1 How a company squeezes into "making movie business" and gets successful

Phase 1 Final Project

Authors: Elena Kazakova
Cohort: DS02222021
Instructor: James Irving

1.1 Overview

This project analyzes the three publically avalable online databases, IMDb, TN and BOM. IMDb (an acronym for Internet Movie Database) is an online database of information related to films, television programs, home videos, video games, and streaming content online. The Numbers (TN) is a film industry data website that tracks box office revenue in a systematic, algorithmic way.Box Office Mojo (BOM) is an American website that tracks box-office revenue in a systematic, algorithmic way. Exploratory and descriptive analysis suggests that a company looking into joining lucrative movie business needs to partner with the studios producing the highest ROIs, look into investing into making movies in Horror, Mystery and Thriller genres and carefully plan the release date of their products.

1.2 Business Problem

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 producing movies. They need recommendations on how to minimize the risk to their investment

and maximize the profitability of their future products. Though the scope of this project is limited and further in-depth analysis should be considered, the results of the analysis reveals several valuable recommendations.

1.3 Data Understanding

As pointed in the overview section, the project uses the data from three databases already available as zipped csv files imported from IMDb, TN, and BOM databases. Additional data from Rotten Tomatoes (RT) and The Movie Database (TMdb) were explored and initially considered, and it has been decided not to use this information in the analysis performed. This data might be considered for future exploration. An analysis of the content in all the sources available was performed to aid in making this decision. The data diagram of all the tables was created, and only tables with movie financial and most easily joined tables have been chosen for further analysis. The rest of the tables should be considered for performing analysis of ratings and professional staff performance. Another consideration for the data sources' choice was the number of movie records available in each of the tables. Please see below the description and the results of data sources analysis.

In [1]:
```
# Import standard packages to be used in the process, it essential to run me
import pandas as pd
from pandasql import sqldf
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import gzip
import shutil
import os
import sqlite3
from sqlite3 import Error
import csv
import io
import warnings
warnings.filterwarnings(action='ignore', category=FutureWarning)


%matplotlib inline
```

executed in 955ms, finished 17:25:49 2021-03-28

In [1]:
```
#!rm data/sqlite/db/movies.db
```

executed in 4ms, finished 18:55:38 2021-03-28

1.3.1 Unzipping the source csv and tsv files and converting them into movies.db tables

In [3]:
```
# This function might not be needed but is left here just in case I need and

def insert_nulls(table_name):
    q1 = 'SELECT * FROM '+ table_name+''
    df = pd.DataFrame(cur.execute(q1))
    df.columns = [x[0] for x in cur.description]
    column_names=list(df.columns)

# dictReader reads empty values as '', they need to be replaced with Nulls i
    for i in column_names:
        q2='UPDATE '+table_name+' SET '+i+' =NULL WHERE '+i+'=""'
        cur.execute(q2)
    return
```

executed in 15ms, finished 17:25:49 2021-03-28

In [4]:
```
# This function is needed to easily display the dataframe from a table with

def display_tableDF(table_name):
    q1 = 'SELECT * FROM '+ table_name+''
    df = pd.DataFrame(cur.execute(q1))
    df.columns = [x[0] for x in cur.description]
    return df
```

executed in 15ms, finished 17:25:49 2021-03-28

In [5]:
```
# This function is needed to easily display the dataframe from a csv file wi

def display_csvfileDF(file_name):
    df = pd.read_csv('data/unzippedData/'+file_name, header=0, encoding='UTF
    return df
```

executed in 15ms, finished 17:25:49 2021-03-28

In [6]:
```
# This function is needed to easily display the dataframe from a tsv file wi
def display_tsvfileDF(file_name):
    df = pd.read_csv('data/unzippedData/'+file_name, sep = '\t', header=0, e
    return df
```

executed in 15ms, finished 17:25:49 2021-03-28

In [7]:
```
def table_query(q):
    df = pd.DataFrame(cur.execute(q))
    df.columns = [x[0] for x in cur.description]
    return df
```

executed in 15ms, finished 17:25:49 2021-03-28

Unzipping the files

In [8]:
```
# Testing unzipping the gz file

# The first step to unzip the files provided is to create a separate directo
# the address is  ~/Documents/Flatiron/Phase1/Project/dsc-project-template/d

with gzip.open('data/zippedData/bom.movie_gross.csv.gz') as f:
            bom_movie_gross = pd.read_csv(f)
bom_movie_gross.head()
```

executed in 31ms, finished 17:25:49 2021-03-28

Out[8]:

	title	studio	domestic_gross	foreign_gross	year
0	Toy Story 3	BV	415000000.0	652000000	2010
1	Alice in Wonderland (2010)	BV	334200000.0	691300000	2010
2	Harry Potter and the Deathly Hallows Part 1	WB	296000000.0	664300000	2010
3	Inception	WB	292600000.0	535700000	2010
4	Shrek Forever After	P/DW	238700000.0	513900000	2010

In [9]:
```
#Testing Saving the file above as an csv file to a directory where unzipped

with gzip.open('data/zippedData/bom.movie_gross.csv.gz', 'rb') as f_out:
    with open('data/unzippedData/bom.movie_gross.csv', 'wb') as f_in:
        shutil.copyfileobj(f_out, f_in)
```

executed in 15ms, finished 17:25:49 2021-03-28

In [10]:
```
# Creating a list of file names to loop throught unzipping;

# Unzipping the files in the list of gz files

file_list_to_unzip_raw = ['bom.movie_gross.csv.gz', 'imdb.name.basics.csv.gz
                          'imdb.title.basics.csv.gz', 'imdb.title.crew.csv.g
                          'imdb.title.ratings.csv.gz', 'rt.movie_info.tsv.gz
                          'tmdb.movies.csv.gz', 'tn.movie_budgets.csv.gz']
addition_path_from = 'data/zippedData/'
addition_path_to = 'data/unzippedData/'
for file in file_list_to_unzip_raw:
    with gzip.open(addition_path_from + file, 'rb') as f_out:
        with open(addition_path_to + file[0:-3], 'wb') as f_in:
            shutil.copyfileobj(f_out, f_in)
```

executed in 734ms, finished 17:25:50 2021-03-28

In [11]:
```
# Checking the content of the data/zippedData directory

!ls -l data/zippedData/
```

executed in 47ms, finished 17:25:50 2021-03-28

```
total 45716
-rw-r--r-- 1 elena 197121    53544 Mar 13 22:49 bom.movie_gross.csv.gz
-rw-r--r-- 1 elena 197121 18070960 Mar 13 22:49 imdb.name.basics.csv.gz
-rw-r--r-- 1 elena 197121  5599979 Mar 13 22:49 imdb.title.akas.csv.gz
-rw-r--r-- 1 elena 197121  3459897 Mar 13 22:49 imdb.title.basics.csv.gz
-rw-r--r-- 1 elena 197121  1898523 Mar 13 22:49 imdb.title.crew.csv.gz
-rw-r--r-- 1 elena 197121 12287583 Mar 13 22:49 imdb.title.principals.csv.gz
-rw-r--r-- 1 elena 197121   539530 Mar 13 22:49 imdb.title.ratings.csv.gz
-rw-r--r-- 1 elena 197121   498202 Mar 13 22:49 rt.movie_info.tsv.gz
-rw-r--r-- 1 elena 197121  3402194 Mar 13 22:49 rt.reviews.tsv.gz
-rw-r--r-- 1 elena 197121   827840 Mar 13 22:49 tmdb.movies.csv.gz
-rw-r--r-- 1 elena 197121   153218 Mar 13 22:49 tn.movie_budgets.csv.gz
```

In [12]:
```
# Checking if all the files have been unzipped

!ls -l data/unzippedData/
```

executed in 79ms, finished 17:25:50 2021-03-28

```
total 147828
-rw-r--r-- 1 elena 197121   142555 Mar 28 17:25 bom.movie_gross.csv
-rw-r--r-- 1 elena 197121 48926352 Mar 28 17:25 imdb.name.basics.csv
-rw-r--r-- 1 elena 197121 18945529 Mar 28 17:25 imdb.title.akas.csv
-rw-r--r-- 1 elena 197121 11852240 Mar 28 17:25 imdb.title.basics.csv
-rw-r--r-- 1 elena 197121  5728745 Mar 28 17:25 imdb.title.crew.csv
-rw-r--r-- 1 elena 197121 50505795 Mar 28 17:25 imdb.title.principals.csv
-rw-r--r-- 1 elena 197121  1950137 Mar 28 17:25 imdb.title.ratings.csv
-rw-r--r-- 1 elena 197121  1184685 Mar 28 17:25 rt.movie_info.tsv
-rw-r--r-- 1 elena 197121  9395716 Mar 28 17:25 rt.reviews.tsv
-rw-r--r-- 1 elena 197121  2301228 Mar 28 17:25 tmdb.movies.csv
-rw-r--r-- 1 elena 197121   422521 Mar 28 17:25 tn.movie_budgets.csv
```

Result: All the files unzipped correctly

Tesing converting the unzipped files to DataFrames

In [13]:
```
#Testing conversion of an unzipped tsv file into a DataFrame and printing in

rt_movie_info = pd.read_csv('data/unzippedData/rt.reviews.tsv', sep = '\t',
print(rt_movie_info.info())
rt_movie_info.head()
```

executed in 142ms, finished 17:25:50 2021-03-28

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 54432 entries, 0 to 54431
Data columns (total 8 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   id          54432 non-null  int64 
 1   review      48869 non-null  object
 2   rating      40915 non-null  object
 3   fresh       54432 non-null  object
 4   critic      51710 non-null  object
 5   top_critic  54432 non-null  int64 
 6   publisher   54123 non-null  object
 7   date        54432 non-null  object
dtypes: int64(2), object(6)
memory usage: 3.3+ MB
None
```

Out[13]:

	id	review	rating	fresh	critic	top_critic	publisher	date
0	3	A distinctly gallows take on contemporary fina...	3/5	fresh	PJ Nabarro	0	Patrick Nabarro	November 10, 2018
1	3	It's an allegory in search of a meaning that n...	NaN	rotten	Annalee Newitz	0	io9.com	May 23, 2018
2	3	... life lived in a bubble in financial dealin...	NaN	fresh	Sean Axmaker	0	Stream on Demand	January 4, 2018
3	3	Continuing along a line introduced in last yea...	NaN	fresh	Daniel Kasman	0	MUBI	November 16, 2017
4	3	... a perverse twist on neorealism...	NaN	fresh	NaN	0	Cinema Scope	October 12, 2017

In [14]:
```
#Testing conversion of an unzipped csv file into a DataFrame and printing in

imdb_name_basics = pd.read_csv('data/unzippedData/imdb.name.basics.csv', hea
print(imdb_name_basics.info())
imdb_name_basics.head()
```

executed in 975ms, finished 17:25:51 2021-03-28

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 606648 entries, 0 to 606647
Data columns (total 6 columns):
 #   Column              Non-Null Count   Dtype  
---  ------              --------------   -----  
 0   nconst              606648 non-null  object 
 1   primary_name        606648 non-null  object 
 2   birth_year          82736 non-null   float64
 3   death_year          6783 non-null    float64
 4   primary_profession  555308 non-null  object 
 5   known_for_titles    576444 non-null  object 
dtypes: float64(2), object(4)
memory usage: 27.8+ MB
None
```

Out[14]:

	nconst	primary_name	birth_year	death_year	primary_profe
0	nm0061671	Mary Ellen Bauder	NaN	NaN	miscellaneous,production_manager
1	nm0061865	Joseph Bauer	NaN	NaN	composer,music_department,sound_de
2	nm0062070	Bruce Baum	NaN	NaN	miscellaneous,a
3	nm0062195	Axel Baumann	NaN	NaN	camera_department,cinematographer,art_de
4	nm0062798	Pete Baxter	NaN	NaN	production_designer,art_department,set_

Creating DataFrames out of all unzipped files and displaying all DF info for each

In [15]:
```
#Leaving this code for now, most probably needs to be removed

#listing the files in the unzipped directory to make a list with path define
list_unzipped_files = os.listdir('data/unzippedData')
list_unzipped_files
```

executed in 15ms, finished 17:25:51 2021-03-28

Out[15]:
```
['bom.movie_gross.csv',
 'imdb.name.basics.csv',
 'imdb.title.akas.csv',
 'imdb.title.basics.csv',
 'imdb.title.crew.csv',
 'imdb.title.principals.csv',
 'imdb.title.ratings.csv',
 'rt.movie_info.tsv',
 'rt.reviews.tsv',
 'tmdb.movies.csv',
 'tn.movie_budgets.csv']
```

In [16]:
```
list_csv_files=[]
list_tsv_files=[]

for i in list_unzipped_files:
    if i[-3:]=='csv':
        list_csv_files.append(i)
    else:
        list_tsv_files.append(i)
print(list_csv_files)
print(list_tsv_files)
```

executed in 15ms, finished 17:25:51 2021-03-28

```
['bom.movie_gross.csv', 'imdb.name.basics.csv', 'imdb.title.akas.csv', 'imdb.ti
tle.basics.csv', 'imdb.title.crew.csv', 'imdb.title.principals.csv', 'imdb.titl
e.ratings.csv', 'tmdb.movies.csv', 'tn.movie_budgets.csv']
['rt.movie_info.tsv', 'rt.reviews.tsv']
```

In [17]:
```
#Creating an empty sqlite3 movies database. The directory sqlite within data
#sqlite directory was created in bash terminal by mkdir data/sqlite/db

conn = sqlite3.connect('data/sqlite/db/movies.db')
cur = conn.cursor()
```

executed in 14ms, finished 17:25:51 2021-03-28

In [18]:
```
# Checking if the database has no tables

cur.execute("""SELECT name FROM sqlite_master WHERE type='table'""").fetchal
```

executed in 15ms, finished 17:25:51 2021-03-28

Out[18]:
```
[]
```

Displaying files info in order to create a data diagram

In [19]:
```
for i in list_tsv_files:
    print(i)
    display_tsvfileDF(i).info()
    print('************************************************************')
```

executed in 159ms, finished 17:25:52 2021-03-28

```
rt.movie_info.tsv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1560 entries, 0 to 1559
Data columns (total 12 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
 0   id            1560 non-null   int64 
 1   synopsis      1498 non-null   object
 2   rating        1557 non-null   object
 3   genre         1552 non-null   object
 4   director      1361 non-null   object
 5   writer        1111 non-null   object
 6   theater_date  1201 non-null   object
 7   dvd_date      1201 non-null   object
 8   currency      340 non-null    object
 9   box_office    340 non-null    object
 10  runtime       1530 non-null   object
 11  studio        494 non-null    object
dtypes: int64(1), object(11)
memory usage: 146.4+ KB
************************************************************
rt.reviews.tsv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 54432 entries, 0 to 54431
Data columns (total 8 columns):
 #   Column      Non-Null Count  Dtype 
---  ------      --------------  ----- 
 0   id          54432 non-null  int64 
 1   review      48869 non-null  object
 2   rating      40915 non-null  object
 3   fresh       54432 non-null  object
 4   critic      51710 non-null  object
 5   top_critic  54432 non-null  int64 
 6   publisher   54123 non-null  object
 7   date        54432 non-null  object
dtypes: int64(2), object(6)
memory usage: 3.3+ MB
************************************************************
```

In [20]:
```
for i in list_csv_files:
    print(i)
    display_csvfileDF(i).info()
    print('************************************************************')
```

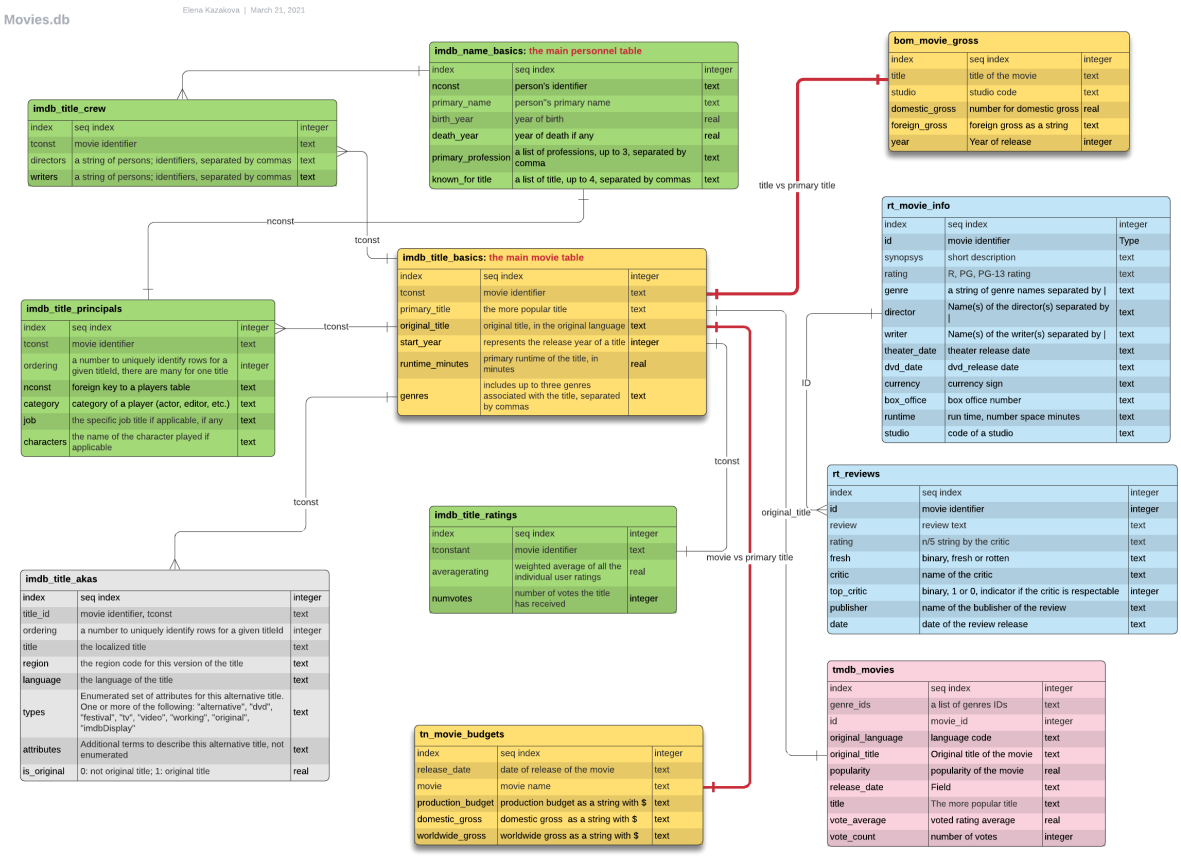
executed in 2.79s, finished 17:25:54 2021-03-28

```
bom.movie_gross.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3387 entries, 0 to 3386
Data columns (total 5 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   title           3387 non-null   object 
 1   studio          3382 non-null   object 
 2   domestic_gross  3359 non-null   float64
 3   foreign_gross   2037 non-null   object 
 4   year            3387 non-null   int64  
dtypes: float64(1), int64(1), object(3)
memory usage: 132.4+ KB
************************************************************
imdb.name.basics.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 606648 entries, 0 to 606647
Data columns (total 6 columns):
 #   Column              Non-Null Count   Dtype  
---  ------              --------------   -----  
 0   nconst              606648 non-null  object 
 1   primary_name        606648 non-null  object 
 2   birth_year          82736 non-null   float64
 3   death_year          6783 non-null    float64
 4   primary_profession  555308 non-null  object 
 5   known_for_titles    576444 non-null  object 
dtypes: float64(2), object(4)
memory usage: 27.8+ MB
************************************************************
imdb.title.akas.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 331703 entries, 0 to 331702
Data columns (total 8 columns):
 #   Column            Non-Null Count   Dtype  
---  ------            --------------   -----  
 0   title_id          331703 non-null  object 
 1   ordering          331703 non-null  int64  
 2   title             331703 non-null  object 
 3   region            278410 non-null  object 
 4   language          41715 non-null   object 
 5   types             168447 non-null  object 
 6   attributes        14925 non-null   object 
 7   is_original_title  331678 non-null  float64
dtypes: float64(1), int64(1), object(6)
memory usage: 20.2+ MB
************************************************************
imdb.title.basics.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 146144 entries, 0 to 146143
Data columns (total 6 columns):
```

```
 #   Column           Non-Null Count   Dtype  
---  ------           --------------   -----  
 0   tconst           146144 non-null  object 
 1   primary_title    146144 non-null  object 
 2   original_title   146123 non-null  object 
 3   start_year       146144 non-null  int64  
 4   runtime_minutes  114405 non-null  float64
 5   genres           140736 non-null  object 
dtypes: float64(1), int64(1), object(4)
memory usage: 6.7+ MB
**********************************************************
imdb.title.crew.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 146144 entries, 0 to 146143
Data columns (total 3 columns):
 #   Column     Non-Null Count   Dtype 
---  ------     --------------   ----- 
 0   tconst     146144 non-null  object
 1   directors  140417 non-null  object
 2   writers    110261 non-null  object
dtypes: object(3)
memory usage: 3.3+ MB
**********************************************************
imdb.title.principals.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1028186 entries, 0 to 1028185
Data columns (total 6 columns):
 #   Column      Non-Null Count    Dtype 
---  ------      --------------    ----- 
 0   tconst      1028186 non-null  object
 1   ordering    1028186 non-null  int64 
 2   nconst      1028186 non-null  object
 3   category    1028186 non-null  object
 4   job         177684 non-null   object
 5   characters  393360 non-null   object
dtypes: int64(1), object(5)
memory usage: 47.1+ MB
**********************************************************
imdb.title.ratings.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 73856 entries, 0 to 73855
Data columns (total 3 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   tconst         73856 non-null  object 
 1   averagerating  73856 non-null  float64
 2   numvotes       73856 non-null  int64  
dtypes: float64(1), int64(1), object(1)
memory usage: 1.7+ MB
**********************************************************
tmdb.movies.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 26517 entries, 0 to 26516
Data columns (total 10 columns):
 #   Column             Non-Null Count  Dtype 
---  ------             --------------  ----- 
 0   Unnamed: 0         26517 non-null  int64 
```

```
 1   genre_ids          26517 non-null  object
 2   id                 26517 non-null  int64
 3   original_language  26517 non-null  object
 4   original_title     26517 non-null  object
 5   popularity         26517 non-null  float64
 6   release_date       26517 non-null  object
 7   title              26517 non-null  object
 8   vote_average       26517 non-null  float64
 9   vote_count         26517 non-null  int64
dtypes: float64(2), int64(3), object(5)
memory usage: 2.0+ MB
************************************************************
tn.movie_budgets.csv
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5782 entries, 0 to 5781
Data columns (total 6 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   id                 5782 non-null   int64
 1   release_date       5782 non-null   object
 2   movie              5782 non-null   object
 3   production_budget  5782 non-null   object
 4   domestic_gross     5782 non-null   object
 5   worldwide_gross    5782 non-null   object
dtypes: int64(1), object(5)
memory usage: 271.2+ KB
************************************************************
```

- **The following future database tables diagram was created in LucidChart:**



1.3.2 Analysis of the diagram

- Based on the diagram above, the tables highlighted in yellow provide basic movie information and financial information, and information that can be used easily by joining them using the title fields in each table.
- The tables imdb_title_basics contains additional details on runtime of a movie and its' genres
- The table tn_movie_budgets table has production budget information along with domestic and worldwide gross income
- The table bom_movie_gross table has domestic and worldwide gross income information along with data on the production studios

In [21]:
```
# Testing generation of a list of table names out of a list of filenames to
# by replacing '.' with '_'# creating a function
list_table_names=[]
for i in list_unzipped_files:
    if i[-3:]=='csv':
        list_table_names.append(i.replace('.','_').replace('_csv',''))
    else:
        list_table_names.append(i.replace('.','_').replace('_tsv',''))
list_table_names
```

executed in 15ms, finished 17:25:54 2021-03-28

Out[21]:
```
['bom_movie_gross',
 'imdb_name_basics',
 'imdb_title_akas',
 'imdb_title_basics',
 'imdb_title_crew',
 'imdb_title_principals',
 'imdb_title_ratings',
 'rt_movie_info',
 'rt_reviews',
 'tmdb_movies',
 'tn_movie_budgets']
```

In [22]:
```
list_unzipped_files
```

executed in 15ms, finished 17:25:54 2021-03-28

Out[22]:
```
['bom.movie_gross.csv',
 'imdb.name.basics.csv',
 'imdb.title.akas.csv',
 'imdb.title.basics.csv',
 'imdb.title.crew.csv',
 'imdb.title.principals.csv',
 'imdb.title.ratings.csv',
 'rt.movie_info.tsv',
 'rt.reviews.tsv',
 'tmdb.movies.csv',
 'tn.movie_budgets.csv']
```

In [23]:
```
#Creating file names/table names dictionary

#file_table_dict = dict(zip(list_table_names, list_unzipped_files))
#file_table_dict
```

executed in 13ms, finished 17:25:54 2021-03-28

In [24]:
```
#importing files data into tables


#for key, value in file_table_dict.items():
#    if key[-3:]=='csv':
#        display_csvfileDF(value).to_sql(key, conn, if_exists='replace', ind
#    else:
#        display_tsvfileDF(value).to_sql(key, conn, if_exists='replace', ind
```

executed in 14ms, finished 17:25:54 2021-03-28

In [25]:
```
cur.execute("""SELECT name FROM sqlite_master WHERE type='table'""").fetchal
```

executed in 15ms, finished 17:25:54 2021-03-28

Out[25]:
```
[]
```

In [26]:
```
display_csvfileDF('bom.movie_gross.csv').to_sql('bom_movie_gross', conn, if_
display_csvfileDF('imdb.name.basics.csv').to_sql('imdb_name_basics', conn, i
display_csvfileDF('imdb.title.akas.csv').to_sql('imdb_title_akas', conn, if_
display_csvfileDF('imdb.title.basics.csv').to_sql('imdb_title_basics', conn,
display_csvfileDF('imdb.title.crew.csv').to_sql('imdb_title_crew', conn, if_
display_csvfileDF('imdb.title.principals.csv').to_sql('imdb_title_principals
display_csvfileDF('imdb.title.ratings.csv').to_sql('imdb_title_ratings', con
display_tsvfileDF('rt.movie_info.tsv').to_sql('rt_movie_info', conn, if_exis
display_tsvfileDF('rt.reviews.tsv').to_sql('rt_reviews', conn, if_exists='re
display_csvfileDF('tmdb.movies.csv').to_sql('tmdb_movies', conn, if_exists='
display_csvfileDF('tn.movie_budgets.csv').to_sql('tn_movie_budgets', conn, i
```

executed in 10.3s, finished 17:26:05 2021-03-28

```
C:\Users\elena\anaconda3\envs\learn-env\lib\site-packages\pandas\core\generic.p
y:2605: UserWarning: The spaces in these column names will not be changed. In p
andas versions < 0.14, spaces were converted to underscores.
  sql.to_sql(
```

In [27]:
```
cur.execute("""SELECT name FROM sqlite_master WHERE type='table'""").fetchal
```

executed in 15ms, finished 17:26:05 2021-03-28

Out[27]:
```
[('bom_movie_gross',),
 ('imdb_name_basics',),
 ('imdb_title_akas',),
 ('imdb_title_basics',),
 ('imdb_title_crew',),
 ('imdb_title_principals',),
 ('imdb_title_ratings',),
 ('rt_movie_info',),
 ('rt_reviews',),
 ('tmdb_movies',),
 ('tn_movie_budgets',)]
```

In [28]:
```
conn.commit()
```

executed in 15ms, finished 17:26:05 2021-03-28

In [29]:
```
for i in list_table_names:
    print(i)
    display_tableDF(i).info()
    print('************************************************************')
```

executed in 6.47s, finished 17:26:11 2021-03-28

```
bom_movie_gross
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3387 entries, 0 to 3386
Data columns (total 5 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   title           3387 non-null   object 
 1   studio          3382 non-null   object 
 2   domestic_gross  3359 non-null   float64
 3   foreign_gross   2037 non-null   object 
 4   year            3387 non-null   int64  
dtypes: float64(1), int64(1), object(3)
memory usage: 132.4+ KB
************************************************************
imdb_name_basics
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 606648 entries, 0 to 606647
Data columns (total 6 columns):
 #   Column              Non-Null Count   Dtype  
---  ------              --------------   -----  
 0   nconst              606648 non-null  object 
 1   primary_name        606648 non-null  object 
 2   birth_year          82736 non-null   float64
 3   death_year          6783 non-null    float64
 4   primary_profession  555308 non-null  object 
 5   known_for_titles    576444 non-null  object 
dtypes: float64(2), object(4)
memory usage: 27.8+ MB
************************************************************
imdb_title_akas
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 331703 entries, 0 to 331702
Data columns (total 8 columns):
 #   Column            Non-Null Count   Dtype  
---  ------            --------------   -----  
 0   title_id          331703 non-null  object 
 1   ordering          331703 non-null  int64  
 2   title             331703 non-null  object 
 3   region            278410 non-null  object 
 4   language          41715 non-null   object 
 5   types             168447 non-null  object 
 6   attributes        14925 non-null   object 
 7   is_original_title  331678 non-null  float64
dtypes: float64(1), int64(1), object(6)
memory usage: 20.2+ MB
************************************************************
imdb_title_basics
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 146144 entries, 0 to 146143
```

```
Data columns (total 6 columns):
 #   Column           Non-Null Count   Dtype  
---  ------           --------------   -----  
 0   tconst           146144 non-null  object 
 1   primary_title    146144 non-null  object 
 2   original_title   146123 non-null  object 
 3   start_year       146144 non-null  int64  
 4   runtime_minutes  114405 non-null  float64
 5   genres           140736 non-null  object 
dtypes: float64(1), int64(1), object(4)
memory usage: 6.7+ MB
************************************************************
imdb_title_crew
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 146144 entries, 0 to 146143
Data columns (total 3 columns):
 #   Column     Non-Null Count   Dtype 
---  ------     --------------   ----- 
 0   tconst     146144 non-null  object
 1   directors  140417 non-null  object
 2   writers    110261 non-null  object
dtypes: object(3)
memory usage: 3.3+ MB
************************************************************
imdb_title_principals
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1028186 entries, 0 to 1028185
Data columns (total 6 columns):
 #   Column      Non-Null Count    Dtype 
---  ------      --------------    ----- 
 0   tconst      1028186 non-null  object
 1   ordering    1028186 non-null  int64 
 2   nconst      1028186 non-null  object
 3   category    1028186 non-null  object
 4   job         177684 non-null   object
 5   characters  393360 non-null   object
dtypes: int64(1), object(5)
memory usage: 47.1+ MB
************************************************************
imdb_title_ratings
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 73856 entries, 0 to 73855
Data columns (total 3 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   tconst         73856 non-null  object 
 1   averagerating  73856 non-null  float64
 2   numvotes       73856 non-null  int64  
dtypes: float64(1), int64(1), object(1)
memory usage: 1.7+ MB
************************************************************
rt_movie_info
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1560 entries, 0 to 1559
Data columns (total 12 columns):
 #   Column        Non-Null Count  Dtype 
---  ------        --------------  ----- 
```

```
 0   id            1560 non-null   int64
 1   synopsis      1498 non-null   object
 2   rating        1557 non-null   object
 3   genre         1552 non-null   object
 4   director      1361 non-null   object
 5   writer        1111 non-null   object
 6   theater_date  1201 non-null   object
 7   dvd_date      1201 non-null   object
 8   currency      340 non-null    object
 9   box_office    340 non-null    object
 10  runtime       1530 non-null   object
 11  studio        494 non-null    object
dtypes: int64(1), object(11)
memory usage: 146.4+ KB
************************************************************
rt_reviews
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 54432 entries, 0 to 54431
Data columns (total 8 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   id          54432 non-null  int64
 1   review      48869 non-null  object
 2   rating      40915 non-null  object
 3   fresh       54432 non-null  object
 4   critic      51710 non-null  object
 5   top_critic  54432 non-null  int64
 6   publisher   54123 non-null  object
 7   date        54432 non-null  object
dtypes: int64(2), object(6)
memory usage: 3.3+ MB
************************************************************
tmdb_movies
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 26517 entries, 0 to 26516
Data columns (total 10 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
 0   Unnamed: 0         26517 non-null  int64
 1   genre_ids          26517 non-null  object
 2   id                 26517 non-null  int64
 3   original_language  26517 non-null  object
 4   original_title     26517 non-null  object
 5   popularity         26517 non-null  float64
 6   release_date       26517 non-null  object
 7   title              26517 non-null  object
 8   vote_average       26517 non-null  float64
 9   vote_count         26517 non-null  int64
dtypes: float64(2), int64(3), object(5)
memory usage: 2.0+ MB
************************************************************
tn_movie_budgets
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5782 entries, 0 to 5781
Data columns (total 6 columns):
 #   Column             Non-Null Count  Dtype
---  ------             --------------  -----
```

```
 0   id                 5782 non-null   int64
 1   release_date       5782 non-null   object
 2   movie              5782 non-null   object
 3   production_budget  5782 non-null   object
 4   domestic_gross     5782 non-null   object
 5   worldwide_gross    5782 non-null   object
dtypes: int64(1), object(5)
memory usage: 271.2+ KB
**********************************************************
```

2 Data Preparation

In the process of cleaning the data, I did not drop any columns, leaving the tables in their original form. The reason was that I could manipulate DataFrames out of the tables and not recreate the tables every time I made a mistake. However, I did check for duplicates and null values in the tables and handle them according to the goals of the project

---

Steps taken:

- Checking for null values in the columns of the tables
- Checking for duplicates in the tables to be used in the analysis
- Cleaning the data by updating some values and removing rows with NULL values in the essential columns

---

2.0.1 Checking for null values in the columns of the tables

In [30]:
```
#In imdb__title_basics null values
display_tableDF('imdb_title_basics').isna().sum()
```

executed in 445ms, finished 17:26:12 2021-03-28

Out[30]:
```
tconst                0
primary_title         0
original_title       21
start_year            0
runtime_minutes    31739
genres              5408
dtype: int64
```

In [31]:
```
#In imdb__title_basics null values
display_tableDF('tn_movie_budgets').isna().sum()
```
executed in 31ms, finished 17:26:12 2021-03-28

Out[31]:
```
id                   0
release_date         0
movie                0
production_budget    0
domestic_gross       0
worldwide_gross      0
dtype: int64
```

In [32]:
```
#In imdb__title_basics null values
display_tableDF('bom_movie_gross').isna().sum()
```
executed in 15ms, finished 17:26:12 2021-03-28

Out[32]:
```
title                0
studio               5
domestic_gross      28
foreign_gross     1350
year                 0
dtype: int64
```

2.0.2 Checking for duplicates in the tables to be used in the analysis

In [33]:
```
df1 = display_tableDF('imdb_title_basics')
df2 = df1.duplicated()
df2[df2==True]
```
executed in 526ms, finished 17:26:12 2021-03-28

Out[33]:
```
Series([], dtype: bool)
```

In [34]:
```
df1 = display_tableDF('tn_movie_budgets')
df2 = df1.duplicated()
df2[df2==True]
```
executed in 47ms, finished 17:26:12 2021-03-28

Out[34]:
```
Series([], dtype: bool)
```

In [35]:
```
df1 = display_tableDF('bom_movie_gross')
df2 = df1.duplicated()
df2[df2==True]
```
executed in 15ms, finished 17:26:12 2021-03-28

Out[35]:
```
Series([], dtype: bool)
```

2.0.3 Description of the data in the tables under consideration

tn_movie_budgets table:

> **Original number** of records **5782**
> No **Null** values in tn_movie_budgets; therefore nothing to clean in this department
> **No Duplicates**
> After removing movies older than 2010 and newer than 2019
> the number of records is **2191**

imdb_title_basics table:

> **Original number** of records **146144**
> **21 Null cells** in **original_title**: replaced with "Missing original title"
> **5408 Null cells** in **genres**: replaced with "Unknown" and split by **.explode**
> **31739 Null cells** in **runtime_minutes**: left as is
> **No Duplicates**
> After splitting genres and removing movies older than 2010 and newer than 2019
> the number of records is **233337**

bom_movie_gross table:

> **Original Number** of records **3387**
> **5 Null cells** in **studio**: replaced with **Unknown**
> **28 Null cells** in **domestic_gross**
> **1350 Null cells** in **foreign_gross**
> **No Duplicates**

2.0.4 Cleaning the data

In [36]:
```
1 #Replacing NULL values in genres column in imdb_title_basics table with "Unk
2 cur.execute("""UPDATE imdb_title_basics SET genres='Unknown' WHERE genres is
```

executed in 79ms, finished 17:26:12 2021-03-28

Out[36]:
```
<sqlite3.Cursor at 0x1dcb7146730>
```

In [37]:
```
1 display_tableDF('imdb_title_basics').isna().sum()
```

executed in 446ms, finished 17:26:13 2021-03-28

Out[37]:
```
tconst                0
primary_title         0
original_title       21
start_year            0
runtime_minutes    31739
genres                0
dtype: int64
```

In [38]:
```
#Replacing NULL values in original_title column in imdb_title_basics table w
cur.execute("""UPDATE imdb_title_basics SET original_title='Missing original
```

executed in 30ms, finished 17:26:13 2021-03-28

Out[38]:
```
<sqlite3.Cursor at 0x1dcb7146730>
```

2.0.5 Manipulating the data

2.0.6 Description of the data in the tables under consideration

Steps: for all the table under consideration where applicable

Steps taken:

- Splitting genres field list of genres into separate genres multiple rows in imdb_title_basics
- Splitting release_date to fill in the year, quarter, month in tn_movie_budgets
- Deleting records from the years before 2010 and after 2019 in all three tables
- Replacing studio NULL values in bom_movie_gross with "Unknown"

In [39]:
```
df_test = display_tableDF('imdb_title_basics')
df_test_exploded = df_test.assign(genres=df_test.genres.str.split(",")).expl
```

executed in 847ms, finished 17:26:14 2021-03-28

In [40]:
```
1 df_test_exploded
```
executed in 15ms, finished 17:26:14 2021-03-28

Out[40]:

	tconst	primary_title	original_title	start_year	runtime_minutes	genres
0	tt0063540	Sunghursh	Sunghursh	2013	175.0	Action
0	tt0063540	Sunghursh	Sunghursh	2013	175.0	Crime
0	tt0063540	Sunghursh	Sunghursh	2013	175.0	Drama
1	tt0066787	One Day Before the Rainy Season	Ashad Ka Ek Din	2019	114.0	Biography
1	tt0066787	One Day Before the Rainy Season	Ashad Ka Ek Din	2019	114.0	Drama
...	...	...	...	...	...	...
146139	tt9916538	Kuambil Lagi Hatiku	Kuambil Lagi Hatiku	2019	123.0	Drama
146140	tt9916622	Rodolpho Teóphilo - O Legado de um Pioneiro	Rodolpho Teóphilo - O Legado de um Pioneiro	2015	NaN	Documentary
146141	tt9916706	Dankyavar Danka	Dankyavar Danka	2013	NaN	Comedy
146142	tt9916730	6 Gunn	6 Gunn	2017	116.0	Unknown
146143	tt9916754	Chico Albuquerque - Revelações	Chico Albuquerque - Revelações	2013	NaN	Documentary

234958 rows × 6 columns

2.1 Importing the cleaned data into the tables

In [41]:
```
1 df_test_exploded.to_sql('imdb_title_basics', conn, if_exists='replace', inde
```
executed in 716ms, finished 17:26:14 2021-03-28

In [42]:
```
1 display_tableDF('imdb_title_basics').head()
```
executed in 636ms, finished 17:26:15 2021-03-28

Out[42]:

	tconst	primary_title	original_title	start_year	runtime_minutes	genres
0	tt0063540	Sunghursh	Sunghursh	2013	175.0	Action
1	tt0063540	Sunghursh	Sunghursh	2013	175.0	Crime
2	tt0063540	Sunghursh	Sunghursh	2013	175.0	Drama
3	tt0066787	One Day Before the Rainy Season	Ashad Ka Ek Din	2019	114.0	Biography
4	tt0066787	One Day Before the Rainy Season	Ashad Ka Ek Din	2019	114.0	Drama

In [43]:
```
1 display_tableDF('imdb_title_basics').info()
```
executed in 684ms, finished 17:26:16 2021-03-28

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 234958 entries, 0 to 234957
Data columns (total 6 columns):
 #   Column           Non-Null Count   Dtype  
---  ------           --------------   -----  
 0   tconst           234958 non-null  object 
 1   primary_title    234958 non-null  object 
 2   original_title   234958 non-null  object 
 3   start_year       234958 non-null  int64  
 4   runtime_minutes  195904 non-null  float64
 5   genres           234958 non-null  object 
dtypes: float64(1), int64(1), object(4)
memory usage: 10.8+ MB
```

In [44]:
```
1 conn.commit()
```
executed in 15ms, finished 17:26:16 2021-03-28

In [45]:
```
1 cur.execute("""ALTER TABLE tn_movie_budgets ADD COLUMN year""")
```
executed in 15ms, finished 17:26:16 2021-03-28

Out[45]:
```
<sqlite3.Cursor at 0x1dcb7146730>
```

In [46]:
```
1 cur.execute("""ALTER TABLE tn_movie_budgets ADD COLUMN quarter""")
```
executed in 15ms, finished 17:26:16 2021-03-28

Out[46]:
```
<sqlite3.Cursor at 0x1dcb7146730>
```

In [47]:
```
1 cur.execute("""ALTER TABLE tn_movie_budgets ADD COLUMN month""")
```
executed in 15ms, finished 17:26:16 2021-03-28

Out[47]:
```
<sqlite3.Cursor at 0x1dcb7146730>
```

In [48]:
```
1 #Adding 3 new columns as integers
2 df_ = display_tableDF('tn_movie_budgets')
3 df_['year'] = pd.to_datetime(df_['release_date']).dt.year
4 df_['quarter'] = pd.to_datetime(df_['release_date']).dt.quarter
5 df_['month'] = pd.to_datetime(df_['release_date']).dt.month
6 df_.to_sql('tn_movie_budgets', conn, if_exists='replace', index = False)
```
executed in 1.63s, finished 17:26:17 2021-03-28

In [49]:
```
1 #updated the new column from the dataframe df_ with datatime operation
2 df_.to_sql('tn_movie_budgets', conn, if_exists='replace', index = False)
```
executed in 46ms, finished 17:26:18 2021-03-28

In [50]:
```
1 display_tableDF('tn_movie_budgets').info()
```
executed in 31ms, finished 17:26:18 2021-03-28

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5782 entries, 0 to 5781
Data columns (total 9 columns):
 #   Column             Non-Null Count  Dtype 
---  ------             --------------  ----- 
 0   id                 5782 non-null   int64 
 1   release_date       5782 non-null   object
 2   movie              5782 non-null   object
 3   production_budget  5782 non-null   object
 4   domestic_gross     5782 non-null   object
 5   worldwide_gross    5782 non-null   object
 6   year               5782 non-null   int64 
 7   quarter            5782 non-null   int64 
 8   month              5782 non-null   int64 
dtypes: int64(4), object(5)
memory usage: 406.7+ KB
```

In [51]:
```
1 conn.commit()
```
executed in 15ms, finished 17:26:18 2021-03-28

In [52]:
```
1 display_tableDF('tn_movie_budgets').head()
```
executed in 31ms, finished 17:26:18 2021-03-28

Out[52]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	ye
0	1	Dec 18, 2009	Avatar	$425,000,000	$760,507,625	$2,776,345,279	
1	2	May 20, 2011	Pirates of the Caribbean: On Stranger Tides	$410,600,000	$241,063,875	$1,045,663,875	
2	3	Jun 7, 2019	Dark Phoenix	$350,000,000	$42,762,350	$149,762,350	
3	4	May 1, 2015	Avengers: Age of Ultron	$330,600,000	$459,005,868	$1,403,013,963	
4	5	Dec 15, 2017	Star Wars Ep. VIII: The Last Jedi	$317,000,000	$620,181,382	$1,316,721,747	

In [53]:
```
1 # Replacing studio NULL values
2 cur.execute("""UPDATE bom_movie_gross SET studio='Unknown' WHERE studio is N
```
executed in 15ms, finished 17:26:18 2021-03-28

Out[53]:
```
<sqlite3.Cursor at 0x1dcb7146730>
```

In [54]:
```
q="Select * from bom_movie_gross WHERE foreign_gross is NULL"
df=table_query(q)
df
```

executed in 15ms, finished 17:26:18 2021-03-28

Out[54]:

	title	studio	domestic_gross	foreign_gross	year
0	Flipped	WB	1800000.0	None	2010
1	The Polar Express (IMAX re-issue 2010)	WB	673000.0	None	2010
2	Tiny Furniture	IFC	392000.0	None	2010
3	Grease (Sing-a-Long re-issue)	Par.	366000.0	None	2010
4	Last Train Home	Zeit.	288000.0	None	2010
...	...	...	...	...	...
1345	The Quake	Magn.	6200.0	None	2018
1346	Edward II (2018 re-release)	FM	4800.0	None	2018
1347	El Pacto	Sony	2500.0	None	2018
1348	The Swan	Synergetic	2400.0	None	2018
1349	An Actor Prepares	Grav.	1700.0	None	2018

1350 rows × 5 columns

In [55]:
```
q="Select * from bom_movie_gross WHERE domestic_gross is NULL"
df=table_query(q)
df
```

executed in 15ms, finished 17:26:18 2021-03-28

Out[55]:

	title	studio	domestic_gross	foreign_gross	year
0	It's a Wonderful Afterlife	UTV	None	1300000	2010
1	Celine: Through the Eyes of the World	Sony	None	119000	2010
2	White Lion	Scre.	None	99600	2010
3	Badmaash Company	Yash	None	64400	2010
4	Aashayein (Wishes)	Relbig.	None	3800	2010
5	Force	FoxS	None	4800000	2011
6	Empire of Silver	NeoC	None	19000	2011
7	Solomon Kane	RTWC	None	19600000	2012
8	The Tall Man	Imag.	None	5200000	2012
9	Keith Lemon: The Film	Unknown	None	4000000	2012
10	Lula, Son of Brazil	NYer	None	3800000	2012
11	The Cup (2012)	Myr.	None	1800000	2012
12	Dark Tide	WHE	None	432000	2012
13	The Green Wave	RF	None	70100	2012
14	22 Bullets	Cdgm.	None	21300000	2013
15	Matru Ki Bijlee Ka Mandola	FIP	None	6000000	2013
16	The Snitch Cartel	PI	None	2100000	2013
17	All the Boys Love Mandy Lane	RTWC	None	1900000	2013
18	6 Souls	RTWC	None	852000	2013
19	Jessabelle	LGF	None	7000000	2014
20	14 Blades	RTWC	None	3800000	2014
21	Jack and the Cuckoo-Clock Heart	Shout!	None	3400000	2014
22	Lila Lila	Crnth	None	1100000	2014
23	Surprise - Journey To The West	AR	None	49600000	2015
24	Finding Mr. Right 2	CL	None	114700000	2016
25	Solace	LGP	None	22400000	2016
26	Viral	W/Dim.	None	552000	2016
27	Secret Superstar	Unknown	None	122000000	2017

In [56]:
```
cur.execute("""DELETE FROM imdb_title_basics WHERE start_year not IN
(2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019)""")
```

executed in 79ms, finished 17:26:18 2021-03-28

Out[56]:
```
<sqlite3.Cursor at 0x1dcb7146730>
```

In [57]:
```
cur.execute("""DELETE FROM tn_movie_budgets WHERE year not IN
(2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019)""")
```

executed in 15ms, finished 17:26:18 2021-03-28

Out[57]:
```
<sqlite3.Cursor at 0x1dcb7146730>
```

In [58]:
```
#Listing the number of movies made each year and their percentage from all t
# bom_movie_gross table
#Note that 2019 is not represented in this table

q="SELECT year, COUNT(*) as num_movies FROM bom_movie_gross group by year or
df_bom_year = table_query(q)
df_bom_year['percentage_of_all'] = round(df_bom_year['num_movies']/df_bom_ye
df_bom_year
```

executed in 15ms, finished 17:26:18 2021-03-28

Out[58]:

	year	num_movies	percentage_of_all
0	2010	328	9.68
1	2011	399	11.78
2	2012	400	11.81
3	2013	350	10.33
4	2014	395	11.66
5	2015	450	13.29
6	2016	436	12.87
7	2017	321	9.48
8	2018	308	9.09

In [59]:

```
#Listing the number of movies made each year and their percentage from all t
# imdb_title_basics table

q="SELECT start_year, COUNT(DISTINCT tconst) as num_movies FROM imdb_title_b
df_imdb_year = table_query(q)
df_imdb_year['percentage_of_all'] = round(df_imdb_year['num_movies']/df_imdb
df_imdb_year
```

executed in 287ms, finished 17:26:18 2021-03-28

Out[59]:

	start_year	num_movies	percentage_of_all
0	2010	11849	8.17
1	2011	12900	8.89
2	2012	13787	9.50
3	2013	14709	10.14
4	2014	15589	10.75
5	2015	16243	11.20
6	2016	17272	11.91
7	2017	17504	12.06
8	2018	16849	11.61
9	2019	8379	5.78

In [60]:
```
#Listing the number of movies made each year and their percentage from all t
# tn_movie_budgets table

q="SELECT year, count(*) as num_movies FROM tn_movie_budgets group by year o
df_tn_year = table_query(q)
df_tn_year['percentage_of_all'] = round(df_tn_year['num_movies']/df_tn_year[
df_tn_year
```

executed in 15ms, finished 17:26:18 2021-03-28

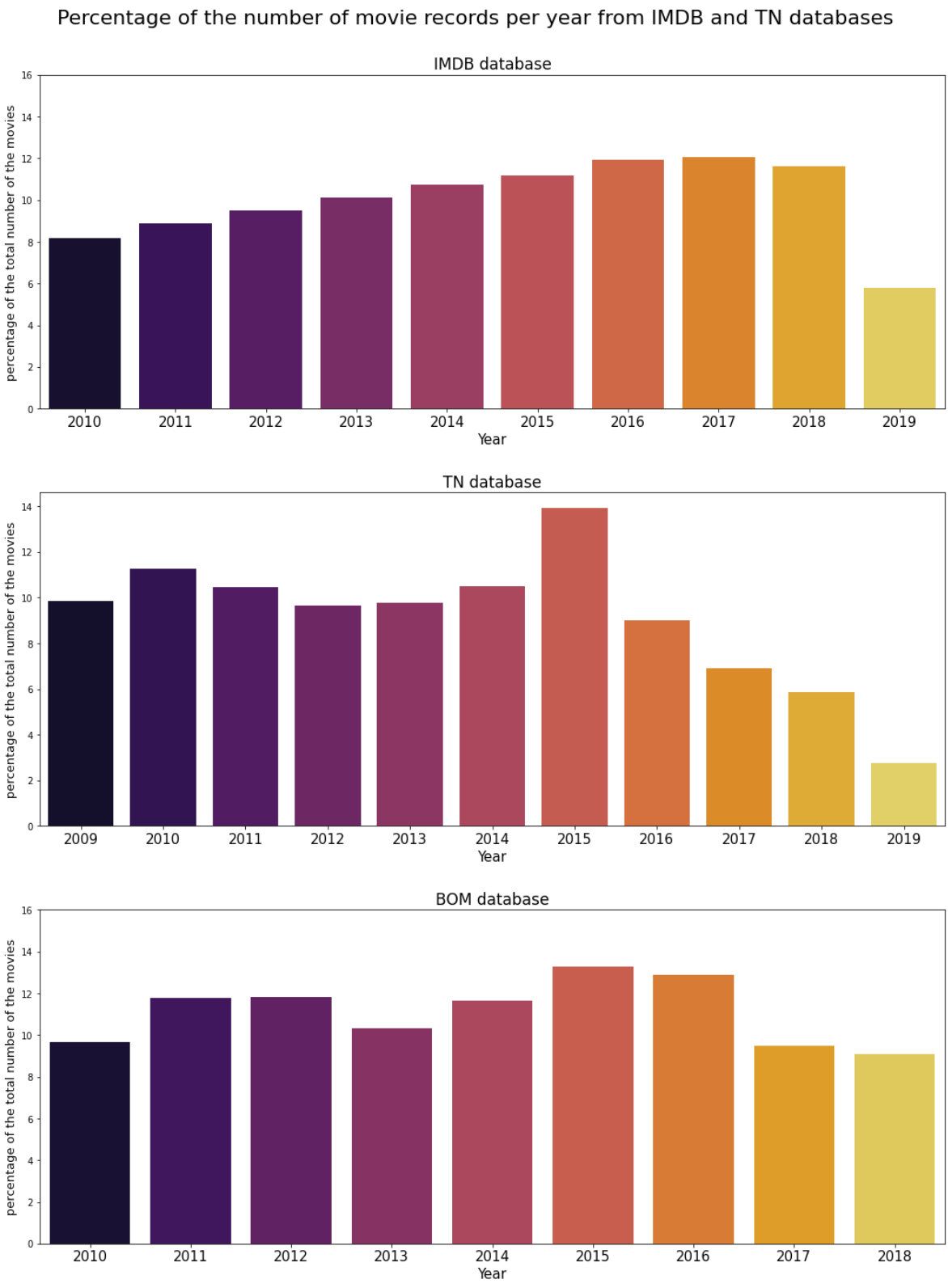
Out[60]:

	year	num_movies	percentage_of_all
0	2009	239	9.84
1	2010	274	11.28
2	2011	254	10.45
3	2012	235	9.67
4	2013	238	9.79
5	2014	255	10.49
6	2015	338	13.91
7	2016	219	9.01
8	2017	168	6.91
9	2018	143	5.88
10	2019	67	2.76

In [61]:

```
# Visualizing how well movies are reresented in each of the tables for yeach
#

fig, axes = plt.subplots(figsize=(15,20), nrows=3)
fig.suptitle('Percentage of the number of movie records per year from IMDB a

sns.barplot(data=df_imdb_year, x='start_year', y='percentage_of_all', ax=axe
axes[0].set_title('IMDB database', fontsize=17)
axes[0].set_ylabel('percentage of the total number of the movies', fontsize=
axes[0].set_xlabel('Year', fontsize=15)
axes[0].set_xticklabels(df_imdb_year['start_year'], fontsize=15)
axes[0].set_ylim(0, 16)

sns.barplot(data=df_tn_year, x='year',  y='percentage_of_all', ax=axes[1], p
axes[1].set_title('TN database', fontsize=17)
axes[1].set_ylabel('percentage of the total number of the movies', fontsize=
axes[1].set_xlabel('Year', fontsize=15)
axes[1].set_xticklabels(df_tn_year['year'], fontsize=15)

sns.barplot(data=df_bom_year, x='year',  y='percentage_of_all', ax=axes[2],
axes[2].set_title('BOM database', fontsize=17)
axes[2].set_ylabel('percentage of the total number of the movies', fontsize=
axes[2].set_xlabel('Year', fontsize=15)
axes[2].set_xticklabels(df_bom_year['year'], fontsize=15)
axes[2].set_ylim(0, 16)
plt.tight_layout(pad=3)

```

executed in 543ms, finished 17:26:19 2021-03-28



The visualization above reflects the fact that the TN and BOM 2009-2019 movies' data is not as illustrative of the overall volume of released movies as the IMDB data is. The other conclusion is that 2019 is not well represented in any of the databases; therefore, the 2019 data f is not sufficiently reliable. However, I decided to leave the records from this year in for this project. These factors should be taken into consideration when evaluating the reliability of the conclusion of this study.

2.2 Joining the tables by movie titles

2.2.1 bom_movie_gross with tn_movie_budget into df_tn_bom DataFrame and a new table ROI_tn_bom

- These tables need to be joined on two columns, title and year, because there are movies with the same title but different years on release
- I dropped the rows that have ROI < -99% due to unreliability of the data
- Data from this process is going to be used to identify the **most successful studios** (the highest median ROI is the measurement of success), the overall distribution of ROI (domestic and worldwide) as box plots per year, and the most successful months of the year (highest median ROI per month of the year)
- The DataFrame with all financial measure is going to be saved for future use and visuals; there are **1208** record matched.

In [62]:

```
#Joining tn_movie_budgets and bom_movie_gross table with titles and year of
#The year is necessary because there are movies with the same titles but dif

q="""SELECT title, bom.year, month, studio, production_budget, tn.domestic_g
     worldwide_gross from tn_movie_budgets tn
     JOIN bom_movie_gross bom ON
     (tn.movie=bom.title) AND (tn.year=bom.year)"""

df_tn_bom = table_query(q)

for i in range(len(df_tn_bom['domestic_gross'])):
    row = df_tn_bom['domestic_gross'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_bom['domestic_gross'][i]=row_num

for i in range(len(df_tn_bom['production_budget'])):
    row = df_tn_bom['production_budget'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_bom['production_budget'][i]=row_num

for i in range(len(df_tn_bom['worldwide_gross'])):
    row = df_tn_bom['worldwide_gross'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_bom['worldwide_gross'][i]=row_num

#df_tn_bom['diff'] = df_tn_bom['bom_domestic_gross']-df_tn_bom['tn_domestic_
#df_tn_bom.loc[df_tn_bom['diff']==max(df_tn_bom['diff'])]
#df_tn_bom.sort_values('diff').tail(30)
df_tn_bom['domestic_revenue'] = df_tn_bom['domestic_gross'] - df_tn_bom['pro
df_tn_bom['worldwide_revenue'] = df_tn_bom['worldwide_gross'] - df_tn_bom['p
df_tn_bom['ROI_domestic'] = df_tn_bom['domestic_revenue']/df_tn_bom['product
df_tn_bom['ROI_worldwide'] = df_tn_bom['worldwide_revenue']/df_tn_bom['produ
df_tn_bom.drop(df_tn_bom.loc[df_tn_bom['ROI_worldwide']<=(-99.0)].index, inp
df_tn_bom.sort_values('ROI_worldwide')
```

executed in 271ms, finished 17:26:19 2021-03-28

```
<ipython-input-62-da7ef484df03>:15: SettingWithCopyWarning:
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://pand
as.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-v
ersus-a-copy)
  df_tn_bom['domestic_gross'][i]=row_num
<ipython-input-62-da7ef484df03>:21: SettingWithCopyWarning:
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://pand
as.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-v
ersus-a-copy)
  df_tn_bom['production_budget'][i]=row_num
<ipython-input-62-da7ef484df03>:27: SettingWithCopyWarning:
```

```
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#returning-a-view-versus-a-copy)
  df_tn_bom['worldwide_gross'][i]=row_num
```

Out[62]:

	title	year	month	studio	production_budget	domestic_gross	worldwi
1102	13 Sins	2014	4	RTWC	4e+06	9134	
834	The Last Godfather	2011	4	RAtt.	1.34e+07	164247	
1202	They Will Have to Kill Us First	2016	3	BBC	600000	0	
729	The Tempest	2010	12	Mira.	2e+07	277943	
953	Strangerland	2015	7	Alc	1e+07	17472	
...	...	...	...	...	...	...	
1115	Paranormal Activity 2	2010	10	Par.	3e+06	8.47529e+07	1
1177	Unfriended	2015	4	Uni.	1e+06	3.27896e+07	6
1171	Insidious	2011	4	FD	1.5e+06	5.40092e+07	9
1176	The Devil Inside	2012	1	Par.	1e+06	5.32629e+07	1
1212	The Gallows	2015	7	WB (NL)	100000	2.27644e+07	4

1208 rows × 11 columns

In [63]:

```
#Creating additional table out of this join
df_tn_bom.to_sql('ROI_tn_bom', conn, if_exists='replace', index = False)
```

executed in 31ms, finished 17:26:19 2021-03-28

In [64]:
```
1 display_tableDF('ROI_tn_bom').info()
```
executed in 14ms, finished 17:26:19 2021-03-28

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1208 entries, 0 to 1207
Data columns (total 11 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   title              1208 non-null   object 
 1   year               1208 non-null   int64  
 2   month              1208 non-null   int64  
 3   studio             1208 non-null   object 
 4   production_budget  1208 non-null   float64
 5   domestic_gross     1208 non-null   float64
 6   worldwide_gross    1208 non-null   float64
 7   domestic_revenue   1208 non-null   float64
 8   worldwide_revenue  1208 non-null   float64
 9   ROI_domestic       1208 non-null   float64
 10  ROI_worldwide      1208 non-null   float64
dtypes: float64(7), int64(2), object(2)
memory usage: 103.9+ KB
```

In [65]:
```
1 conn.commit()
```
executed in 15ms, finished 17:26:19 2021-03-28

2.2.2 imdb_title_basics with tn_movie_budget into df_tn_imdb DataFrame and a new table ROI_tn_imdb

- These tables need to be joined on two columns, title and year, because there are movies with the same title but different years on release
- I dropped the rows that have ROI < -99% due to unreliability of the data
- Data from this process is going to be used to identify the **most successful genres** (the highest median ROI is the measurement of success) and overall distribution of ROI (domestic and worldwide) as box plots per year and the most successful months of the year (highest median ROI per month of the year)
- Additional visual will include runtime (buckets) with their average ROI per year (the idea is that over time shorter runtime translates into more profitability
- The DataFrame with all financial measure is going to be saved for future use and visuals; there are **1388** record matched

In [66]:

```
q="""SELECT DISTINCT tconst, primary_title 'title', start_year 'year', month
     worldwide_gross FROM imdb_title_basics imdb
     JOIN tn_movie_budgets tn
     ON (imdb.primary_title=tn.movie) AND (imdb.start_year=tn.year)"""

df_tn_imdb = table_query(q)

for i in range(len(df_tn_imdb['domestic_gross'])):
    row = df_tn_imdb['domestic_gross'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_imdb['domestic_gross'][i]=row_num

for i in range(len(df_tn_imdb['production_budget'])):
    row = df_tn_imdb['production_budget'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_imdb['production_budget'][i]=row_num

for i in range(len(df_tn_imdb['worldwide_gross'])):
    row = df_tn_imdb['worldwide_gross'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_imdb['worldwide_gross'][i]=row_num

df_tn_imdb['domestic_revenue'] = df_tn_imdb['domestic_gross'] - df_tn_imdb['
df_tn_imdb['worldwide_revenue'] = df_tn_imdb['worldwide_gross'] - df_tn_imdb
df_tn_imdb['ROI_domestic'] = df_tn_imdb['domestic_revenue']/df_tn_imdb['prod
df_tn_imdb['ROI_worldwide'] = df_tn_imdb['worldwide_revenue']/df_tn_imdb['pr
df_tn_imdb.drop(df_tn_imdb.loc[df_tn_imdb['ROI_worldwide']<=(-99.0)].index,
#df_tn_imdb.sort_values('ROI_worldwide')
df_tn_imdb
```

executed in 527ms, finished 17:26:19 2021-03-28

```
<ipython-input-66-a2603e62e1d1>:12: SettingWithCopyWarning:
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/sta
ble/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pyd
ata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
opy)
  df_tn_imdb['domestic_gross'][i]=row_num
<ipython-input-66-a2603e62e1d1>:18: SettingWithCopyWarning:
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/sta
ble/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pyd
ata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
opy)
  df_tn_imdb['production_budget'][i]=row_num
<ipython-input-66-a2603e62e1d1>:24: SettingWithCopyWarning:
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/sta
```

```
ble/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pyd
ata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-c
opy)
  df_tn_imdb['worldwide_gross'][i]=row_num
```

Out[66]:

	tconst	title	year	month	runtime_minutes	production_budget	domestic_gr
1	tt0359950	The Secret Life of Walter Mitty	2013	12	114.0	9.1e+07	5.8236
2	tt0365907	A Walk Among the Tombstones	2014	9	114.0	2.8e+07	2.6017
3	tt0369610	Jurassic World	2015	6	124.0	2.15e+08	6.5227
4	tt0376136	The Rum Diary	2011	10	119.0	4.5e+07	1.3109
5	tt0383010	The Three Stooges	2012	4	92.0	3e+07	4.4338
...	...	...	...	...	...	...	
1537	tt8155288	Happy Death Day 2U	2019	2	100.0	9e+06	2.805
1541	tt8632862	Fahrenheit 11/9	2018	9	128.0	5e+06	6.3523
1543	tt9024106	Unplanned	2019	3	106.0	6e+06	1.8107
1544	tt9347476	Believe	2016	12	NaN	3.5e+06	8
1545	tt9889072	The Promise	2017	4	NaN	9e+07	8.2242

1388 rows × 12 columns

In [67]:
```
#Creating a new table
df_tn_imdb.to_sql('ROI_tn_imdb', conn, if_exists='replace', index = False)
```
executed in 30ms, finished 17:26:19 2021-03-28

In [68]:
```
conn.commit()
```
executed in 8ms, finished 17:26:20 2021-03-28

2.3 Data Modeling

The analysis below is intended to answer four main questions:

- What studios are most successful in the movie production business?
- Does the runtime of a movie affect the movie's profitability?
- How does the timing of a movie release affect its' profitability?
- What movie genres are most profitable considering Return of Investment measurement?

2.3.1 Exploratory Analysis of studio profitability data and Visualization of the results

Using information in TheNumbers data in conjunction with IMDB data

In [69]:
```
# How many unique studios are in TheNumbers database
len(df_tn_bom['studio'].unique())
```
executed in 13ms, finished 17:26:20 2021-03-28

Out[69]: 95

In [70]:
```
q="""SELECT count(*) num_movies, avg(ROI_domestic) ROI, year,
     studio FROM ROI_tn_bom GROUP BY studio, year"""
df_studios_d=table_query(q)
```
executed in 15ms, finished 17:26:20 2021-03-28

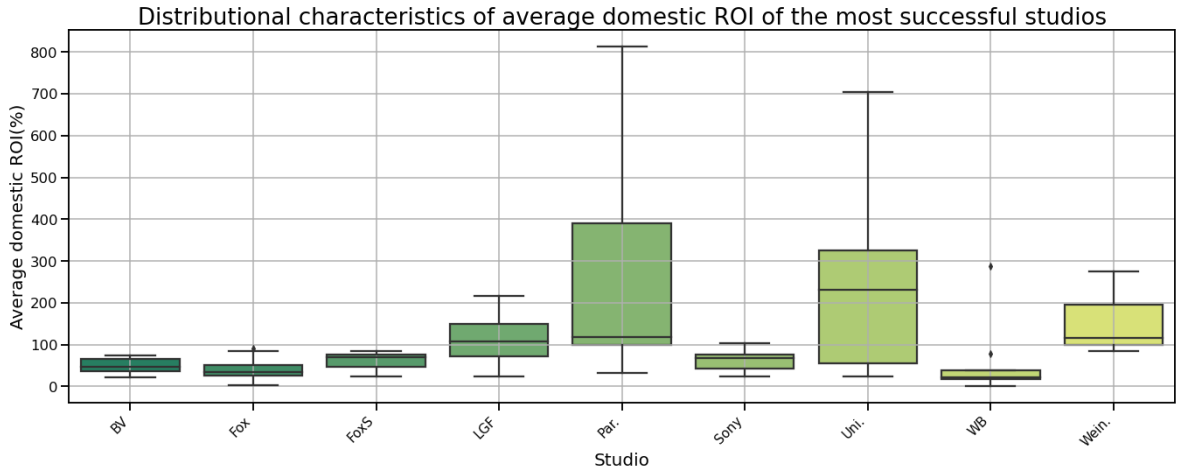
In [71]:
```
#Only studios with a number of movies per each year of the period 2009-2018
#From this pool studios with very low profitability are removed to make visu
#I am also dropping the records from several studios that exibit either very
#made movies over too few years in the studies period. The decision is made

df_studios_d.drop(df_studios_d.loc[df_studios_d['num_movies']<=6].index, inp
df_studios_d.drop(df_studios_d.loc[df_studios_d['studio']=='IFC'].index, inp
df_studios_d.drop(df_studios_d.loc[df_studios_d['studio']=='LG/S'].index, in
df_studios_d.drop(df_studios_d.loc[df_studios_d['studio']=='Magn.'].index, i
df_studios_d.drop(df_studios_d.loc[df_studios_d['studio']=='RAtt.'].index, i
df_studios_d.drop(df_studios_d.loc[df_studios_d['studio']=='Rela.'].index, i
df_studios_d.drop(df_studios_d.loc[df_studios_d['studio']=='SPC'].index, inp
```
executed in 15ms, finished 17:26:20 2021-03-28

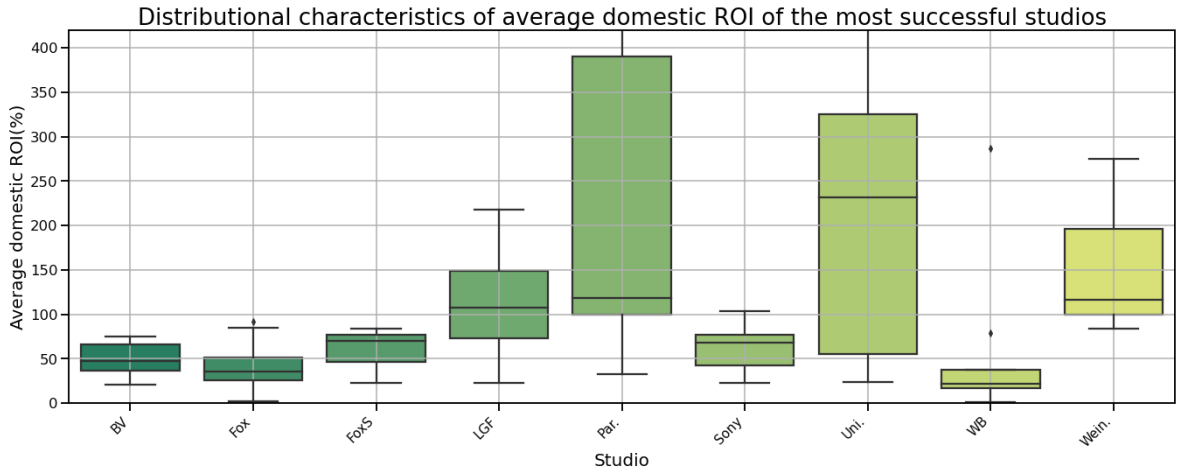
In [72]:
```
sns.set_context("talk");
```
executed in 15ms, finished 17:26:20 2021-03-28

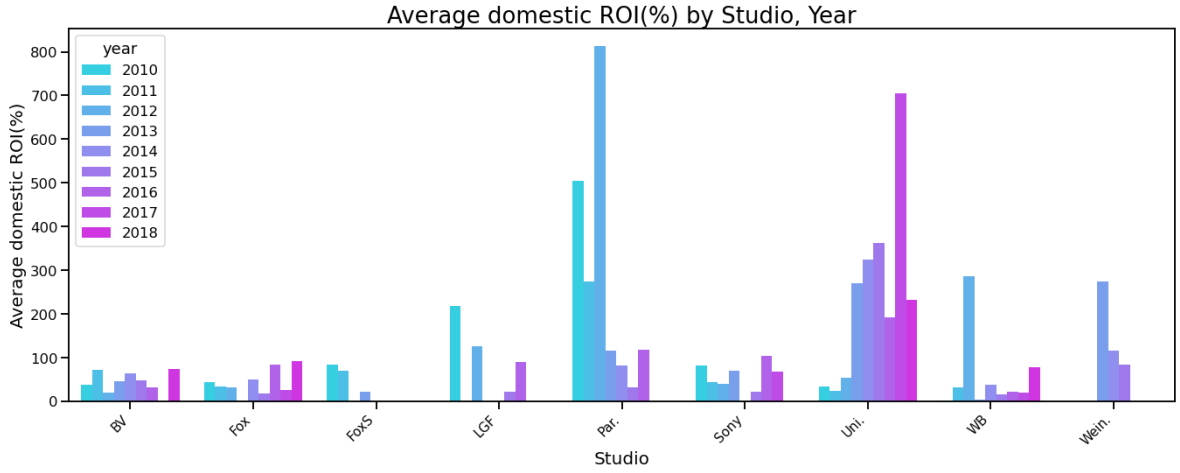
In [73]:

```
fig, axes = plt.subplots(figsize=(20,25), nrows=3)
sns.boxplot(data=df_studios_d, x="studio", y= "ROI", palette='summer', ax=ax
sns.boxplot(data=df_studios_d, x="studio", y= "ROI", palette='summer', ax=ax
sns.barplot(data=df_studios_d, x="studio", y="ROI", hue="year", palette='coo

axes[0].set_title("Distributional characteristics of average domestic ROI of
axes[0].grid();
axes[0].set_ylabel('Average domestic ROI(%)', fontsize=20);
axes[0].set_xlabel('Studio', fontsize=20);
axes[0].set_xticklabels(axes[0].get_xticklabels(), rotation=45, ha='right',
#axes[0].set_yticklabels(axes[0].get_yticklabels(), fontsize=15)

axes[1].set_title("Distributional characteristics of average domestic ROI of
axes[1].set_ylim(0, 420);
axes[1].set_ylabel('Average domestic ROI(%)', fontsize=20);
axes[1].set_xlabel('Studio', fontsize=20);
axes[1].set_xticklabels(axes[1].get_xticklabels(), rotation=45, ha='right',
axes[1].grid();

axes[2].set_title("Average domestic ROI(%) by Studio, Year", fontsize=26);
axes[2].set_ylabel('Average domestic ROI(%)', fontsize=20)
axes[2].set_xlabel('Studio', fontsize=20);
axes[2].set_xticklabels(axes[2].get_xticklabels(), rotation=45, ha='right',


plt.tight_layout(pad=3)
sns.set_context("talk");
```

executed in 1.25s, finished 17:26:21 2021-03-28







Using information in TheNumbers data in conjunction with Box-Office Movie data

The next step is to investigate worldwide profitability of the movies in the database by using the same approach as above.

In [74]:
```
q="""SELECT count(*) num_movies, avg(ROI_worldwide) ROI, year,
     studio FROM ROI_tn_bom GROUP BY studio, year"""
df_studios_w=table_query(q)
```

executed in 14ms, finished 17:26:21 2021-03-28

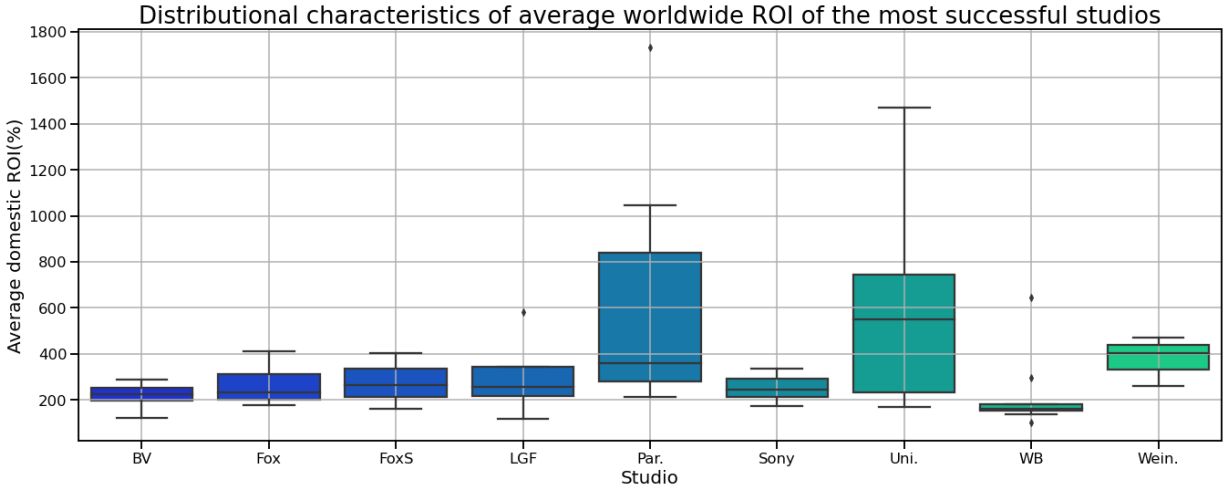
In [75]:
```
#Only studios with a number of movies per each year of the period 2009-2018
#From this pool studios with very low profitability are removed to make visu
df_studios_w.drop(df_studios_w.loc[df_studios_w['num_movies']<=6].index, inp
df_studios_w.drop(df_studios_w.loc[df_studios_w['studio']=='IFC'].index, inp
df_studios_w.drop(df_studios_w.loc[df_studios_w['studio']=='LG/S'].index, in
df_studios_w.drop(df_studios_w.loc[df_studios_w['studio']=='Magn.'].index, i
df_studios_w.drop(df_studios_w.loc[df_studios_w['studio']=='RAtt.'].index, i
df_studios_w.drop(df_studios_w.loc[df_studios_w['studio']=='Rela.'].index, i
df_studios_w.drop(df_studios_w.loc[df_studios_w['studio']=='SPC'].index, inp
```

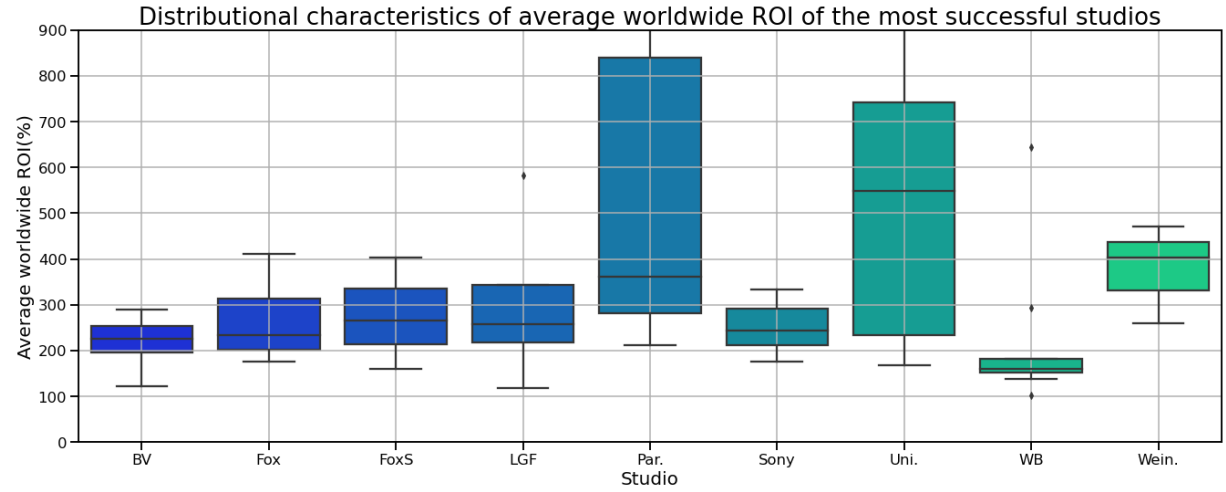
executed in 15ms, finished 17:26:21 2021-03-28

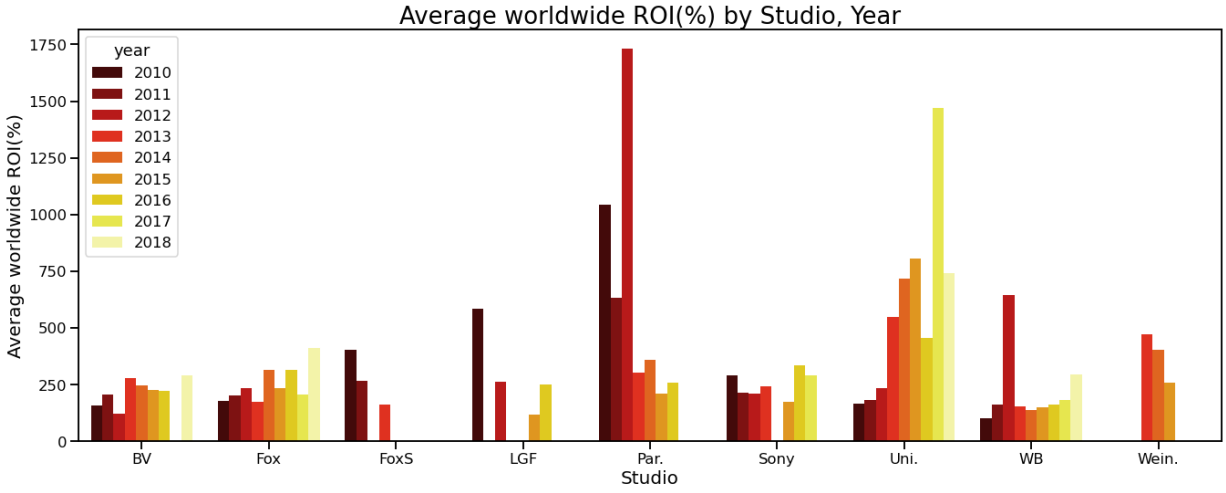
In [76]:

```
fig, axes = plt.subplots(figsize=(20,25), nrows=3)
sns.boxplot(data=df_studios_w, x="studio", y= "ROI", palette='winter', ax=ax
sns.boxplot(data=df_studios_w, x="studio", y= "ROI", palette='winter', ax=ax
sns.barplot(data=df_studios_w, x="studio", y="ROI", hue="year", palette='hot

axes[0].set_title("Distributional characteristics of average worldwide ROI o
axes[0].grid();
axes[0].set_ylabel('Average domestic ROI(%)', fontsize=20);
axes[0].set_xlabel('Studio', fontsize=20);


axes[1].set_title("Distributional characteristics of average worldwide ROI o
axes[1].set_ylim(0, 900);
axes[1].set_ylabel('Average worldwide ROI(%)', fontsize=20);
axes[1].set_xlabel('Studio', fontsize=20);
axes[1].grid();

axes[2].set_title("Average worldwide ROI(%) by Studio, Year", fontsize=26);
axes[2].set_ylabel('Average worldwide ROI(%)', fontsize=20)
axes[2].set_xlabel('Studio', fontsize=20);


plt.tight_layout(pad=3)
sns.set_context("talk");
```

executed in 1.18s, finished 17:26:22 2021-03-28







Conclusion of the analysis of the data above, based on Box-Office Mojo and TheNumbers financial data:

Universal Studios, Paramount Pictures, The Weinstein Company, and Lions Gate Films Corporation studios (in that order) have been the most successful studios for the last nine years. The median of the average domestic ROI for these studios is above 100%, and lower and upper quartiles are between 50% and 400%, with wiskers of all four never going below the red line.

The same tendencies can be observed in the analysis of movies' worldwide profitability by major players in the industry. Universal Studios, Paramount Picture, The Weinstein Company, and Lions Gate Films Corporation studios remain the most successful American studios globally. However, all of the studios under consideration maintained an average ROI above 100%.

2.3.2 Exploratory Analysis of runtime changes over the last 10 years and its' possible correlation with profitability

In [77]:
```
q="""SELECT  year, AVG(runtime_minutes) average_runtime FROM ROI_tn_imdb GRO
df_runtime=table_query(q)
df_runtime
```

executed in 14ms, finished 17:26:22 2021-03-28

Out[77]:

	year	average_runtime
0	2010	104.907407
1	2011	104.884393
2	2012	108.260563
3	2013	109.537037
4	2014	108.159236
5	2015	108.112500
6	2016	109.915033
7	2017	108.932203
8	2018	111.818966
9	2019	112.531250

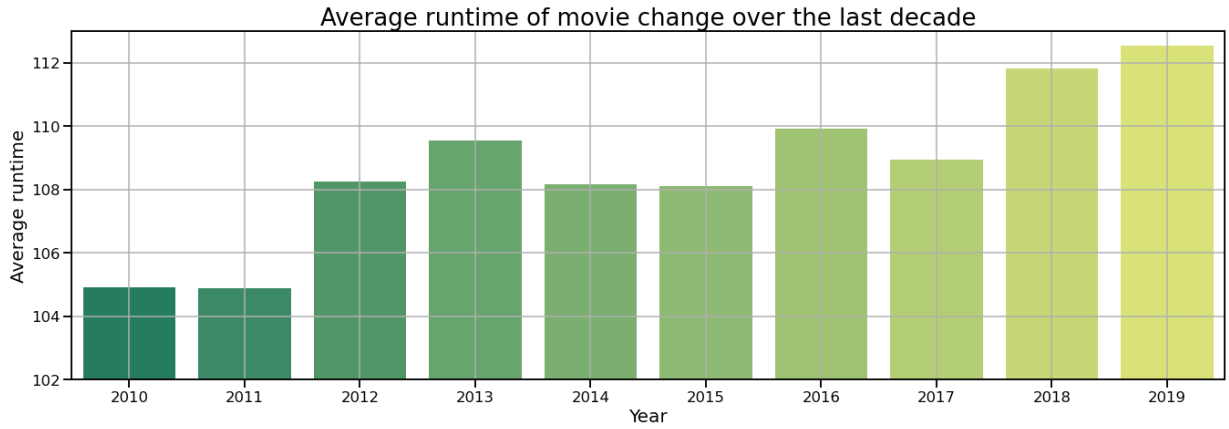
In [78]:
```
df_ROI_runtime= display_tableDF('ROI_tn_imdb')
```

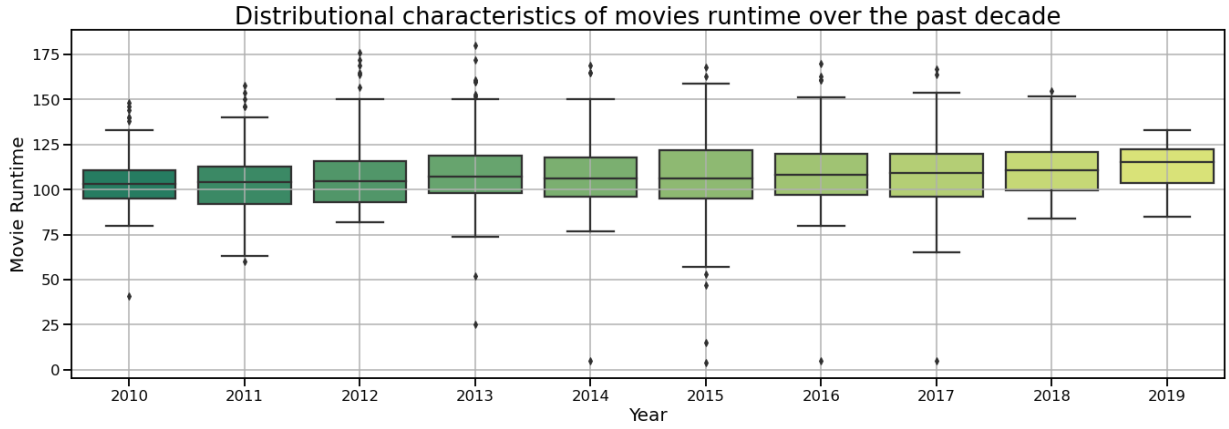
executed in 15ms, finished 17:26:22 2021-03-28

In [79]:

```
fig, axes = plt.subplots(figsize=(20,15), nrows=2)
sns.barplot(data=df_runtime, x="year", y="average_runtime", palette='summer'

axes[0].set_ylim(102, 113);
axes[0].set_title("Average runtime of movie change over the last decade", fo
axes[0].set_ylabel('Average runtime', fontsize=20);
axes[0].set_xlabel('Year', fontsize=20);
axes[0].grid();

sns.boxplot(data=df_ROI_runtime, x="year", y="runtime_minutes", palette='sum

axes[1].set_title("Distributional characteristics of movies runtime over the
axes[1].set_ylabel('Movie Runtime', fontsize=20);
axes[1].set_xlabel('Year', fontsize=20);
axes[1].grid();

plt.tight_layout(pad=3)
```

executed in 430ms, finished 17:26:22 2021-03-28





Conclusion of the analysis of the data above:

Though the average runtime of a movie within the industry grew between years 2010 and 2019, the tendency is very weakly pronounced and is within the margin of error.

2.3.3 ROI statistics evaluation

In [80]:
```
#DEscribing statistical measures of ROI (domestically and worldwide) based o
q="""SELECT  year, ROI_domestic, ROI_worldwide FROM ROI_tn_imdb"""
df_ROI_stat=table_query(q)
df_ROI_stat.describe()
```

executed in 30ms, finished 17:26:23 2021-03-28

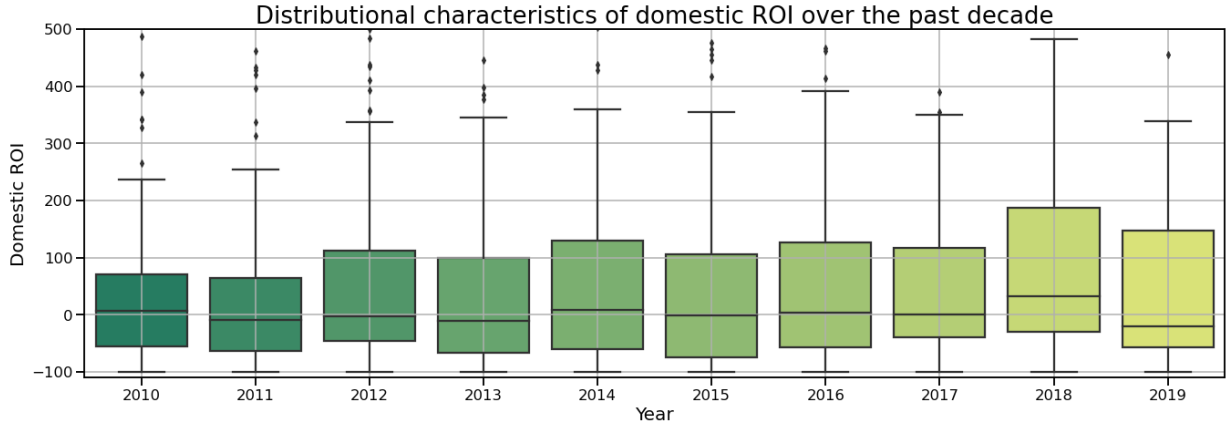
Out[80]:

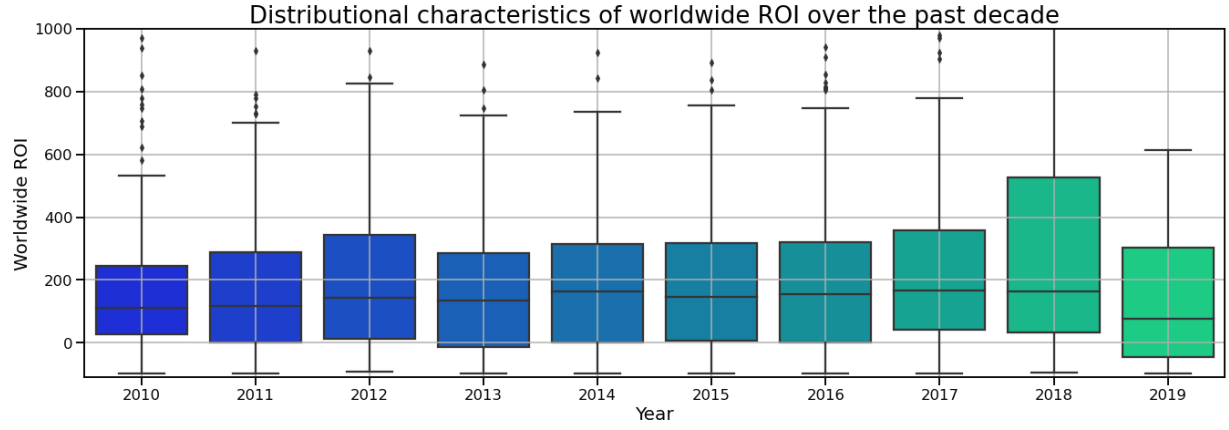
	year	ROI_domestic	ROI_worldwide
count	1388.000000	1388.000000	1388.000000
mean	2013.888329	100.937681	304.048304
std	2.612389	681.511253	1248.468460
min	2010.000000	-100.000000	-98.906170
25%	2012.000000	-55.890353	8.420845
50%	2014.000000	2.602221	135.418452
75%	2016.000000	110.078026	320.349247
max	2019.000000	22664.410000	41556.474000

In [81]:

```
fig, axes = plt.subplots(figsize=(20,15), nrows=2)
sns.boxplot(data=df_ROI_stat, x="year", y="ROI_domestic", palette='summer',a

axes[0].set_ylim(-110, 500);
axes[0].set_title("Distributional characteristics of domestic ROI over the p
axes[0].set_ylabel('Domestic ROI', fontsize=20);
axes[0].set_xlabel('Year', fontsize=20);
axes[0].grid();

sns.boxplot(data=df_ROI_stat, x="year", y="ROI_worldwide", palette='winter',

axes[1].set_ylim(-110, 1000);
axes[1].set_title("Distributional characteristics of worldwide ROI over the
axes[1].set_ylabel('Worldwide ROI', fontsize=20);
axes[1].set_xlabel('Year', fontsize=20);
axes[1].grid();

plt.tight_layout(pad=3)
```

executed in 543ms, finished 17:26:23 2021-03-28





Conclusion of the analysis of the data above:

Though the distribution of domestic ROI shows its' median over the years remaining close to 0%, the overall tendency is shifted toward the upper quartile, and the mean is close to 100% The distribution of worldwide ROI assures a more promising outcome for a newcomer studio with lower and upper quartiles above 0% and the mean of the distribution slightly above 300%.

A customer should be advised to expand into foreign markets to increase their overall profit. Additional analysis is suggested for the most promising foreign markets (needs more data)

2.3.4 Exploratory analysis of month of release/ROI correlation

Analysis based on joined ROI_tn_imdb table

In [82]:
```
#creating a DataFrame out of TN IMDB data

q="""SELECT  month, ROI_domestic, ROI_worldwide FROM ROI_tn_imdb"""
df_ROI_stat_month=table_query(q)
df_ROI_stat_month
```

executed in 15ms, finished 17:26:23 2021-03-28

Out[82]:

	month	ROI_domestic	ROI_worldwide
0	12	-36.003475	106.440860
1	9	-7.079696	121.816382
2	6	203.381686	666.909239
3	10	-70.867078	-52.122818
4	4	47.794080	80.174163
...	...	...	...
1383	2	211.678278	613.105500
1384	9	27.046120	33.074300
1385	3	201.793683	201.793683
1386	12	-74.562771	-74.562771
1387	4	-90.861902	-88.276203

1388 rows × 3 columns

In [83]:

```
#Replacing month numbers by their names for better visualization

q="""SELECT  month, count(*) num_movies FROM ROI_tn_imdb GROUP by month"""
df_num_month=table_query(q)
df_num_month

months={1:'January', 2: 'February', 3:'March', 4:'April', 5: 'May', 6: 'June
         9: 'September', 10: 'October', 11: 'November', 12: 'December'}
df_num_month['month']=df_num_month['month'].map(months)
df_num_month
```

executed in 15ms, finished 17:26:23 2021-03-28

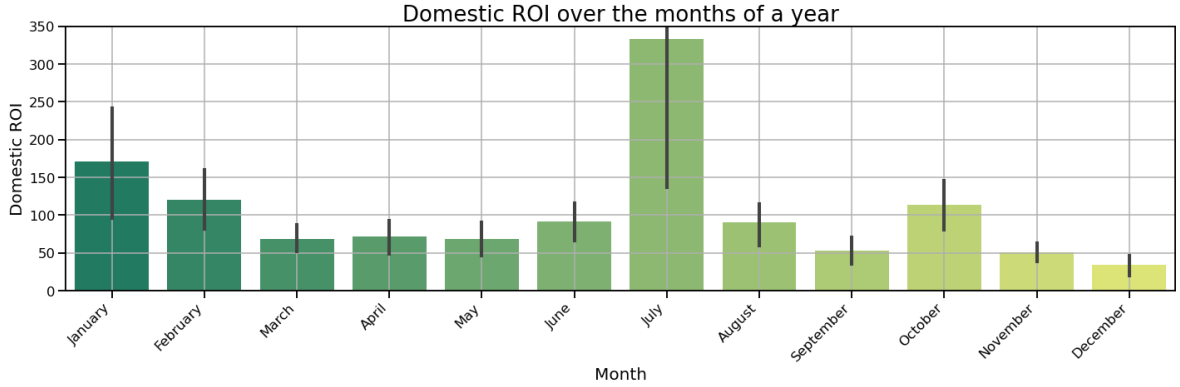
Out[83]:

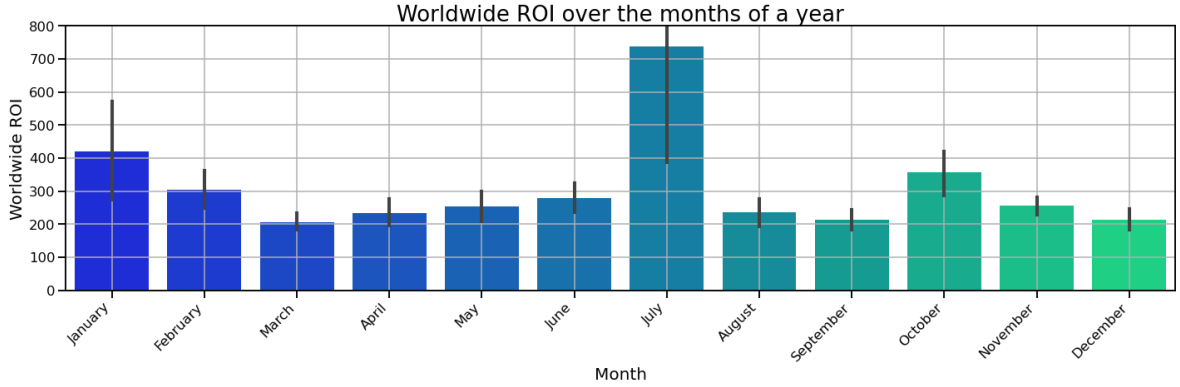
	month	num_movies
0	January	68
1	February	86
2	March	123
3	April	98
4	May	93
5	June	116
6	July	118
7	August	114
8	September	138
9	October	149
10	November	141
11	December	144

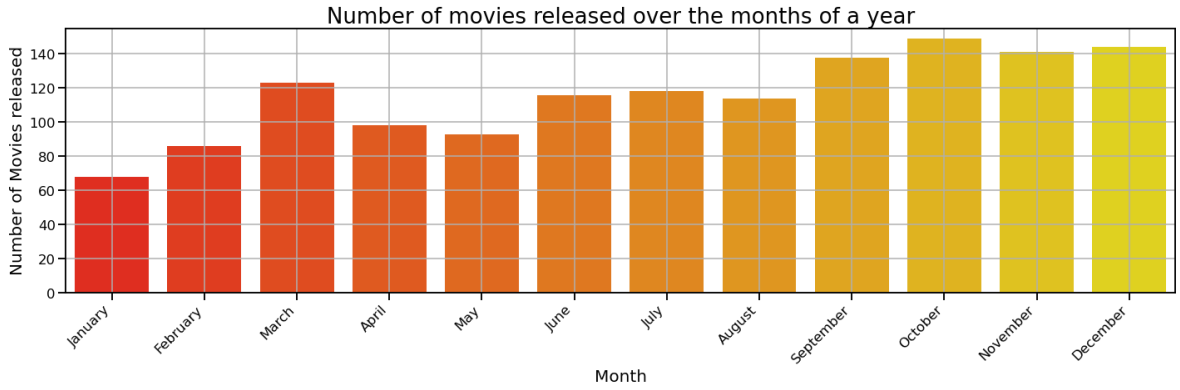
In [84]:

```
fig, axes = plt.subplots(figsize=(20,20), nrows=3)
sns.barplot(data=df_ROI_stat_month, x="month", y="ROI_domestic", palette='su

axes[0].set_ylim(0, 350);
axes[0].set_title("Domestic ROI over the months of a year", fontsize=26);
axes[0].set_ylabel('Domestic ROI', fontsize=20);
axes[0].set_xlabel('Month', fontsize=20);
axes[0].set_xticklabels(['January', 'February','March', 'April', 'May', 'Jun
         'September', 'October', 'November', 'December'], rotation=45, ha='r
axes[0].grid();

sns.barplot(data=df_ROI_stat_month, x="month", y="ROI_worldwide", palette='w

axes[1].set_ylim(0, 800);
axes[1].set_title('Worldwide ROI over the months of a year', fontsize=26);
axes[1].set_ylabel('Worldwide ROI', fontsize=20);
axes[1].set_xlabel('Month', fontsize=20);
axes[1].set_xticklabels(['January', 'February','March', 'April', 'May', 'Jun
         'September', 'October', 'November', 'December'], rotation=45, ha='r
axes[1].grid();

sns.barplot(data=df_num_month, x="month", y="num_movies", palette='autumn',a

axes[2].set_ylim(0, 155);
axes[2].set_title("Number of movies released over the months of a year", fon
axes[2].set_ylabel('Number of Movies released', fontsize=20);
axes[2].set_xlabel('Month', fontsize=20);
axes[2].set_xticklabels(axes[2].get_xticklabels(), rotation=45, ha='right')
axes[2].grid();

plt.tight_layout()
```

executed in 1.02s, finished 17:26:24 2021-03-28


Domestic ROI over the months of a year
Domestic ROI
0
50
100
150
200
250
300
350
January
February
March
April
May
June
July
August
September
October
November
December
Month

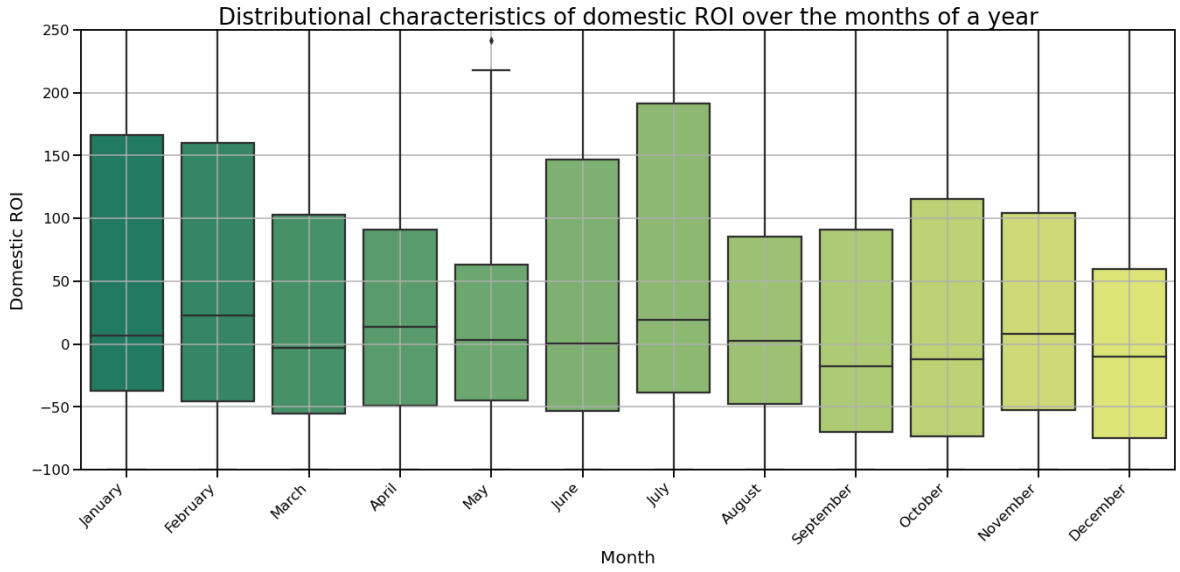

Worldwide ROI over the months of a year
Worldwide ROI
0
100
200
300
400
500
600
700
800
January
February
March
April
May
June
July
August
September
October
November
December
Month

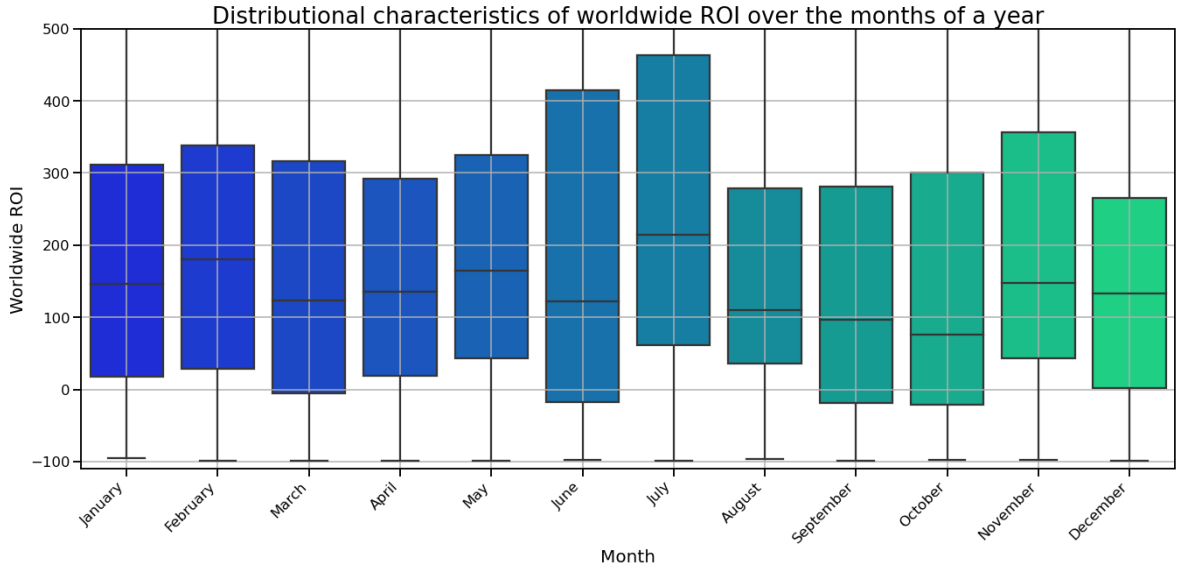

Number of movies released over the months of a year
Number of Movies released
0
20
40
60
80
100
120
140
January
February
March
April
May
June
July
August
September
October
November
December
Month

In [85]:

```
# This visualization is for my own evaluation of the statistics of ROI value

fig, axes = plt.subplots(figsize=(20,20), nrows=2)
sns.boxplot(data=df_ROI_stat_month, x="month", y="ROI_domestic", palette='su

axes[0].set_ylim(-100, 250);
axes[0].set_title("Distributional characteristics of domestic ROI over the m
axes[0].set_ylabel('Domestic ROI', fontsize=20);
axes[0].set_xlabel('Month', fontsize=20);
axes[0].set_xticklabels(['January', 'February','March', 'April', 'May', 'Jun
         'September', 'October', 'November', 'December'], rotation=45, ha='r
axes[0].grid();

sns.boxplot(data=df_ROI_stat_month, x="month", y="ROI_worldwide", palette='w

axes[1].set_ylim(-110, 500);
axes[1].set_title("Distributional characteristics of worldwide ROI over the
axes[1].set_ylabel('Worldwide ROI', fontsize=20);
axes[1].set_xlabel('Month', fontsize=20);
axes[1].set_xticklabels(['January', 'February','March', 'April', 'May', 'Jun
         'September', 'October', 'November', 'December'], rotation=45, ha='r
axes[1].grid();

plt.tight_layout(pad=3)
```

executed in 575ms, finished 17:26:25 2021-03-28





The data above suggests that there might be a negative correlation between the number of the movies released and the ROI (domestic and worldwide), which might be related to the choice of released movies customers have in a particular month as well as holidays and weather in each month.

Exploring correlations between average ROIs (domestic and worldwide)

In [86]:
```
# Bringing up a correlation matrix to confirm or otherwise the conclusion dr
q="""SELECT  month, AVG(ROI_domestic) AVG_dom_ROI, AVG(ROI_worldwide) AVG_ww
df_ROI_month_num=table_query(q)
df_ROI_month_num
df_ROI_month_num.corr(method='pearson')
```

executed in 14ms, finished 17:26:25 2021-03-28

Out[86]:

	month	AVG_dom_ROI	AVG_ww_ROI	num_movies
month	1.000000	-0.251537	-0.114142	0.882608
AVG_dom_ROI	-0.251537	1.000000	0.980399	-0.274592
AVG_ww_ROI	-0.114142	0.980399	1.000000	-0.162320
num_movies	0.882608	-0.274592	-0.162320	1.000000

There are negative correlations indeed. They are not very strong ones, and the correlation with the average ROI is less pronounced abroad. The fact of the difference might be related to the fact that all three factors, the number of released movies, holidays, and weather, domestically and abroad, are different, and the picture is less pronounced

Visual exploration of the correlations between average ROIs (domestic and worldwide)

Because any visual information is consumed by the general public better, the correlation is presented in a visual form.

In [87]:
```
months={1:'January', 2: 'February', 3:'March', 4:'April', 5: 'May', 6: 'June
                9: 'September', 10: 'October', 11: 'November', 12: 'Decembe
df_ROI_month_num['month']=df_ROI_month_num['month'].map(months)
df_ROI_month_num
```

executed in 15ms, finished 17:26:25 2021-03-28

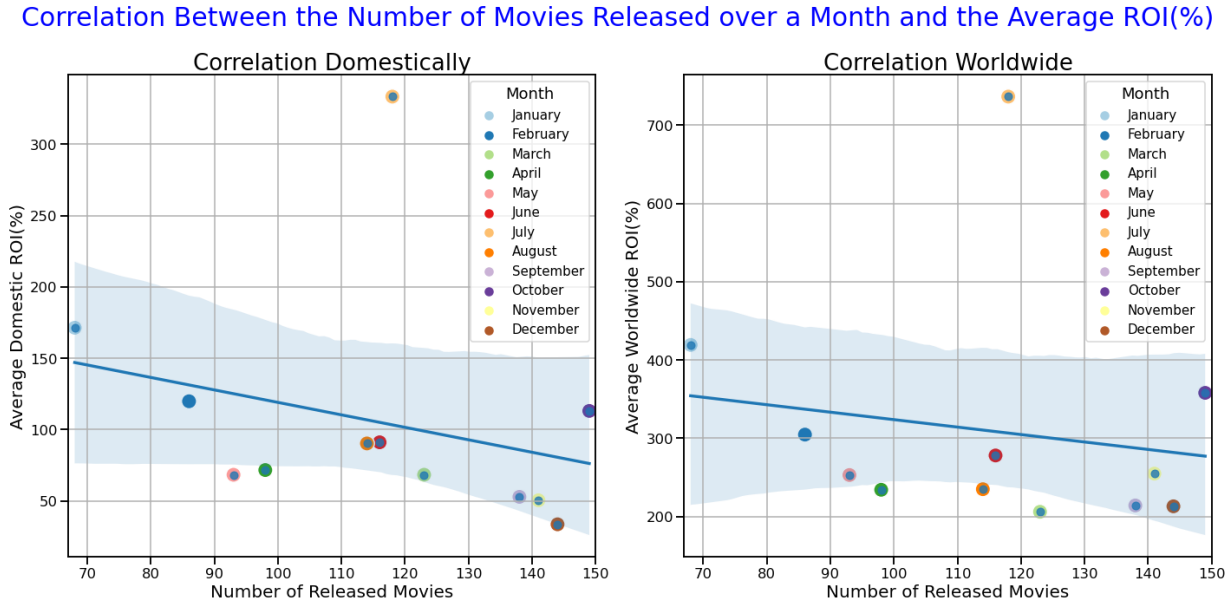
Out[87]:

	month	AVG_dom_ROI	AVG_ww_ROI	num_movies
0	January	171.390237	419.234690	68
1	February	119.888883	304.706920	86
2	March	68.399687	206.108429	123
3	April	71.700163	234.234485	98
4	May	68.384754	253.086232	93
5	June	91.143942	278.057627	116
6	July	333.312316	736.334952	118
7	August	90.342197	234.981215	114
8	September	52.931118	214.220586	138
9	October	113.122930	358.019641	149
10	November	50.515662	254.869722	141
11	December	33.693626	213.117295	144

In [88]:

```
fig, axes = plt.subplots(figsize=(20,10), ncols=2)
sns.scatterplot(data=df_ROI_month_num, x="num_movies", y="AVG_dom_ROI", hue
                ax=axes[0])
sns.scatterplot(data=df_ROI_month_num, x="num_movies", y="AVG_ww_ROI", hue='
               ax=axes[1])

sns.regplot(data=df_ROI_month_num, x="num_movies", y="AVG_dom_ROI", ax=axes[
sns.regplot(data=df_ROI_month_num, x="num_movies", y="AVG_ww_ROI", ax=axes[1

axes[0].set_title("Correlation Domestically", fontsize=26);
axes[0].set_xlabel('Number of Released Movies', fontsize=20)
axes[0].set_ylabel('Average Domestic ROI(%)', fontsize=20)
axes[0].grid()
axes[0].set_xlim(67, 150);
axes[0].legend(title='Month', loc='upper right', fontsize=15)

axes[1].set_title("Correlation Worldwide", fontsize=26);
axes[1].set_ylabel('Average Worldwide ROI(%)', fontsize=20);
axes[1].set_xlabel('Number of Released Movies', fontsize=20);
axes[1].grid();
axes[1].set_xlim(67, 150);
axes[1].legend(title='Month', loc='upper right', fontsize=15)

plt.suptitle("Correlation Between the Number of Movies Released over a Month
plt.tight_layout()
```

executed in 926ms, finished 17:26:26 2021-03-28



Conclusion of the analysis of the data above:

The negative correlation between the number of movies released over a time period suggests that the customer should consider this factor when planning a movie release. The only exception is the month of July, an outlier among other months of a year. It seems that no matter how many movies are in the theaters, it will be more profitable than in other months of the year.

2.3.5 Exploratory Analysis of Genre effect on movies profitability and Visualization of the results

Exploration of Single Genre effect on ROI of a movie (domestic and worldwide)

In this section, we are going to explore how profitable movies of a particular genre are, based on the data in IMDB and TN databases.

In [89]:

```
#Joining IMDB and TN databases with genres as a column

q="""SELECT DISTINCT tconst, primary_title title, genres, start_year year, m
     production_budget, tn.domestic_gross domestic_gross,
     worldwide_gross FROM imdb_title_basics imdb
     JOIN tn_movie_budgets tn
     ON (imdb.primary_title=tn.movie) AND (imdb.start_year=tn.year)"""

df_tn_imdb_genres = table_query(q)


for i in range(len(df_tn_imdb_genres['domestic_gross'])):
    row = df_tn_imdb_genres['domestic_gross'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_imdb_genres['domestic_gross'][i]=row_num

for i in range(len(df_tn_imdb_genres['production_budget'])):
    row = df_tn_imdb_genres['production_budget'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_imdb_genres['production_budget'][i]=row_num

for i in range(len(df_tn_imdb_genres['worldwide_gross'])):
    row = df_tn_imdb_genres['worldwide_gross'][i]
    row = row.replace(',', '').replace('$','')
    row_num = float(row)
    df_tn_imdb_genres['worldwide_gross'][i]=row_num

df_tn_imdb_genres['domestic_revenue'] = df_tn_imdb_genres['domestic_gross']
df_tn_imdb_genres['worldwide_revenue'] = df_tn_imdb_genres['worldwide_gross'
df_tn_imdb_genres['ROI_domestic'] = df_tn_imdb_genres['domestic_revenue']/df
df_tn_imdb_genres['ROI_worldwide'] = df_tn_imdb_genres['worldwide_revenue']/
df_tn_imdb_genres.drop(df_tn_imdb_genres.loc[df_tn_imdb_genres['ROI_worldwid
#df_tn_imdb.sort_values('ROI_worldwide')
df_tn_imdb_genres
```

executed in 1.04s, finished 17:26:27 2021-03-28

```
<ipython-input-89-32ed9c593cb4>:16: SettingWithCopyWarning:
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://pand
as.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-v
ersus-a-copy)
  df_tn_imdb_genres['domestic_gross'][i]=row_num
<ipython-input-89-32ed9c593cb4>:22: SettingWithCopyWarning:
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://pand
as.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-v
ersus-a-copy)
  df_tn_imdb_genres['production_budget'][i]=row_num
<ipython-input-89-32ed9c593cb4>:28: SettingWithCopyWarning:
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://pand
as.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-v
ersus-a-copy)
  df_tn_imdb_genres['worldwide_gross'][i]=row_num
```

Out[89]:

	tconst	title	genres	year	month	runtime_minutes	production_budget
3	tt0359950	The Secret Life of Walter Mitty	Adventure	2013	12	114.0	9.1e+07
4	tt0359950	The Secret Life of Walter Mitty	Comedy	2013	12	114.0	9.1e+07
5	tt0359950	The Secret Life of Walter Mitty	Drama	2013	12	114.0	9.1e+07
6	tt0365907	A Walk Among the Tombstones	Action	2014	9	114.0	2.8e+07
7	tt0365907	A Walk Among the Tombstones	Crime	2014	9	114.0	2.8e+07
...	...	...	...	...	...	...	..
3878	tt8632862	Fahrenheit 11/9	Documentary	2018	9	128.0	5e+06
3880	tt9024106	Unplanned	Biography	2019	3	106.0	6e+06
3881	tt9024106	Unplanned	Drama	2019	3	106.0	6e+06
3882	tt9347476	Believe	Unknown	2016	12	NaN	3.5e+06
3883	tt9889072	The Promise	Drama	2017	4	NaN	9e+07

3548 rows × 13 columns

In [90]:
```
#Creating a new table
df_tn_imdb_genres.to_sql('ROI_tn_imdb_genres', conn, if_exists='replace', in
```

executed in 94ms, finished 17:26:27 2021-03-28

In [91]:
```
conn.commit()
```

executed in 15ms, finished 17:26:27 2021-03-28

In [92]:
```
#How many unique genres are there?
len(df_tn_imdb_genres['genres'].unique())
```

executed in 15ms, finished 17:26:27 2021-03-28

Out[92]: 22

In [93]:
```
q="""SELECT count(*) num_movies, avg(ROI_domestic) ROI_d, avg(ROI_worldwide)
     FROM ROI_tn_imdb_genres GROUP BY genres"""
df_ROI_genres=table_query(q)
df_ROI_genres
```

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Out[93]:

	num_movies	ROI_d	ROI_w	genres
0	410	14.016189	184.090202	Action
1	340	22.883264	217.499552	Adventure
2	97	43.555617	282.592459	Animation
3	130	81.652163	251.161007	Biography
4	474	82.976304	242.476102	Comedy
5	218	19.295245	130.768016	Crime
6	45	106.361963	230.621110	Documentary
7	672	79.986621	244.995889	Drama
8	87	45.364585	172.140462	Family
9	116	50.135361	235.957915	Fantasy
10	39	22.747490	154.924390	History
11	152	452.788298	967.473325	Horror
12	48	90.751560	269.447152	Music
13	7	24.571384	276.252407	Musical
14	117	418.803413	944.531168	Mystery
15	176	121.683535	290.467763	Romance
16	124	66.709295	289.939903	Sci-Fi
17	33	44.773880	116.350760	Sport
18	234	238.701633	599.538310	Thriller
19	4	-48.600458	493.001530	Unknown
20	16	-28.882477	49.884569	War
21	9	2.509016	87.547842	Western

In [94]:

```
#Answering the question what genres are most profitable in average ROI terms

fig, axes = plt.subplots(figsize=(20,20), nrows=2)
sns.barplot(data=df_ROI_genres, x="genres", y="ROI_d", palette='summer',
            order=df_ROI_genres.sort_values('ROI_d', ascending = False).genr
sns.barplot(data=df_ROI_genres, x="genres", y="ROI_w", palette='winter',
            order=df_ROI_genres.sort_values('ROI_w', ascending = False).genr


axes[0].set_title("Average Domestic ROI(%) by Genres", fontsize=26);
axes[0].set_ylabel('Average domestic ROI(%)', fontsize=20)
axes[0].set_xlabel('Genres', fontsize=20);
axes[0].set_xticklabels(axes[0].get_xticklabels(), rotation=45, ha='right')
axes[0].grid();

axes[1].set_title("Average Worldwide ROI(%) by Genres", fontsize=26);
axes[1].set_ylabel('Average worldwide ROI(%)', fontsize=20)
axes[1].set_xlabel('Genres', fontsize=20);
axes[1].set_xticklabels(axes[1].get_xticklabels(), rotation=45, ha='right')
axes[1].grid();

plt.tight_layout(pad=3)
sns.set_context("talk");
```

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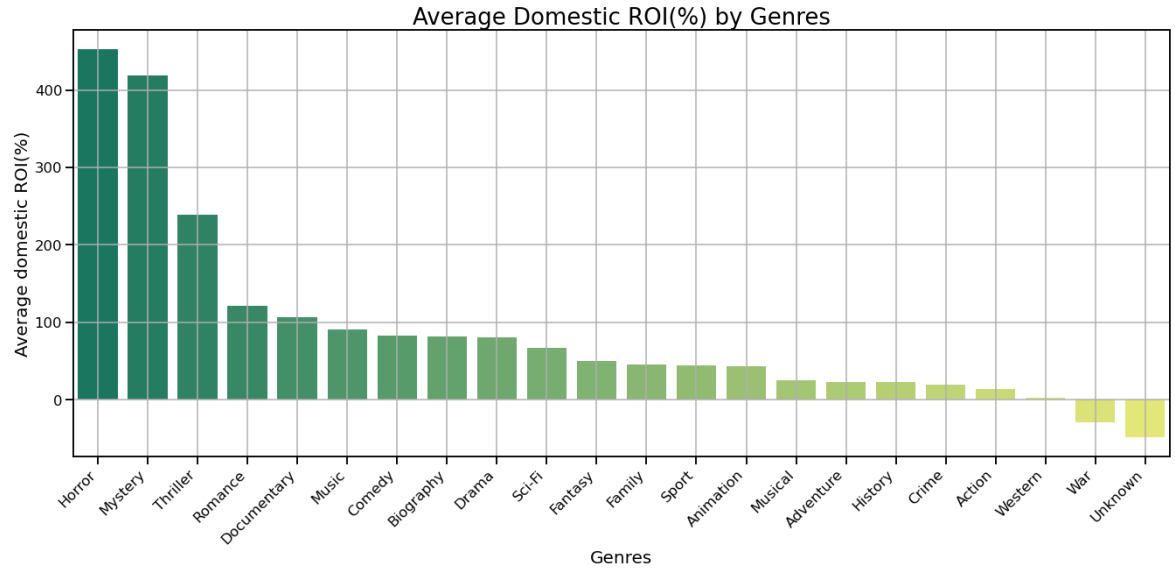

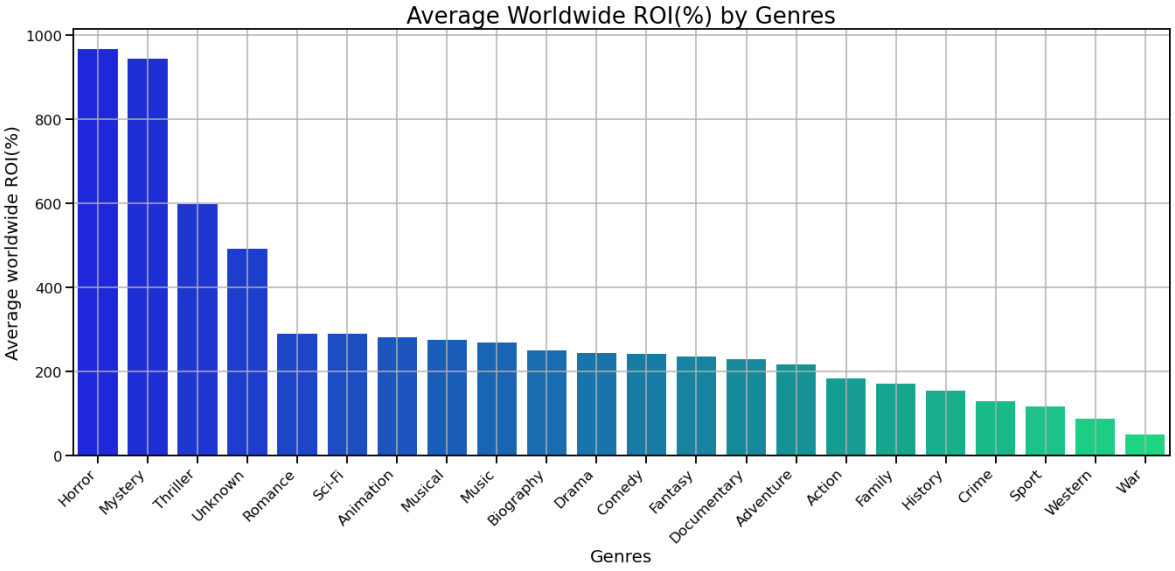

Conclusion of the analysis of the data in this subsection:

Conclusions of the analysis in this subsection are that the three most profitable genres are Horror, Mystery, and Thriller (in that order), both domestically and abroad. The strong presence of the "Unknown" category of movies internationally might be partly due to a practice of categorizing them abroad differently. It is just a guess, but given the significance of the difference, the issue should not be brushed aside but further investigated.

Exploration of an effect of production budget on gross income of a movie

In this section, we are going to explore how profitable movies are based on their production budgets. The data used in this section are from IMDB and TN tables.

In [95]:
```
# DataFrame with budget, gross income and genres
q="""SELECT production_budget budget, domestic_gross, worldwide_gross, genre
     FROM ROI_tn_imdb_genres"""
df_budget_gross_income=table_query(q)
df_budget_gross_income
```

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Out[95]:

	budget	domestic_gross	worldwide_gross	genres
0	91000000.0	58236838.0	187861183.0	Adventure
1	91000000.0	58236838.0	187861183.0	Comedy
2	91000000.0	58236838.0	187861183.0	Drama
3	28000000.0	26017685.0	62108587.0	Action
4	28000000.0	26017685.0	62108587.0	Crime
...	...	...	...	...
3543	5000000.0	6352306.0	6653715.0	Documentary
3544	6000000.0	18107621.0	18107621.0	Biography
3545	6000000.0	18107621.0	18107621.0	Drama
3546	3500000.0	890303.0	890303.0	Unknown
3547	90000000.0	8224288.0	10551417.0	Drama

3548 rows × 4 columns

In [96]:
```
# Pearson correlation for the daraFrame above
df_budget_gross_income.corr(method='pearson')
```

executed in 15ms, finished 17:26:28 2021-03-28

Out[96]:

	budget	domestic_gross	worldwide_gross
budget	1.000000	0.697090	0.774382
domestic_gross	0.697090	1.000000	0.943957
worldwide_gross	0.774382	0.943957	1.000000

Based on the Pearson correlation coefficients averaged over the past decade, the correlation between the gross income and the movie budget is strong both domestically and worldwide. Now let's represent it visually.

In [97]:

```
#Visualizing the correlation for movies of all genres
fig, axes = plt.subplots(figsize=(20,10), ncols=2)
sns.scatterplot(data=df_budget_gross_income, x="budget", y="domestic_gross",
                ax=axes[0])
sns.scatterplot(data=df_budget_gross_income, x="budget", y="worldwide_gross"
                ax=axes[1])
g1=sns.regplot(data=df_budget_gross_income, x="budget", y="domestic_gross",
g2=sns.regplot(data=df_budget_gross_income, x="budget", y="worldwide_gross",

axes[0].set_title("Correlation Domestically", fontsize=26);
axes[0].set_ylabel('Gross Income, Domestic', fontsize=20)
axes[0].set_xlabel('Production Budget', fontsize=20)
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g1.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g1.get_yticks()/1000000]
axes[0].set_xticklabels(xlabels)
axes[0].set_yticklabels(ylabels)
axes[0].set_ylim(-50000000, 800000000)
axes[0].set_xlim(0, 450000000)
axes[0].grid()

axes[1].set_title("Correlation Worldwide", fontsize=26);
axes[1].set_ylabel('Gross Income, Worldwide', fontsize=20)
axes[1].set_xlabel('Production Budget', fontsize=20)
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g2.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g2.get_yticks()/1000000]
axes[1].set_xticklabels(xlabels)
axes[1].set_yticklabels(ylabels)
axes[1].set_xlim(0, 450000000)
#axes[1].set_ylim(-50000000, 2000000000)
axes[1].grid();

plt.suptitle("Correlation Between Production Budget and Gross Income", size=
plt.tight_layout(pad=3)
```

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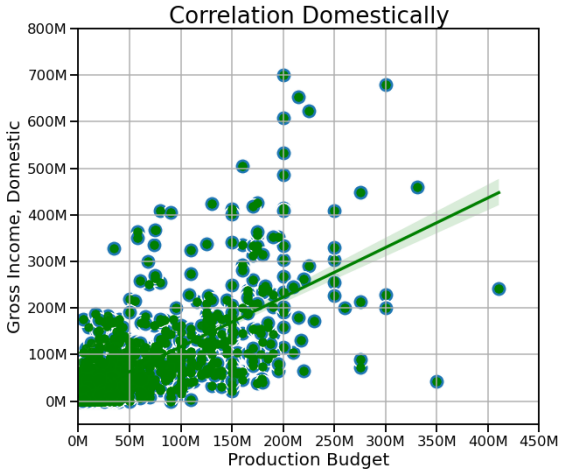
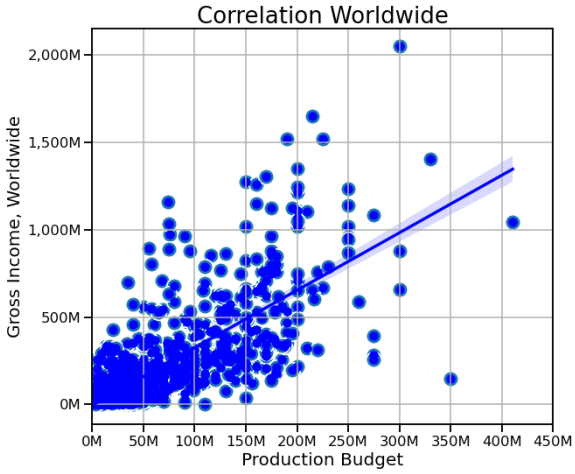
```
<ipython-input-97-ac2ba7c2ce5c>:15: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[0].set_xticklabels(xlabels)
<ipython-input-97-ac2ba7c2ce5c>:16: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[0].set_yticklabels(ylabels)
<ipython-input-97-ac2ba7c2ce5c>:26: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[1].set_xticklabels(xlabels)
<ipython-input-97-ac2ba7c2ce5c>:27: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[1].set_yticklabels(ylabels)
```

Correlation Between Production Budget and Gross Income





The correlation between Gross Income and budget can be seen in the plots above. However, it might be too congested because the movies of different genres are clumped together. It is logical to assume that movies of different genres might have different budget needs. For example, horror movies are cheaper to produce, while sci-fi or action movies are pretty expensive. It would be an excellent exercise to put side by side the correlations within all three genres that performed the best on their ROI (Horror, Mystery, Thriller), both domestically and abroad.

In [98]:
```
#Generating a Dataframe with financial data for three genres
q="""SELECT production_budget budget, domestic_gross, worldwide_gross, genre
     FROM ROI_tn_imdb_genres where genres in ('Horror', 'Mystery','Thriller'
df_budget_gross_income_three_genres=table_query(q)
```

executed in 15ms, finished 17:26:28 2021-03-28

In [99]:
```
#Generating three separate DataFrames per genre
q="""SELECT production_budget budget, domestic_gross, worldwide_gross, genre
     FROM ROI_tn_imdb_genres where genres='Horror'"""
df_budget_gross_income_horror=table_query(q)

q="""SELECT production_budget budget, domestic_gross, worldwide_gross, genre
     FROM ROI_tn_imdb_genres where genres='Mystery'"""
df_budget_gross_income_mystery=table_query(q)

q="""SELECT production_budget budget, domestic_gross, worldwide_gross, genre
     FROM ROI_tn_imdb_genres where genres='Thriller'"""
df_budget_gross_income_thriller=table_query(q)
```

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In [100]:
```
#To visualize the correlation between domestic/worldwide pairplot is being u
sns.pairplot(data=df_budget_gross_income_three_genres, kind='reg', hue='genr
```

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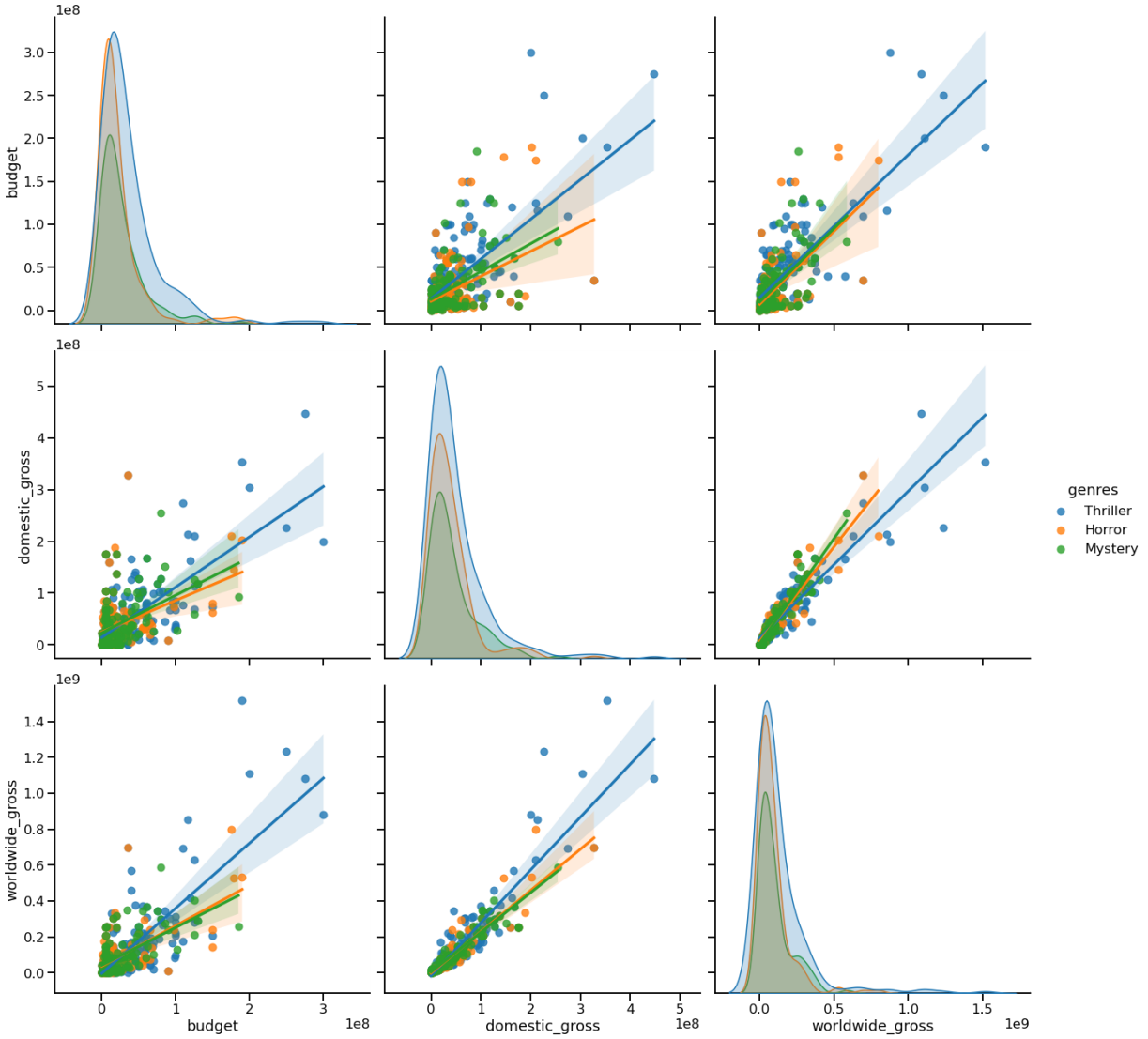
Out[100]: <seaborn.axisgrid.PairGrid at 0x1dcb5315e20>



The plots above clearly conclude that there are three separate correlations between gross income and production budget for movies in Horror, Mystery, and Thriller genres.

Based on the analysis above, it would be logical to visualize all three genres' correlations to present them to the customer.

In [101]:

```
fig, axes = plt.subplots(figsize=(20,25), ncols=2, nrows=3)
#sns.set_style('whitegrid')
sns.scatterplot(data=df_budget_gross_income_horror, x="budget", y="domestic_
sns.scatterplot(data=df_budget_gross_income_horror, x="budget", y="worldwide
sns.scatterplot(data=df_budget_gross_income_mystery, x="budget", y="domestic
sns.scatterplot(data=df_budget_gross_income_mystery, x="budget", y="worldwid
sns.scatterplot(data=df_budget_gross_income_thriller, x="budget", y="domesti
sns.scatterplot(data=df_budget_gross_income_thriller, x="budget", y="worldwi

g1=sns.regplot(data=df_budget_gross_income_horror, x="budget", y="domestic_g
g2=sns.regplot(data=df_budget_gross_income_horror, x="budget", y="worldwide_
g3=sns.regplot(data=df_budget_gross_income_mystery, x="budget", y="domestic_
g4=sns.regplot(data=df_budget_gross_income_mystery, x="budget", y="worldwide
g5=sns.regplot(data=df_budget_gross_income_thriller, x="budget", y="domestic
g6=sns.regplot(data=df_budget_gross_income_thriller, x="budget", y="worldwid

axes[0,0].set_title("Correlation Domestically, Horror", fontsize=26);
axes[0,0].set_ylabel('Gross Income, Domestic', fontsize=20)
axes[0,0].set_xlabel('Production Budget', fontsize=20)
axes[0,0].set_ylim((-20000000.0), (400000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g1.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g1.get_yticks()/1000000]
axes[0,0].set_xticklabels(xlabels)
axes[0,0].set_yticklabels(ylabels)
axes[0,0].grid()

axes[0,1].set_title("Correlation Worldwide, Horror", fontsize=26);
axes[0,1].set_ylabel('Gross Income, Worldwide', fontsize=20)
axes[0,1].set_xlabel('Production Budget', fontsize=20)
axes[0,1].set_ylim((-20000000.0), (1500000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g2.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g2.get_yticks()/1000000]
axes[0,1].set_xticklabels(xlabels)
axes[0,1].set_yticklabels(ylabels)
axes[0,1].grid()

axes[1,0].set_title("Correlation Domestically, Mystery", fontsize=26);
axes[1,0].set_ylabel('Gross Income, Domestic', fontsize=20)
axes[1,0].set_xlabel('Production Budget', fontsize=20)
axes[1,0].set_ylim((-20000000.0), (400000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g3.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g3.get_yticks()/1000000]
axes[1,0].set_xticklabels(xlabels)
axes[1,0].set_yticklabels(ylabels)
axes[1,0].grid()

axes[1,1].set_title("Correlation Worldwide, Mystery", fontsize=26);
axes[1,1].set_ylabel('Gross Income, Worldwide', fontsize=20)
axes[1,1].set_xlabel('Production Budget', fontsize=20)
axes[1,1].set_ylim((-20000000.0), (1500000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g4.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g4.get_yticks()/1000000]
axes[1,1].set_xticklabels(xlabels)
axes[1,1].set_yticklabels(ylabels)
axes[1,1].grid()

```

```
axes[2,0].set_title("Correlation Domestically, Thriller", fontsize=26);
axes[2,0].set_ylabel('Gross Income, Domestic', fontsize=20)
axes[2,0].set_xlabel('Production Budget', fontsize=20)
axes[2,0].set_ylim((-20000000.0), (400000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g5.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g5.get_yticks()/1000000]
axes[2,0].set_xticklabels(xlabels)
axes[2,0].set_yticklabels(ylabels)
axes[2,0].grid()

axes[2,1].set_title("Correlation Worldwide, Thriller", fontsize=26);
axes[2,1].set_ylabel('Gross Income, Worldwide', fontsize=20)
axes[2,1].set_xlabel('Production Budget', fontsize=20)
axes[2,1].set_ylim((-20000000.0), (1400000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g6.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g6.get_yticks()/1000000]
axes[2,1].set_xticklabels(xlabels)
axes[2,1].set_yticklabels(ylabels)
axes[2,1].grid()

plt.suptitle("Correlation Between Production Budget and Gross Income", size=
plt.tight_layout()
```

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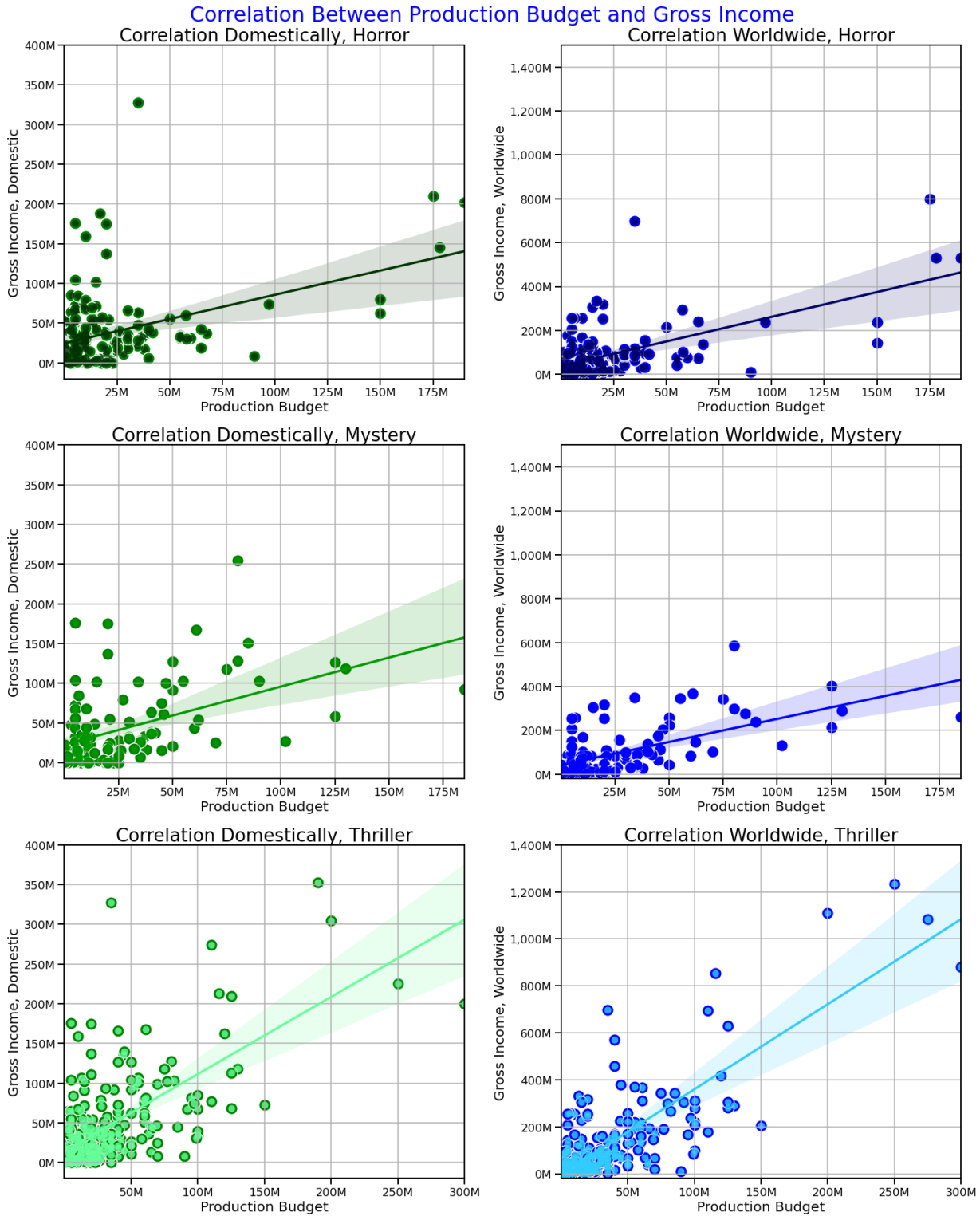
```
<ipython-input-101-47ae24401000>:23: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[0,0].set_xticklabels(xlabels)
<ipython-input-101-47ae24401000>:24: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[0,0].set_yticklabels(ylabels)
<ipython-input-101-47ae24401000>:33: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[0,1].set_xticklabels(xlabels)
<ipython-input-101-47ae24401000>:34: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[0,1].set_yticklabels(ylabels)
<ipython-input-101-47ae24401000>:43: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[1,0].set_xticklabels(xlabels)
<ipython-input-101-47ae24401000>:44: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[1,0].set_yticklabels(ylabels)
<ipython-input-101-47ae24401000>:53: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[1,1].set_xticklabels(xlabels)
<ipython-input-101-47ae24401000>:54: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[1,1].set_yticklabels(ylabels)
<ipython-input-101-47ae24401000>:63: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[2,0].set_xticklabels(xlabels)
<ipython-input-101-47ae24401000>:64: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[2,0].set_yticklabels(ylabels)
<ipython-input-101-47ae24401000>:73: UserWarning: FixedFormatter should only
be used together with FixedLocator
```

```
  axes[2,1].set_xticklabels(xlabels)
<ipython-input-101-47ae24401000>:74: UserWarning: FixedFormatter should only
be used together with FixedLocator
  axes[2,1].set_yticklabels(ylabels)
```



Visual investigation of the plots above suggests a closer examination of the lower quadrant data.

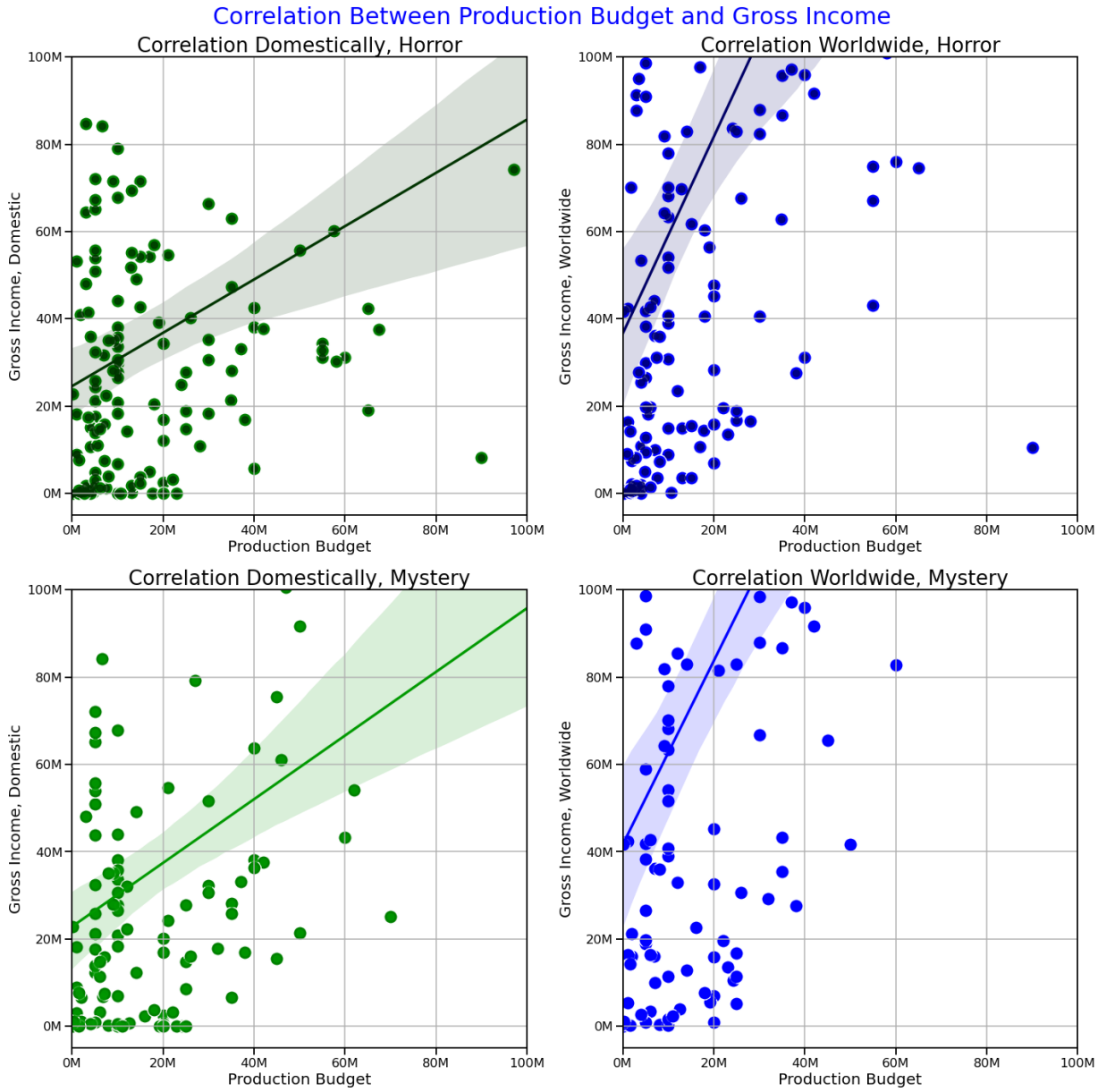
In [102]:

```
#Ploting Horror and Mystery movies data in the low quadrant plots above, zoo
fig, axes = plt.subplots(figsize=(20,20), ncols=2, nrows=2)
#sns.set_style('whitegrid')
sns.scatterplot(data=df_budget_gross_income_horror, x="budget", y="domestic_
sns.scatterplot(data=df_budget_gross_income_horror, x="budget", y="worldwide
sns.scatterplot(data=df_budget_gross_income_mystery, x="budget", y="domestic
sns.scatterplot(data=df_budget_gross_income_mystery, x="budget", y="worldwid

g1=sns.regplot(data=df_budget_gross_income_horror, x="budget", y="domestic_g
g2=sns.regplot(data=df_budget_gross_income_horror, x="budget", y="worldwide_
g3=sns.regplot(data=df_budget_gross_income_mystery, x="budget", y="domestic_
g4=sns.regplot(data=df_budget_gross_income_mystery, x="budget", y="worldwide

axes[0,0].set_title("Correlation Domestically, Horror", fontsize=26);
axes[0,0].set_ylabel('Gross Income, Domestic', fontsize=20)
axes[0,0].set_xlabel('Production Budget', fontsize=20)
axes[0,0].set_ylim((-5000000.0), (100000000.0))
axes[0,0].set_xlim((0), (100000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g1.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g1.get_yticks()/1000000]
axes[0,0].set_xticklabels(xlabels)
axes[0,0].set_yticklabels(ylabels)
axes[0,0].grid()

axes[0,1].set_title("Correlation Worldwide, Horror", fontsize=26);
axes[0,1].set_ylabel('Gross Income, Worldwide', fontsize=20)
axes[0,1].set_xlabel('Production Budget', fontsize=20)
axes[0,1].set_ylim((-5000000.0), (100000000.0))
axes[0,1].set_xlim((0), (100000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g2.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g2.get_yticks()/1000000]
axes[0,1].set_xticklabels(xlabels)
axes[0,1].set_yticklabels(ylabels)
axes[0,1].grid()

axes[1,0].set_title("Correlation Domestically, Mystery", fontsize=26);
axes[1,0].set_ylabel('Gross Income, Domestic', fontsize=20)
axes[1,0].set_xlabel('Production Budget', fontsize=20)
axes[1,0].set_ylim((-5000000.0), (100000000.0))
axes[1,0].set_xlim((0), (100000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g3.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g3.get_yticks()/1000000]
axes[1,0].set_xticklabels(xlabels)
axes[1,0].set_yticklabels(ylabels)
axes[1,0].grid()

axes[1,1].set_title("Correlation Worldwide, Mystery", fontsize=26);
axes[1,1].set_ylabel('Gross Income, Worldwide', fontsize=20)
axes[1,1].set_xlabel('Production Budget', fontsize=20)
axes[1,1].set_ylim((-5000000.0), (100000000.0))
axes[1,1].set_xlim((0), (100000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g4.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g4.get_yticks()/1000000]
axes[1,1].set_xticklabels(xlabels)
axes[1,1].set_yticklabels(ylabels)
axes[1,1].grid()
```

```
57
58
59 plt.suptitle("Correlation Between Production Budget and Gross Income", size=
60 plt.tight_layout()
```

executed in 829ms, finished 17:26:34 2021-03-28

```
<ipython-input-102-46ccc466aada>:21: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[0,0].set_xticklabels(xlabels)
<ipython-input-102-46ccc466aada>:22: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[0,0].set_yticklabels(ylabels)
<ipython-input-102-46ccc466aada>:32: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[0,1].set_xticklabels(xlabels)
<ipython-input-102-46ccc466aada>:33: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[0,1].set_yticklabels(ylabels)
<ipython-input-102-46ccc466aada>:43: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[1,0].set_xticklabels(xlabels)
<ipython-input-102-46ccc466aada>:44: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[1,0].set_yticklabels(ylabels)
<ipython-input-102-46ccc466aada>:54: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[1,1].set_xticklabels(xlabels)
<ipython-input-102-46ccc466aada>:55: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[1,1].set_yticklabels(ylabels)
```



Visual investigation of the plots above suggests that in the Domestic market, one can expect close to 2 coefficient in investment with budgets of 20 million and lower for movies in Horror and Mystery genres

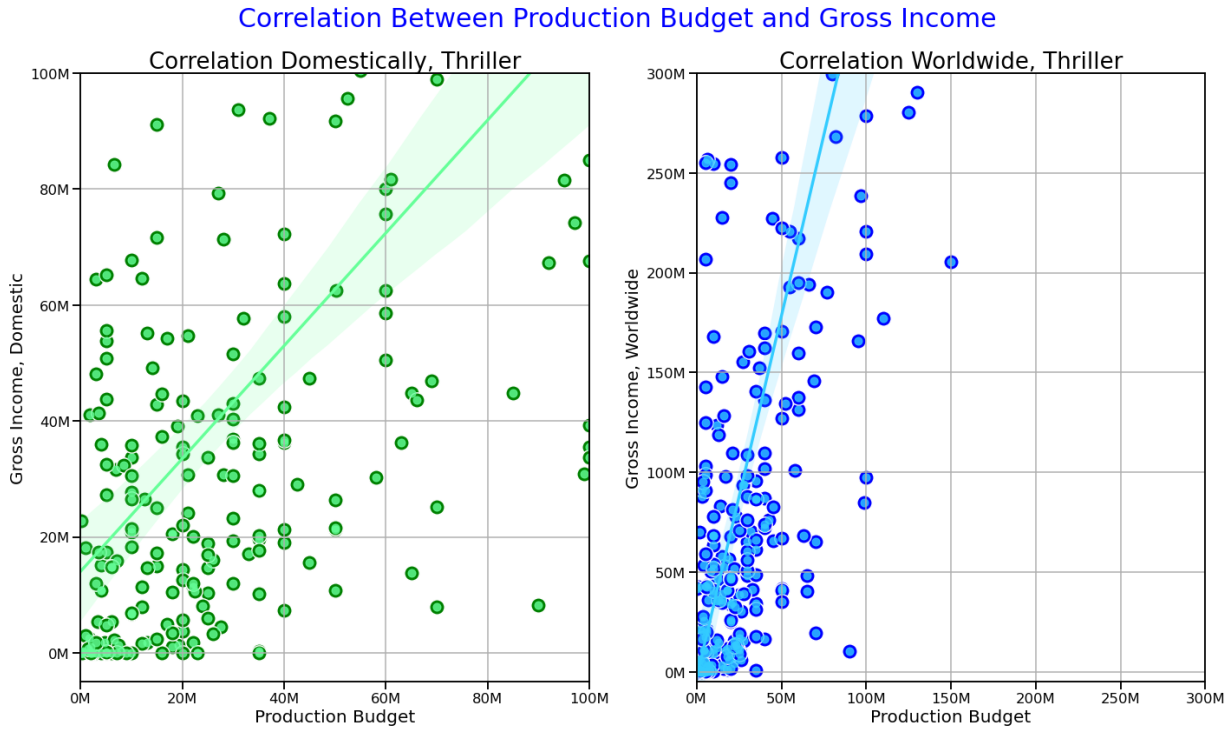
However, as the budget grows, the return falls.

In [103]:

```
fig, axes = plt.subplots(figsize=(20,12), ncols=2)
#sns.set_style('whitegrid')

sns.scatterplot(data=df_budget_gross_income_thriller, x="budget", y="domesti
sns.scatterplot(data=df_budget_gross_income_thriller, x="budget", y="worldwi


g5=sns.regplot(data=df_budget_gross_income_thriller, x="budget", y="domestic
g6=sns.regplot(data=df_budget_gross_income_thriller, x="budget", y="worldwid


axes[0].set_title("Correlation Domestically, Thriller", fontsize=26);
axes[0].set_ylabel('Gross Income, Domestic', fontsize=20)
axes[0].set_xlabel('Production Budget', fontsize=20)
axes[0].set_ylim((-5000000.0), (100000000.0))
axes[0].set_xlim((0), (100000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g5.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g5.get_yticks()/1000000]
axes[0].set_xticklabels(xlabels)
axes[0].set_yticklabels(ylabels)
axes[0].grid()

axes[1].set_title("Correlation Worldwide, Thriller", fontsize=26);
axes[1].set_ylabel('Gross Income, Worldwide', fontsize=20)
axes[1].set_xlabel('Production Budget', fontsize=20)
axes[1].set_ylim((-5000000.0), (300000000.0))
axes[1].set_xlim((0), (300000000.0))
xlabels = ['{:,.0f}'.format(x) + 'M' for x in g6.get_xticks()/1000000]
ylabels = ['{:,.0f}'.format(x) + 'M' for x in g6.get_yticks()/1000000]
axes[1].set_xticklabels(xlabels)
axes[1].set_yticklabels(ylabels)
axes[1].grid()

plt.suptitle("Correlation Between Production Budget and Gross Income", size=
plt.tight_layout()
```

executed in 479ms, finished 17:26:34 2021-03-28

```
<ipython-input-103-cec999eb1eb4>:19: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[0].set_xticklabels(xlabels)
<ipython-input-103-cec999eb1eb4>:20: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[0].set_yticklabels(ylabels)
<ipython-input-103-cec999eb1eb4>:30: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[1].set_xticklabels(xlabels)
<ipython-input-103-cec999eb1eb4>:31: UserWarning: FixedFormatter should only be
used together with FixedLocator
  axes[1].set_yticklabels(ylabels)
```



Visual investigation of the plots above suggests that while Thriller movies do not perform quite as well as horror and mystery movies domestically, the regression model suggests that 20 million investment would generate slightly above 30 million in gross income (a coefficient of return is about 1.75). Internationally, thriller movies tend to do much better, and an estimate of a coefficient of return is about 3.5. If they choose to produce a Thriller genre movie, the customer is recommended to release it to the foreign markets to maximize the return.
The conclusion is that thriller movie budgets tend to be higher than those of Horror and Mystery movies. However, the overall profit for Thriller movies tends to be higher. The production of **several** Horror/Mystery movies might cost the same as the production of one Thriller movie to generate the same amount of gross profit. However, several movies' production versus one might be a smart move because it increases the probability of success overall (not putting all your eggs in one basket approach.

In [104]:
```
1 conn.commit()
```
executed in 15ms, finished 17:26:34 2021-03-28

In [105]:
```
1 cur.close()
```
executed in 15ms, finished 17:26:34 2021-03-28

2.4 Evaluation

The business problem solution should maximize the return over investment value along with minimizing the risks.

The provided analysis investigates:

- How well various studios perform in terms of their ROI both domestically and worldwide
- How timing of a release of a movie influences its' profitability
- How a genre of a movie influences its' profitability
- If a movie budget plays a significant role in the amount of its' gross income and if movies of different genres have different correlations between their budgets and gross income generated.

2.5 Conclusions

The customer is advised:

- To either partner with Universal Studios, Paramount Pictures, The Weinstein Company, and Lions Gate Films Corporation studios (in that order) or invest in investigating their business practices and replicating them in their business.
- To carefully plan the timing of releasing their movies because Return on Investment tends to be higher in the time periods when fewer movies are available to the viewers. The only exception is the month of July, an outlier among other months of a year. It seems that no matter how many movies are in the theaters, it will be more profitable than in other months of a year.
- To invest in the three most profitable genres in terms of Return on Investment, Horror, Mystery, and Thriller (in that order), both domestically and abroad. Their production budgets tend to be lower than movies in other genres, but the ratio between their gross incomes to the production costs is higher. In other words, it is more profitable to make many movies in these genres than just one movie in a genre with higher production costs and higher one-movie gross income. These tactics have the additional benefit of minimizing the risk of investment.

Additional analysis suggested:

- Update data available for analysis by either creating APIs with the sources or webscraping their sites
- Investigate the effect of a choice of directors/writers on the profitability of a movie using additional tables in the database
- Use Rotten Tomatoes tables to analyze the correlations between the profitability of a movie and its' critics rating and viewers' rating
- Replicate the analysis of this project using Rotten Tomatoes tables to confirm the findings

In [ ]:
```
1
```