='skyblue',bins=7,label='Bin Range of $9M')

ax1.set_xlabel('Production Budgets', fontsize=15)
ax1.set_ylabel('Number of Films', fontsize=15)
ax1.set_title('533 Successful Films: Histogram of Production Budgets',fontsize=20)
#Set the Average Line
ax1.axvline(df_budg_success_11yrs["production_budget"].mean(), ls='--',
            color='green',label='$22.6M Mean')
ax1.set(xlim = (0,67000000))
# fixing xticks warning with matplotlib.ticker "FixedLocator"
ticks_loc = ax1.get_xticks().tolist()
ax1.xaxis.set_major_locator(mticker.FixedLocator(ticks_loc))
ax1.set_xticklabels(['{:,.2f}'.format(x/1000000) + 'M' for x in ticks_loc])

ax1.set(xlim = (0,67000000))
ax1.legend(loc='upper right')

fig.savefig('./images/ProdBudg.png', bbox_inches='tight')


plt.show();
```

executed in 514ms, finished 18:13:21 2021-05-04



Conclusion: Most of the movies are in the 2M to 11M and 11M to 20M bin ranges with a steady decline as budgets increase. We do not need to spend a high amount on budget to make a successful film. We need to look at *genres* of the movies to determine more. Looking at the Average ROI per range would also be informative.

4.2.3 Question: What types of feature film genres should we make?

Lets pull in genre information for the movies. This has been noted in the df_imdbbasics. We will join this with out budget data.

In [372]:
```
df_imdbbasics.head(3)
```
executed in 13ms, finished 18:13:21 2021-05-04

Out[372]:

tconst	primary_title	original_title	start_year	runtime_minutes	genres
tt0063540	Sunghursh	Sunghursh	2013	175.0	Action,Crime,Drama
tt0066787	One Day Before the Rainy Season	Ashad Ka Ek Din	2019	114.0	Biography,Drama
tt0069049	The Other Side of the Wind	The Other Side of the Wind	2018	122.0	Drama

In [373]:
```
df_budg_success_11yrs.info()
```
executed in 14ms, finished 18:13:21 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 533 entries, 0 to 532
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   id                 533 non-null    int64  
 1   release_date       533 non-null    object 
 2   movie              533 non-null    object 
 3   production_budget  533 non-null    float64
 4   domestic_gross     533 non-null    float64
 5   worldwide_gross    533 non-null    float64
 6   profit_over_pb     533 non-null    float64
 7   roi_percent        533 non-null    float64
 8   x_times_invest     533 non-null    float64
dtypes: float64(6), int64(1), object(2)
memory usage: 41.6+ KB
```

In [374]:
```
#We will do a left join on the successful movies and the imdb basics
#keying on movie name and year of release
df_budget_genres = pd.merge(df_budg_success_11yrs, df_imdbbasics,
                            left_on=  ['movie',
                                       pd.to_datetime(df_budg_success_11yrs['release_date']).dt.year],
                            right_on= ['primary_title','start_year'],
                            how = 'left')
```

executed in 141ms, finished 18:13:21 2021-05-04

In [375]:
```
df_budget_genres.info()
```

executed in 15ms, finished 18:13:21 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 544 entries, 0 to 543
Data columns (total 14 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   id                 544 non-null    int64  
 1   release_date       544 non-null    object 
 2   movie              544 non-null    object 
 3   production_budget  544 non-null    float64
 4   domestic_gross     544 non-null    float64
 5   worldwide_gross    544 non-null    float64
 6   profit_over_pb     544 non-null    float64
 7   roi_percent        544 non-null    float64
 8   x_times_invest     544 non-null    float64
 9   primary_title      429 non-null    object 
 10  original_title     429 non-null    object 
 11  start_year         544 non-null    int64  
 12  runtime_minutes    429 non-null    float64
 13  genres             429 non-null    object 
dtypes: float64(7), int64(2), object(5)
memory usage: 63.8+ KB
```

In [376]:
```
#We have to exclude where the genres were unknown or Nan
df_budget_genres = df_budget_genres[df_budget_genres.genres != 'unknown']
```

executed in 14ms, finished 18:13:21 2021-05-04

In [377]:
```
df_budget_genres = df_budget_genres[df_budget_genres.primary_title.notna()]
```

executed in 13ms, finished 18:13:21 2021-05-04

In [378]:
```
#We have matching genre info for 428 successful movies
df_budget_genres.info()
```

executed in 15ms, finished 18:13:21 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 428 entries, 0 to 543
Data columns (total 14 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   id                 428 non-null    int64  
 1   release_date       428 non-null    object 
 2   movie              428 non-null    object 
 3   production_budget  428 non-null    float64
 4   domestic_gross     428 non-null    float64
 5   worldwide_gross    428 non-null    float64
 6   profit_over_pb     428 non-null    float64
 7   roi_percent        428 non-null    float64
 8   x_times_invest     428 non-null    float64
 9   primary_title      428 non-null    object 
 10  original_title     428 non-null    object 
 11  start_year         428 non-null    int64  
 12  runtime_minutes    428 non-null    float64
 13  genres             428 non-null    object 
dtypes: float64(7), int64(2), object(5)
memory usage: 50.2+ KB
```

In [379]:
```
#Onlyrun this code once or the genre lis will be in a list itself
#genres is a list of upto 3 genres, splitting it to get the individual genres
df_budget_genres['genres'] = df_budget_genres['genres'].astype(str).apply(lambda x: x.split(",") if x else x
df_budget_genres.tail(10)
```

executed in 29ms, finished 18:13:21 2021-05-04

Out[379]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_inve
530	1	Feb 18, 2011	Big Mommas: Like Father, Like Son	32000000.0	37915414.0	82332450.0	50332450.0	157.3	2
532	66	Dec 19, 2012	Zero Dark Thirty	52500000.0	95720716.0	134612435.0	82112435.0	156.4	2
535	62	Jan 12, 2018	The Commuter	40000000.0	36343858.0	101985431.0	61985431.0	155.0	2
536	77	Sep 21, 2012	The Perks of Being a Wallflower	13000000.0	17742948.0	33069303.0	20069303.0	154.4	2
537	6	Oct 24, 2014	John Wick	30000000.0	43037835.0	76235001.0	46235001.0	154.1	2

In [380]:
```
df_budget_genres.info()
```
executed in 14ms, finished 18:13:21 2021-05-04

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 428 entries, 0 to 543
Data columns (total 14 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   id                 428 non-null    int64  
 1   release_date       428 non-null    object 
 2   movie              428 non-null    object 
 3   production_budget  428 non-null    float64
 4   domestic_gross     428 non-null    float64
 5   worldwide_gross    428 non-null    float64
 6   profit_over_pb     428 non-null    float64
 7   roi_percent        428 non-null    float64
 8   x_times_invest     428 non-null    float64
 9   primary_title      428 non-null    object 
 10  original_title     428 non-null    object 
 11  start_year         428 non-null    int64  
 12  runtime_minutes    428 non-null    float64
 13  genres             428 non-null    object 
dtypes: float64(7), int64(2), object(5)
memory usage: 50.2+ KB
```

In [381]:
```
#a set of distinct genres in the df
all_genres = set()
for genres in df_budget_genres['genres']:
    if genres:
        all_genres.update(genres)
```
executed in 14ms, finished 18:13:21 2021-05-04

In [382]:
```
#Listing of all distinct genres
all_genres
```

executed in 14ms, finished 18:13:21 2021-05-04

Out[382]:
```
{'Action',
 'Adventure',
 'Animation',
 'Biography',
 'Comedy',
 'Crime',
 'Documentary',
 'Drama',
 'Family',
 'Fantasy',
 'History',
 'Horror',
 'Music',
 'Musical',
 'Mystery',
 'Romance',
 'Sci-Fi',
 'Sport',
 'Thriller',
 'War',
 'Western'}
```

In [383]:
```
#adding cols with zeros for all the genres we have. Will modify genre to 1
#if the film is of that genre.
for genre in all_genres:
    df_budget_genres[genre] = np.zeros(shape=df_budget_genres.shape[0])

df_budget_genres.head()
```

executed in 45ms, finished 18:13:21 2021-05-04

Out[383]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_invest	p
0	65	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1	59.2	
2	49	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4	51.1	
4	51	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8	41.4	
5	84	Oct 3, 2014	Annabelle	6500000.0	84273813.0	256862920.0	250362920.0	3851.7	39.5	
7	56	Dec 21, 2016	Dangal	9500000.0	12391761.0	294654618.0	285154618.0	3001.6	31.0	

5 rows × 35 columns

In [384]:
```
#setting the genre to be 1 if the film is of that genre
for index, row in df_budget_genres.iterrows():
    if row['genres']:
        for genre in row['genres']:
            df_budget_genres.loc[index, genre] = 1

df_budget_genres.head()
```

executed in 363ms, finished 18:13:21 2021-05-04

Out[384]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_invest	p
0	65	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1	59.2	
2	49	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4	51.1	
4	51	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8	41.4	
5	84	Oct 3, 2014	Annabelle	6500000.0	84273813.0	256862920.0	250362920.0	3851.7	39.5	
7	56	Dec 21, 2016	Dangal	9500000.0	12391761.0	294654618.0	285154618.0	3001.6	31.0	

5 rows × 35 columns

In [385]:
```
len(all_genres)
```

executed in 14ms, finished 18:13:21 2021-05-04

Out[385]: 21

In [386]:
```
#checking the counts for all different genres
#all_genres
for col in all_genres:
    print(f'Viewing values in col: {col}')
    print(f'Top 5 values:\n{df_budget_genres[col].value_counts()}')
```

executed in 31ms, finished 18:13:21 2021-05-04

```
Viewing values in col: Documentary
Top 5 values:
0.0    416
1.0     12
Name: Documentary, dtype: int64
Viewing values in col: Adventure
Top 5 values:
0.0    384
1.0     44
Name: Adventure, dtype: int64
Viewing values in col: History
Top 5 values:
0.0    415
1.0     13
Name: History, dtype: int64
Viewing values in col: Crime
Top 5 values:
0.0    366
1.0     62
```

In [387]:
```
#making a list of all genres
cols = list(df_budget_genres.columns)
genre_cols = cols[14:]

#getting a dict with genre counts
genre_count = {}
for col in genre_cols:
    count = np.sum(df_budget_genres[col] == 1).sum()
    genre_count[col] = count
```

executed in 15ms, finished 18:13:21 2021-05-04

In [388]:
```
genre_count
```
executed in 14ms, finished 18:13:21 2021-05-04

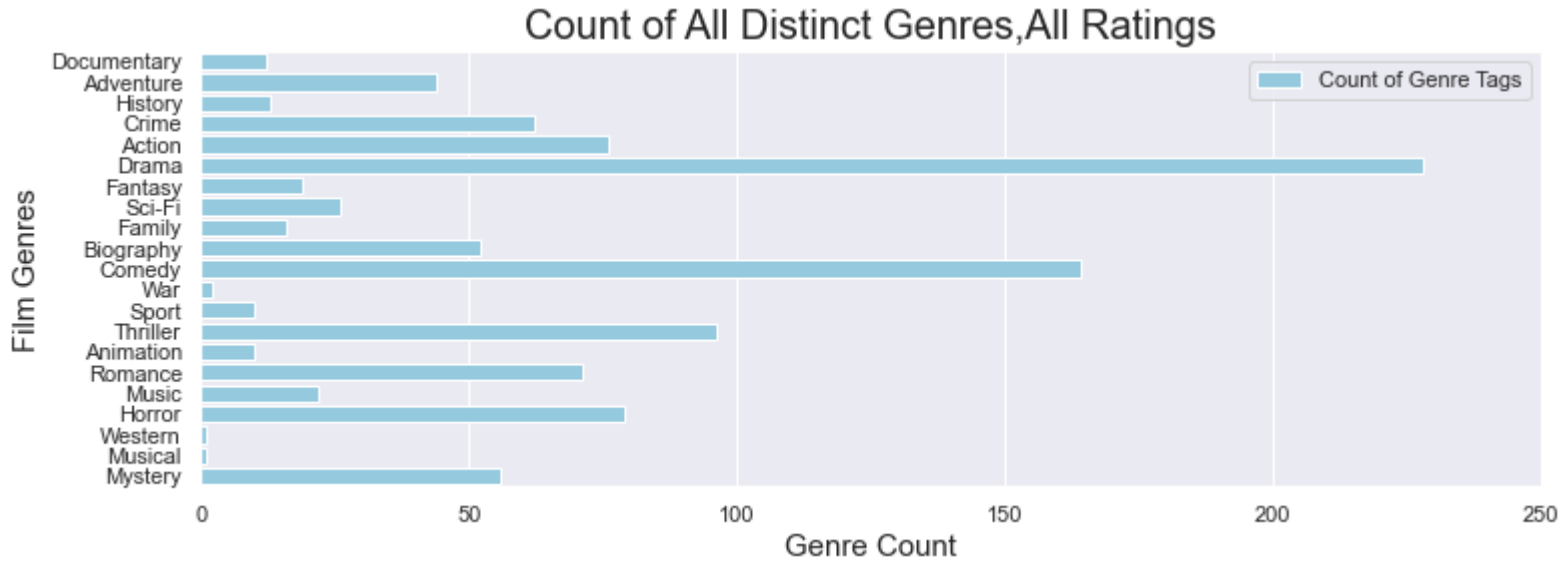
```
 'Adventure': 44,
 'History': 13,
 'Crime': 62,
 'Action': 76,
 'Drama': 228,
 'Fantasy': 19,
 'Sci-Fi': 26,
 'Family': 16,
 'Biography': 52,
 'Comedy': 164,
 'War': 2,
 'Sport': 10,
 'Thriller': 96,
 'Animation': 10,
 'Romance': 71,
 'Music': 22,
 'Horror': 79,
 'Western': 1,
 'Musical': 1,
 'Mvsterv': 56}
```

In [389]:
```
keys = list(genre_count.keys())
values = list(genre_count.values())
```
executed in 15ms, finished 18:13:21 2021-05-04

In [390]:

```
#Histogram of Genres Counts

sns.set(style="darkgrid")
fig, ax1 = plt.subplots(figsize=(12,4),sharex=True ,sharey=True)

histplot = sns.barplot(y = keys, x = values, color = 'skyblue',
                       label='Count of Genre Tags')

ax1.set_xlabel('Genre Count', fontsize=15)
ax1.set_ylabel('Film Genres', fontsize=15)
ax1.set_title('Count of All Distinct Genres,All Ratings',fontsize=20)
#Set the Average Line

ax1.set(xlim = (0,250))

ax1.legend(loc='upper right')
plt.show();
```

executed in 410ms, finished 18:13:22 2021-05-04



The 6 most popular genres are Drama, Comedy, Thriller, Horror, Action and Romance.

Grouping by genres to look at sum, mean and max related to worldwide gross and roi_percent.

In [391]:
```
#Total Gross by Genre
ww_gross = {}
for genre in all_genres:
    grouped = df_budget_genres.groupby(by =''.join(genre)).sum()
    ww_gross[genre] = grouped.iloc[1]['worldwide_gross']
```

executed in 61ms, finished 18:13:22 2021-05-04

In [392]:
```
#Average Gross by Genre
ww_gross_avg = {}
for genre in all_genres:
    grouped = df_budget_genres.groupby(by =''.join(genre)).mean()
    ww_gross_avg[genre] = grouped.iloc[1]['worldwide_gross']
```

executed in 61ms, finished 18:13:22 2021-05-04

In [393]:
```
#Max Roi% by Genre
max_roi_genre = {}
for genre in all_genres:
    grouped = df_budget_genres.groupby(by =''.join(genre)).max()
    max_roi_genre[genre] = grouped.iloc[1]['roi_percent']
```

executed in 412ms, finished 18:13:22 2021-05-04

In [394]:
```
#Average Roi% by Genre
avg_roi_genre = {}
for genre in all_genres:
    grouped = df_budget_genres.groupby(by =''.join(genre)).mean()
    avg_roi_genre[genre] = grouped.iloc[1]['roi_percent']
```

executed in 62ms, finished 18:13:22 2021-05-04

In [395]:
```
#Average Prod Budget by Genre
avg_prod_budget = {}
for genre in all_genres:
    grouped = df_budget_genres.groupby(by =''.join(genre)).mean()
    avg_prod_budget[genre] = grouped.iloc[1]['production_budget']
```

executed in 62ms, finished 18:13:22 2021-05-04

In [396]:
```
#Min Prod Budget by Genre
min_prod_budget = {}
for genre in all_genres:
    grouped = df_budget_genres.groupby(by =''.join(genre)).min()
    min_prod_budget[genre] = grouped.iloc[1]['production_budget']
```

executed in 394ms, finished 18:13:23 2021-05-04

In [397]:
```
ww_gross_avg
```
executed in 14ms, finished 18:13:23 2021-05-04

Out[397]:
```
{'Documentary': 61298916.916666664,
 'Adventure': 162563478.88636363,
 'History': 152316510.76923078,
 'Crime': 122348923.75806452,
 'Action': 166454629.31578946,
 'Drama': 116104601.25438596,
 'Fantasy': 103467528.4736842,
 'Sci-Fi': 149113348.15384614,
 'Family': 117984713.4375,
 'Biography': 147391950.3653846,
 'Comedy': 123180125.51829268,
 'War': 109060110.0,
 'Sport': 106054711.0,
 'Thriller': 138370908.53125,
 'Animation': 238795442.3,
 'Romance': 120397643.92957747,
 'Music': 145486606.3181818,
 'Horror': 109805546.06329113,
 'Western': 252276928.0,
 'Musical': 50827466.0,
 'Mystery': 121582196.875}
```

In [398]:
```
ww_gross
```
executed in 14ms, finished 18:13:23 2021-05-04

Out[398]:
```
{'Documentary': 735587003.0,
 'Adventure': 7152793071.0,
 'History': 1980114640.0,
 'Crime': 7585633273.0,
 'Action': 12650551828.0,
 'Drama': 26471849086.0,
 'Fantasy': 1965883041.0,
 'Sci-Fi': 3876947052.0,
 'Family': 1887755415.0,
 'Biography': 7664381419.0,
 'Comedy': 20201540585.0,
 'War': 218120220.0,
 'Sport': 1060547110.0,
 'Thriller': 13283607219.0,
 'Animation': 2387954423.0,
 'Romance': 8548232719.0,
 'Music': 3200705339.0,
 'Horror': 8674638139.0,
 'Western': 252276928.0,
 'Musical': 50827466.0,
 'Mystery': 6808603025.0}
```

In [399]:
```
max_roi_genre
```

executed in 14ms, finished 18:13:23 2021-05-04

Out[399]:
```
{'Documentary': 2876.1,
 'Adventure': 1281.1,
 'History': 827.1,
 'Crime': 1234.9,
 'Action': 3001.6,
 'Drama': 3001.6,
 'Fantasy': 2296.9,
 'Sci-Fi': 1867.8,
 'Family': 1423.0,
 'Biography': 3001.6,
 'Comedy': 2617.9,
 'War': 468.1,
 'Sport': 1075.1,
 'Thriller': 5007.4,
 'Animation': 710.9,
 'Romance': 2617.9,
 'Music': 2031.8,
 'Horror': 5817.1,
 'Western': 620.8,
 'Musical': 512.4,
 'Mystery': 5007.4}
```

In [400]:
```
avg_roi_genre
```

executed in 14ms, finished 18:13:23 2021-05-04

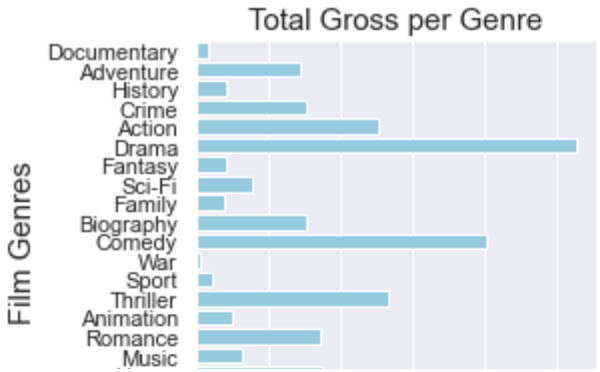
Out[400]:
```
{'Documentary': 625.5666666666666,
 'Adventure': 375.74090909090904,
 'History': 436.8076923076923,
 'Crime': 336.148387096774,
 'Action': 441.0249999999998,
 'Drama': 554.131140350877,
 'Fantasy': 598.884210526316,
 'Sci-Fi': 603.6384615384616,
 'Family': 420.64375,
 'Biography': 549.0634615384616,
 'Comedy': 458.09085365853673,
 'War': 384.3,
 'Sport': 361.71,
 'Thriller': 821.5989583333327,
 'Animation': 412.9200000000001,
 'Romance': 515.9394366197183,
 'Music': 549.4454545454547,
 'Horror': 1035.9037974683538,
 'Western': 620.8,
 'Musical': 512.4,
 'Mystery': 1009.175}
```

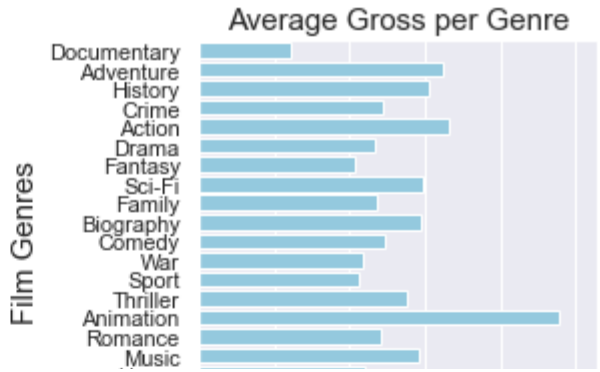
In [401]:

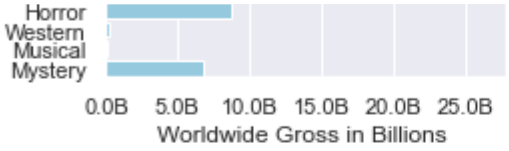
```
#Genre Grid
#This graph of subplots could be refactored to a function and could be reused
sns.set(style="darkgrid")
fig, ((ax1, ax2), (ax3, ax4), (ax5, ax6)) = plt.subplots(figsize=(10,14),
                                                         nrows=3,ncols=2, )

df_items1 = pd.DataFrame(ww_gross.items())
barplot = sns.barplot(data=df_items1, x=1, y=0,ax=ax1, color = 'skyblue',)
ax1.set(xlabel = 'Worldwide Gross in Billions ',
        ylabel='Genre', title='Total Gross per Genre');
ax1.set_ylabel('Film Genres', fontsize=15)
ax1.set_title('Total Gross per Genre',fontsize=15)
# fixing xticks warning with matplotlib.ticker "FixedLocator"
ticks_loc = ax1.get_xticks().tolist()
ax1.xaxis.set_major_locator(mticker.FixedLocator(ticks_loc))
ax1.set_xticklabels(['{:,.1f}'.format(x/1000000000) + 'B' for x in ticks_loc])


df_items2 = pd.DataFrame(ww_gross_avg.items())
ax2 = sns.barplot(data=df_items2, x=1, y=0,ax=ax2,color = 'skyblue')
ax2.set(xlabel = 'Worldwide Gross in Millions ', ylabel='Genre',
        title='Average Gross per Genre');

ax2.set_ylabel('Film Genres', fontsize=15)
ax2.set_title('Average Gross per Genre',fontsize=15)
# fixing xticks warning with matplotlib.ticker "FixedLocator"
ticks_loc = ax2.get_xticks().tolist()
ax2.xaxis.set_major_locator(mticker.FixedLocator(ticks_loc))
ax2.set_xticklabels(['{:,.0f}'.format(x/1000000) + 'M' for x in ticks_loc])


df_items3 = pd.DataFrame(max_roi_genre.items())
ax3 = sns.barplot(data=df_items3, x=1, y=0, ax=ax3,color = 'skyblue')
ax3.set(xlabel = '% ROI', ylabel='Film Genre', title='Max Roi Percent per Genre');
ax3.set_ylabel('Film Genres', fontsize=15)
ax3.set_title('Max Roi Percent per Genre',fontsize=15)

df_items4 = pd.DataFrame(avg_roi_genre.items())
ax4 = sns.barplot(data=df_items4, x=1, y=0, ax=ax4, color = 'skyblue')
ax4.set(xlabel = '% ROI', ylabel='Film Genre', title='Avg Roi Percent per Genre');
ax4.set_ylabel('Film Genres', fontsize=15)
ax4.set_title('Avg Roi Percent per Genre',fontsize=15)
```

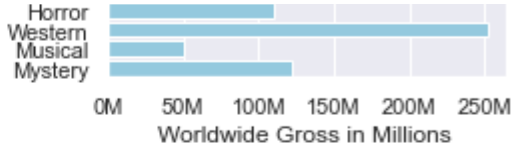
```
# Save just the portion _inside_ the second axis's boundaries
extent = ax4.get_window_extent().transformed(fig.dpi_scale_trans.inverted())

# Pad the saved area by 10% in the x-direction and 20% in the y-direction
fig.savefig('./images/ax4_genre.png', bbox_inches=extent.expanded(1.1, 1.2))


df_items5 = pd.DataFrame(min_prod_budget.items())
ax5 = sns.barplot(data=df_items5, x=1, y=0, ax=ax5, color = 'skyblue')
ax5.set(xlabel = 'Production Budget in Millions', ylabel='Genre', title='Min Production per Genre')
ax5.set_ylabel('Film Genres', fontsize=15)
ax5.set_title('Min Production per Genre',fontsize=15)
# fixing xticks warning with matplotlib.ticker "FixedLocator"
ticks_loc = ax5.get_xticks().tolist()
ax5.xaxis.set_major_locator(mticker.FixedLocator(ticks_loc))
ax5.set_xticklabels(['{:,.2f}'.format(x/1000000) + 'M' for x in ticks_loc])


df_items6 = pd.DataFrame(avg_prod_budget.items())
ax6 = sns.barplot(data=df_items6, x=1, y=0, ax=ax6, color = 'skyblue')
ax6.set(xlabel = 'Production Budget in Millions', ylabel='Genre', title='Avg Production per Genre')
ax6.set_ylabel('Film Genres', fontsize=15)
ax6.set_title('Avg Production per Genre',fontsize=15)
# fixing xticks warning with matplotlib.ticker "FixedLocator"
ticks_loc = ax6.get_xticks().tolist()
ax6.xaxis.set_major_locator(mticker.FixedLocator(ticks_loc))
ax6.set_xticklabels(['{:,.2f}'.format(x/1000000) + 'M' for x in ticks_loc])

plt.subplots_adjust(wspace=0.8,hspace=.4)
plt.show();
```

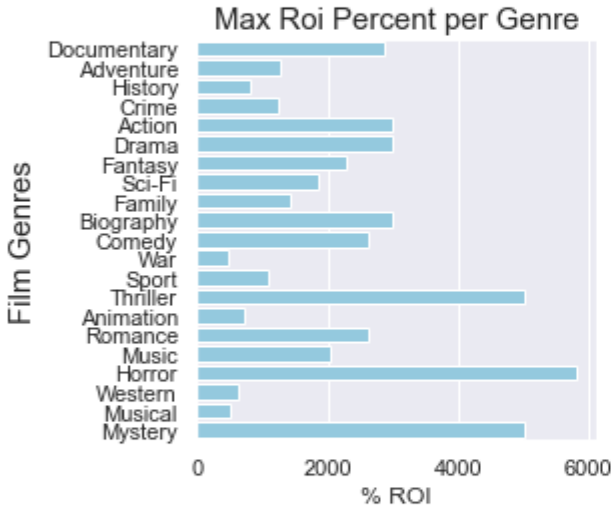
executed in 2.46s, finished 18:13:25 2021-05-04

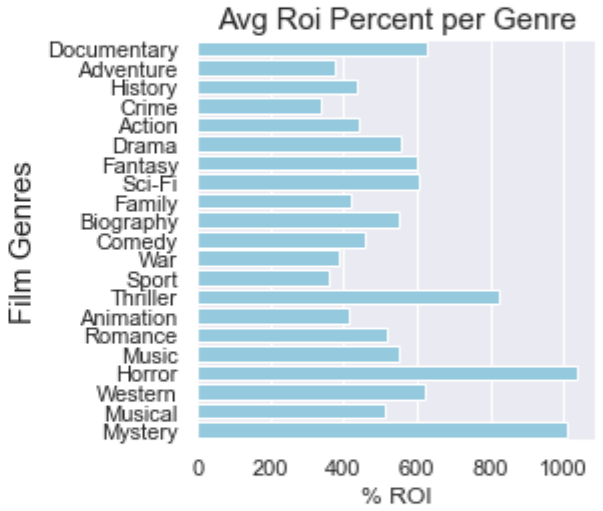


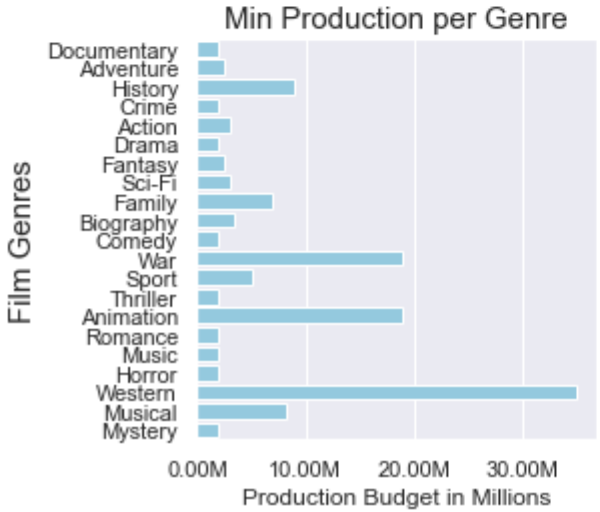


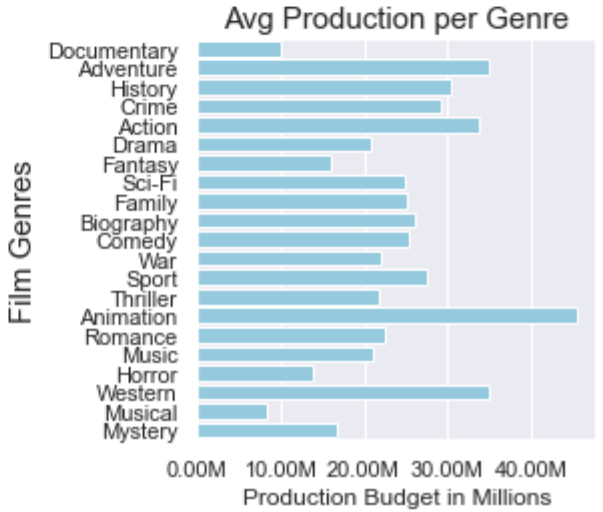












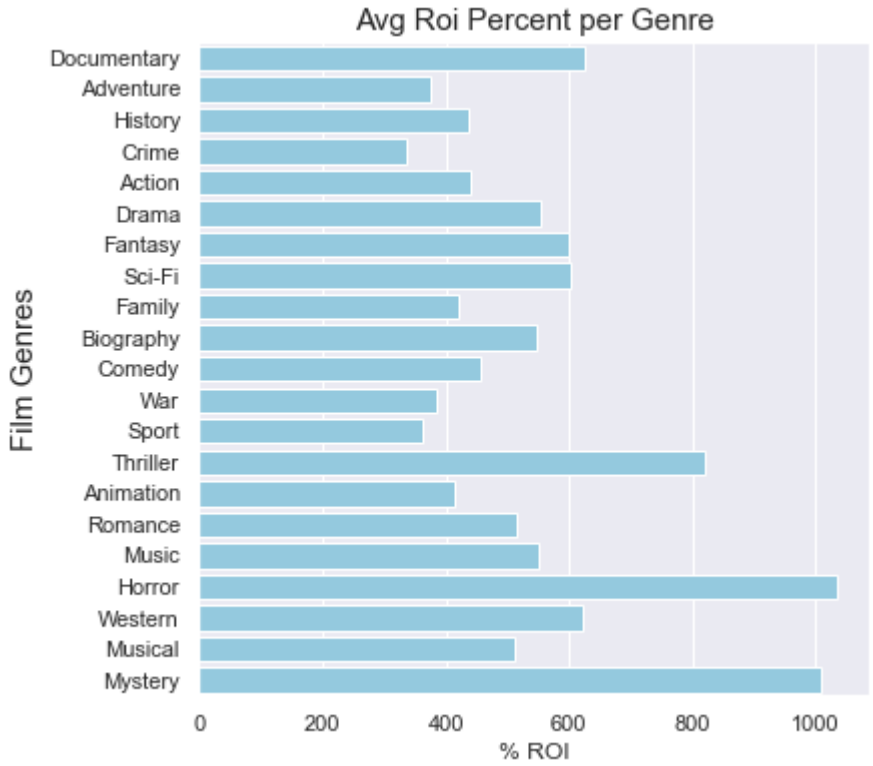
In [402]:
```
#Observations---Horror Mystery Thriller are top3 Average Return on budget.  Thriller is one of the top 3 in
```

executed in 15ms, finished 18:13:25 2021-05-04

In [ ]:

In [403]:
```
#This graph of subplots could be refactored to a function and could be reused
sns.set(style="darkgrid")
fig, ax4 = plt.subplots(figsize=(6,6),
                                                nrows=1,ncols=1, )
df_items4 = pd.DataFrame(avg_roi_genre.items())
ax4 = sns.barplot(data=df_items4, x=1, y=0, ax=ax4, color = 'skyblue')
ax4.set(xlabel = '% ROI', ylabel='Film Genre', title='Avg Roi Percent per Genre');
ax4.set_ylabel('Film Genres', fontsize=15)
ax4.set_title('Avg Roi Percent per Genre',fontsize=15)
# Save just the portion _inside_ the second axis's boundaries
extent = ax4.get_window_extent().transformed(fig.dpi_scale_trans.inverted())

# Pad the saved area by 10% in the x-direction and 20% in the y-direction
fig.savefig('./images/ax4_genre.png', bbox_inches=extent.expanded(1.1, 1.2))
```

executed in 484ms, finished 18:13:26 2021-05-04



In [ ]:

In [ ]:

Conclusion: Higher returns are with the Horror, Mystery, and Thriller genres.

4.2.3.1 How does MPAA Rating correlate?

In [404]:
```
#Lets Add in Movie MPAA Rating and exclude R to protect our parent name brand
#MPAA Rating is in the
df_budget_genres
```
executed in 44ms, finished 18:13:26 2021-05-04

Out[404]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_invest
0	65	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1	59.2
2	49	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4	51.1
4	51	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8	41.4
5	84	Oct 3, 2014	Annabelle	6500000.0	84273813.0	256862920.0	250362920.0	3851.7	39.5
7	56	Dec 21, 2016	Dangal	9500000.0	12391761.0	294654618.0	285154618.0	3001.6	31.0
...	...	...	...	...	...	...	...	...	...
539	81	Mar 4, 2011	The Adjustment Bureau	50200000.0	62495645.0	126931325.0	76731325.0	152.9	2.5
540	58	Mar 18, 2011	Paul	40000000.0	37412945.0	101162106.0	61162106.0	152.9	2.5
541	82	Dec 25, 2014	Unbroken	65000000.0	115637895.0	163527824.0	98527824.0	151.6	2.5
542	8	Dec 29, 2010	Another Year	8000000.0	3205706.0	20005613.0	12005613.0	150.1	2.5
543	81	Nov 11, 2016	Almost Christmas	17000000.0	42065185.0	42493506.0	25493506.0	150.0	2.5

428 rows × 35 columns

In [405]:
```
df_mpaa_ratings = pd.read_csv('./data/tn_mpaa_ratings.csv',index_col = 0, encoding='utf8')
```
executed in 13ms, finished 18:13:26 2021-05-04

In [406]:
```
df_mpaa_ratings.head(10)
```
executed in 15ms, finished 18:13:26 2021-05-04

Out[406]:

	Released	Title	ProductionBudget	WorldwideBox Office	mpaa_rating
0	Feb 11, 2011	Gnomeo and Juliet	$36,000,000	$193,737,977	G
1	Feb 11, 2011	Justin Bieber: Never Say Never	$13,000,000	$99,034,125	G
2	Jul 15, 2011	Winnie the Pooh	$30,000,000	$50,145,607	G
3	Jul 23, 2010	Ramona and Beezus	$15,000,000	$27,469,621	G
4	Feb 17, 2012	Kari gurashi no Arietti	$23,000,000	$151,496,097	G
5	Dec 13, 2011	George Balanchine's The Nutcracker	$19,000,000	$2,119,994	G
6	Oct 21, 2011	The Mighty Macs	$7,000,000	$1,891,936	G
7	Aug 29, 2012	The Oogieloves in the BIG Balloon Adv…	$20,000,000	$1,065,907	G
8	Oct 4, 2011	La vÃ©ritable histoire du Chat BottÃ©	$25,000,000	$8,208,594	G
9	Dec 31, 2012	Zambezia	$20,000,000	$34,454,336	G

In [407]:
```
#We will do a left join on the successful movies and the imdb basics
#keying on movie name and year of release
df_budget_genre_ratings = pd.merge(df_budget_genres, df_mpaa_ratings,
                           left_on=  ['movie',
                                      pd.to_datetime(df_budget_genres['release_date']).dt.year],
                           right_on= ['Title',
                                      pd.to_datetime(df_mpaa_ratings['Released']).dt.year],
                           how = 'left')
```
executed in 248ms, finished 18:13:26 2021-05-04

In [408]:
```
df_budget_genre_ratings = df_budget_genre_ratings[df_budget_genre_ratings['mpaa_rating'].notna()]
```
executed in 13ms, finished 18:13:26 2021-05-04

In [409]:
```
df_budget_genre_ratings.head()
```
executed in 29ms, finished 18:13:26 2021-05-04

Out[409]:

	id	key_1	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_in
0	65	2010	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1	
1	49	2017	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4	
2	51	2011	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8	
5	67	2013	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2	
6	67	2013	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2	

5 rows × 41 columns

In [410]:
```
df_budget_genre_ratings.drop(columns=['id', 'key_1','primary_title',
                                      'original_title','Released',
                                      'ProductionBudget',
                                      'WorldwideBox Office','runtime_minutes'],
                             inplace=True)
```
executed in 14ms, finished 18:13:26 2021-05-04

In [411]:
```
df_budget_genre_ratings.reset_index(inplace=True)
```
executed in 14ms, finished 18:13:26 2021-05-04

In [412]:
```
df_budget_genre_ratings
```
executed in 45ms, finished 18:13:26 2021-05-04

Out[412]:

	index	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_inve
0	0	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1	59
1	1	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4	51
2	2	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8	41
3	5	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2	30
4	6	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2	30
...	...	...	...	...	...	...	...	...	
399	451	Mar 4, 2011	The Adjustment Bureau	50200000.0	62495645.0	126931325.0	76731325.0	152.9	2
400	452	Mar 18, 2011	Paul	40000000.0	37412945.0	101162106.0	61162106.0	152.9	2
401	453	Dec 25, 2014	Unbroken	65000000.0	115637895.0	163527824.0	98527824.0	151.6	2
402	454	Dec 29, 2010	Another Year	8000000.0	3205706.0	20005613.0	12005613.0	150.1	2
403	455	Nov 11, 2016	Almost Christmas	17000000.0	42065185.0	42493506.0	25493506.0	150.0	2

404 rows × 34 columns

In [413]:
```
df_budget_genre_ratings.drop(columns=['index'], inplace=True)
```
executed in 14ms, finished 18:13:26 2021-05-04

In [414]:
```
df_budget_genre_ratings.head()
```
executed in 30ms, finished 18:13:26 2021-05-04

Out[414]:

	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_invest	start_
0	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1	59.2	2
1	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4	51.1	2
2	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8	41.4	1
3	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2	30.4	2
4	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2	30.4	2

5 rows × 33 columns

In [415]:
```
df_budget_genre_ratings.mpaa_rating.value_counts()
```
executed in 13ms, finished 18:13:26 2021-05-04

Out[415]:
```
R        193
PG-13    173
PG        37
G          1
Name: mpaa_rating, dtype: int64
```

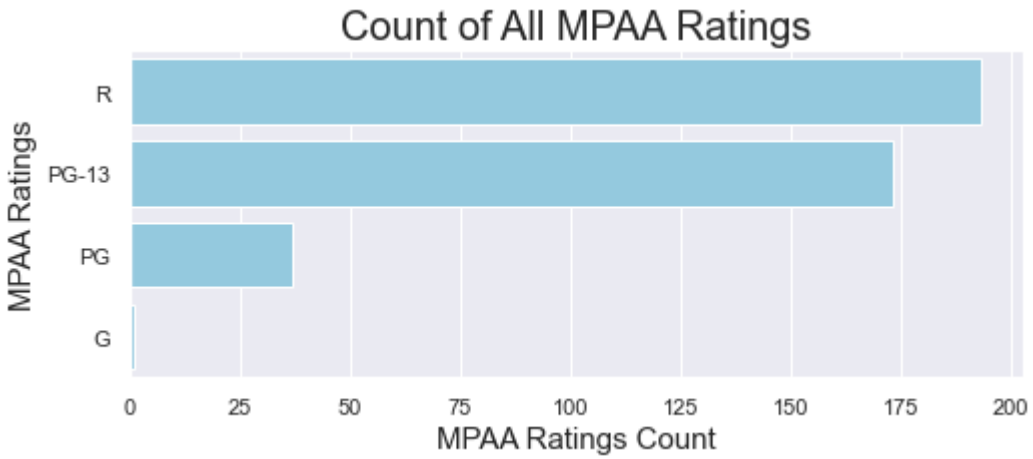
In [416]:
```
ratings = ['R','PG-13','PG','G']
```
executed in 13ms, finished 18:13:26 2021-05-04

In [417]:
```
ratingsvalues = list(df_budget_genre_ratings.mpaa_rating.value_counts())
```
executed in 13ms, finished 18:13:26 2021-05-04

In [418]:
```
ratingsvalues
```
executed in 14ms, finished 18:13:26 2021-05-04

Out[418]: [193, 173, 37, 1]

In [419]:
```
#Histogram of Production budget bins

sns.set(style="darkgrid")
fig, ax1 = plt.subplots(figsize=(8,3))

histplot = sns.barplot(y = ratings, x = ratingsvalues, color = 'skyblue',
                       label='Count of MPAA Rating')

ax1.set_xlabel('MPAA Ratings Count', fontsize=15)
ax1.set_ylabel('MPAA Ratings', fontsize=15)
ax1.set_title('Count of All MPAA Ratings',fontsize=20)
#Set the Average Line

#ax1.set(xlim = (0,250))

#ax1.legend(loc='upper right')
plt.show();
```
executed in 235ms, finished 18:13:27 2021-05-04



In [420]:
```
df_budget_genre_ratings
```
executed in 45ms, finished 18:13:27 2021-05-04

Out[420]:

	release_date	movie	production_budget	domestic_gross	worldwide_gross	profit_over_pb	roi_percent	x_times_invest	sta
0	Oct 20, 2010	Paranormal Activity 2	3000000.0	84752907.0	177512032.0	174512032.0	5817.1	59.2	
1	Feb 24, 2017	Get Out	5000000.0	176040665.0	255367951.0	250367951.0	5007.4	51.1	
2	Oct 21, 2011	Paranormal Activity 3	5000000.0	104028807.0	207039844.0	202039844.0	4040.8	41.4	
3	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2	30.4	
4	Jun 7, 2013	The Purge	3000000.0	64473115.0	91266581.0	88266581.0	2942.2	30.4	
...	...	...	...	...	...	...	...	...	
399	Mar 4, 2011	The Adjustment Bureau	50200000.0	62495645.0	126931325.0	76731325.0	152.9	2.5	
400	Mar 18, 2011	Paul	40000000.0	37412945.0	101162106.0	61162106.0	152.9	2.5	
401	Dec 25, 2014	Unbroken	65000000.0	115637895.0	163527824.0	98527824.0	151.6	2.5	
402	Dec 29, 2010	Another Year	8000000.0	3205706.0	20005613.0	12005613.0	150.1	2.5	
403	Nov 11, 2016	Almost Christmas	17000000.0	42065185.0	42493506.0	25493506.0	150.0	2.5	

404 rows × 33 columns

In [421]:
```
grouped = df_budget_genre_ratings.groupby(by ='mpaa_rating').mean()
```
executed in 14ms, finished 18:13:27 2021-05-04

In [422]:
```
avg_roi_by_rating[ratings] = grouped.iloc[1]['roi_percent']
```
executed in 14ms, finished 18:13:27 2021-05-04

```
---------------------------------------------------------------------------
NameError                                 Traceback (most recent call last)
<ipython-input-422-49c89dc1aed1> in <module>
----> 1 avg_roi_by_rating[ratings] = grouped.iloc[1]['roi_percent']

NameError: name 'avg_roi_by_rating' is not defined
```

In [ ]:
```
avg_roi_by_rating
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
df_not_R = df_budget_genre_ratings[df_budget_genre_ratings['mpaa_rating'] != 'R']
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
df_not_R
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
#making a list of all columns
colsnotr = list(df_not_R.columns)
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
colsnotr
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
genre_colsnotr = cols[14:36]
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
df_not_R
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
genre_colsnotr = cols[14:36]

#getting a dict with genre counts
genre_countnotr = {}
for col in genre_cols:
    count = np.sum(df_not_R[col] == 1).sum()
    genre_countnotr[col] = count
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
genre_countnotr
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
keys_notr = list(genre_countnotr.keys())
values_notr = list(genre_countnotr.values())
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
#Histogram of Genres Counts

sns.set(style="darkgrid")
fig, ax1 = plt.subplots(figsize=(12,4),sharex=True ,sharey=True)

histplot = sns.barplot(y = keys_notr, x = values_notr, color = 'skyblue',
                       label='Count of Genre Tags')

ax1.set_xlabel('Genre Count', fontsize=15)
ax1.set_ylabel('Film Genres', fontsize=15)
ax1.set_title('Count of All Distinct Genres not R rated',fontsize=20)
#Set the Average Line

ax1.set(xlim = (0,140))

ax1.legend(loc='upper right')
plt.show();
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```

```

In [ ]:
```
#Average Roi% by Genre
max_roi_genrenotr= {}
for genre in all_genresnotr:
    grouped = df_not_R.groupby(by =''.join(genre)).max()
    max_roi_genrenotr[genre] = grouped.iloc[0]['roi_percent']
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
#Average Roi% by Genre
avg_roi_genrenotr= {}
for genre in all_genresnotr:
    grouped = df_not_R.groupby(by =''.join(genre)).mean()
    avg_roi_genrenotr[genre] = grouped.iloc[0]['roi_percent']
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
#Average Gross by Genre
ww_gross_avgnotr = {}
for genre in all_genresnotr:
    grouped = df_not_R.groupby(by =''.join(genre)).mean()
    ww_gross_avg[genre] = grouped.iloc[0]['worldwide_gross']
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
#Average PB by Genre
pb_avgnotr = {}
for genre in all_genresnotr:
    grouped = df_not_R.groupby(by =''.join(genre)).mean()
    pb_avgnotr[genre] = grouped.iloc[0]['production_budget']
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
max_pb_genrenotr = {}
for genre in all_genresnotr:
    grouped = df_not_R.groupby(by =''.join(genre)).max()
    max_pb_genrenotr[genre] = grouped.iloc[0]['production_budget']
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
max_roi_genrenotr
```
executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:

```
#a set of distinct genres in the df
all_genresnotr = set()
for genres in df_not_R['genres']:
    if genres:
        all_genresnotr.update(genres)
```

executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:

```
#Genre Grid
#This graph of subplots could be refactored to a function and could be reused
sns.set(style="darkgrid")
fig, ((ax3, ax4), (ax5, ax6)) = plt.subplots(figsize=(10,12),
                                             nrows=2,ncols=2, )
max_roi_genrenotr
df_items3 = pd.DataFrame(max_roi_genrenotr.items())
ax3 = sns.barplot(data=df_items3, x=1, y=0, ax=ax3, color = 'skyblue')
ax3.set(xlabel = '% ROI', ylabel='Film Genre', title='Max Roi Percent per Genre');
ax3.set_ylabel('Film Genres', fontsize=15)
ax3.set_title('Max Roi Percent per Genre',fontsize=15)



df_items4 = pd.DataFrame(avg_roi_genrenotr.items())
ax4 = sns.barplot(data=df_items4, x=1, y=0, ax=ax4, color = 'skyblue')
ax4.set(xlabel = '% ROI', ylabel='Film Genre', title='Avg Roi Percent per Genre');
ax4.set_ylabel('Film Genres', fontsize=15)
ax4.set_title('Avg Roi Percent per Genre',fontsize=15)

df_items5 = pd.DataFrame(max_pb_genrenotr.items())
ax5 = sns.barplot(data=df_items5, x=1, y=0, ax=ax5, color = 'skyblue')
ax5.set(xlabel = 'PB', ylabel='Film Genre', title='Max PB per Genre');
ax5.set_ylabel('Film Genres', fontsize=15)
ax5.set_title('Max PB per Genre',fontsize=15)
# fixing xticks warning with matplotlib.ticker "FixedLocator"
ticks_loc = ax5.get_xticks().tolist()
ax5.xaxis.set_major_locator(mticker.FixedLocator(ticks_loc))
ax5.set_xticklabels(['{:,.0f}'.format(x/1000000) + 'M' for x in ticks_loc])

df_items6 = pd.DataFrame(pb_avgnotr.items())
ax6 = sns.barplot(data=df_items6, x=1, y=0, ax=ax6, color = 'skyblue')
ax6.set(xlabel = 'Production Budget in Millions', ylabel='Genre', title='Avg Production per Genre')
ax6.set_ylabel('Film Genres', fontsize=15)
ax6.set_title('Avg Production per Genre',fontsize=15)
# fixing xticks warning with matplotlib.ticker "FixedLocator"
ticks_loc = ax6.get_xticks().tolist()
ax6.xaxis.set_major_locator(mticker.FixedLocator(ticks_loc))
ax6.set_xticklabels(['{:,.0f}'.format(x/1000000) + 'M' for x in ticks_loc])

plt.subplots_adjust(wspace=0.8,hspace=.4)
plt.show();
```

executed in 22.0s, finished 18:13:27 2021-05-04

In [ ]:
```
sns.set(style="darkgrid")
fig, ax4 = plt.subplots(figsize=(6,6),nrows=1,ncols=1, )

df_items4 = pd.DataFrame(avg_roi_genrenotr.items())
ax4 = sns.barplot(data=df_items4, x=1, y=0, ax=ax4, color = 'skyblue')
ax4.set(xlabel = '% ROI', ylabel='Film Genre', title='Avg Roi Percent per Genre');
ax4.set_ylabel('Film Genres', fontsize=15)
ax4.set_title('Avg Roi Percent per Genre',fontsize=15)
```
executed in 21.9s, finished 18:13:27 2021-05-04

Conclusion: Genres higher average returns are with R rating are Horror, Mystery and Thrillers. Excluding R ratings, Comedy has a higher ROI% closely followed by Adventure, Crime, Action, Sport, Romance. Anything really except Horror, Drama are worst when not R rated but not by much.

4.2.4 Question: When should we most optimally release our movies? Are there better months for our releases?

In answering the question When to Release the movie lets look to see when previous movies were released. Lets make a column for release month.

In [ ]:
```
df_budget_genres.head()
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_budget_genres['release_month'] = pd.to_datetime(df_budget_genres.release_date).dt.strftime('%b')
#df_budget_genres['release_month'] = pd.to_datetime(df_budget_genres.release_date).dt.month
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_budget_genres.head()
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_budget_genres
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
pd.to_datetime(df_budget_genres['release_date']).dt.year
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_budget_genres['month'] = pd.to_datetime(df_budget_genres['release_date']).dt.month
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_budget_genres.sort_values(by='month', inplace=True)
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
##Histplot of movies release in month
sns.set(style="darkgrid")
fig, (ax1, ax2) = plt.subplots(figsize=(16,6),nrows =2, ncols=1,sharex=True ,sharey=False)
ax1 = sns.histplot(df_budget_genres, x="release_month",bins=12,shrink=.8, ax=ax1)
ax1.set(xlabel = 'Month of Film Release', ylabel='Number of Films', title='Count per Month')

sns.boxplot(x='release_month',y='roi_percent',data=df_budget_genres,ax=ax2,
            palette='cool',fliersize=0)
ax2.set(xlabel = 'Month vs ROI %', ylabel='ROI %', )
ax2.set_ylim(top=1600)
ax2.axhline(y=570)

plt.subplots_adjust(wspace=0.8, hspace=0.05)
plt.show();
```
executed in 21.9s, finished 18:13:27 2021-05-04

Conclusion: Some very good high returns on investment occurred in the months of October and December. The median returns per month are similar and all under the 10 times investment. There is a down trend with September and May not having huge gains. October could be closely related with Halloween and Horror and/or Thriler movies. Safe months are June, July, Aug, Oct Nov.

4.2.5 Question: How many feature films should we release per year? ie drives initial investment

#How many movies a year? Lets Look at the successful studios number a year. df_bom has studio info...We can join on budget genres to get month and year.

In [ ]:
```
df_bom.head()
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_budget_genres.info()
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_studios_bud_genres = pd.merge(df_budget_genres, df_bom,
                                 left_on=  ['movie',pd.to_datetime(df_budget_genres['release_date']).dt.year],
                                 right_on= ['title','year'],
                                 how = 'left')
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_studios_bud_genres[df_studios_bud_genres.studio.isna()]
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_bom[df_bom.index== 'Get Out']
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_studios_bud_genres = df_studios_bud_genres[df_studios_bud_genres.studio.notna()]
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
#a set of distinct genres in the df
all_studios = set(df_studios_bud_genres['studio'])
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
all_studios
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
#getting a dict with Studio counts
studio_count = {}
for col in genre_cols:
    count = np.sum(df_budget_genres[col] == 1).sum()
    genre_count[col] = count
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_studios_bud_genres['studio'].value_counts()
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
studio_count = dict(df_studios_bud_genres['studio'].value_counts())
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
studio_count
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_bom_studio = df_bom.groupby(by=['studio','year']).count()
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_bom_studio
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_bom_studio_pivott = df_bom.pivot_table(index='studio' ,values='worldwide_gross',
                                          columns='year',
                                          margins=True,margins_name='count',
                                          aggfunc='count',fill_value=0)
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```

df_bom_studio_pivott.sort_values(['count'], ascending=[False], inplace=True)
df_bom_studio_pivott
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
type(df_bom_studio)
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
testpiv = df_bom_studio_pivott[1:21]
```
executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
mask=[False, False, False, False, False, False,
                        False, False, False,True]
# use Seaborn styles
sns.set()
fig, ax9 = plt.subplots(figsize=(12, 8))

ax9 = sns.heatmap(annot=True, fmt="d", linewidths=.5,data=testpiv, ax=ax9, cmap='coolwarm',mask=mask)
ax9.set(xlabel = 'Film Year', ylabel='Film Studio', title='Studio Films per Year ')
plt.show()
```

executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
# of the Successful movies number per year
#df_studios_bud_genres['studio'].value_counts())
df_studio_budget_pivott = df_studios_bud_genres.pivot_table(index='studio' ,values='worldwide_gross_x',
                                        columns='year',
                                        margins=True,margins_name='count',
                                        aggfunc='count',fill_value=0)
```

executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```
df_studio_budget_pivott.sort_values(['count'], ascending=[False], inplace=True)
```

executed in 21.9s, finished 18:13:27 2021-05-04

In [ ]:
```

```

executed in 17ms, finished 09:58:25 2021-04-29

In [ ]:
```
mask=[False, False, False, False, False, False,
                        False, False, False,True]
# use Seaborn styles
sns.set()
fig, ax10 = plt.subplots(figsize=(12, 8))

ax10 = sns.heatmap(annot=True, fmt="d", linewidths=.5,data=df_studio_budget_pivott[1:21], ax=ax10, cmap='coo
ax10.set(xlabel = 'Film Year', ylabel='Film Studio', title='Successful Films per Year ')
fig.savefig('./images/SuccessFilmsYear.png', bbox_inches='tight')
plt.show()
```

executed in 21.8s, finished 18:13:27 2021-05-04

In [ ]:

```
```

Conclusion: With a max of 9 successful films a year is spectacular, a safe bet looks to be 3 to 5 starting out.

4.2.6 Question: What are the sources of the movies?

We scraped some data from TheNumbers which had the source material.

In [ ]:

```
df_movie_source = pd.read_csv('./data/tn_moviesource.csv',index_col = 0, encoding='utf8')
```

executed in 21.8s, finished 18:13:27 2021-05-04

In [ ]:

```
df_movie_source['Source'].value_counts()
```

executed in 21.8s, finished 18:13:27 2021-05-04

In [ ]:

```
df_budget_genre_ratings_source = pd.merge(df_budget_genre_ratings, df_movie_source,
                            left_on=  ['movie'],
                            right_on= ['Title'],
                            how = 'left')
```

executed in 21.8s, finished 18:13:27 2021-05-04

In [ ]:

```
df_budget_genre_ratings_source.columns
```

executed in 21.8s, finished 18:13:27 2021-05-04

In [ ]:

```
df_budget_genre_ratings_source.drop(columns=['Title','Released_y','Released_x', 'Title_y',
                                             'Source_x','Released_x', 'Title_y', 'Source_x'],inplace=True)
```

executed in 21.8s, finished 18:13:27 2021-05-04

In [ ]:

```
df_budget_genre_ratings_source
```

executed in 21.8s, finished 18:13:27 2021-05-04

In [ ]:
```
sourcecounts = df_budget_genre_ratings_source['Source_y'].value_counts(ascending=False).to_frame()
```
executed in 21.8s, finished 18:13:27 2021-05-04

In [ ]:
```
sourcecounts
```
executed in 21.8s, finished 18:13:27 2021-05-04

Conclusion: Original Screenplay 219 , Based on book or short story 70, Real Life Events 48

5 Conclusions

Empower Studios Portfolio Strategy includes: Either
Embrace R
Horror Mystery Thriller Highest ROI%
Have the highest average return on Investment.
or
Produce No R Drama, Comedy and Romance, or any except Horror aka Disney Approach

Both Plans include
Produce 5 to 8 films per year in the <$20M budget Range
Release in Summer or late Fall
Looking for 50% Original Content 50% Book Source or Factual Events other

5.1 Next Steps

Analysis of Successful Producers, Directors, Cinematographers, Actors
Associating critical rating with success
Academy Awards nominations with successful box office

In [ ]: