1 Final Project Submission

Please fill out:

- Student name: Ethan Kunin
- Student pace: Full Time
- Scheduled project review date/time: March 23rd 4:00pm EST
- Instructor name: James Irving
- Blog post URL: https://github.com/kuninethan95/dsc-phase-1-project (https://github.com/kuninethan95/dsc-phase-1-project)

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 creating movies. You are charged with exploring what types of films are currently doing the best at the box office. You must then translate those findings into actionable insights that the head of Microsoft's new movie studio can use to help decide what type of films to create.

2.1 Questions and Conclusions

- Which directors generate the highest revenue per film?
- What month generates the highest revenue for films?
- What film length generates the highest revenue?
- Do franchise films earn more than non-franchise films

In [1]:
```
# Import necessary libraries and packages

import os,glob
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib as mpl
import seaborn as sns
import requests
```

In [2]:
```
# Display where the data is contained

folder = "/Users/ethankunin/Documents/Flatiron/Phase_1/Movie_Project1/dsc-p
os.listdir(folder)
```

Out[2]:
```
['imdb.title.crew.csv.gz',
 '.DS_Store',
 'tmdb.movies.csv.gz',
 'imdb.title.akas.csv.gz',
 'imdb.title.ratings.csv.gz',
 'imdb.name.basics.csv.gz',
 'rt.reviews.tsv.gz',
 'imdb.title.basics.csv.gz',
 'rt.movie_info.tsv.gz',
 'tn.movie_budgets.csv.gz',
 'bom.movie_gross.csv.gz',
 'imdb.title.principals.csv.gz']
```

In [3]:
```
files = glob.glob(f"{folder}*.csv*")
```

In [4]:
```
# Load in files and display preview

tables = {}
dashes='---'*25

for file in files:
    ## Save a variable-friendly version of the file name
    table_name = file.replace('.csv.gz','').split('/')[-1].replace('.','_')
    print(dashes)

    ## Load and preview dataframe
    print(f"Preview of {table_name}")
    tables[table_name] = pd.read_csv(file)
    display(tables[table_name].head(5))
    print()
```

```
---------------------------------------------------------------------------
--
Preview of imdb_title_crew
```

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

```
---------------------------------------------------------------------------
--
Preview of tmdb_movies
```

3 Description of each table with unique identifiers

- imdb_title_crew: id's to link crew members with titles
- tmdb_movies - titles and stats from IMDB
- imdb_title_akas - link between id and movie title
- imdb_title_ratings - link between title and IMDB ratings
- imdb_name_basics - name of cast member and id
- imdb_title_basics - movie title, id, and runtime
- tn_movie_budgets - movie title, release date, and earnings/costs
- bom_movie_gross - movie title, studio, and earnings
- imdb_title_principals - link between movie title and cast cast id

In [5]:
```
# Link each file to a Pandas dataframe

filepath0 = files[0]
imdb_title_crew = pd.read_csv(filepath0)
```

In [6]:
```
filepath1 = files[1]
tmdb_movies = pd.read_csv(filepath1)
```

In [7]:
```
filepath2 = files[2]
imdb_title_akas = pd.read_csv(filepath2)
```

In [8]:
```
filepath3 = files[3]
imdb_title_ratings = pd.read_csv(filepath3)
```

In [9]:
```
filepath4 = files[4]
imdb_name_basics = pd.read_csv(filepath4)
```

In [10]:
```
filepath5 = files[5]
imdb_title_basics = pd.read_csv(filepath5)
```

In [11]:
```
filepath6 = files[6]
tn_movie_budgets = pd.read_csv(filepath6)
```

In [12]:
```
filepath7 = files[7]
bom_movie_gross = pd.read_csv(filepath7)
```

In [13]:
```
filepath8 = files[8]
imdb_title_principals = pd.read_csv(filepath8)
```

4 Analyze how runtime impacts revenue

- Do longer movies earn more revenue than shorter movies?
- Is there correlation between film length and run time?

In [14]:
```
# Merge movie budgets/earnings with titles to display runtime

movie_rt = tn_movie_budgets.merge(imdb_title_basics, left_on='movie', right
```

In [15]:
```
movie_rt.head()
```

Out[15]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	tconst	pri
0	2	May 20, 2011	Pirates of the Caribbean: On Stranger Tides	$410,600,000	$241,063,875	$1,045,663,875	tt1298650	Pir O
1	3	Jun 7, 2019	Dark Phoenix	$350,000,000	$42,762,350	$149,762,350	tt6565702	Da
2	4	May 1, 2015	Avengers: Age of Ultron	$330,600,000	$459,005,868	$1,403,013,963	tt2395427	Ag
3	7	Apr 27, 2018	Avengers: Infinity War	$300,000,000	$678,815,482	$2,048,134,200	tt4154756	I
4	9	Nov 17, 2017	Justice League	$300,000,000	$229,024,295	$655,945,209	tt0974015	

In [16]:
```
movie_rt.info()

# Going to have to turn production_budget/domestic_gross/worldwide_gross in
# Only column with significant null values is runtime_minutues, may account
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 3537 entries, 0 to 3536
Data columns (total 12 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   id                 3537 non-null   int64  
 1   release_date       3537 non-null   object 
 2   movie              3537 non-null   object 
 3   production_budget  3537 non-null   object 
 4   domestic_gross     3537 non-null   object 
 5   worldwide_gross    3537 non-null   object 
 6   tconst             3537 non-null   object 
 7   primary_title      3537 non-null   object 
 8   original_title     3537 non-null   object 
 9   start_year         3537 non-null   int64  
 10  runtime_minutes    3070 non-null   float64
 11  genres             3473 non-null   object 
dtypes: float64(1), int64(2), object(9)
memory usage: 359.2+ KB
```

4.1 Clean Data

- Sort for commercial release by only including films with production_budgets > $20,000000 (classified as commercial budget)
- Only use movies from 2010 onwards (streaming more prominence)

- Convert production_budget/domestic_gross/worldwide_gross into integers
- Impute runtime_minutes with either mean/median
- Check for outliers
- Feature engineer short/medium/long
- Drop unnecessary columns
- https://www.marketwatch.com/story/netflix-reportedly-set-to-produce-90-movies-a-year-with-budgets-up-to-200-million-2018-12-16 (https://www.marketwatch.com/story/netflix-reportedly-set-to-produce-90-movies-a-year-with-budgets-up-to-200-million-2018-12-16)

In [17]:
```
# Feature engineer function to turn budget/gross into integers

def col_to_int(df, colm):
    df[colm] = df[colm].map(lambda x: x.replace('$', '')).map(lambda x: x.r
    return df
```

In [18]:
```
col_to_int(movie_rt, 'production_budget')
```

Out[18]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	tconst
0	2	May 20, 2011	Pirates of the Caribbean: On Stranger Tides	410600000	$241,063,875	$1,045,663,875	tt1298650
1	3	Jun 7, 2019	Dark Phoenix	350000000	$42,762,350	$149,762,350	tt6565702
2	4	May 1, 2015	Avengers: Age of Ultron	330600000	$459,005,868	$1,403,013,963	tt2395427
3	7	Apr 27, 2018	Avengers: Infinity War	300000000	$678,815,482	$2,048,134,200	tt4154756
4	9	Nov 17, 2017	Justice League	300000000	$229,024,295	$655,945,209	tt0974015
...	...	...	...	...	...	...	...
3532	68	Jul 6, 2001	Cure	10000	$94,596	$94,596	tt5936960
3533	70	Apr 1, 1996	Bang	10000	$527	$527	tt6616538
3534	73	Jan 13, 2012	Newlyweds	9000	$4,584	$4,584	tt1880418
3535	78	Dec 31, 2018	Red 11	7000	$0	$0	tt7837402
3536	81	Sep 29, 2015	A Plague So Pleasant	1400	$0	$0	tt2107644

3537 rows × 12 columns

In [19]:
```
col_to_int(movie_rt, 'domestic_gross')
```

Out[19]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	tconst
0	2	May 20, 2011	Pirates of the Caribbean: On Stranger Tides	410600000	241063875	$1,045,663,875	tt1298650
1	3	Jun 7, 2019	Dark Phoenix	350000000	42762350	$149,762,350	tt6565702
2	4	May 1, 2015	Avengers: Age of Ultron	330600000	459005868	$1,403,013,963	tt2395427
3	7	Apr 27, 2018	Avengers: Infinity War	300000000	678815482	$2,048,134,200	tt4154756
4	9	Nov 17, 2017	Justice League	300000000	229024295	$655,945,209	tt0974015
...	...	...	...	...	...	...	...
3532	68	Jul 6, 2001	Cure	10000	94596	$94,596	tt5936960
3533	70	Apr 1, 1996	Bang	10000	527	$527	tt6616538
3534	73	Jan 13, 2012	Newlyweds	9000	4584	$4,584	tt1880418
3535	78	Dec 31, 2018	Red 11	7000	0	$0	tt7837402
3536	81	Sep 29, 2015	A Plague So Pleasant	1400	0	$0	tt2107644

3537 rows × 12 columns

In [20]:
```
col_to_int(movie_rt, 'worldwide_gross')
```

Out[20]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	tconst
0	2	May 20, 2011	Pirates of the Caribbean: On Stranger Tides	410600000	241063875	1045663875	tt1298650
1	3	Jun 7, 2019	Dark Phoenix	350000000	42762350	149762350	tt6565702
2	4	May 1, 2015	Avengers: Age of Ultron	330600000	459005868	1403013963	tt2395427
3	7	Apr 27, 2018	Avengers: Infinity War	300000000	678815482	2048134200	tt4154756
4	9	Nov 17, 2017	Justice League	300000000	229024295	655945209	tt0974015
...	...	...	...	...	...	...	...
3532	68	Jul 6, 2001	Cure	10000	94596	94596	tt5936960
3533	70	Apr 1, 1996	Bang	10000	527	527	tt6616538
3534	73	Jan 13, 2012	Newlyweds	9000	4584	4584	tt1880418
3535	78	Dec 31, 2018	Red 11	7000	0	0	tt7837402
3536	81	Sep 29, 2015	A Plague So Pleasant	1400	0	0	tt2107644

3537 rows × 12 columns

In [21]:
```
# Filter out movies with production budgets under $20,000,000

movie_rt = movie_rt.loc[movie_rt['production_budget'] > 20000000]
```

In [22]:
```
# Feature Engineer year column. Not going to use DateTime yet because will
# Convert year into an int

movie_rt['year'] = movie_rt['release_date'].map(lambda x: x[-4:])
movie_rt['year'] = movie_rt['year'].astype('int')
```

```
<ipython-input-22-9bf4465972f1>:4: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-do
cs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (http
s://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returni
ng-a-view-versus-a-copy)
  movie_rt['year'] = movie_rt['release_date'].map(lambda x: x[-4:])
<ipython-input-22-9bf4465972f1>:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-do
cs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (http
s://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returni
ng-a-view-versus-a-copy)
  movie_rt['year'] = movie_rt['year'].astype('int')
```

In [23]:
```
# Slice out movies from before 2010

movie_rt = movie_rt[movie_rt['year'] >= 2010]
```

In [24]:
```
# We have 8.2% of movies with null runtime_minutes

(movie_rt['runtime_minutes'].isna().sum())/len(movie_rt)* 100
```

Out[24]:
```
8.018018018018019
```

In [25]:
```
# Check for duplicates
# 298 duplicates, upon inspection doesn't look like there's a reason other
#Drop if they contain the same movie title and release date

movie_rt[movie_rt.duplicated(subset=['movie', 'release_date'])]
movie_rt.duplicated(subset=['movie', 'release_date']).sum()
movie_rt.drop
```

Out[25]:
```
<bound method DataFrame.drop of       id  release_date
movie  \
0      2  May 20, 2011  Pirates of the Caribbean: On Stranger Tides
1      3   Jun 7, 2019                                 Dark Phoenix
2      4   May 1, 2015                     Avengers: Age of Ultron
3      7  Apr 27, 2018                      Avengers: Infinity War
4      9  Nov 17, 2017                             Justice League
...   ..           ...                                         ...
1578  69   Aug 4, 2017                                      Kidnap
1579  72   Dec 9, 2011                   Tinker Tailor Soldier Spy
1581  79   May 6, 2011                                 The Beaver
1582  80  Feb 24, 2017                               Bitter Harvest
1586  82   Feb 1, 2019                               Velvet Buzzsaw

      production_budget  domestic_gross  worldwide_gross     tconst  \
0             410600000       241063875       1045663875  tt1298650
1             350000000        42762350        149762350  tt6565702
2             330600000       459005868       1403013963  tt2395427
3             300000000       678815482       2048134200  tt4154756
4             300000000       229024295        655945209  tt0974015
...                 ...             ...              ...        ...
1578           21000000        30718107         34836080  tt9603698
1579           21000000        24149393         81452811  tt1340800
1581           21000000          970816          5046038  tt1321860
1582           21000000          557241           606162  tt3182620
1586           21000000               0                0  tt7043012

                                  primary_title  \
0     Pirates of the Caribbean: On Stranger Tides
1                                   Dark Phoenix
2                       Avengers: Age of Ultron
3                        Avengers: Infinity War
4                               Justice League
...                                        ...
1578                                   Kidnap
1579                     Tinker Tailor Soldier Spy
1581                                The Beaver
1582                              Bitter Harvest
1586                              Velvet Buzzsaw

                                  original_title  start_year  \
0     Pirates of the Caribbean: On Stranger Tides        2011
1                                   Dark Phoenix        2019
2                       Avengers: Age of Ultron        2015
3                        Avengers: Infinity War        2018
4                               Justice League        2017
...                                        ...         ...
1578                                   Kidnap        2012
1579                     Tinker Tailor Soldier Spy        2011
```

```
1581                                The Beaver        2011
1582                          Bitter Harvest        2017
1586                          Velvet Buzzsaw        2019

      runtime_minutes                    genres  year
0               136.0  Action,Adventure,Fantasy  2011
1               113.0   Action,Adventure,Sci-Fi  2019
2               141.0   Action,Adventure,Sci-Fi  2015
3               149.0   Action,Adventure,Sci-Fi  2018
4               120.0  Action,Adventure,Fantasy  2017
...               ...                       ...   ...
1578             50.0           Horror,Thriller  2017
1579            122.0    Drama,Mystery,Thriller  2011
1581             91.0                     Drama  2011
1582            103.0         Drama,Romance,War  2017
1586            113.0   Horror,Mystery,Thriller  2019

[1110 rows x 13 columns]>
```

In [26]:
```
# Clear out movies with runtimes under 80 minutes
#https://screenwriting.io/what-is-a-feature-film/#:~:text=A%20modern%20feat

movie_rt = movie_rt[(movie_rt['runtime_minutes'] > 80) & (movie_rt['runtime
```

In [27]:
```
movie_rt.isna().sum()
```

Out[27]:
```
id                  0
release_date        0
movie               0
production_budget   0
domestic_gross      0
worldwide_gross     0
tconst              0
primary_title       0
original_title      0
start_year          0
runtime_minutes     0
genres              0
year                0
dtype: int64
```

In [28]:
```
# Find the approxomate cutoff for short/medium/long movies based on quintil
# For analysis, want an equal amount of observations in each row

display(np.quantile(movie_rt['runtime_minutes'], 0.33))
np.quantile(movie_rt['runtime_minutes'], 0.66)
```

```
102.0
```

Out[28]:
```
117.0
```

In [29]:
```
#Now we check again for null values

(movie_rt['runtime_minutes'].isna().sum())/len(movie_rt)* 100
```

Out[29]:
```
0.0
```

In [30]:
```
# Feature engineer function to categorize movie lenght by duration
# Use .33 and 0.66 quintile to distinguish length

def length(mins):
    if mins < 100:
        return 'short'
    elif mins < 120:
        return 'medium'
    else:
        return 'long'
```

In [31]:
```
movie_rt['duration'] = movie_rt['runtime_minutes'].map(length)
```

```
<ipython-input-31-612a18e56b11>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-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)
  movie_rt['duration'] = movie_rt['runtime_minutes'].map(length)
```

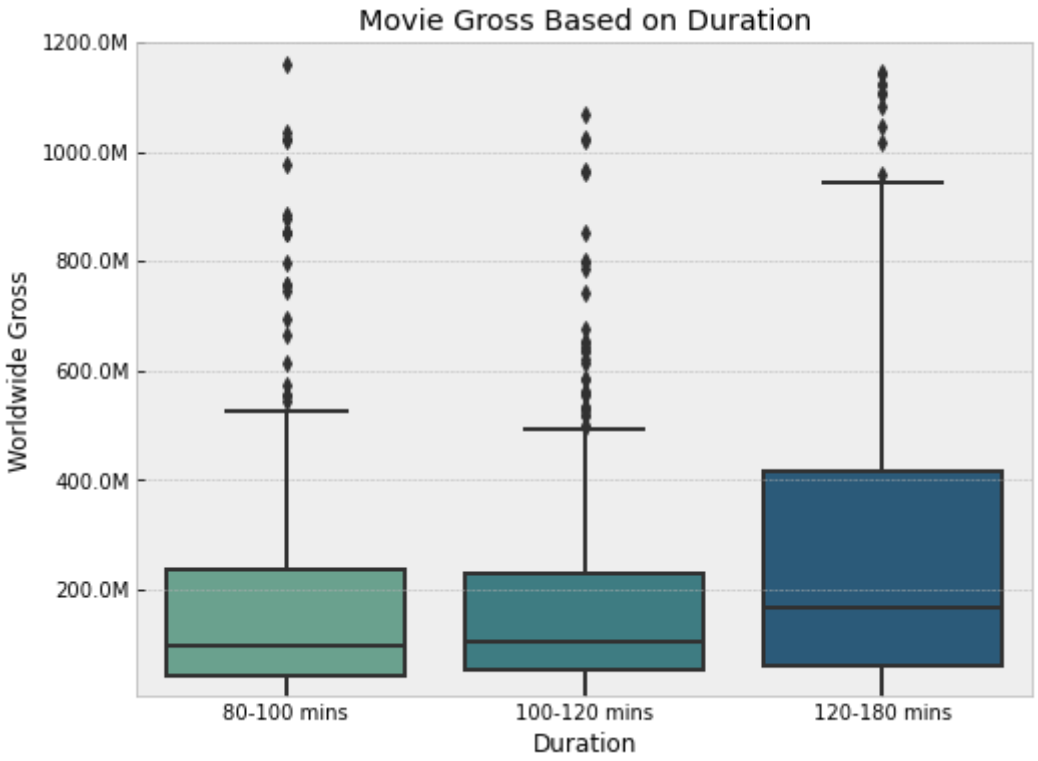
In [32]:
```
# Most movies fall into the short category, then medium, then long

movie_rt.groupby('duration').count()
```

Out[32]:

duration	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	tconst	p
long	273	273	273	273	273	273	273	
medium	398	398	398	398	398	398	398	
short	250	250	250	250	250	250	250	

4.2 Visualization A: Create boxplot to illustrate how runtime impacts revenue

In [33]:
```
from matplotlib.ticker import FuncFormatter

def millions(x, pos):
    return '%1.1fM' % (x * 1e-6)

#https://stackoverflow.com/questions/61330427/set-y-axis-in-millions

with plt.style.context('bmh'):
    fig, ax = plt.subplots(figsize=(8, 6))
    ax = sns.boxplot(x='duration', y='worldwide_gross', data=movie_rt, pale

    ax.set_ylim(5000000, 1200000000)
    ax.set_title('Movie Gross Based on Duration')
    ax.set_ylabel('Worldwide Gross')
    ax.set_xlabel('Duration')
    formatter = FuncFormatter(millions)
    ax.yaxis.set_major_formatter(formatter)
    x_labs = ['80-100 mins', '100-120 mins', '120-180 mins']
    ax.set_xticklabels(x_labs);
    #plt.savefig("/Users/ethankunin/Desktop/movie_season.png", transparent=
```

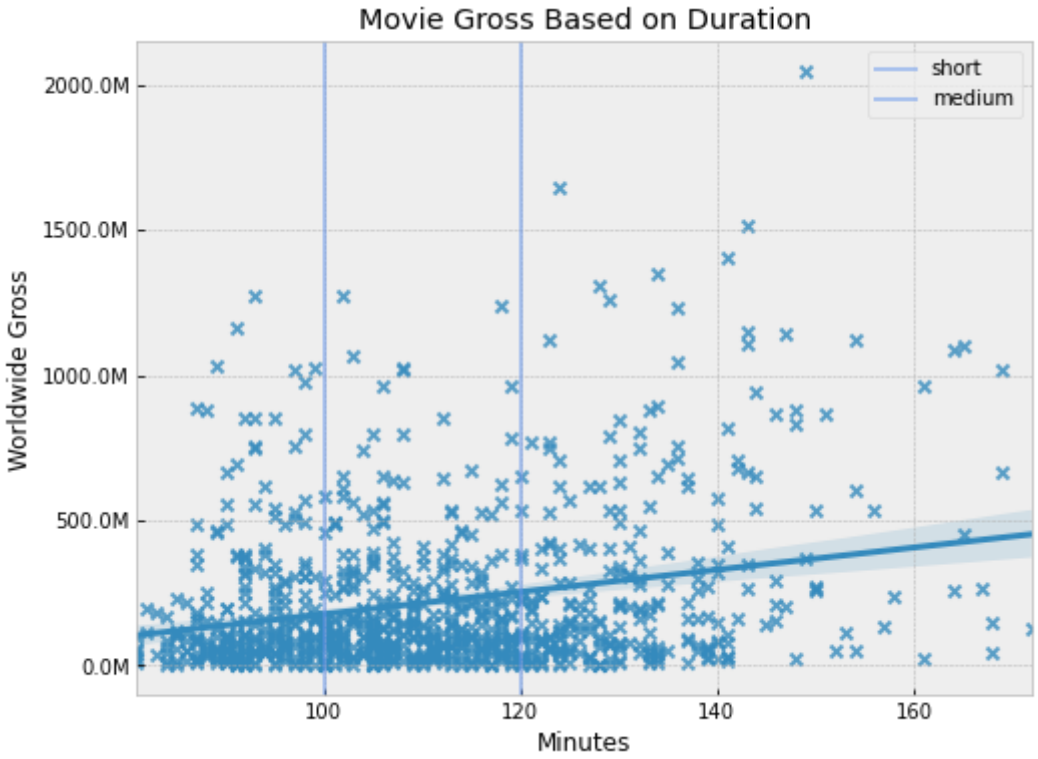


4.2.1 Conclusion

- Long movies have the highest median
- Long movies have the largest distributional spread
- Short and medium length movies have similar distributions
- Overall, I recommend making long movies based on this figure

4.3 Visualization B: Create linear regression plot to illustrate how runtime impacts revenue

In [34]:
```
with plt.style.context('bmh'):
    fig, ax = plt.subplots(figsize=(8, 6))
    ax = sns.regplot(x='runtime_minutes', y='worldwide_gross', data=movie_r

    ax.set_title('Movie Gross Based on Duration')
    ax.set_ylabel('Worldwide Gross')
    ax.set_xlabel('Minutes')
    ax.axvline(x=100, color='cornflowerblue', linestyle='solid', label='sho
    ax.axvline(x=120, color='cornflowerblue', linestyle='solid', label='med
    formatter = FuncFormatter(millions)
    ax.yaxis.set_major_formatter(formatter)
    ax.legend();
```



4.3.1 Conclusion

- There is a positive trend between film duration and worldwide gross
- Long movies have more outlier values

5 Analyze which directors generate the highest revenue

- Are the top directors generally profitable?
- How much revenue do top directors' films earn?
- Are all films that top directors produce domestically and globabally profitable

In [35]:
```
# Merge to create table that shows primary name with nconst/tconst id

name_titles = imdb_name_basics.merge(imdb_title_principals, how='left', on=
name_titles.head()
```

Out[35]:

	nconst	primary_name	birth_year	death_year	primary_profession	
0	nm0061671	Mary Ellen Bauder	NaN	NaN	miscellaneous,production_manager,producer	tt
1	nm0061865	Joseph Bauer	NaN	NaN	composer,music_department,sound_department	tt
2	nm0061865	Joseph Bauer	NaN	NaN	composer,music_department,sound_department	tt
3	nm0061865	Joseph Bauer	NaN	NaN	composer,music_department,sound_department	tt
4	nm0061865	Joseph Bauer	NaN	NaN	composer,music_department,sound_department	tt

In [36]:
```
#Merge to create table that shows primary name and job function

names_movies = imdb_title_akas.merge(name_titles, how='inner', left_on='tit
```

5.1 Clean Data

- Sort for only directors and US verion of movies
- Handle duplicates
- Handle null values

In [37]:
```
# Filter out non-directors

names_movies = names_movies[names_movies['category'] == 'director']
```

In [38]:
```
# Sort such that we are only showing the American version use 'US'

names_movies = names_movies[names_movies['region'] == 'US']
```

In [39]:
```
# Filter out directors who are no longer alive

names_movies = names_movies[names_movies['death_year'].isna()]
names_movies.head()
```

Out[39]:

	title_id	ordering_x	title	region	language	types	attributes	is_original_title	ncon
125	tt0369610	21	Jurassic World 3D	US	NaN	NaN	3-D version	0.0	nm11198
205	tt0369610	29	Jurassic World	US	NaN	NaN	NaN	0.0	nm11198
215	tt0369610	2	Ebb Tide	US	NaN	NaN	fake working title	0.0	nm11198
285	tt0369610	36	Jurassic Park IV	US	NaN	working	NaN	0.0	nm11198
375	tt0369610	44	Jurassic Park 4	US	NaN	NaN	informal alternative title	0.0	nm11198

In [40]:
```
# Merge to create table that shows primary name and movie

movie_direct = movie_rt.merge(names_movies, how='left', left_on='movie', ri
```

In [41]:
```
# Clean up excess columns from merge

movie_direct.columns
cols_to_remove = ['original_title', 'runtime_minutes', 'genres', 'year', 'd
                  'title', 'types','nconst','primary_profession', 'known_fo
                  'tconst_y', 'category', 'job', 'primary_title', 'start_ye
                   'language', 'is_original_title', 'ordering_y', 'characte
```

In [42]:
```
movie_direct = movie_direct.drop(columns=(cols_to_remove))
```

In [43]:
```
# Check for duplicates from merge

(movie_direct.duplicated(subset=['release_date', 'movie'])).sum()
```

Out[43]: 518

In [44]:
```
movie_direct = movie_direct.drop_duplicates(subset=['release_date', 'movie'
```

In [45]:
```
# Remove null values

movie_direct[movie_direct['primary_name'].isna()]
```

Out[45]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	tconst_x
8	10	Nov 6, 2015	Spectre	300000000	200074175	879620923	tt2379713
9	11	Jul 20, 2012	The Dark Knight Rises	275000000	448139099	1084439099	tt1345836
89	88	Jul 1, 2016	The Legend of Tarzan	180000000	126643061	348902025	tt0918940
144	36	Dec 21, 2018	Aquaman	160000000	335061807	1146894640	tt1477834
150	46	Jun 10, 2016	Warcraft	160000000	47225655	425522281	tt0803096
...	...	...	...	...	...	...	...
1306	49	Oct 31, 2014	Before I Go to Sleep	22000000	3242457	19563579	tt1726592
1313	52	Dec 31, 2013	Metegol	22000000	0	34061097	tt1634003
1314	58	Jun 22, 2012	To Rome with Love	21500000	16684352	74326015	tt1859650
1325	79	May 6, 2011	The Beaver	21000000	970816	5046038	tt1321860
1326	80	Feb 24, 2017	Bitter Harvest	21000000	557241	606162	tt3182620

127 rows × 11 columns

In [46]:
```
movie_direct = movie_direct.dropna(axis=0, subset=['primary_name'])
```

5.2 Categorize/List Top Directors

- Groupby sum/mean of domestic/worlwide gross
- Feature engineer T/F of profitable/unprofitable for scatter plot

In [47]:
```
# Prepare plots by grouping by top 20 director name, type of gross, mean an

tp_dgmean = movie_direct.groupby('primary_name')['domestic_gross'].mean().s
tp_dgmean
```

Out[47]:

	primary_name	domestic_gross
0	Ryan Coogler	700059566.0
1	Colin Trevorrow	652270625.0
2	Joss Whedon	541142707.5
3	Angus MacLane	486295561.0
4	Joe Russo	448882263.0
5	J.A. Bayona	417719760.0
6	Patty Jenkins	412563408.0
7	Adam Green	400738009.0
8	Tim Miller	363070709.0
9	Artie Mandelberg	356461711.0
10	Brad Bird	351009033.0
11	Jared Bush	341268248.0
12	Jon Favreau	338217227.0
13	Jon Watts	334201140.0
14	James Gunn	333172112.0
15	Andy Muschietti	327481748.0
16	Taika Waititi	315058289.0
17	Lee Unkrich	312365447.5
18	Sam Mendes	304360277.0
19	David Slade	300531751.0

In [48]:
```
tp_dgsum = movie_direct.groupby('primary_name')['domestic_gross'].sum().sor
```

In [49]:
```
tp_wgmean = movie_direct.groupby('primary_name')['worldwide_gross'].mean().
```

In [50]:
```
tp_wgsum = movie_direct.groupby('primary_name')['worldwide_gross'].sum().so
tp_wgsum
```

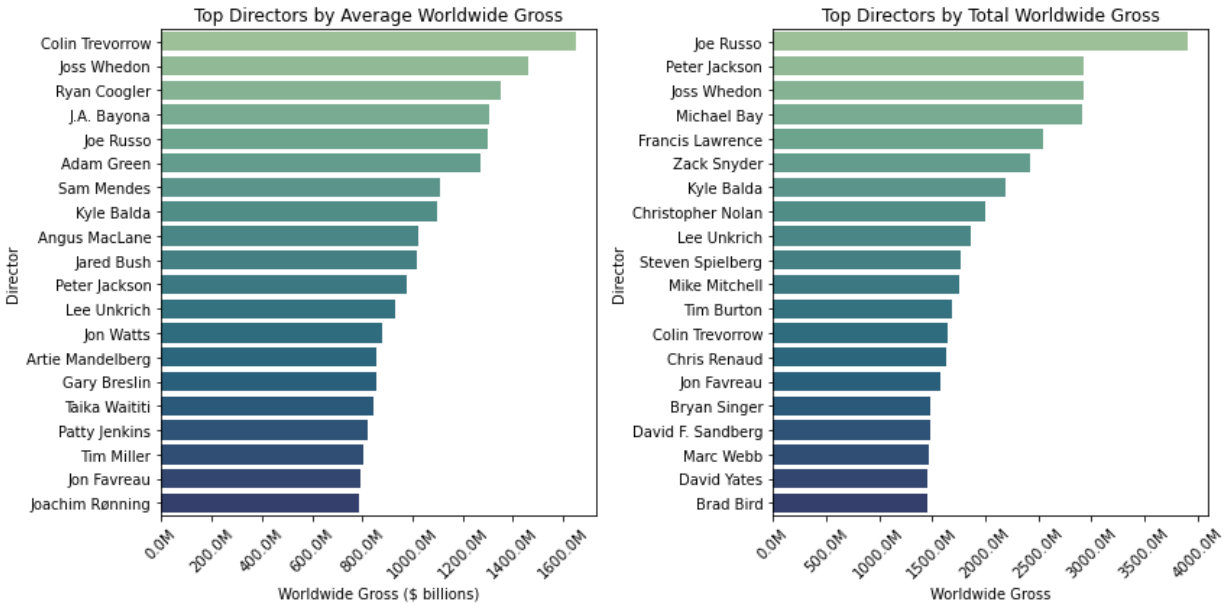
Out[50]:

	primary_name	worldwide_gross
0	Joe Russo	3902605502
1	Peter Jackson	2922948044
2	Joss Whedon	2920949860
3	Michael Bay	2911998250
4	Francis Lawrence	2543191543
5	Zack Snyder	2420920114
6	Kyle Balda	2195063923
7	Christopher Nolan	2001741385
8	Lee Unkrich	1866887623
9	Steven Spielberg	1762841457
10	Mike Mitchell	1760496511
11	Tim Burton	1689848988
12	Colin Trevorrow	1648854864
13	Chris Renaud	1632032904
14	Jon Favreau	1584010936
15	Bryan Singer	1488087924
16	David F. Sandberg	1485961283
17	Marc Webb	1466886603
18	David Yates	1454622939
19	Brad Bird	1449148229

5.3 Create Visualization: Top 20 Directors, 2 Graphs to display WW and Mean/Sum

In [51]:
```
# Opted to use mean because the outliers are a valuable data point
# Outlier movies can produce significant impact on production company balan

fig, (ax1, ax2) = plt.subplots(nrows=1, ncols=2, figsize=(12,6))

x_labels1 = ['$0.0', '$0.2', '$0.4', '$0.6', '$0.8', '$1.0', '$1.2', '$1.4'
x_labels2 = ['$0.0', '$0.5', '$1.0', '$1.5', '$2.0', '$2.5', '$3.0', '$3.5'
ax1 = sns.barplot(data=tp_wgmean, x='worldwide_gross', y='primary_name', ax
ax1.set_title('Top Directors by Average Worldwide Gross')
ax1.set_xlabel('Worldwide Gross ($ billions)')
ax1.set_ylabel('Director')
ax1.set_xticklabels(x_labels1)
formatter = FuncFormatter(millions)
ax1.xaxis.set_major_formatter(formatter)
ax1.tick_params(axis='x', labelrotation = 45)


ax2 = sns.barplot(data=tp_wgsum, x='worldwide_gross', y='primary_name', ax=
ax2.set_title('Top Directors by Total Worldwide Gross')
ax2.set_xlabel('Worldwide Gross')
ax2.set_ylabel('Director')
ax2.set_xticklabels(x_labels2)
formatter = FuncFormatter(millions)
ax2.xaxis.set_major_formatter(formatter)
ax2.tick_params(axis='x', labelrotation = 45)
fig.tight_layout();
```

```
<ipython-input-51-7733827f78ab>:12: UserWarning: FixedFormatter should on
ly be used together with FixedLocator
  ax1.set_xticklabels(x_labels1)
<ipython-input-51-7733827f78ab>:22: UserWarning: FixedFormatter should on
ly be used together with FixedLocator
  ax2.set_xticklabels(x_labels2)
```



5.3.1 Conclusion

- Many of the directors on the left chart also appear on the right
- Valuable list to parse through when considering who will direct the first film

In [52]:
```
# Create list of top 20 directors by total worldwide gross

td = list(tp_wgsum['primary_name'])
```

In [53]:
```
# Group table into top 20 directors and determine how profitable they are

dftd = movie_direct[movie_direct['primary_name'].isin(td)]
```

In [54]:
```
dftd2 = dftd.copy()
```

In [55]:
```
# Profit column for absolute

dftd2['profit'] = dftd2['worldwide_gross'] - dftd2['production_budget']
```

In [56]:
```
# Feature engineer column to display if movie is profitable (domestic/world

def profitable(num):
    if num > 0:
        return True
    elif num < 0:
        return False
```

In [57]:
```
dftd2['pwtf'] = dftd2['profit'].map(profitable)
```

In [58]:
```
# Profit margin column

dftd2['pmarg'] = (dftd2['worldwide_gross'] - dftd2['domestic_gross'])/(dftd
```

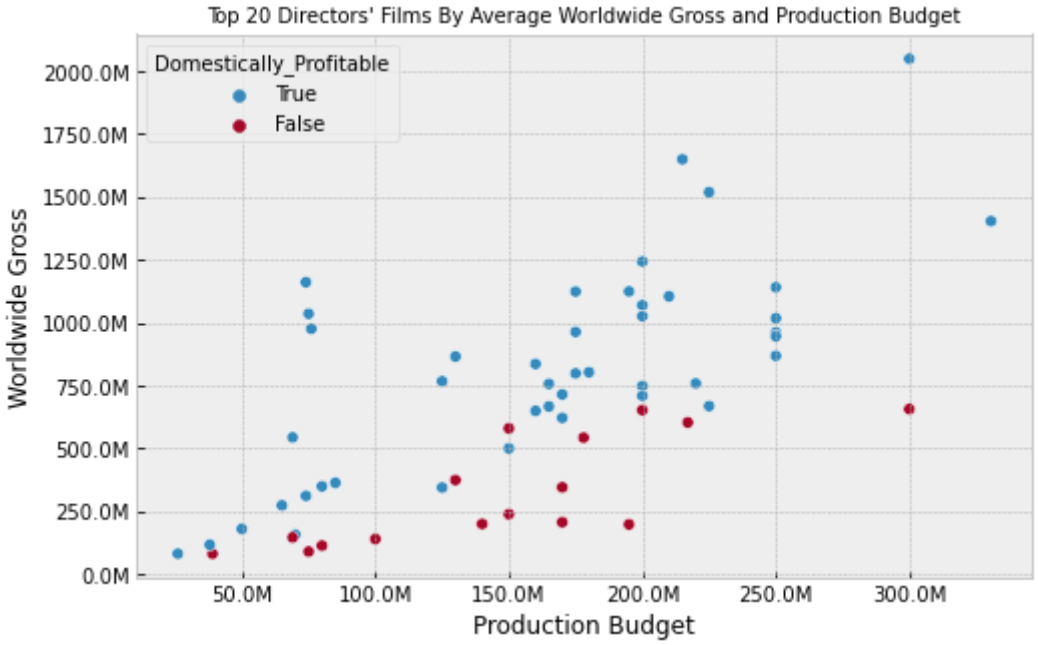
In [59]:
```
dftd2['profitdom'] = dftd2['domestic_gross'] - dftd2['production_budget']
```

In [60]:
```
# Insert column with boolean values for film profitability

dftd2['pdtf'] = dftd2['profitdom'].map(profitable).rename('Domestically Pro
dftd2.rename(columns={'pdtf': 'Domestically_Profitable'}, inplace=True)
```

5.4 Create Visualization: Analyze profitablity and

relationship between budget and worldwide revenue for Top Directors

In [61]:
```
with plt.style.context('bmh'):
    fig, ax = plt.subplots(figsize=(8,5))
    sns.scatterplot(x='production_budget', y='worldwide_gross', data=dftd2,
                    hue='Domestically_Profitable',hue_order=(True, False))

    ax.set_title('Top 20 Directors\' Films By Average Worldwide Gross and P
    ax.set_xlabel('Production Budget')
    ax.set_ylabel('Worldwide Gross')

    formatter = FuncFormatter(millions)
    ax.yaxis.set_major_formatter(formatter)
    formatter = FuncFormatter(millions)
    ax.xaxis.set_major_formatter(formatter)
```



5.4.1 Conclusion

- Positive relationship between production budget & worldwide gross
- Not all movies are domestically profitable
- All movies are profitable when comparing production budget to worldwide gross

6 Analyze when the best time to release a movie is

- Create visualization based on month showing average earnings
- Analyze which season is generates the highest amount of revenue
- Analyze which month generates the highest revenue per film on average

6.1 Clean Data:

- Feature engineer month column
- Feature engineer season column

In [62]:
```
budgets_seasons = movie_direct.copy()
```

In [63]:
```
# Add month column

budgets_seasons['month'] = budgets_seasons['release_date'].map(lambda x: x[
```

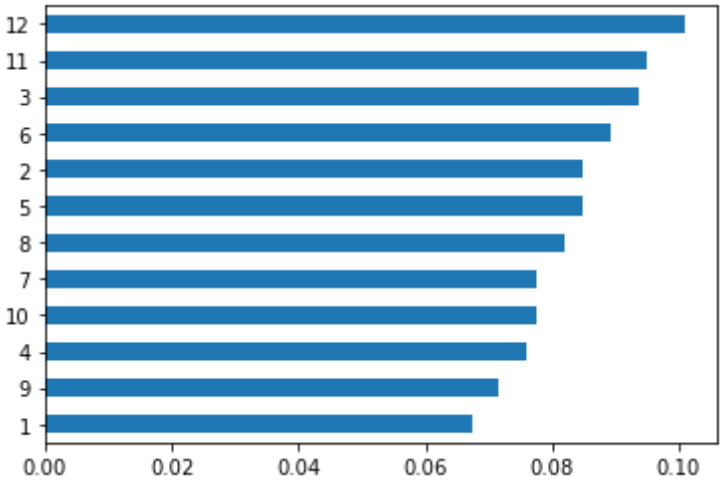
In [64]:
```
# Map month to numbers

month_map = {'Jan':1, 'Feb':2, 'Mar':3, 'Apr':4, 'May':5, 'Jun': 6, 'Jul':
budgets_seasons['month_num'] = budgets_seasons['month'].map(month_map)
```

In [65]:
```
# Check for NaN
# No relevant NaN values

budgets_seasons.isna().sum()
```

Out[65]:
```
id                    0
release_date          0
movie                 0
production_budget     0
domestic_gross        0
worldwide_gross       0
tconst_x              0
region                0
primary_name          0
birth_year          151
death_year          684
month                 0
month_num             0
dtype: int64
```

In [66]:
```
# Quickly analyze distribution of film releases by month

budgets_seasons['month_num'].value_counts(normalize=True).sort_values().plo
```

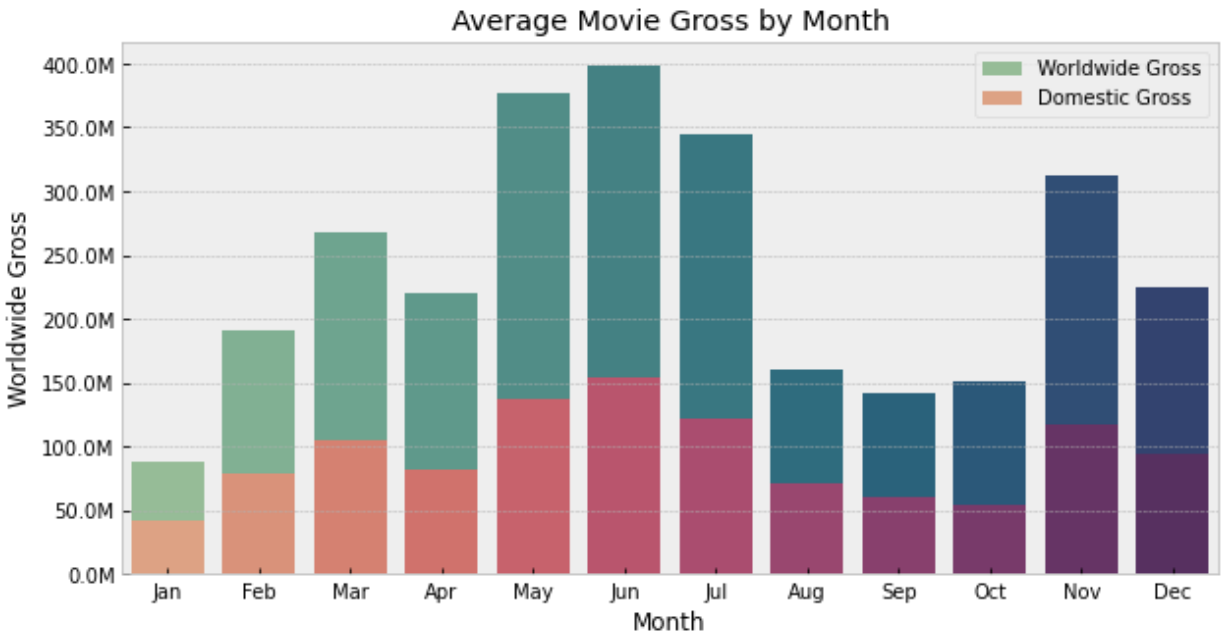
Out[66]: <AxesSubplot:>



In [67]:
```
# Groupby month and display domestic/worlwide growth

g2p = budgets_seasons.groupby('month_num')[['domestic_gross', 'worldwide_gr
```

6.2 Create Visualization: Side by Side bar plot showing how much revenue each month generates on average

In [68]:
```
with plt.style.context('bmh'):
    fig, ax = plt.subplots(figsize=(10,5))
    ax = sns.barplot(x='month_num', y="worldwide_gross", data=g2p, label='W
    ax = sns.barplot(x='month_num', y="domestic_gross", data=g2p, label= 'D
    t_labels = ['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Se
    ax.set_xticklabels(t_labels)

    ax.set_xlabel('Month', color='black')
    ax.set_ylabel('Worldwide Gross')
    ax.set_title('Average Movie Gross by Month')
    formatter = FuncFormatter(millions)
    ax.yaxis.set_major_formatter(formatter)
    ax.legend()
    plt.savefig("/Users/ethankunin/Desktop/movie_month1.png")
```



6.2.1 Conclusion

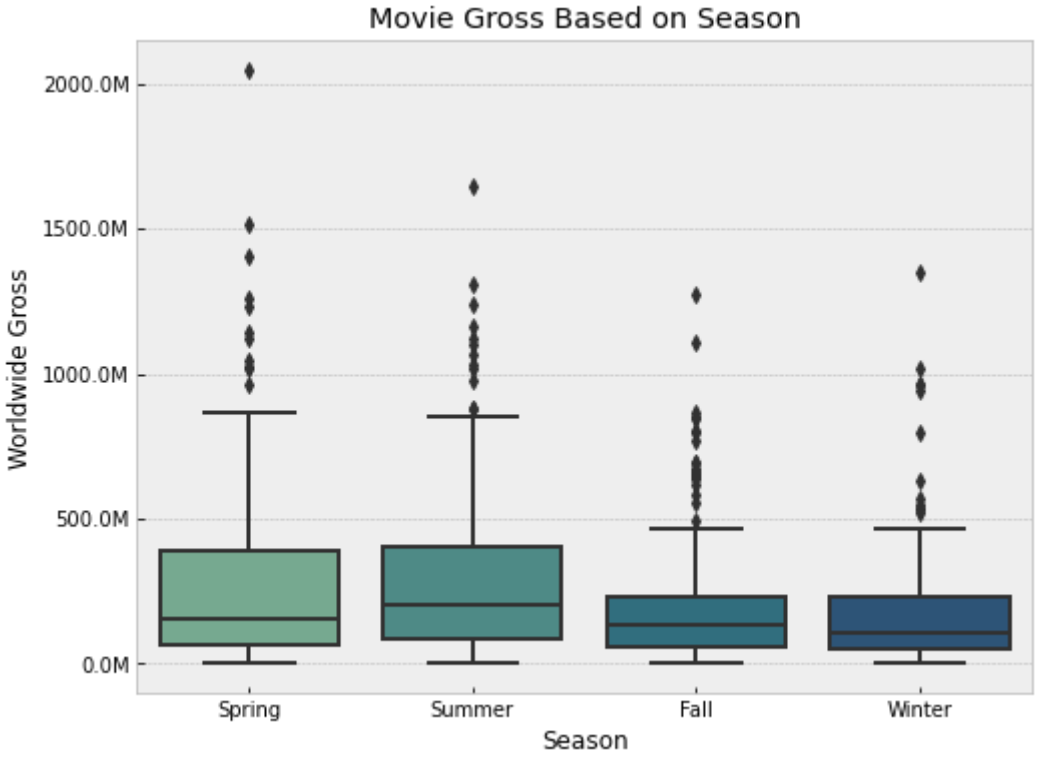
- June movie generate the highest revenue on average followed by May and July
- Worldwide gross is greater than domestic gross in every month

In [69]:
```
# Feature engineer function that turns month into corresponding season

def seasons(month):
    if (month >= 3) & (month <= 5):
        return 'Spring'
    elif (month >= 6) & (month <=8):
        return 'Summer'
    elif (month >= 9) & (month <=11):
        return 'Fall'
    else:
        return 'Winter'
```

In [70]:
```
budgets_seasons['season'] = budgets_seasons['month_num'].map(seasons)
```

6.3 Create Visualization: Boxplot of worldwide gross based on season

In [71]:
```
with plt.style.context('bmh'):
    fig, ax = plt.subplots(figsize=(8, 6))
    ax = sns.boxplot(x='season', y='worldwide_gross', data=budgets_seasons,
    ax.set_title('Movie Gross Based on Season')
    ax.set_ylabel('Worldwide Gross')
    ax.set_xlabel('Season')
    formatter = FuncFormatter(millions)
    ax.yaxis.set_major_formatter(formatter)
```



6.3.1 Conclusion

- Spring and Summer films have the highest medians
- Spring and Summer films have larger distributions
- Corresponds with our month observations

7 Display how movies have performed the past 10 years through trends

- Group movies into median gross by year
- Prefer this to line graph because there's too much noise/daily movements to accurately show the trend
- Show how production costs have varied

- Show how Worldwide/Domestic revenue has varied
- Include this in the introduction

In [72]:
```
budgets_years = budgets_seasons.copy()
```

In [73]:
```
# Feature engineer year column

budgets_years['year'] = budgets_years['release_date'].map(lambda x: x[-4:])
budgets_years['year'] = budgets_years['year'].astype(int)
```

In [74]:
```
#Ensure we are working with movies from the correct year

budgets_years['year'].unique()
```

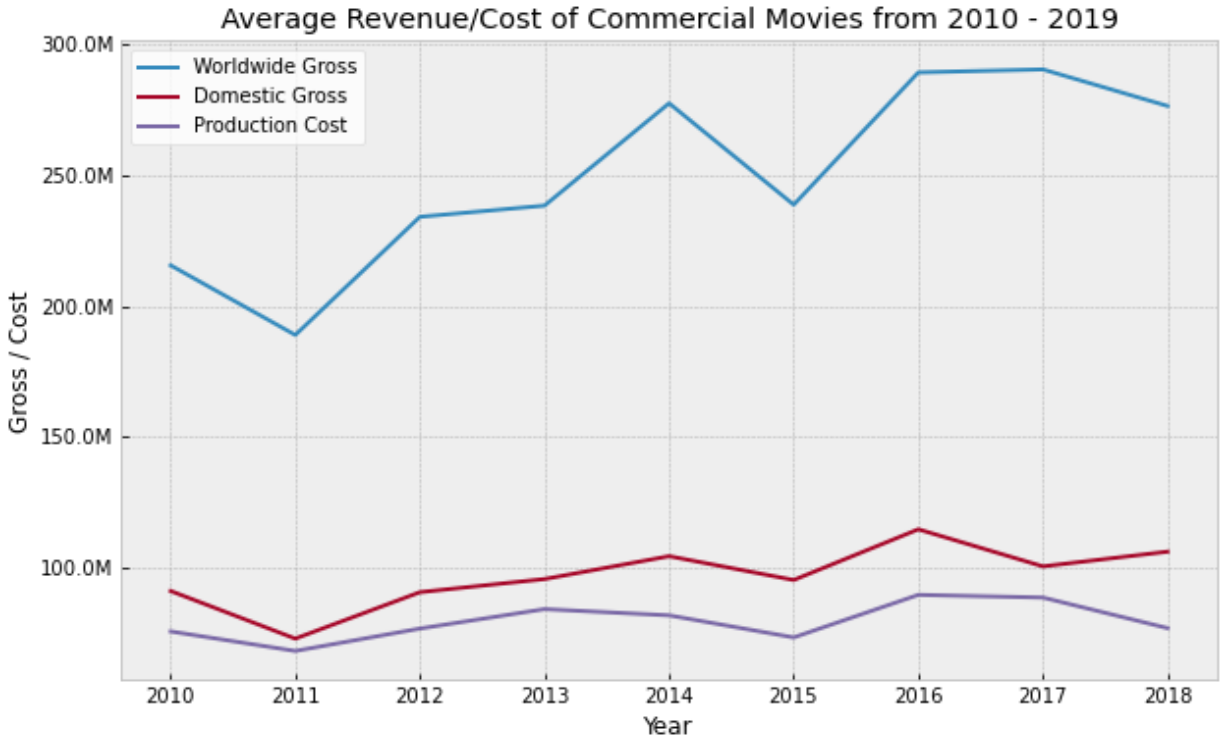
Out[74]:
```
array([2011, 2019, 2015, 2018, 2017, 2013, 2012, 2010, 2016, 2014])
```

In [75]:
```
# Groupby year and display domestic/worlwide growth/production cost

gby = budgets_years.groupby('year')[['production_budget','domestic_gross',
```

7.1 Create Visualization: Lineplot of worldwide/domestic gross/cost based on year

In [76]:
```
gby = gby.drop(9, axis=0)
```

In [77]:
```
with plt.style.context('bmh'):
    fig, ax = plt.subplots(figsize=(10,6))
    ax.plot(gby['year'], gby['worldwide_gross'], label='Worldwide Gross')
    ax.plot(gby['year'], gby['domestic_gross'], label='Domestic Gross')
    ax.plot(gby['year'], gby['production_budget'], label='Production Cost')

    ax.set_xlabel('Year')
    ax.set_ylabel('Gross / Cost')
    ax.set_title('Average Revenue/Cost of Commercial Movies from 2010 - 201
    formatter = FuncFormatter(millions)
    ax.yaxis.set_major_formatter(formatter)

    ax.legend(facecolor='white')
    ax.set_xticks(np.arange(2010, 2019, 1))
    plt.savefig("/Users/ethankunin/Desktop/overtyears.png")
```



8 Analyze how franchises perform compared to non-franchises

- Over time has the trend changed
- Do they have a higher positive correlation between production cost and worldwide gross
- Use this site to gather data: https://www.filmsite.org/ (https://www.filmsite.org/)

8.1 Gather Data on franchises

- Use read_html to gather the data
- Turn the data into DF's
- Feature engineer a way to properly show the data we are looking for
- Create test to show if movie is part of a franchise

Create test to show if movie is part of a franchise

In [78]:
```
# Begin loading in datasets and transform into readable Dataframes
#Page 1
#https://stackoverflow.com/questions/39710903/pd-read-html-imports-a-list-r

url = 'https://www.filmsite.org/series-boxoffice.html'
dfs = pd.read_html(url)
df1 = pd.concat(dfs)
df1.drop(columns=[0,1,5], inplace=True)
df1 = df1.rename(columns={2: 'series_list', 3:'number_of_films_in_franchise
df1
```

Out[78]:

	series_list	number_of_films_in_franchise	top_movie
0	NaN	NaN	NaN
0	NaN	NaN	NaN
0	Greatest Film Series Franchises (part 1 of 4,...	Greatest Film Series Franchises (part 1 of 4,...	Greatest Film Series Franchises (part 1 of 4,...
1	Individual Films in Franchise (if clickable, ...	# of Films in Franchise	# 1 Film in Franchise
2	Marvel's Cinematic Universe Iron Man (2008) ...	23	Avengers: Endgame (2019)
3	Pixar-Disney Animations * Toy Story (1995) A...	23	Incredibles 2 (2018)
4	Star Wars (Ranked) Star Wars: (Original Trilo...	12	Star Wars: Episode VII - The Force Awakens (2015)
5	Disney (Live-Action Animations Reimagined) Th...	15	The Lion King (2019)
6	J.K. Rowling Wizardry Harry Potter Harry Pott...	10 (or 8)	Harry Potter and the Deathly Hallows, Part 2 (...
7	Avengers (see Marvel's Cinematic Universe) M...	4	Avengers: Endgame (2019)
8	Spider-Man Spider-Man (Sam Raimi) Spider-Man (...	9	Spider-Man (2002)
9	X-Men X-Men (Original Series) X-Men (2000) X...	12	Deadpool (2016)
10	Batman Batman (Early Films) Batman: The Movie...	11	The Dark Knight (2008)
11	DC Extended Universe Man of Steel (2013) B...	8	Wonder Woman (2017)
12	James Bond (ranked) Dr. No (1962) From Russia...	25	Skyfall (2012)
13	Jurassic Park Jurassic Park Jurassic Park (19...	5	Jurassic World (2015)
14	Middle Earth The Lord of the Rings The Lord o...	6	The Lord of the Rings: The Return of the King ...
15	Fast and the Furious The Fast and the Furious...	9	Fast & Furious 7 (2015)
16	Transformers Transformers: The Movie (1986) ...	7	Transformers: Revenge of the Fallen (2009)

	series_list	number_of_films_in_franchise	top_movie
17	Pirates of the Caribbean Pirates of the Carib...	5	Pirates of the Caribbean: Dead Man's Chest (2006)
18	The Hunger Games The Hunger Games (2012) The...	4	The Hunger Games: Catching Fire (2013)
19	Shrek (Original and Sequels) Shrek (2001) Shr...	5	Shrek 2 (2004)
20	Star Trek Star Trek (Original) Star Trek: The ...	13	Star Trek (2009)
21	Twilight Saga Twilight (2008) The Twilight S...	5	The Twilight Saga: Eclipse (2010)
22	Toy Story (see Pixar-Disney) Toy Story (1995)...	4	Toy Story 4 (2019)
23	Despicable Me Despicable Me Despicable Me (2...	4	Despicable Me 2 (2013)
24	The Dark Knight Trilogy (see Batman) Batman B...	3	The Dark Knight (2008)
25	Mission: Impossible Mission: Impossible (1996...	6	Mission: Impossible - Fallout (2018)
26	Superman Superman (Original) Superman (1978) ...	7	Batman v Superman: Dawn of Justice (2016)
27	Iron Man (see Marvel's Cinematic Universe) Iro...	3	Iron Man 3 (2013)
28	The Lord of the Rings Trilogy (see Middle Eart...	3	The Lord of the Rings: The Return of the King ...
29	Indiana Jones Raiders of the Lost Ark (1981) ...	4	Indiana Jones and the Kingdom of the Crystal S...
30	Captain America (see Marvel's Cinematic Univ...	3	Captain America: Civil War (2016)
31	Jumanji Jumanji (1995) Jumanji: Welcome to t...	3	Jumanji: Welcome to the Jungle (2017)
32	The Hobbit (see The Lord of the Rings) The Ho...	3	The Hobbit: An Unexpected Journey (2012)
33	Bourne The Bourne Identity (2002) The Bourne...	5	The Bourne Ultimatum (2007)
34	Planet of the Apes Planet of the Apes (Origin...	9	Dawn of the Planet of the Apes (2014)
35	Ice Age Ice Age (2002) Ice Age: The Meltdown...	5	Ice Age 3: Dawn of the Dinosaurs (2009)
36	Rocky Rocky (1976) Rocky II (1979) Rocky II...	8	Rocky IV (1985)
0	NaN	NaN	NaN

In [79]:
```
# Regex expression we are using

#([a-zA-Z0-9_ ':]*)(\(\d{3,}\))
```

In [80]:
```
# Page 2

url2 = 'https://www.filmsite.org/series-boxoffice2.html'
dfs2 = pd.read_html(url2)
df2 = pd.concat(dfs2)
df2.drop(columns=[0,1,5], inplace=True)
df2 = df2.rename(columns={2: 'series_list', 3:'number_of_films_in_franchise
```

In [81]:
```
# Page 3

url3 = 'https://www.filmsite.org/series-boxoffice3.html'
dfs3 = pd.read_html(url3)
df3 = pd.concat(dfs3)
df3.drop(columns=[0,1,5], inplace=True)
df3 = df3.rename(columns={2: 'series_list', 3:'number_of_films_in_franchise
```

In [82]:
```
# Page 4

url4 = 'https://www.filmsite.org/series-boxoffice4.html'
dfs4 = pd.read_html(url4)
df4 = pd.concat(dfs4)
df4.drop(columns=[0,1,5], inplace=True)
df4 = df4.rename(columns={2: 'series_list', 3:'number_of_films_in_franchise
```

In [83]:
```
# Feature engineer function that will split the movies in the series_list i
#separate movies and then add them into one list per df
import re
regex1 = r"([a-zA-Z0-9_ ':]*)(\(\d{3,}\))"
df2string = ' '.join(df2['series_list'].dropna())
df2stringreg = re.findall(regex1, df2string)
df2final = [thing[0].strip() for thing in df2stringreg]
```

In [84]:
```
df1string = ' '.join(df1['series_list'].dropna())
df1stringreg = re.findall(regex1, df1string)
df1final = [thing[0].strip() for thing in df1stringreg]
```

In [85]:
```
df3string = ' '.join(df3['series_list'].dropna())
df3stringreg = re.findall(regex1, df3string)
df3final = [thing[0].strip() for thing in df3stringreg]
```

In [86]:
```
df4string = ' '.join(df4['series_list'].dropna())
df4stringreg = re.findall(regex1, df4string)
df4final = [thing[0].strip() for thing in df4stringreg]
```

In [87]:
```
# Combine outputs into one large list of all franchises

all_franchises = df1final + df2final + df3final + df4final
```

In [88]:
```
# Feature engineer column that displays if movie is part of a franchise

def franchise_tf(movie):
    if movie in all_franchises:
        return True
    else:
        return False
```

In [89]:
```
#Test
display(franchise_tf('Harry Potter and the Chamber  of Secrets'))
franchise_tf('Thor')
```

```
True
```

Out[89]:
```
True
```

8.2 Clean tn_movie_budgets and include boolean column for if the film is part of a franchise

In [90]:
```
tn_movie_budgets2 = tn_movie_budgets.copy()
```

In [91]:
```
tn_movie_budgets2['is_franchise'] = tn_movie_budgets2['movie'].map(franchis
```

In [92]:
```
# Make release_date into DateTime and extract year

tn_movie_budgets2['release_date'] = pd.to_datetime(tn_movie_budgets2['relea
```

In [93]:
```
tn_movie_budgets2['year'] = pd.DatetimeIndex(tn_movie_budgets2['release_dat
```

In [94]:
```
# Turn production_budget/worldwide_gross/domestic_gross into integers

col_to_int(tn_movie_budgets2, 'production_budget')
```

Out[94]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	is_franchis
0	1	2009-12-18	Avatar	425000000	$760,507,625	$2,776,345,279	Fals
1	2	2011-05-20	Pirates of the Caribbean: On Stranger Tides	410600000	$241,063,875	$1,045,663,875	Fals
2	3	2019-06-07	Dark Phoenix	350000000	$42,762,350	$149,762,350	Fals
3	4	2015-05-01	Avengers: Age of Ultron	330600000	$459,005,868	$1,403,013,963	Tru
4	5	2017-12-15	Star Wars Ep. VIII: The Last Jedi	317000000	$620,181,382	$1,316,721,747	Fals
...	...	...	...	...	...	...	
5777	78	2018-12-31	Red 11	7000	$0	$0	Fals
5778	79	1999-04-02	Following	6000	$48,482	$240,495	Fals
5779	80	2005-07-13	Return to the Land of Wonders	5000	$1,338	$1,338	Fals
5780	81	2015-09-29	A Plague So Pleasant	1400	$0	$0	Fals
5781	82	2005-08-05	My Date With Drew	1100	$181,041	$181,041	Fals

5782 rows × 8 columns

In [95]:
```
col_to_int(tn_movie_budgets2, 'domestic_gross')
```

Out[95]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	is_franchis
0	1	2009-12-18	Avatar	425000000	760507625	$2,776,345,279	Fals
1	2	2011-05-20	Pirates of the Caribbean: On Stranger Tides	410600000	241063875	$1,045,663,875	Fals
2	3	2019-06-07	Dark Phoenix	350000000	42762350	$149,762,350	Fals
3	4	2015-05-01	Avengers: Age of Ultron	330600000	459005868	$1,403,013,963	Tru
4	5	2017-12-15	Star Wars Ep. VIII: The Last Jedi	317000000	620181382	$1,316,721,747	Fals
...	...	...	...	...	...	...	
5777	78	2018-12-31	Red 11	7000	0	$0	Fals
5778	79	1999-04-02	Following	6000	48482	$240,495	Fals
5779	80	2005-07-13	Return to the Land of Wonders	5000	1338	$1,338	Fals
5780	81	2015-09-29	A Plague So Pleasant	1400	0	$0	Fals
5781	82	2005-08-05	My Date With Drew	1100	181041	$181,041	Fals

5782 rows × 8 columns

In [96]:
```
col_to_int(tn_movie_budgets2, 'worldwide_gross')
```

Out[96]:

	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	is_franchis
0	1	2009-12-18	Avatar	425000000	760507625	2776345279	Fals
1	2	2011-05-20	Pirates of the Caribbean: On Stranger Tides	410600000	241063875	1045663875	Fals
2	3	2019-06-07	Dark Phoenix	350000000	42762350	149762350	Fals
3	4	2015-05-01	Avengers: Age of Ultron	330600000	459005868	1403013963	Tru
4	5	2017-12-15	Star Wars Ep. VIII: The Last Jedi	317000000	620181382	1316721747	Fals
...	...	...	...	...	...	...	
5777	78	2018-12-31	Red 11	7000	0	0	Fals
5778	79	1999-04-02	Following	6000	48482	240495	Fals
5779	80	2005-07-13	Return to the Land of Wonders	5000	1338	1338	Fals
5780	81	2015-09-29	A Plague So Pleasant	1400	0	0	Fals
5781	82	2005-08-05	My Date With Drew	1100	181041	181041	Fals

5782 rows × 8 columns

In [97]:
```
# Filter out movies based on our given criteria

tn_movie_budgets2 = tn_movie_budgets2.loc[(tn_movie_budgets2['production_bu
```

In [98]:
```
# Check % of movies which are franchises

tn_movie_budgets2['is_franchise'].value_counts(normalize=True)
```

Out[98]:
```
False    0.840212
True     0.159788
Name: is_franchise, dtype: float64
```

8.3 Create Visualization A: Time trend for Franchise vs. Non-Franchise movies

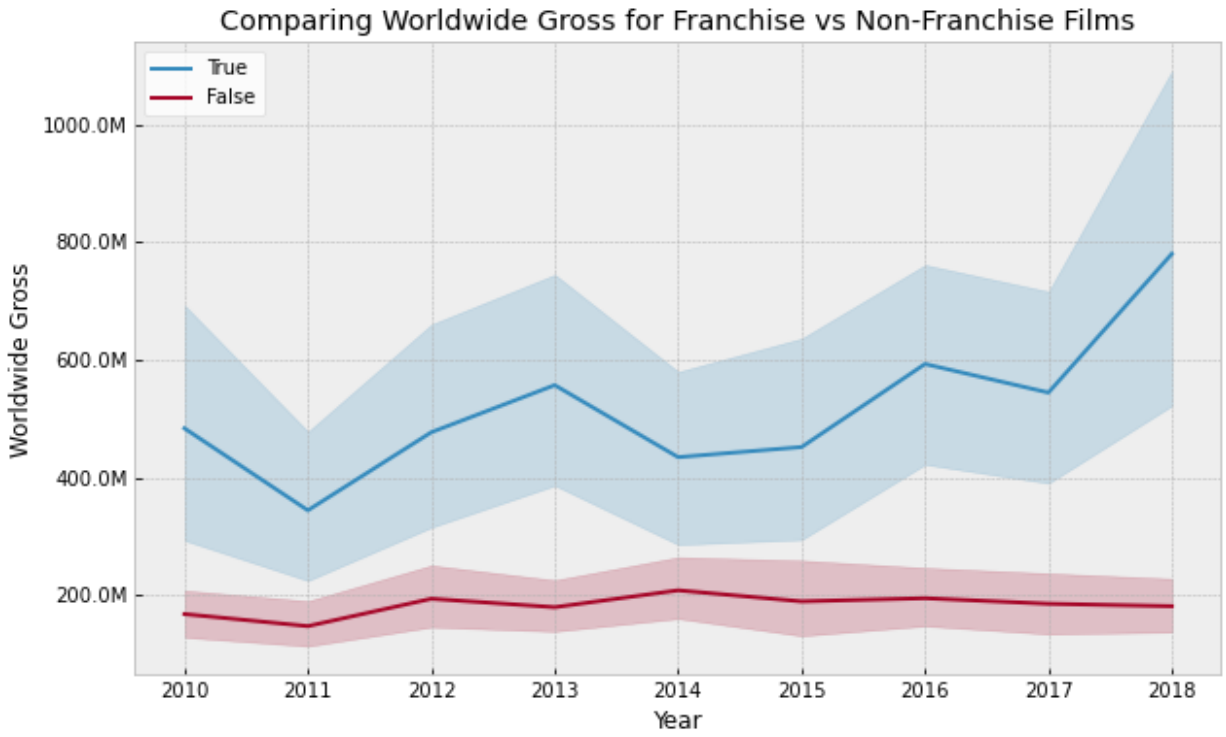
In [99]:
```
# Check if movies have roughly the same count per year

tn_movie_budgets2.groupby('year').count()
```

Out[99]:

year	id	release_date	movie	production_budget	domestic_gross	worldwide_gross	is_franchise
2010	105	105	105	105	105	105	105
2011	124	124	124	124	124	124	124
2012	101	101	101	101	101	101	101
2013	101	101	101	101	101	101	101
2014	90	90	90	90	90	90	90
2015	105	105	105	105	105	105	105
2016	96	96	96	96	96	96	96
2017	97	97	97	97	97	97	97
2018	84	84	84	84	84	84	84
2019	42	42	42	42	42	42	42

In [100]:
```
tn_movie_budgets3 = tn_movie_budgets2[(tn_movie_budgets2['year']>=2010) & (
```

In [101]:
```
with plt.style.context('bmh'):
    fig, ax = plt.subplots(figsize=(10,6))
    sns.lineplot(data=tn_movie_budgets3, x='year', y='worldwide_gross', hue

    ax.set_xlabel('Year')
    ax.set_ylabel('Worldwide Gross')
    ax.set_title('Comparing Worldwide Gross for Franchise vs Non-Franchise

    formatter = FuncFormatter(millions)
    ax.yaxis.set_major_formatter(formatter)

    ax.legend(facecolor='white', loc=2)
    ax.set_xticks(np.arange(2010, 2019, 1));
#     plt.savefig("/Users/ethankunin/Desktop/franvnonfran.png")
```



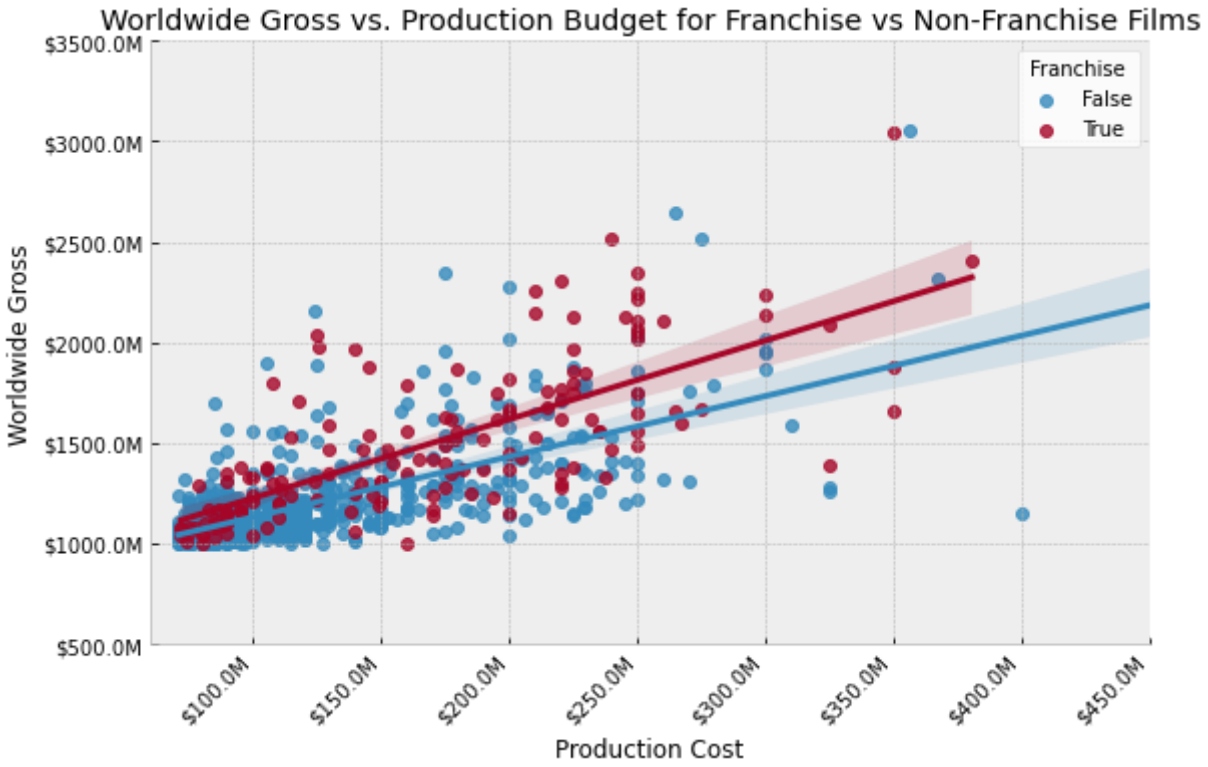
8.3.1 Conclusion:

- Franchise films have outperformed non-franchise films every year
- Franchise films have greater standard deviation

In [102]:
```
tn_movie_budgets2 = tn_movie_budgets2[tn_movie_budgets2['worldwide_gross']
```

8.4 Create Visualization B: Linear Regression Scatter Plot displaying relationship between Worldwide Gross and Production Cost for Franchise vs. Non-Franchise Films

In [103]:
```
with plt.style.context('bmh'):

    #g=sns.FacetGrid(data=tn_movie_budgets2, aspect=(1 * 3))
    g = (sns.lmplot(data=tn_movie_budgets2, x='production_budget', y='world

    g.axes[0,0].set_xlabel('Production Cost')
    g.axes[0,0].set_ylabel('Worldwide Gross')
    g.axes[0,0].set_title('Worldwide Gross vs. Production Budget for Franch
    #factorplot(height=2, aspect=1)

    #formatter = FuncFormatter(millions)
    #g = sns.FacetGrid(data = tn_movie_budgets2, col_wrap = 4, margin_title
    #g.yaxis.set_major_formatter(formatter)

    t_labels = ['$50.0M', '$100.0M', '$150.0M', '$200.0M', '$250.0M', '$300
    g.set_xticklabels(t_labels)
    y_labs5 = ['$500.0M', '$1000.0M', '$1500.0M','$2000.0M', '$2500.0M', '$
    g.set_xticklabels(rotation = 45, ha='right')
    g.set_yticklabels(y_labs5)
#   g.set_xlim(20000000, 500000000)
    g.ax.set_xlim(10000000, 400000000)

    g.ax.legend(title='Franchise', facecolor='white')
```



8.4.1 Conclusion:

- Franchise films have a stronger postive relationship with worldwide gross and production cost than non-franchise films
- Number of outliers is fairly similar

Number of outliers is fairly similar