Project: TMDB Movie Dataset Analysis

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Introduction

Dataset

I choose the TMDb movie dataset. the dataset contains information about 10,000 movies, including id, popularity, budget, revenue, original title, cast, homepage, director, tagline, keywords, overview, runtime, genres, production companies, release date, vote count, vote average, release year, budget adj, revenue adj.

Questions:

1. What are the 10 movies with the highest production budget?
2. What are the 10 movies with the highest revenue?
3. What are the top 10 most profitable movies in the market?
4. What are the top ten movies with the highest popularity?
5. What are the top ten movies with the highest vote average?
6. What are the 10 movies with the highest runtime?
7. What is the average movie runtime over time?
8. What are the average movie profits over time?
9. How many movies per year?
10. In which year has the highest or lowest production of movies?
11. What are the top 10 directors in 2014, according to the vote?
12. How many movies per genre?
13. How many movies per director?
14. What are the top 10 most directors who have maximum movies?
15. What are the most profitable months?

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

In [2]:
```
from IPython.core.display import display
sns.set(rc={'figure.figsize':(14,6)})
```

Data Wrangling

In [3]:
```
df = pd.read_csv('/content/tmdb-movies.csv')
df.head()
```

Out[3]:

	id	imdb_id	popularity	budget	revenue	original_title	cast	homepage	direc
0	135397	tt0369610	32.985763	150000000	1513528810	Jurassic World	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...	http://www.jurassicworld.com/	C Trevor
1	76341	tt1392190	28.419936	150000000	378436354	Mad Max: Fury Road	Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...	http://www.madmaxmovie.com/	Geo Mi
2	262500	tt2908446	13.112507	110000000	295238201	Insurgent	Shailene Woodley|Theo James|Kate Winslet|Ansel...	http://www.thedivergentseries.movie/#insurgent	Rob Schwen
3	140607	tt2488496	11.173104	200000000	2068178225	Star Wars: The Force Awakens	Harrison Ford|Mark Hamill|Carrie Fisher|Adam D...	http://www.starwars.com/films/star-wars-episod...	Abra
4	168259	tt2820852	9.335014	190000000	1506249360	Furious 7	Vin Diesel|Paul Walker|Jason Statham|Michelle ...	http://www.furious7.com/	Jan W

In [4]:
```
df.shape
```

Out[4]: (10866, 21)

In [5]:
```
df.describe()
```

Out[5]:

	id	popularity	budget	revenue	runtime	vote_count	vote_average	release_year	budget_adj
count	10866.000000	10866.000000	1.086600e+04	1.086600e+04	10866.000000	10866.000000	10866.000000	10866.000000	1.086600e+04
mean	66064.177434	0.646441	1.462570e+07	3.982332e+07	102.070863	217.389748	5.974922	2001.322658	1.755104e+07
std	92130.136561	1.000185	3.091321e+07	1.170035e+08	31.381405	575.619058	0.935142	12.812941	3.430616e+07
min	5.000000	0.000065	0.000000e+00	0.000000e+00	0.000000	10.000000	1.500000	1960.000000	0.000000e+00
25%	10596.250000	0.207583	0.000000e+00	0.000000e+00	90.000000	17.000000	5.400000	1995.000000	0.000000e+00
50%	20669.000000	0.383856	0.000000e+00	0.000000e+00	99.000000	38.000000	6.000000	2006.000000	0.000000e+00
75%	75610.000000	0.713817	1.500000e+07	2.400000e+07	111.000000	145.750000	6.600000	2011.000000	2.085325e+07
max	417859.000000	32.985763	4.250000e+08	2.781506e+09	900.000000	9767.000000	9.200000	2015.000000	4.250000e+08

In [6]:
```
df.dtypes
```

Out[6]:
```
id                        int64
imdb_id                  object
popularity              float64
budget                    int64
revenue                   int64
original_title           object
cast                     object
homepage                 object
director                 object
tagline                  object
keywords                 object
overview                 object
runtime                   int64
genres                   object
production_companies     object
release_date             object
vote_count                int64
vote_average            float64
release_year              int64
budget_adj              float64
revenue_adj             float64
dtype: object
```

In [7]:
```
df.columns
```

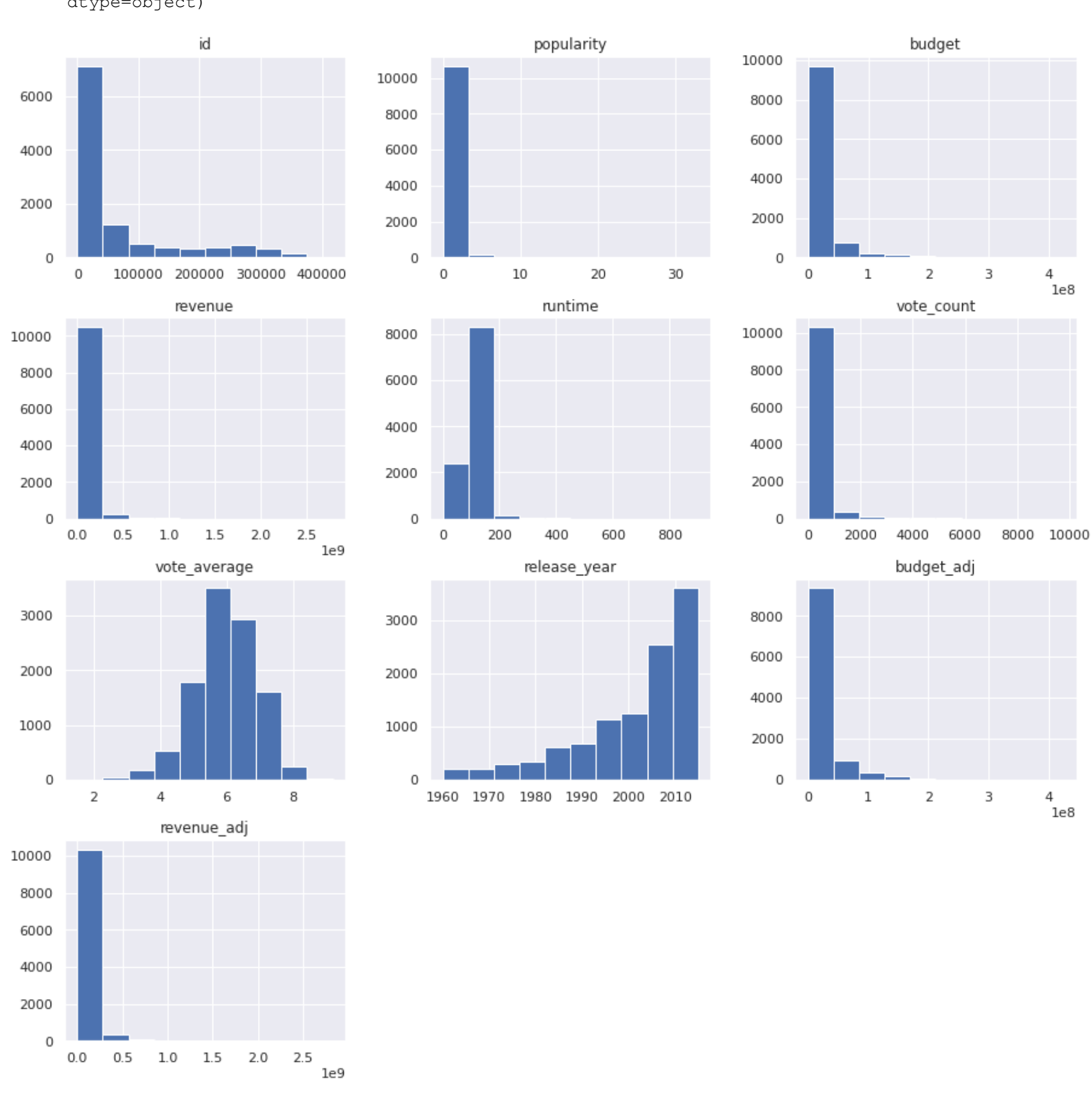
Out[7]:
```
Index(['id', 'imdb_id', 'popularity', 'budget', 'revenue', 'original_title',
       'cast', 'homepage', 'director', 'tagline', 'keywords', 'overview',
       'runtime', 'genres', 'production_companies', 'release_date',
       'vote_count', 'vote_average', 'release_year', 'budget_adj',
       'revenue_adj'],
      dtype='object')
```

In [8]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10866 entries, 0 to 10865
Data columns (total 21 columns):
 #   Column                Non-Null Count  Dtype
---  ------                --------------  -----
 0   id                    10866 non-null  int64
 1   imdb_id               10856 non-null  object
 2   popularity            10866 non-null  float64
 3   budget                10866 non-null  int64
 4   revenue               10866 non-null  int64
 5   original_title        10866 non-null  object
 6   cast                  10790 non-null  object
 7   homepage              2936 non-null   object
 8   director              10822 non-null  object
 9   tagline               8042 non-null   object
 10  keywords              9373 non-null   object
 11  overview              10862 non-null  object
 12  runtime               10866 non-null  int64
 13  genres                10843 non-null  object
 14  production_companies  9836 non-null   object
 15  release_date          10866 non-null  object
 16  vote_count            10866 non-null  int64
 17  vote_average          10866 non-null  float64
 18  release_year          10866 non-null  int64
 19  budget_adj            10866 non-null  float64
 20  revenue_adj           10866 non-null  float64
dtypes: float64(4), int64(6), object(11)
memory usage: 1.7+ MB
```

In [9]:
```
df.hist(figsize=(15,15))
```

Out[9]:
```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x7f6d580bab10>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56ecb890>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56e82f10>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56e435d0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56df6b50>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56dc1190>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56d74890>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56da9ed0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56da9f10>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56ced690>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56ce7210>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x7f6d56c9a890>]],
      dtype=object)
```



Data Cleaning

Drop unnecessary columns

In [10]:
```
df.drop(['imdb_id','homepage','tagline','overview','budget_adj','revenue_adj','production_companies','keywords'], axis=1, inplace=True)
```

In [11]:
```
df.duplicated().sum()
```

Out[11]: 1

Drop duplicates

In [12]:
```
df.drop_duplicates(inplace=True)
df.duplicated().sum()
```

Out[12]: 0

In [13]:
```
df.isnull().sum()
```

Out[13]:
```
id                0
popularity        0
budget            0
revenue           0
original_title    0
cast             76
director         44
runtime           0
genres           23
release_date      0
vote_count        0
vote_average      0
release_year      0
dtype: int64
```

Drop null values

In [14]:
```
df.dropna(subset=['cast','director','genres'], how='any', inplace=True)
```

In [15]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 10731 entries, 0 to 10865
Data columns (total 13 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   id              10731 non-null  int64
 1   popularity      10731 non-null  float64
 2   budget          10731 non-null  int64
 3   revenue         10731 non-null  int64
 4   original_title  10731 non-null  object
 5   cast            10731 non-null  object
 6   director        10731 non-null  object
 7   runtime         10731 non-null  int64
 8   genres          10731 non-null  object
 9   release_date    10731 non-null  object
 10  vote_count      10731 non-null  int64
 11  vote_average    10731 non-null  float64
 12  release_year    10731 non-null  int64
dtypes: float64(2), int64(6), object(5)
memory usage: 1.1+ MB
```

Clean the invalid data

In [16]:
```
df.drop(df.query('runtime == 0 or budget == 0 or revenue == 0 or popularity == 0').index, axis=0, inplace=True)
df.describe()
```

Out[16]:

	id	popularity	budget	revenue	runtime	vote_count	vote_average	release_year
count	3849.000000	3849.000000	3.849000e+03	3.849000e+03	3849.000000	3849.000000	3849.000000	3849.000000
mean	39885.146791	1.192933	3.724886e+07	1.078148e+08	109.217459	528.387114	6.168693	2001.258249
std	67248.890597	1.475622	4.221699e+07	1.766175e+08	19.914141	880.333629	0.794697	11.285642
min	5.000000	0.001117	1.000000e+00	2.000000e+00	15.000000	10.000000	2.200000	1960.000000
25%	6072.000000	0.463337	1.000000e+07	1.367069e+07	95.000000	71.000000	5.700000	1995.000000
50%	11313.000000	0.798582	2.400000e+07	4.490726e+07	106.000000	205.000000	6.200000	2004.000000
75%	38575.000000	1.374300	5.000000e+07	1.243052e+08	119.000000	581.000000	6.700000	2010.000000
max	417859.000000	32.985763	4.250000e+08	2.781506e+09	338.000000	9767.000000	8.400000	2015.000000

In [17]:
```
df.head(2)
```

Out[17]:

	id	popularity	budget	revenue	original_title	cast	director	runtime	genres	release_date	vote_
0	135397	32.985763	150000000	1513528810	Jurassic World	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...	Colin Trevorrow	124	Action|Adventure|Science Fiction|Thriller	6/9/15	
1	76341	28.419936	150000000	378436354	Mad Max: Fury Road	Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...	George Miller	120	Action|Adventure|Science Fiction|Thriller	5/13/15	

Changing format of release date into datetime format

In [18]:
```
df['release_date'] = pd.to_datetime(df['release_date'])
df['release_date'].head()
```

Out[18]:
```
0   2015-06-09
1   2015-05-13
2   2015-03-18
3   2015-12-15
4   2015-04-01
Name: release_date, dtype: datetime64[ns]
```

Exploratory Data Analysis

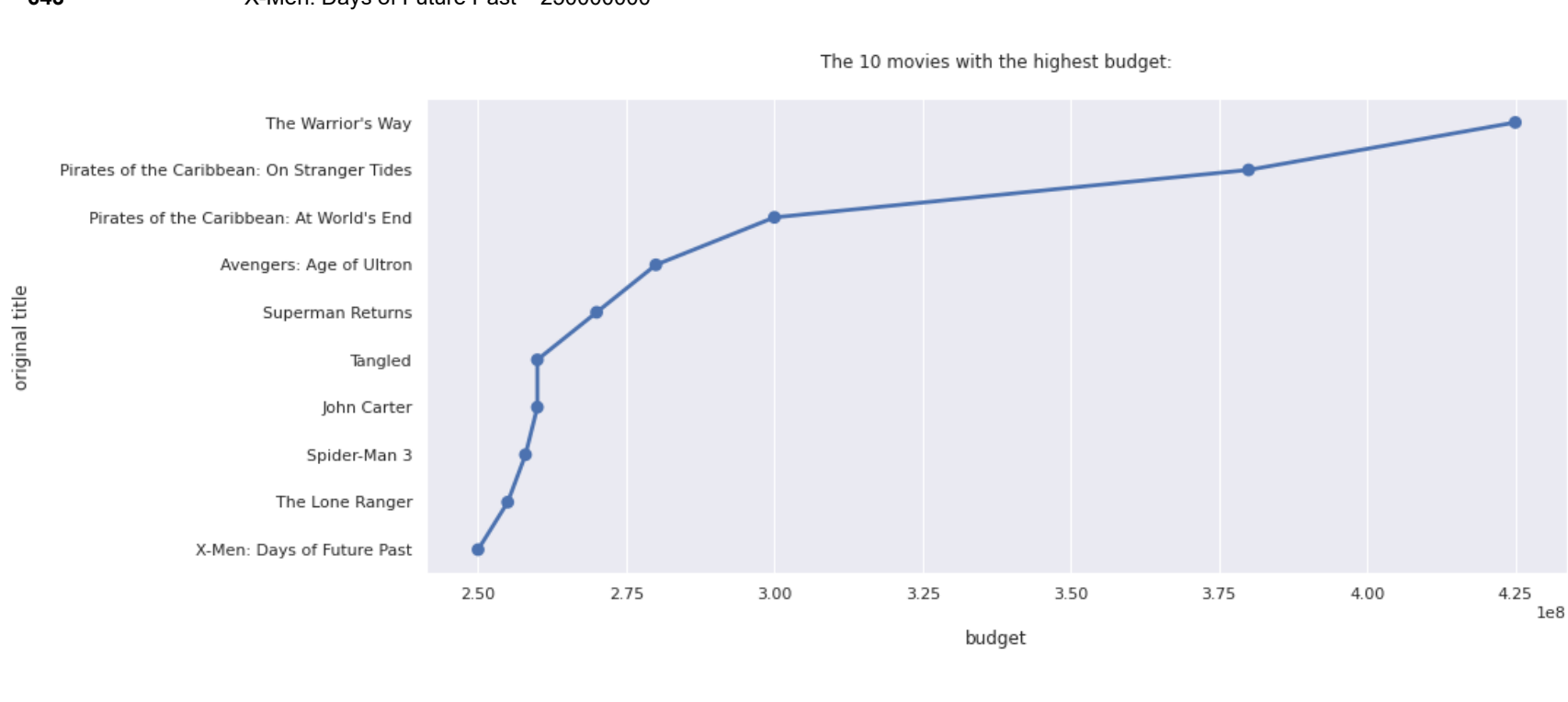
Research Question 1 (What are the 10 movies with the highest production budget?)

In [19]:
```
def top_movies(df, column , top=10):
  # extract data
  top = df.sort_values([column], ascending = False).loc[:,['original_title',column]].head(10)
  # plot
  ax = sns.pointplot(data = top, x = column, y = 'original_title')
  # Add title and format it
  ax.set_title("The 10 movies with the highest {}:\n".format(column))
  # Add x label and format it
  ax.set_xlabel("\n{}".format(column))
  # Add y label
  ax.set_ylabel("original title\n")
  # display dataframe
  print('The 10 movies with the highest {}:\n'.format(column))
  display(top)

# call function
top_movies(df,'budget', top=10)
```

The 10 movies with the highest budget:

	original_title	budget
2244	The Warrior's Way	425000000
3375	Pirates of the Caribbean: On Stranger Tides	380000000
7387	Pirates of the Caribbean: At World's End	300000000
14	Avengers: Age of Ultron	280000000
6570	Superman Returns	270000000
1929	Tangled	260000000
4411	John Carter	260000000
7394	Spider-Man 3	258000000
5508	The Lone Ranger	255000000
643	X-Men: Days of Future Past	250000000



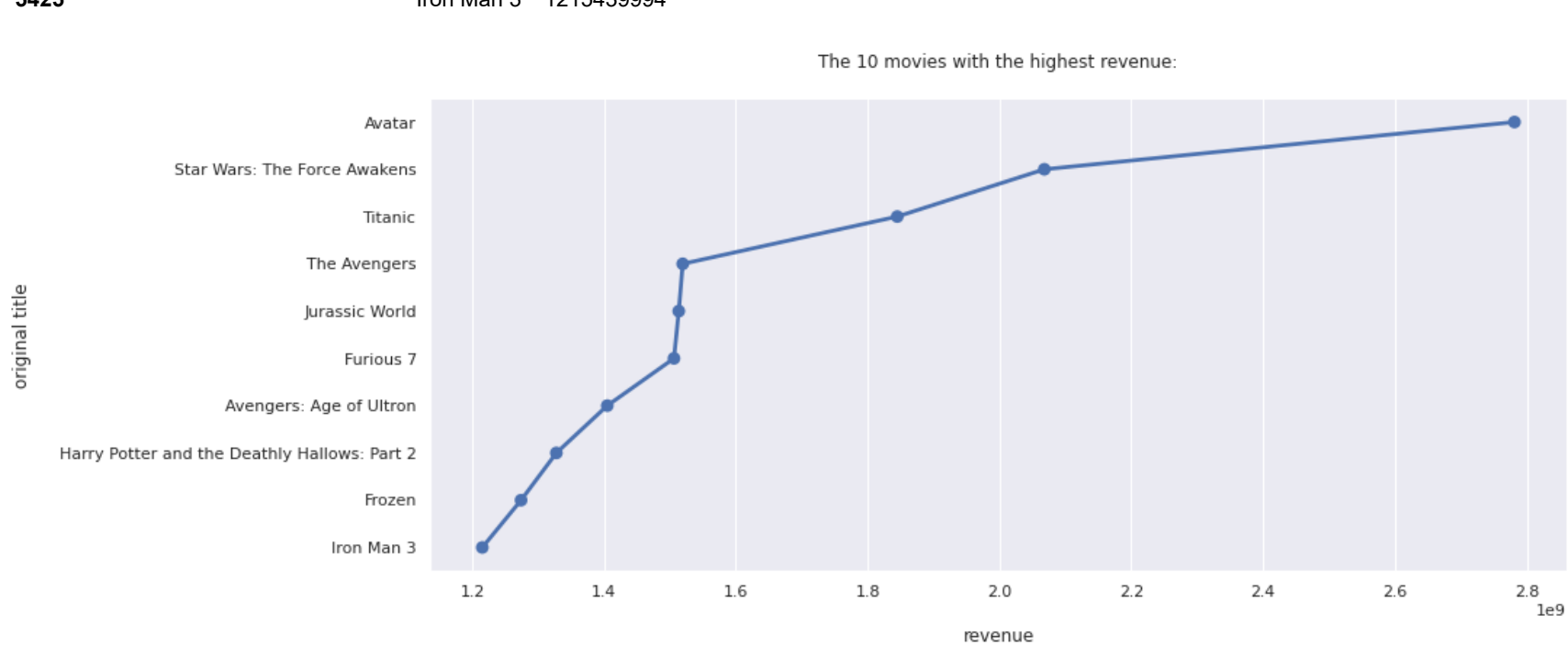
After seeing the plot and the output I can conclude that **'The Warrior's Way'** is a movie that has the highest production budget.

Research Question 2 (What are the 10 movies with the highest revenue?)

In [20]:
```
# call function
top_movies(df,'revenue', top=10)
```

The 10 movies with the highest revenue:

	original_title	revenue
1386	Avatar	2781505847
3	Star Wars: The Force Awakens	2068178225
5231	Titanic	1845034188
4361	The Avengers	1519557910
0	Jurassic World	1513528810
4	Furious 7	1506249360
14	Avengers: Age of Ultron	1405035767
3374	Harry Potter and the Deathly Hallows: Part 2	1327817822
5422	Frozen	1274219009
5425	Iron Man 3	1215439994



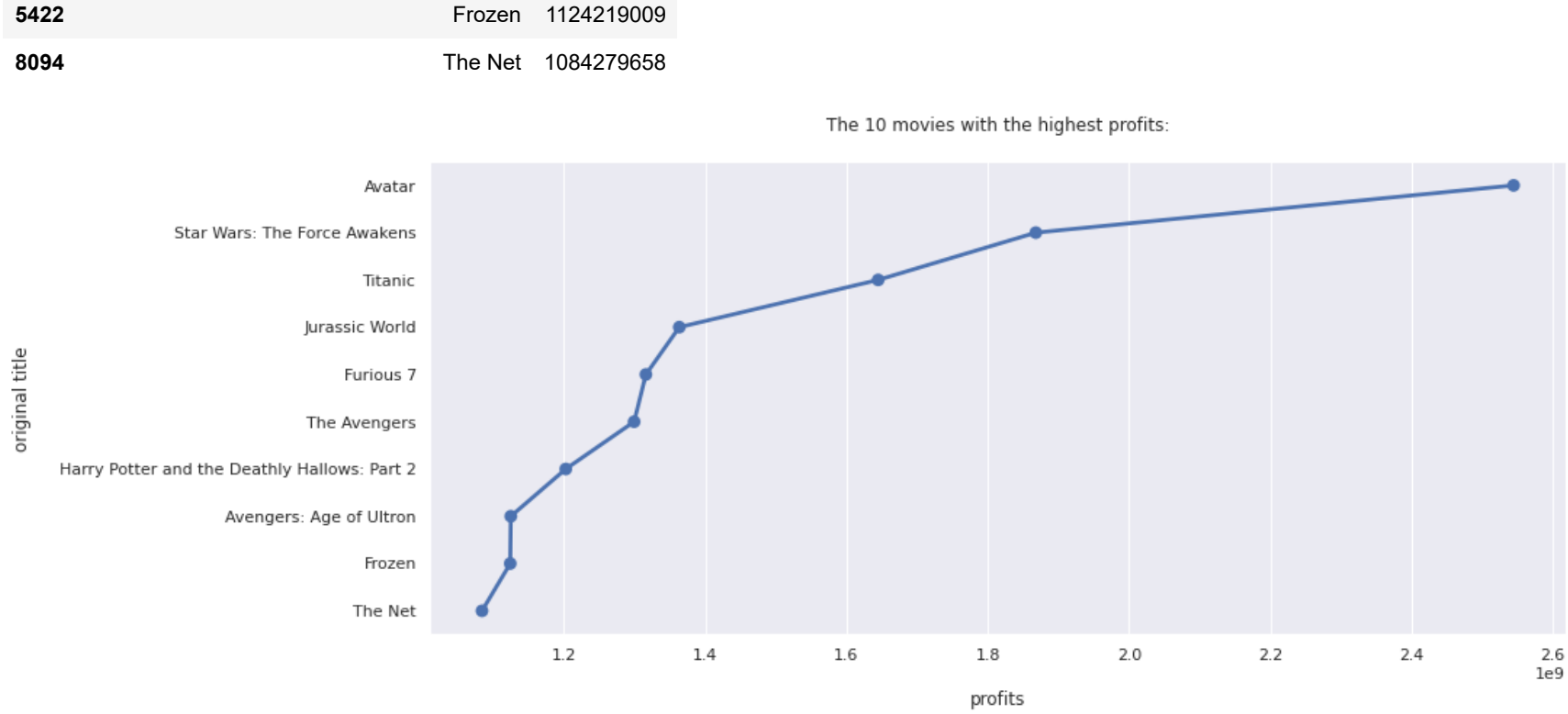
After seeing the plot and the output I can conclude that **'Avatar'** is a movie that has the highest revenue.

Research Question 3 (What are the top 10 most profitable movies in the market?)

In [21]:
```
# add a new column (profits) in the dataframe
df['profits'] = df['revenue'] - df['budget']
# call function
top_movies(df,'profits', top=10)
```

The 10 movies with the highest profits:

	original_title	profits
1386	Avatar	2544505847
3	Star Wars: The Force Awakens	1868178225
5231	Titanic	1645034188
0	Jurassic World	1363528810
4	Furious 7	1316249360
4361	The Avengers	1299557910
3374	Harry Potter and the Deathly Hallows: Part 2	1202817822
14	Avengers: Age of Ultron	1125035767
5422	Frozen	1124219009
8094	The Net	1084279658



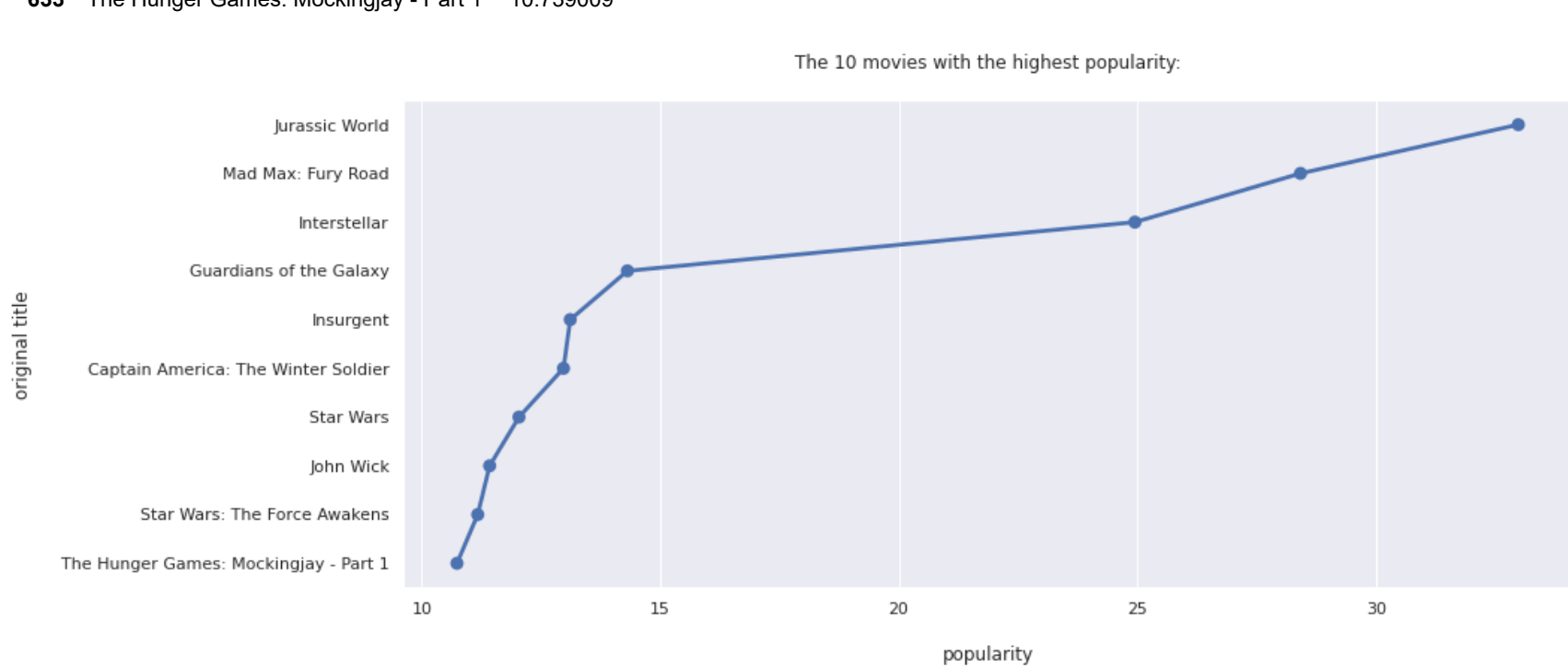
After seeing the plot and the output I can conclude that **'Avatar'** is a movie that has the highest profits in the market.

Research Question 4 (What are the top ten movies with the highest popularity?)

In [22]:
```
# call function
top_movies(df,'popularity', top=10)
```

The 10 movies with the highest popularity:

	original_title	popularity
0	Jurassic World	32.985763
1	Mad Max: Fury Road	28.419936
629	Interstellar	24.949134
630	Guardians of the Galaxy	14.311205
2	Insurgent	13.112507
631	Captain America: The Winter Soldier	12.971027
1329	Star Wars	12.037933
632	John Wick	11.422751
3	Star Wars: The Force Awakens	11.173104
633	The Hunger Games: Mockingjay - Part 1	10.739009



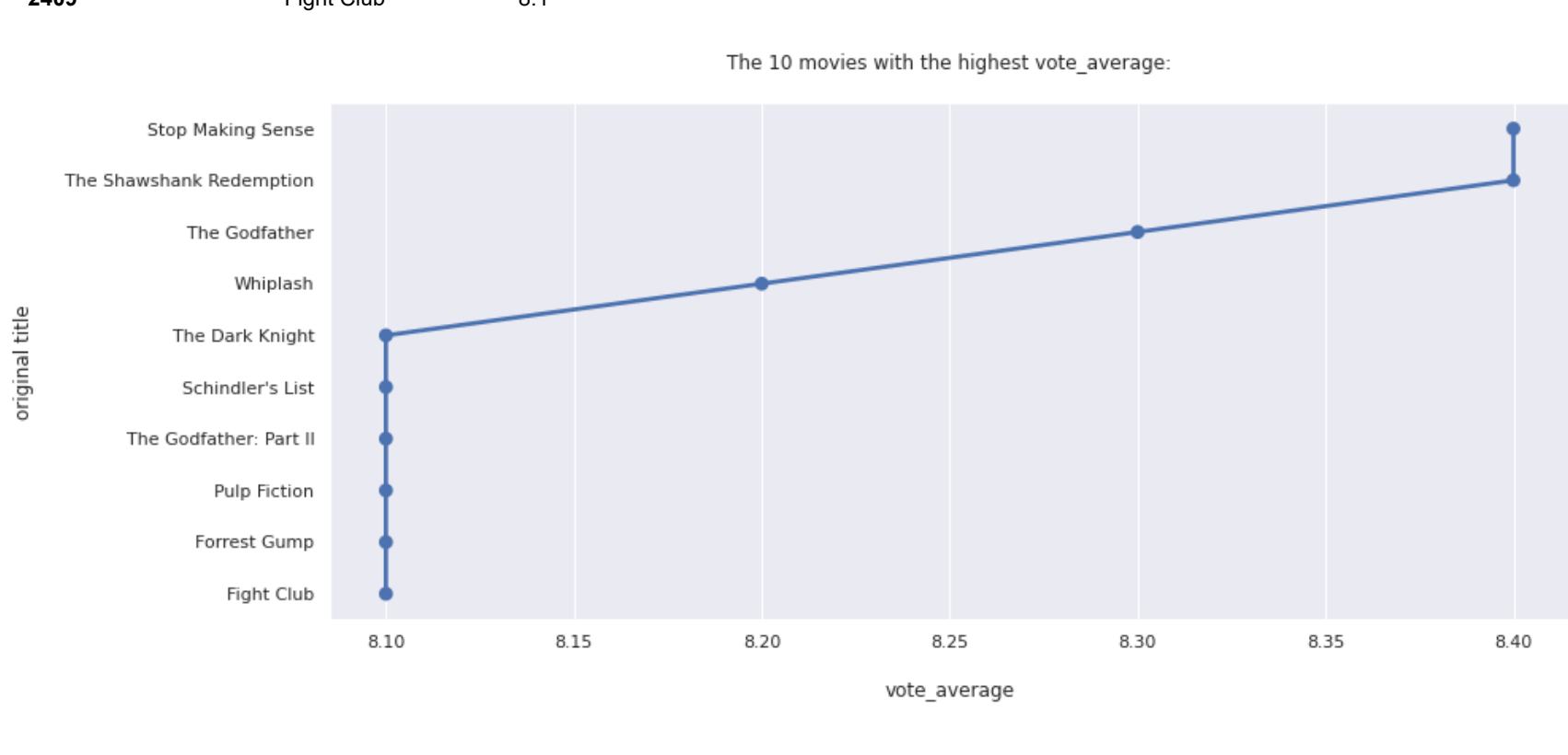
After seeing the plot and the output I can conclude that **'Jurassic World'** is a movie that has the highest popularity.

Research Question 5 (What are the top ten movies with the highest vote average?)

In [23]:
```
# call function
top_movies(df,'vote_average', top=10)
```

The 10 movies with the highest vote_average:

	original_title	vote_average
7948	Stop Making Sense	8.4
4178	The Shawshank Redemption	8.4
7269	The Godfather	8.3
650	Whiplash	8.2
2875	The Dark Knight	8.1
10222	Schindler's List	8.1
9758	The Godfather: Part II	8.1
4177	Pulp Fiction	8.1
4179	Forrest Gump	8.1
2409	Fight Club	8.1



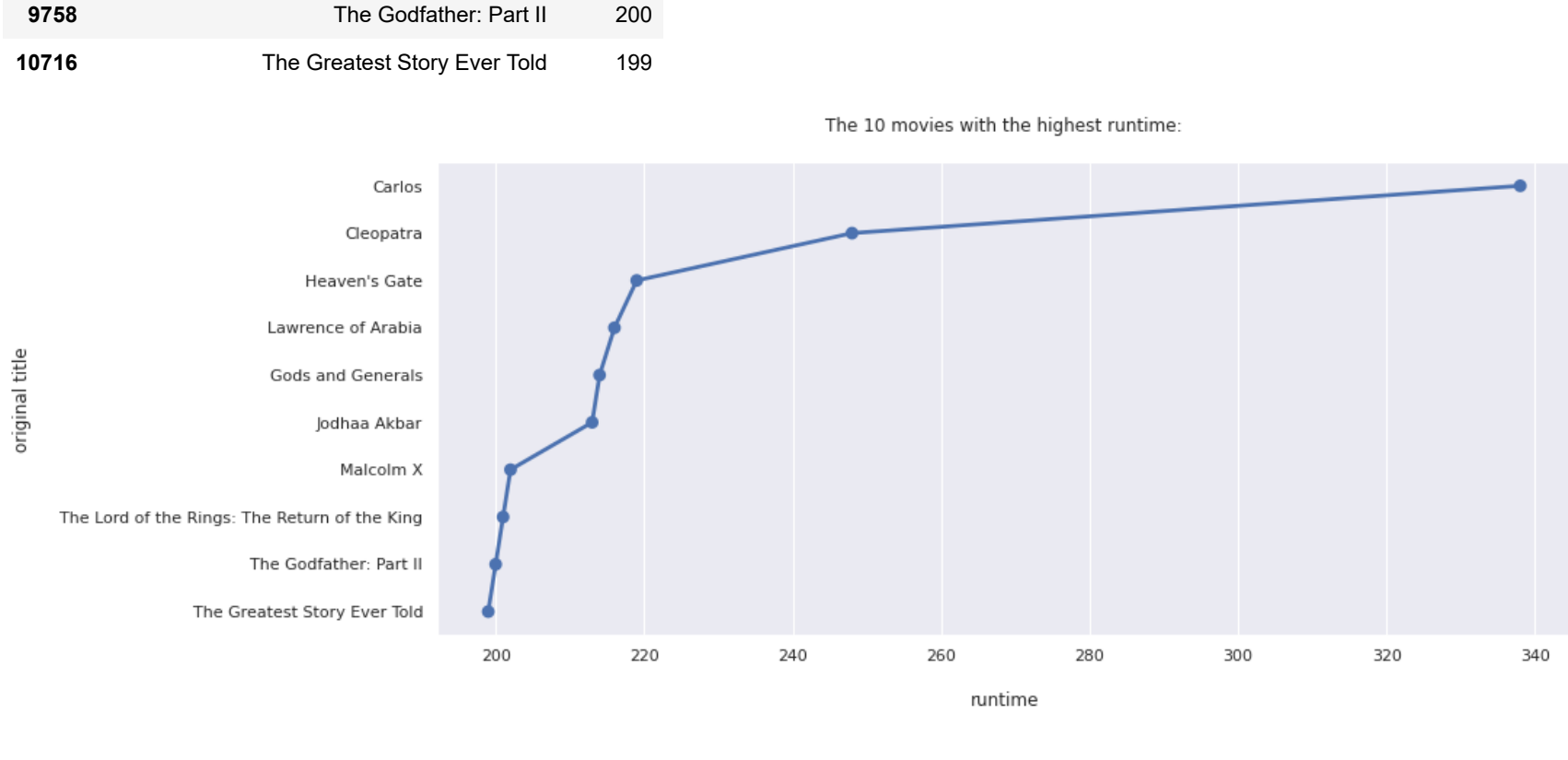
After seeing the plot and the output I can conclude that **'Stop Making Sense'** is a movie that has the highest vote average.

Research Question 6 (What are the 10 movies with the highest runtime?)

In [24]:
```
# call function
top_movies(df,'runtime', top=10)
```

The 10 movies with the highest runtime:

	original_title	runtime
2107	Carlos	338
10443	Cleopatra	248
7332	Heaven's Gate	219
9850	Lawrence of Arabia	216
5065	Gods and Generals	214
3110	Jodhaa Akbar	213
8282	Malcolm X	202
4949	The Lord of the Rings: The Return of the King	201
9758	The Godfather: Part II	200
10716	The Greatest Story Ever Told	199



After seeing the plot and the output I can conclude that **'Carlos'** is a movie that has the highest runtime.

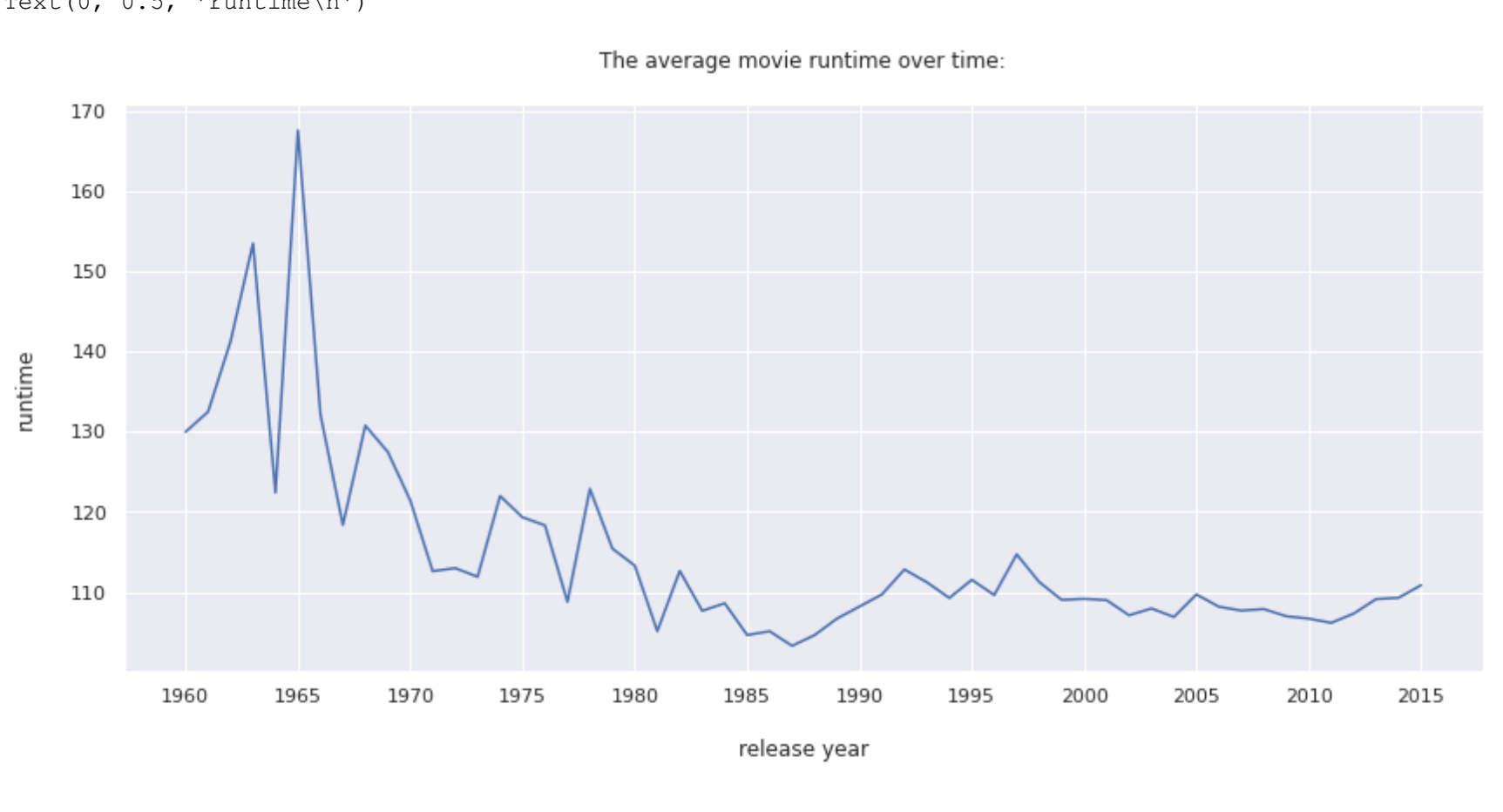
Research Question 7 (What is the average movie runtime over time?)

In [25]:
```
# group DataFrame
average_runtime_over_time = df.groupby('release_year')['runtime'].mean()
average_runtime_over_time
```

Out[25]:
```
release_year
1960    130.000000
1961    132.500000
1962    141.285714
1963    153.500000
1964    122.428571
1965    167.600000
1966    132.200000
1967    118.384615
1968    130.777778
1969    127.500000
1970    121.454545
1971    112.615385
1972    113.000000
1973    111.916667
1974    122.000000
1975    119.333333
1976    118.333333
1977    108.789474
1978    122.882353
1979    115.437500
1980    113.304348
1981    105.133333
1982    112.653846
1983    107.677419
1984    108.619048
1985    104.658537
1986    105.125000
1987    103.304348
1988    104.642857
1989    106.705882
1990    108.207547
1991    109.720000
1992    112.830189
1993    111.236111
1994    109.274194
1995    111.543210
1996    109.639535
1997    114.722222
1998    111.271739
1999    109.043103
2000    109.169811
2001    109.008264
2002    107.119048
2003    107.966942
2004    106.904762
2005    109.717791
2006    108.189349
2007    107.701220
2008    107.891566
2009    107.000000
2010    106.702247
2011    106.170854
2012    107.324841
2013    109.138889
2014    109.296970
2015    110.868750
Name: runtime, dtype: float64
```

In [26]:
```
# plot
average_runtime_over_time.plot(xticks = np.arange(1960,2016,5))
# Add title
plt.title("The average movie runtime over time:\n")
# Add x label
plt.xlabel("\nrelease year")
# Add y label
plt.ylabel("runtime\n")
```

Out[26]: Text(0, 0.5, 'runtime\n')



After seeing the plot and the output I can conclude that the average movie runtime over time is a decreasing.

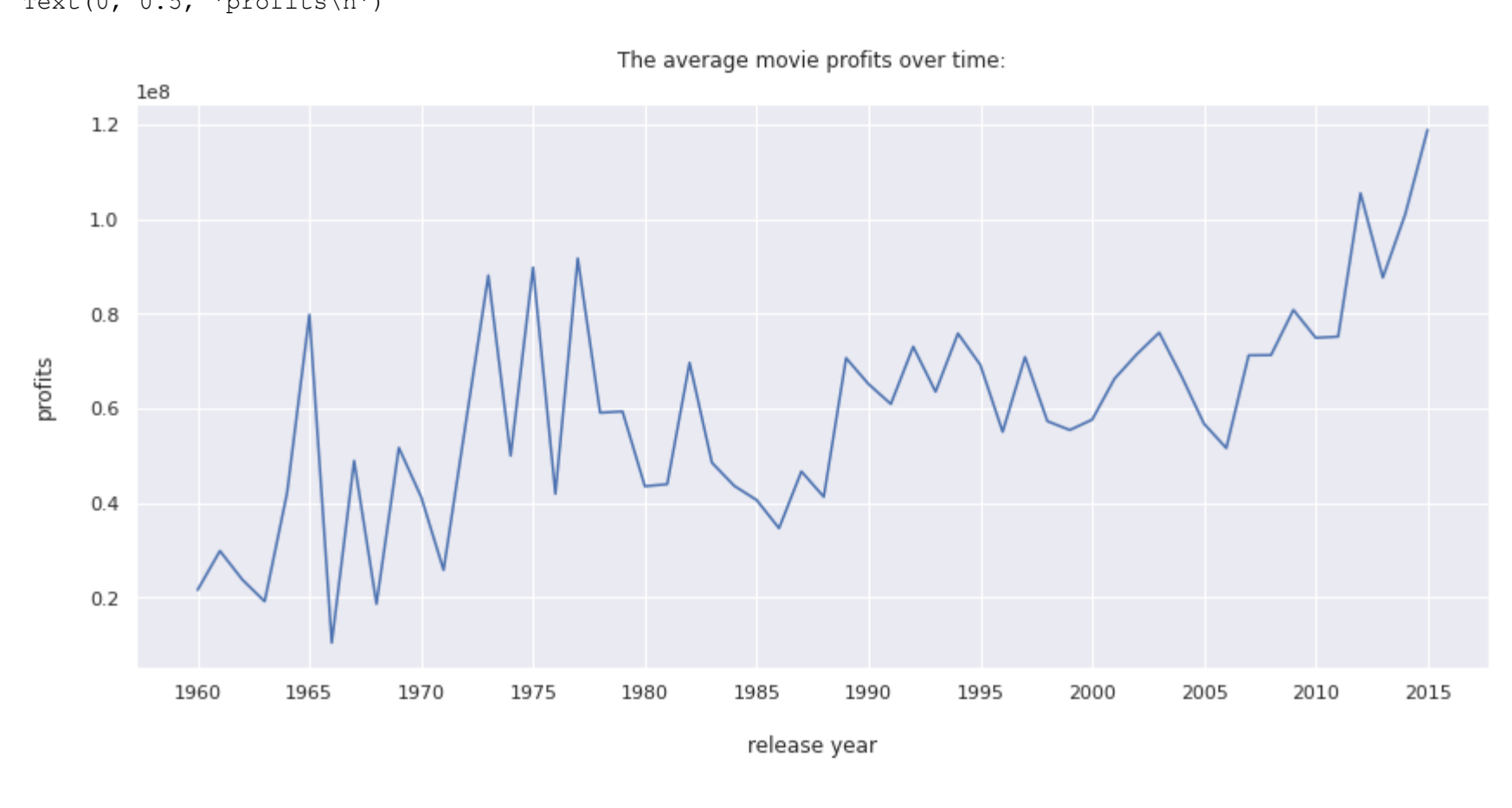
Research Question 8 (What are the average movie profits over time?)

```
In [27]: # group DataFrame
average_profits_over_time = df.groupby('release_year')['profits'].mean()
average_profits_over_time
```

```
Out[27]: release_year
1960    2.163961e+07
1961    2.990832e+07
1962    2.383998e+07
1963    1.923531e+07
1964    4.209691e+07
1965    7.985637e+07
1966    1.049374e+07
1967    4.894882e+07
1968    1.869686e+07
1969    5.171575e+07
1970    4.127909e+07
1971    2.586805e+07
1972    5.715449e+07
1973    8.814051e+07
1974    5.004477e+07
1975    8.980081e+07
1976    4.196177e+07
1977    9.175308e+07
1978    5.912353e+07
1979    5.939563e+07
1980    4.356807e+07
1981    4.400838e+07
1982    6.968294e+07
1983    4.855077e+07
1984    4.365329e+07
1985    4.065607e+07
1986    3.469489e+07
1987    4.670754e+07
1988    4.133906e+07
1989    7.066551e+07
1990    6.518689e+07
1991    6.096243e+07
1992    7.307634e+07
1993    6.355317e+07
1994    7.587717e+07
1995    6.923578e+07
1996    5.507705e+07
1997    7.089157e+07
1998    5.732767e+07
1999    5.545870e+07
2000    5.764882e+07
2001    6.629789e+07
2002    7.148870e+07
2003    7.605087e+07
2004    6.681977e+07
2005    5.680646e+07
2006    5.163491e+07
2007    7.125673e+07
2008    7.130454e+07
2009    8.085808e+07
2010    7.495069e+07
2011    7.520952e+07
2012    1.055156e+08
2013    8.768191e+07
2014    1.010679e+08
2015    1.189509e+08
Name: profits, dtype: float64
```

```
In [28]: # plot
average_profits_over_time.plot(xticks = np.arange(1960,2016,5))
# Add title
plt.title("The average movie profits over time:\n")
# Add x label
plt.xlabel("\nrelease year")
# Add y label
plt.ylabel("profits\n")
```

```
Out[28]: Text(0, 0.5, 'profits\n')
```



After seeing the plot and the output I can conclude that the average movie profits over time vary, but most of them increase.

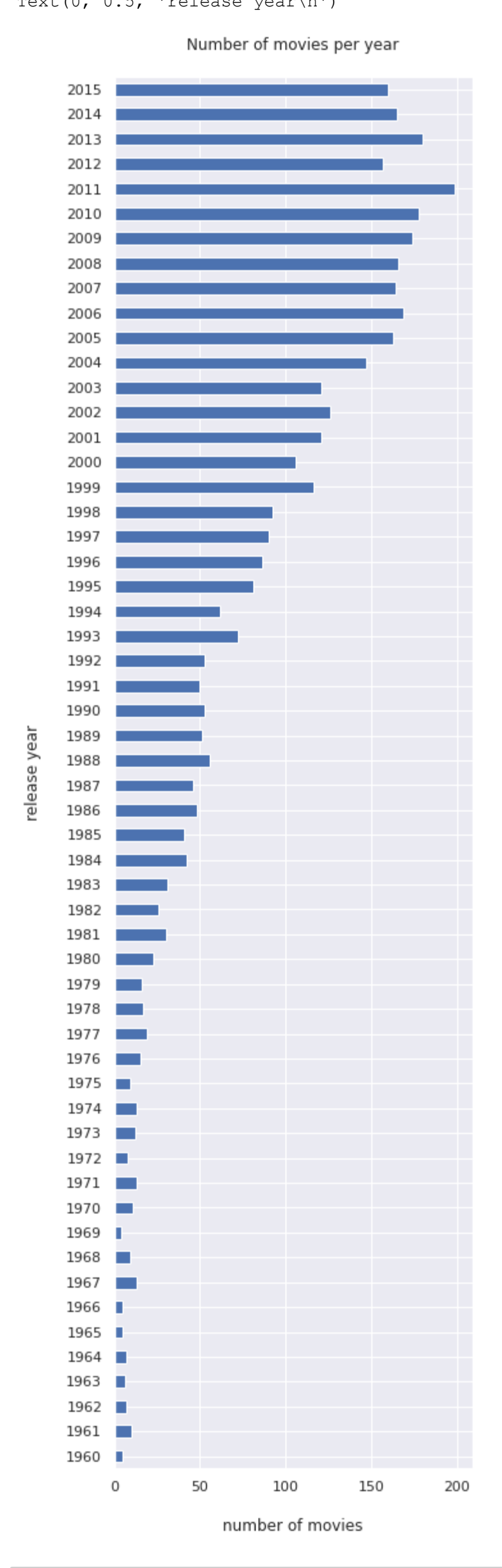
Research Question 9 (How many movies per year?)

```
In [29]: # group DataFrame
num_movies = df.groupby('release_year').count()['id']
num_movies
```

```
Out[29]: release_year
1960      5
1961     10
1962      7
1963      6
1964      7
1965      5
1966      5
1967     13
1968      9
1969      4
1970     11
1971     13
1972      8
1973     12
1974     13
1975      9
1976     15
1977     19
1978     17
1979     16
1980     23
1981     30
1982     26
1983     31
1984     42
1985     41
1986     48
1987     46
1988     56
1989     51
1990     53
1991     50
1992     53
1993     72
1994     62
1995     81
1996     86
1997     90
1998     92
1999    116
2000    106
2001    121
2002    126
2003    121
2004    147
2005    163
2006    169
2007    164
2008    166
2009    174
2010    178
2011    199
2012    157
2013    180
2014    165
2015    160
Name: id, dtype: int64
```

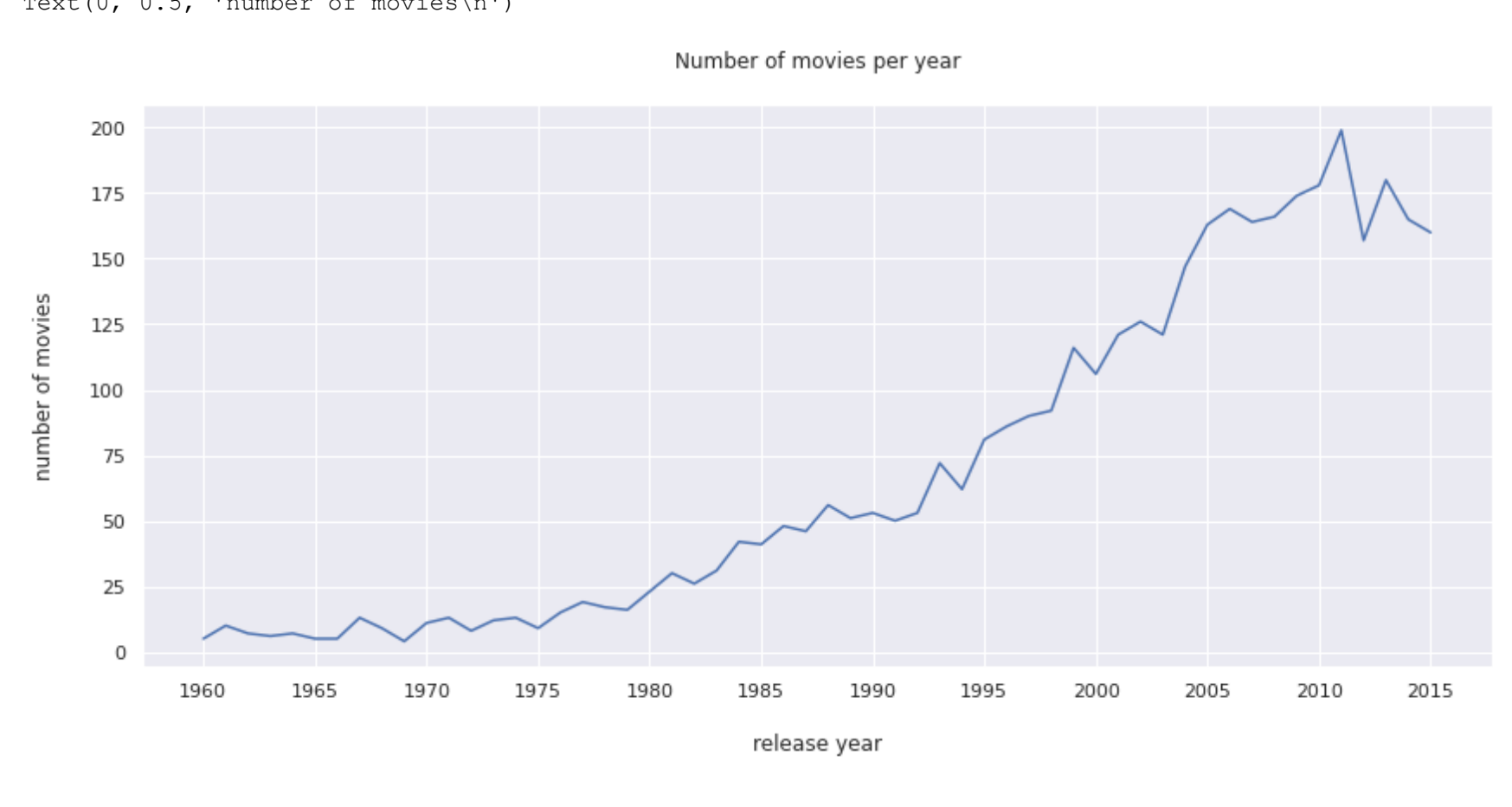
```
In [30]: # plot
num_movies.plot(kind='barh', figsize=(5,20))
# Add title
plt.title("Number of movies per year\n")
# Add x label
plt.xlabel('\nnumber of movies')
# Add y label
plt.ylabel('release year\n')
```

```
Out[30]: Text(0, 0.5, 'release year\n')
```




```
In [31]: # plot
num_movies.plot(figsize = (14,6),xticks = np.arange(1960,2016,5))
# # Add title
plt.title("Number of movies per year\n")
# Add x label
plt.xlabel('\nrelease year',)
# Add y label
plt.ylabel('number of movies\n')
```

```
Out[31]: Text(0, 0.5, 'number of movies\n')
```



After seeing the plot and the output I can conclude that the number of movies is increasing every year.

Research Question 10 (In which year has the highest or lowest production of movies?)

```
In [32]: num_movies = num_movies.sort_values()
print('A year has the lowest production:\n',num_movies.head(1))
print('A year has the highest production:\n',num_movies.tail(1))
```

```
A year has the lowest production:
 release_year
1969    4
Name: id, dtype: int64
A year has the highest production:
 release_year
2011    199
Name: id, dtype: int64
```

After seeing the output I can conclude that 2014 is the year that has the highest production of movies and 1969 is the year that has the lowest production of movies.

Research Question 11 (What are the top 10 directors in 2014, according to the vote?)

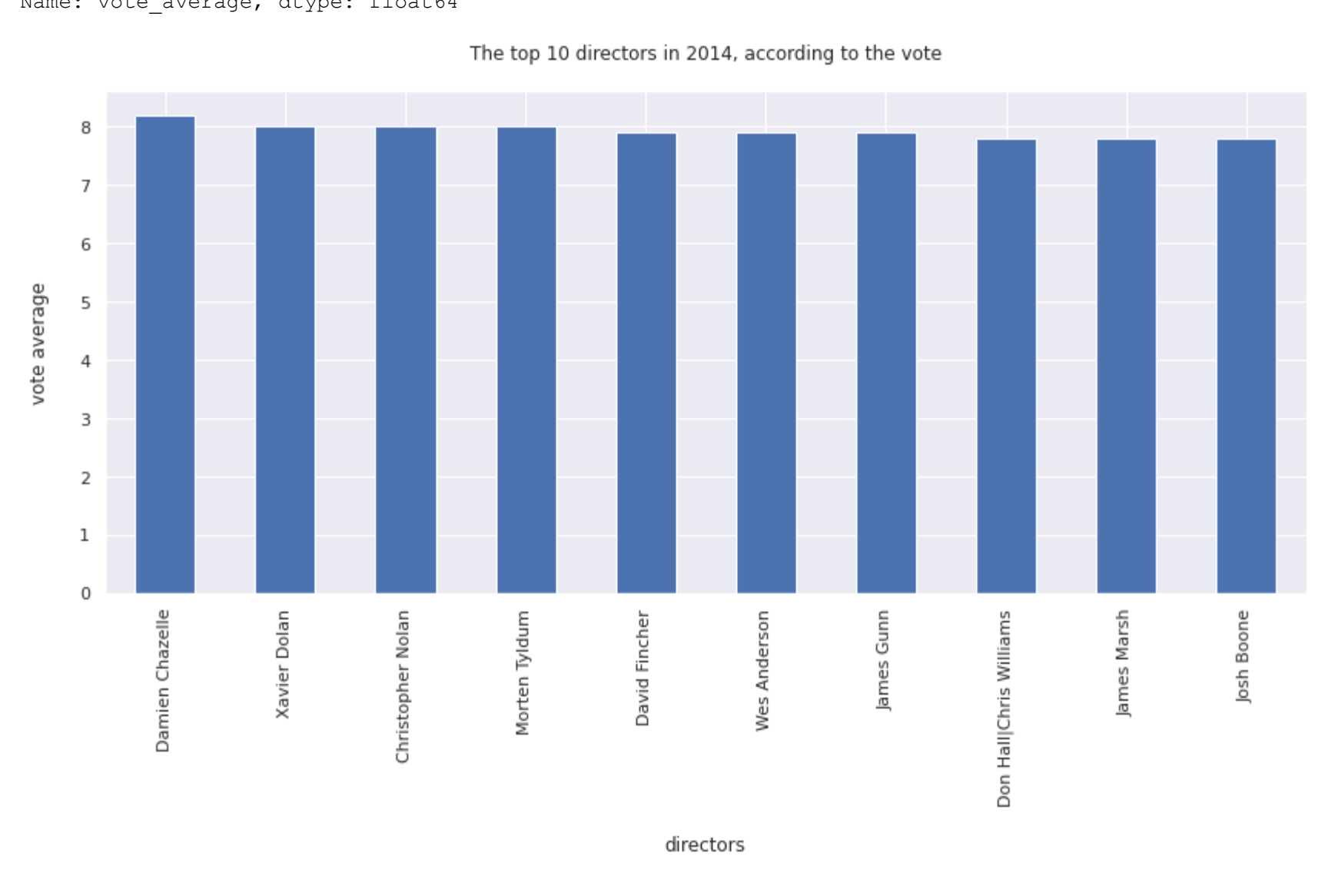
```
In [33]: # group DataFrame
best_director = df.loc[df['release_year']==2014].groupby('director').max().vote_average
# sort values
best_director = best_director.sort_values(ascending=False)
best_director
```

```
Out[33]: director
Damien Chazelle                        8.2
Xavier Dolan                           8.0
Christopher Nolan                      8.0
Morten Tyldum                          8.0
David Fincher                          7.9
                                      ...
GrÃ©gory Levasseur                     4.7
Brian A Miller                         4.6
Matt Bettinelli-Olpin|Tyler Gillett    4.5
Renny Harlin                           4.4
Vic Armstrong                          3.8
Name: vote_average, Length: 160, dtype: float64
```

```
In [34]: # plot
(best_director.head(10)).plot(kind='bar',figsize = (14,6))
# Add title
plt.title("The top 10 directors in 2014, according to the vote\n")
# Add x label
plt.xlabel('\ndirectors',)
# Add y label
plt.ylabel('vote average\n')

best_director.head(10)
```

```
Out[34]: director
Damien Chazelle            8.2
Xavier Dolan               8.0
Christopher Nolan          8.0
Morten Tyldum              8.0
David Fincher              7.9
Wes Anderson               7.9
James Gunn                 7.9
Don Hall|Chris Williams    7.8
James Marsh                7.8
Josh Boone                 7.8
Name: vote_average, dtype: float64
```



After seeing the plot and the output I can conclude that Carl Tibbetts, Paul Dugdale, Damien Chazelle, Stephen Daldry, Brett Sullivan, Tomm Moore, Morten Tyldum, Patrick Osborne, Christopher Nolan, Xavier Dolan, Dan Storey are the top 10 directors in 2014, according to the vote.

Research Question 12 (How many movies per genre?)

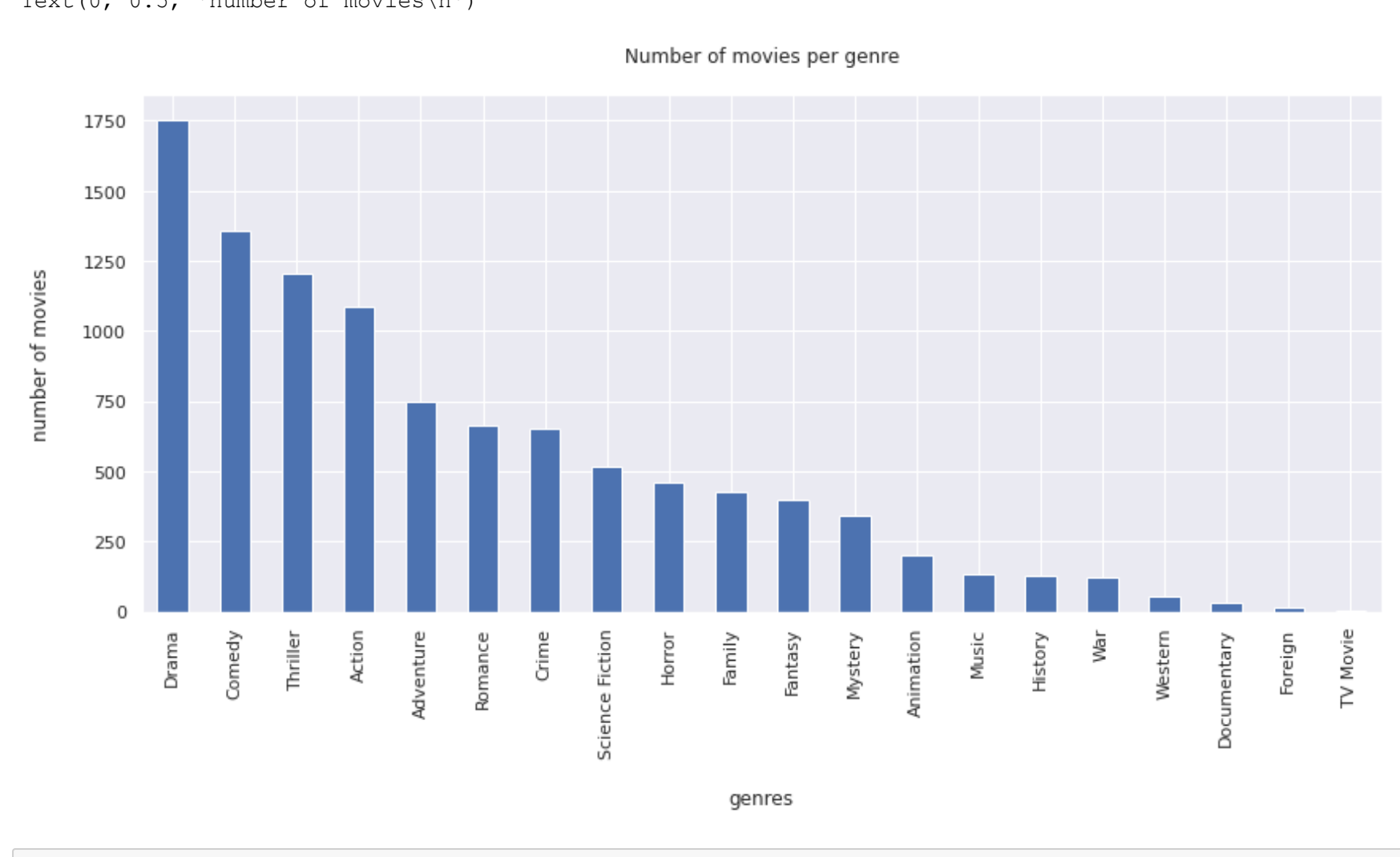
```
In [35]: #split genres
genres_data = pd.Series((df['genres'].str.cat(sep = '|')).split('|'))

genres_data = genres_data.value_counts(ascending=False)
genres_data
```

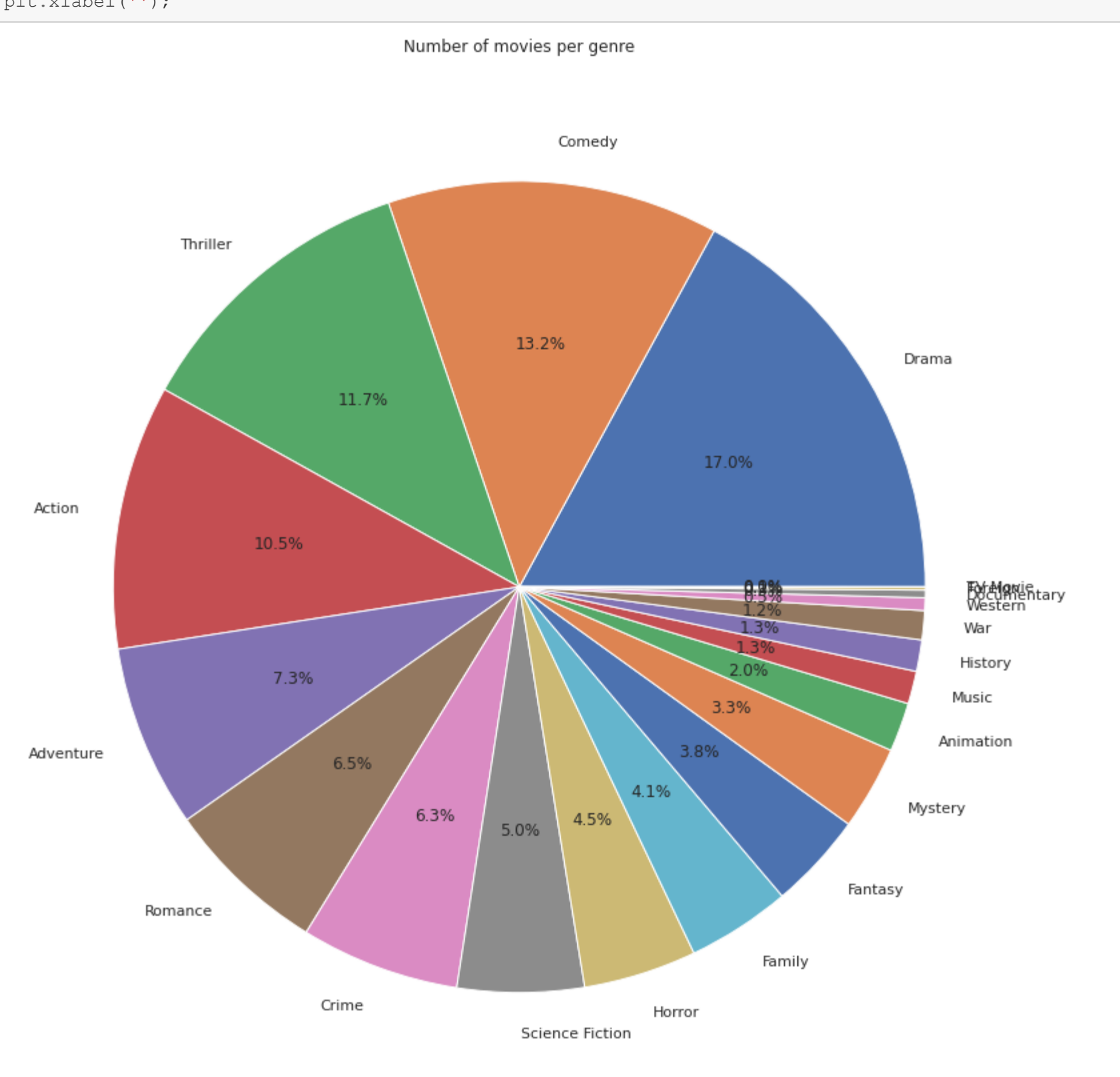
```
Out[35]: Drama              1753
Comedy             1357
Thriller           1203
Action             1085
Adventure           749
Romance             666
Crime               651
Science Fiction     519
Horror              463
Family              425
Fantasy             396
Mystery             344
Animation           201
Music               134
History             129
War                 119
Western              52
Documentary          31
Foreign              12
TV Movie              1
dtype: int64
```

```
In [36]: # plot
genres_data.plot(kind='bar',figsize = (14,6))
# Add title
plt.title("Number of movies per genre\n")
# Add x label
plt.xlabel('\ngenres',)
# Add y label
plt.ylabel('number of movies\n')
```

```
Out[36]: Text(0, 0.5, 'number of movies\n')
```




```
In [37]: # plot
genres_data.plot(kind="pie",figsize = (14,14),autopct="%1.1f%%")
# Add title
plt.title("Number of movies per genre\n")
# Add y label
plt.ylabel('');
# Add x label
plt.xlabel('');
```



After seeing the bar plot, pie plot and output I can conclude that Drama is the most popular genre, following by Comedy, Thriller, Action, Romance, Horror, etc.

Research Question 13 (How many movies per director?)

```
In [38]: # group DataFrame
num_movies_per_director = df.groupby('director').count()['id']
# sort values
num_movies_per_director = num_movies_per_director.sort_values(ascending = False)
num_movies_per_director
```

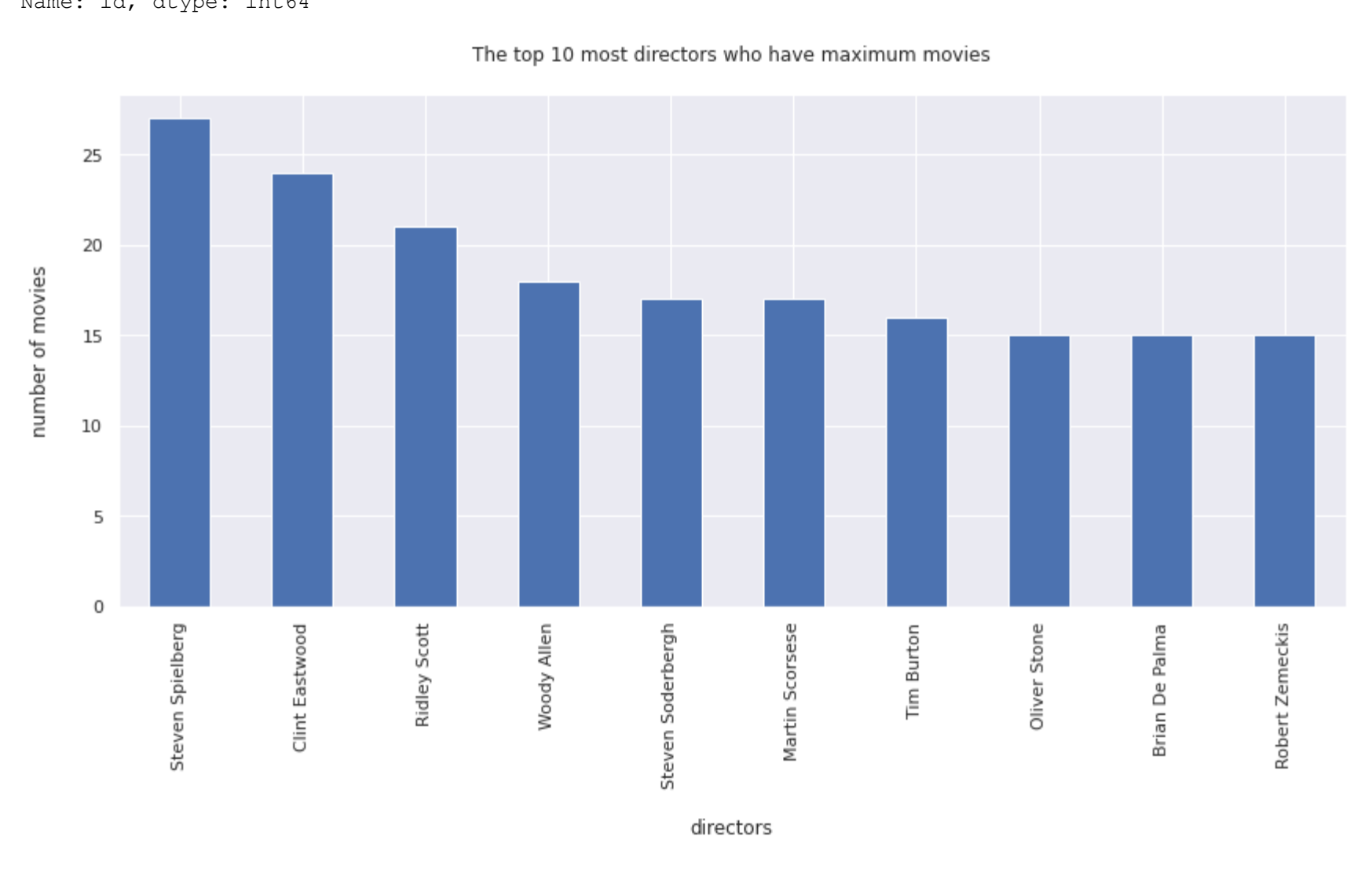
```
Out[38]: director
Steven Spielberg      27
Clint Eastwood        24
Ridley Scott          21
Woody Allen           18
Steven Soderbergh     17
                      ..
Marc Evans             1
Marcel Langenegger     1
Marco Brambilla        1
Marco Schnabel         1
 FrÃ©dÃ©ric Jardin     1
Name: id, Length: 1710, dtype: int64
```

Research Question 14 (What are the top 10 most directors who have maximum movies?)

```
In [39]: # plot
(num_movies_per_director.head(10)).plot(kind='bar',figsize = (14,6))
# Add title
plt.title("The top 10 most directors who have maximum movies\n")
# Add x label
plt.xlabel('\ndirectors',)
# Add y label
plt.ylabel('number of movies\n')

num_movies_per_director.head(10)
```

```
Out[39]: director
Steven Spielberg     27
Clint Eastwood       24
Ridley Scott         21
Woody Allen          18
Steven Soderbergh    17
Martin Scorsese      17
Tim Burton           16
Oliver Stone         15
Brian De Palma       15
Robert Zemeckis      15
Name: id, dtype: int64
```



After seeing the plot and the output I can conclude that Woody Allen, Clint Eastwood, Steven Spielberg, Martin Scorsese, Ridley Scott, Ron Howard, Steven Soderbergh, Joel Schumacher, Brian De Palma, Wes Craven are the top 10 most directors who have maximum movies.

Research Question 15 (What are the most profitable months?)

```
In [40]: # add a new column (month) in the dataframe
df['month'] = df['release_date'].dt.month
# group DataFrame
profits_in_months = df.groupby('month')['profits'].mean()
profits_in_months
```

```
Out[40]: month
1     3.051471e+07
2     4.056733e+07
3     6.559951e+07
4     5.997196e+07
5     1.187381e+08
6     1.266208e+08
7     9.404407e+07
8     4.074104e+07
9     2.941643e+07
10    4.730233e+07
11    1.001690e+08
12    9.198651e+07
Name: profits, dtype: float64
```

```
In [41]: # plot
profits_in_months.plot(kind='bar',figsize = (14,6))
# Add title
plt.title("The most profitable months\n")
# Add x label
plt.xlabel('\nmonths',)
# Add y label
plt.ylabel('profits\n')
```

```
Out[41]: Text(0, 0.5, 'profits\n')
```

After seeing the plot and the output I can conclude that Month 6 is the most profitable Month, following by Month 5, Month 12, Month 11, Month 7, Month 3, Month 4, Month 8, Month 2, Month 10, Month 9, Month 1.

Conclusions

- The Warrior's Way, Pirates of the Caribbean: On Stranger Tides, Pirates of the Caribbean: At World's End, Avengers: Age of Ultron, Superman Returns, John Carter, Tangled, Spider-Man 3, The Lone Ranger, Harry Potter and the Half-Blood Prince **are movies with the highest production budget.**
- Avatar, Star Wars: The Force Awakens, Titanic, The Avengers, Jurassic World, Furious 7, Avengers: Age of Ultron, Harry Potter and the Deathly Hallows: Part 2, Frozen, Iron Man 3 **are movies with the highest revenue.**
- Avatar, Star Wars: The Force Awakens, Titanic, The Avengers, Jurassic World, Furious 7, Avengers: Age of Ultron, Harry Potter and the Deathly Hallows: Part 2, Frozen, The Net **are the top 10 most profitable movies in the market.**
- Jurassic World, Mad Max: Fury Road, Interstellar, Guardians of the Galaxy, Insurgent, Captain America: The Winter Soldier, Star Wars, John Wick, Star Wars: The Force Awakens, The Hunger Games: Mockingjay - Part 1 **are the top ten movies with the highest popularity.**
- The Story of Film: An Odyssey, Black Mirror: White Christmas, Pink Floyd: Pulse, The Art of Flight, A Personal Journey with Martin Scorsese, Dave Chappelle: Killin' Them Softly, Queen - Rock Montreal, The Shawshank Redemption, Rush: Beyond the Lighted Stage, The Jinx: The Life and Deaths of Robert Durst **are the top ten movies with the highest vote average.**
- The Story of Film: An Odyssey, Taken, Band of Brothers, Shoah, Planet Earth, The Pacific, John Adams, Life, Generation Kill, The Pillars of the Earth **are the 10 movies with the highest runtime.**
- **I've noticed that the average movie runtime over time is a decreasing.**
- **I've noticed that the average movie profits over time vary, but most of them increase.**
- **I've noticed that the number of movies is increasing every year.**
- **2014 is a year that has the highest production of movies.**
- **1969 is a year that has the lowest production of movies.**
- Carl Tibbetts, Paul Dugdale, Damien Chazelle, Stephen Daldry, Brett Sullivan, Tomm Moore, Morten Tyldum, Patrick Osborne, Christopher Nolan, Xavier Dolan, Dan Storey **are the top 10 directors in 2014, according to the vote.**
- **Drama is the most popular genre, following by Comedy, Thriller, Action, Romance, Horror, etc.**
- Woody Allen, Clint Eastwood, Steven Spielberg, Martin Scorsese, Ridley Scott, Ron Howard, Steven Soderbergh, Joel Schumacher, Brian De Palma, Wes Craven **are the top 10 most directors who have maximum movies.**
- **Month 6 is the most profitable Month, following by Month 5, Month 12, Month 11, Month 7, Month 3, Month 4, Month 8, Month 2, Month 10, Month 9, Month 1.**

Limitations

- Missing values in the dataset affect the results.
- Duplicates values in the dataset affect the results.
- Some budget and revenue values in the dataset have zeros values.
- Incorrect data type.

Resources

- https://pandas.pydata.org/docs/
- https://seaborn.pydata.org/
- https://github.com/udacity/data-analyst