Project: TMDB Movies database Exploration.

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1. Introduction:

In this jupyter notebook we explore - The Movie Database (TMDb) - dataset which contains information about 10,000+ movies including user ratings, budgets and revenues and much more... I want to explore, find and share answers for many questions on this notebook.

I will try to answer these questions during this interesting exploration:

- Top Ten Directors, Actors, Production Companies and Movie Genres ?
- What is the Movies popularity trend over years ?
- Which genres was more populare over the years ?
- Compare lowest and highest Movies Budgets, Revenues, Profites and Runtime ?
- Check the properities of Top 100 Revenue Movies ?

2. Data Wrangling:

In this section:

```
1. look on the dataset insights, to decide required data cleaning.
2. Clean data (Remove duplicates, fill/drop missing data as required, Drop unused c
olumns).
3. Create function to help answer questions about the datset.
```

2.1. Look on dataset insights

In [1]:
```python
# imports and read file
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline

df = pd.read_csv("tmdb_movies_data.csv")
df.head()
```

Out[1]:

	id	imdb_id	popularity	budget	revenue	original_title	cast	
0	135397	tt0369610	32.985763	150000000	1513528810	Jurassic World	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...	
1	76341	tt1392190	28.419936	150000000	378436354	Mad Max: Fury Road	Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...	
2	262500	tt2908446	13.112507	110000000	295238201	Insurgent	Shailene Woodley|Theo James|Kate Winslet|Ansel...	http://ww
3	140607	tt2488496	11.173104	200000000	2068178225	Star Wars: The Force Awakens	Harrison Ford|Mark Hamill|Carrie Fisher|Adam D...	htt
4	168259	tt2820852	9.335014	190000000	1506249360	Furious 7	Vin Diesel|Paul Walker|Jason Statham|Michelle ...	

5 rows × 21 columns

In [2]:
```
# check tail of dataframe
df.tail()
```

Out[2]:

	id	imdb_id	popularity	budget	revenue	original_title	cast	homepag
10861	21	tt0060371	0.080598	0	0	The Endless Summer	Michael Hynson|Robert August|Lord 'Tally Ho' B...	Na
10862	20379	tt0060472	0.065543	0	0	Grand Prix	James Garner|Eva Marie Saint|Yves Montand|Tosh...	Na
10863	39768	tt0060161	0.065141	0	0	Beregis Avtomobilya	Innokentiy Smoktunovskiy|Oleg Efremov|Georgi Z...	Na
10864	21449	tt0061177	0.064317	0	0	What's Up, Tiger Lily?	Tatsuya Mihashi|Akiko Wakabayashi|Mie Hama|Joh...	Na
10865	22293	tt0060666	0.035919	19000	0	Manos: The Hands of Fate	Harold P. Warren|Tom Neyman|John Reynolds|Dian...	Na

5 rows × 21 columns

In [3]:
```
# check all columns names
df.columns
```

Out[3]:
```
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 [4]:
```
# explore information about data types
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: 1.3+ MB
```

In [5]:
```
# check for duplicated information
df.duplicated().sum()
```

Out[5]: 1

In [6]:
```
# Numerical features exploration
df.describe()
```

Out[6]:

	id	popularity	budget	revenue	runtime	vote_count	vo
count	10866.000000	10866.000000	1.086600e+04	1.086600e+04	10866.000000	10866.000000	1(
mean	66064.177434	0.646441	1.462570e+07	3.982332e+07	102.070863	217.389748	
std	92130.136561	1.000185	3.091321e+07	1.170035e+08	31.381405	575.619058	
min	5.000000	0.000065	0.000000e+00	0.000000e+00	0.000000	10.000000	
25%	10596.250000	0.207583	0.000000e+00	0.000000e+00	90.000000	17.000000	
50%	20669.000000	0.383856	0.000000e+00	0.000000e+00	99.000000	38.000000	
75%	75610.000000	0.713817	1.500000e+07	2.400000e+07	111.000000	145.750000	
max	417859.000000	32.985763	4.250000e+08	2.781506e+09	900.000000	9767.000000	

In [7]:
```
# check NAN values
df.isna().sum()
```

Out[7]:
```
id                         0
imdb_id                   10
popularity                 0
budget                     0
revenue                    0
original_title             0
cast                      76
homepage                7930
director                  44
tagline                 2824
keywords                1493
overview                   4
runtime                    0
genres                    23
production_companies    1030
release_date               0
vote_count                 0
vote_average               0
release_year               0
budget_adj                 0
revenue_adj                0
dtype: int64
```

from the previous exploration:

- Dataset consists of 10866 rows and 21 columns.
- Only 1 duplicated row.
- Various columns including budget and revenue contain 0 values.
- Various columns contain NAN values.
- Cast, Genres, and production companies columns need string sepration.

2.2. Clean Data:

```
* Drop duplicates.
* Drop not required columns.
* Drop (runtime, budget_adj and revenue_adj) rows with 0 values.
* Create profit column.
* Separet strings in cast, genres and production_companies columns.
```

In [8]:
```
# drop duplicates
df.drop_duplicates(inplace = True)
df.shape
```

Out[8]:
```
(10865, 21)
```

In [9]:
```
# drop unwanted columns
del_columns = ['id', 'imdb_id', 'homepage', 'tagline', 'keywords', 'overview',
'release_date',
               'vote_count', 'vote_average','budget','revenue']
# id, imdb_id won't be used
# release_year will be used instead of release_date
# popularity will be used instead of vote_count and vote_average
# budget_adj and revenue_adj will be used instead of budget and revenue to inc
lude inflation over time
# rest of deleted columns are not required
df.drop(del_columns, axis= 1, inplace = True)
df.head()
```

Out[9]:

	popularity	original_title	cast	director	runtime	genres	produc
0	32.985763	Jurassic World	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...	Colin Trevorrow	124	Action|Adventure|Science Fiction|Thriller	Univers Entertai
1	28.419936	Mad Max: Fury Road	Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...	George Miller	120	Action|Adventure|Science Fiction|Thriller	\ Picture
2	13.112507	Insurgent	Shailene Woodley|Theo James|Kate Winslet|Ansel...	Robert Schwentke	119	Adventure|Science Fiction|Thriller	Entertai F
3	11.173104	Star Wars: The Force Awakens	Harrison Ford|Mark Hamill|Carrie Fisher|Adam D...	J.J. Abrams	136	Action|Adventure|Science Fiction|Fantasy	Lu Produ
4	9.335014	Furious 7	Vin Diesel|Paul Walker|Jason Statham|Michelle ...	James Wan	137	Action|Crime|Thriller	Filr

In [10]:
```
# In order to increase accuracy of will replace 0 values in budget, revenue, a
nd runtime columns to NAN
df["budget_adj"].replace(0, np.NaN, inplace = True)
df["revenue_adj"].replace(0, np.NaN, inplace = True)
df["runtime"].replace(0, np.NaN, inplace = True)
```

In [11]:
```
# Drop Rows with Nan Values
df.dropna(inplace = True)
df.shape
```

Out[11]:
```
(3805, 10)
```

In [12]:
```
# Create profit column
df["profit"] = df["revenue_adj"] - df["budget_adj"]
df.head(3)
```

Out[12]:

	popularity	original_title	cast	director	runtime	genres	producti
0	32.985763	Jurassic World	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...	Colin Trevorrow	124.0	Action|Adventure|Science Fiction|Thriller	Universal Entertainr
1	28.419936	Mad Max: Fury Road	Tom Hardy|Charlize Theron|Hugh Keays-Byrne|Nic...	George Miller	120.0	Action|Adventure|Science Fiction|Thriller	Vil Pictures
2	13.112507	Insurgent	Shailene Woodley|Theo James|Kate Winslet|Ansel...	Robert Schwentke	119.0	Adventure|Science Fiction|Thriller	Entertainr Fil

In [13]:
```
# Separate mutiple values in Cast, genres, and production_companies columns an
d split them using ("|")
actors = df.cast.str.cat(sep="|").split("|")
genres = df.genres.str.cat(sep="|").split("|")
companies = df.production_companies.str.cat(sep="|").split("|")
#  Create a list of Top ten actors, genres, production companies
actors_list = pd.Series(actors).value_counts()[:10]
genres_list = pd.Series(genres).value_counts()[:10]
companies_list = pd.Series(companies).value_counts()[:10]
```

2.3. Create Function:

In this section we create min_max function to help explore and answer questions about the dataset

min_max Function - takes column name and return the min and max values to compare

In [14]:
```
# Create min_max function

def min_max (col_name):
    min_value = df[col_name].idxmin()
    min_df = pd.DataFrame(df.loc[min_value])

    max_value = df[col_name].idxmax()
    max_df = pd.DataFrame(df.loc[max_value])

    print (f"Lowest {col_name} is {df.original_title[min_value]} movie.")
    print (f"Highest {col_name} is {df.original_title[max_value]} movie.")

    min_max_value = pd.concat([min_df, max_df], axis = 1)
    return min_max_value
```

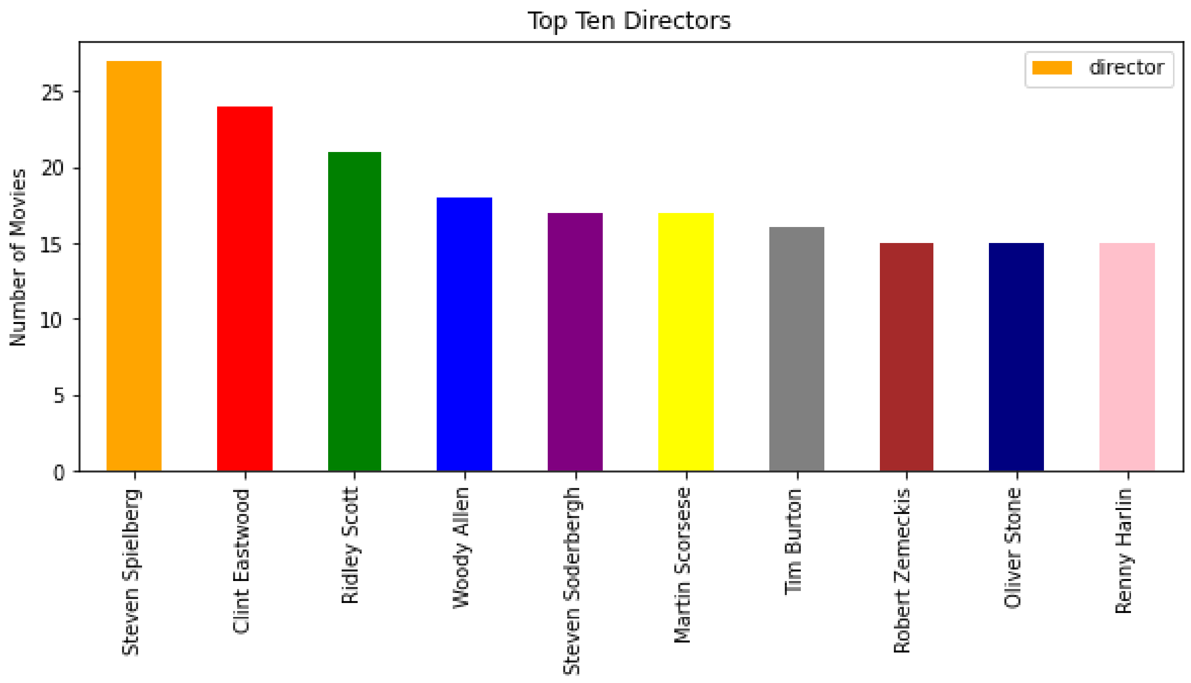
3. EDA - Exploratory Data Analysis

Lets answer some questions !!!

Q-1: Top Ten Directors, Actors, Production Companies and Movie Genres ?

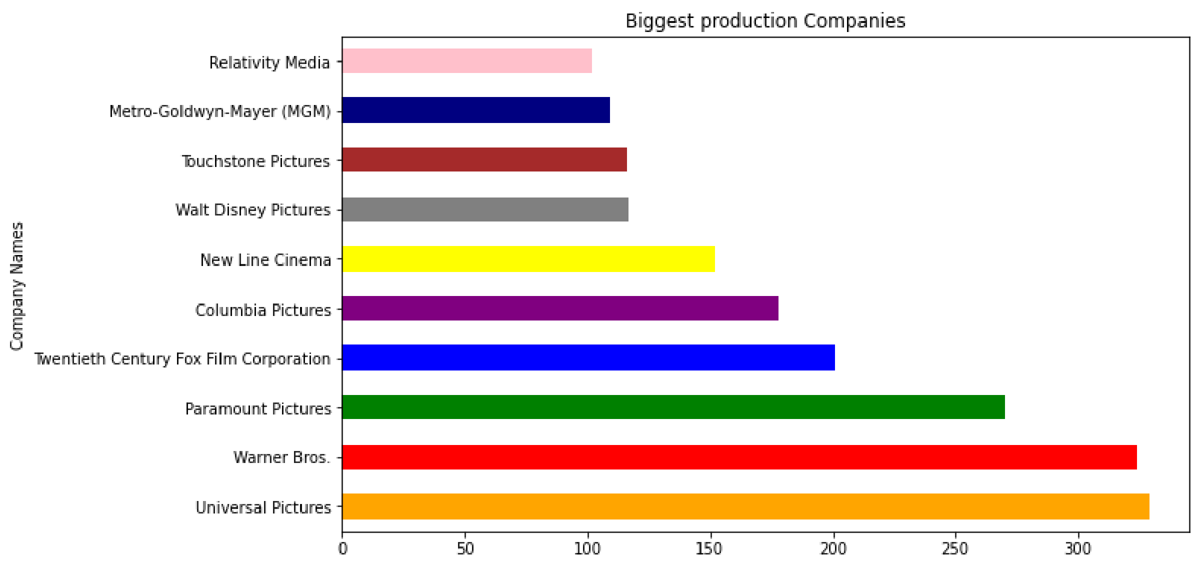
In [15]:
```
# create colors list
colors_list = ["orange","red", "green", "blue","purple", "yellow", "gray","bro
wn", "navy", "pink"]
```

In [17]:
```
# check and plot top ten Directors
top_ten_dir = df.director.value_counts()[:10].plot.bar(figsize = (10,4),
                                                       color = colors_list,
                                                       title = "Top Ten Direct
ors",
                                                       ylabel = "Number of Mov
ies",
                                                       legend = True);
```



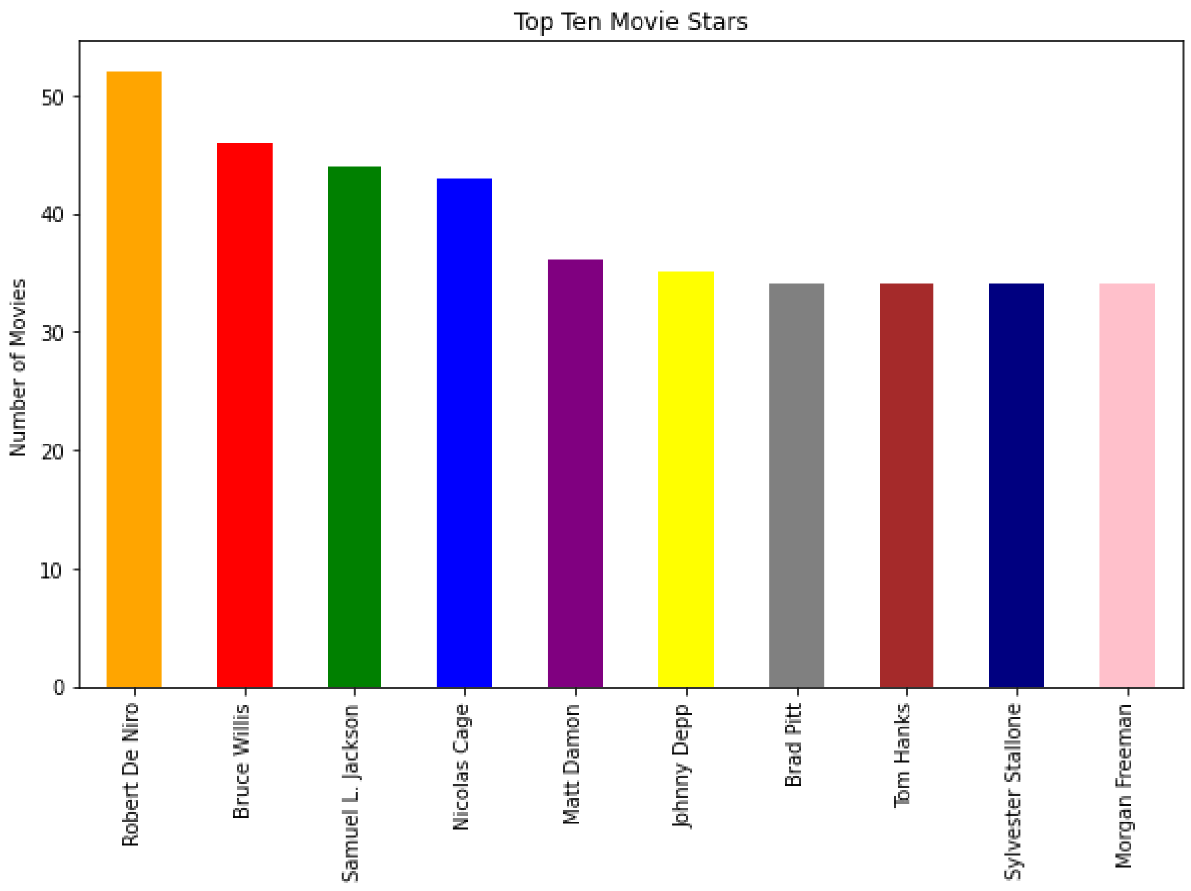
Great Directors in our Top Ten Directors list including: The Great Steven Spielberg, Clint Eastwood (My Favourite), and Ridley Scott.

```
In [19]: # plot biggest production companies
         big_prod_comp = companies_list.plot.barh(figsize=(10,6),
                                                  color=colors_list,
                                                  title = "Biggest production Companie
         s",
                                                  ylabel = "Company Names");
```



Big Names in Top Ten Production Companies; Universal Pictures comes first with over 300 produced movies, Warner Bros comes second with very small margine, Paramount comes third and Walt Disney comes in the Seventh Place.

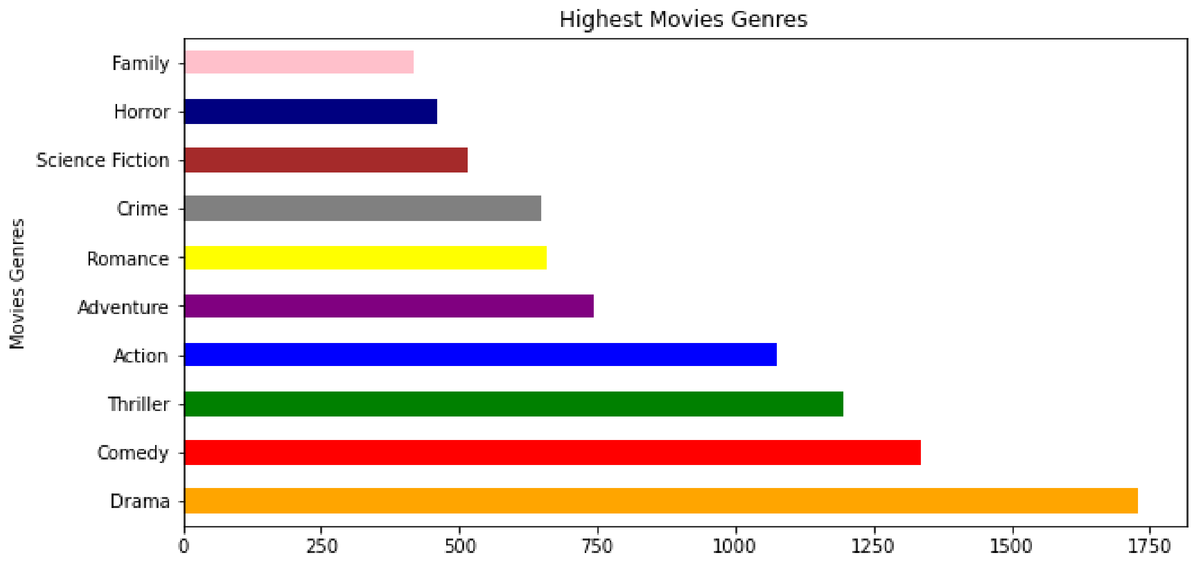
In [20]:
```
# plot top ten movie stars
top_ten_stars = actors_list.plot.bar(figsize =(10,6),
                                     color = colors_list,
                                     title = "Top Ten Movie Stars",
                                     ylabel = "Number of Movies");
```



An incredible list including All time favourite Actors; Robert De Niro (aka: The complete actor) comes in first place with over 50 Movies, Bruce Willis the star of the Die Hard Movies Series comes in second place and the Wonderfull Samuel L.jackson Comes in third place.

We notice that there is No Female Actress Names in the list like Sandra Bullock or Kate Winslet !!

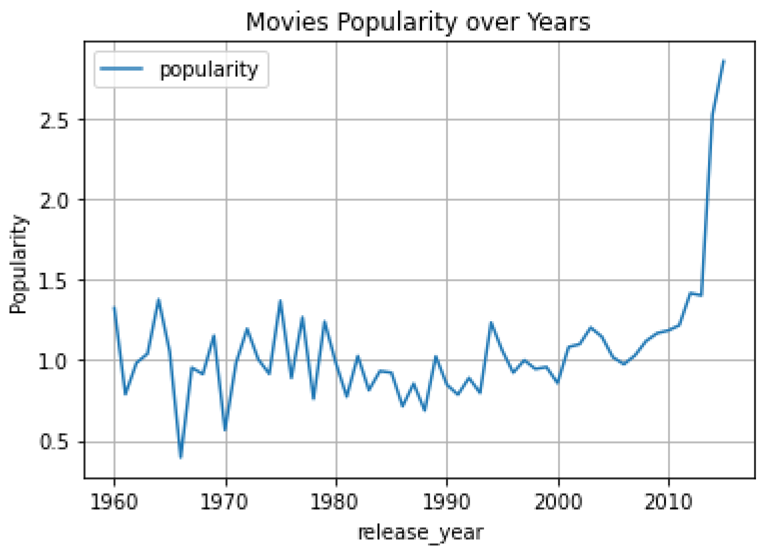
In [46]:
```
# plot highest movie genres
best_genres = genres_list.plot.barh(figsize=(10,5),
                                     color = colors_list,
                                     title = "Highest Movies Genres",
                                    ylabel = "Movies Genres");
```



Drama comes on top of Movies Genres list followed by Comedy and Thriller movies. Romance comes in Sixth place and Family Movies in Tenth place

Q-2: What is the Movies popularity trend over years ?

In [43]:
```
# lets check popularity of movies over the years
year_pop = df.groupby("release_year").popularity.mean()
year_pop.plot(title = "Movies Popularity over Years",
              ylabel = "Popularity",
              legend = True,
             grid = True);
```



*** From the graph a huge drop in Movies popularity is noticed between (1962-1966).**

*** The popularity trends were stable during the 80's and 90's.**

*** From 1993 up to 2005 movies popularity was increasing gradually may be due to increase in number of theaters.**

*** Movies popularity started increasing rapidly after year 2005 we can explain the quick increase due to high budget movies and increased number of produced movies.**

Q-3: which movie genres were popular year to year ?

In [37]:
```
# check movies genres popularity over years
# year to year best genres from 2000 to 2015
sorted_genres = df[["release_year", "genres"]].sort_values(["release_year","ge
nres"], ascending = False)
each_year_sorted_genres = pd.DataFrame(sorted_genres.groupby(["release_year"])
.genres.max())
each_year_sorted_genres.tail(16)
```

Out[37]:

	genres
release_year	
2000	Thriller|Science Fiction|Action
2001	War
2002	Western|Animation|Adventure|Comedy|Family
2003	Western
2004	Western|History|War
2005	Thriller|Science Fiction|Adventure|Action
2006	Western|Drama
2007	Western
2008	War|Drama
2009	Thriller|Science Fiction
2010	Thriller|Mystery
2011	War|Drama
2012	War|Action|Thriller|Science Fiction
2013	Western|Thriller
2014	Western|Drama
2015	Western|Drama|Adventure|Thriller

Notice Thriller genres present in 2009, 2010, 2012, 2013 and 2015.

Q-4: Compare lowest and highest Movies Budgets, Revenues, Profites and Runtime ?

In [40]:
```
# check min vs max profit movies
min_max("profit")
```

```
Lowest profit is The Warrior's Way movie.
Highest profit is Star Wars movie.
```

Out[40]:

	2244	1329
popularity	0.25054	12.0379
original_title	The Warrior's Way	Star Wars
cast	Kate Bosworth|Jang Dong-gun|Geoffrey Rush|Dann...	Mark Hamill|Harrison Ford|Carrie Fisher|Peter ...
director	Sngmoo Lee	George Lucas
runtime	100	121
genres	Adventure|Fantasy|Action|Western|Thriller	Adventure|Action|Science Fiction
production_companies	Boram Entertainment Inc.	Lucasfilm|Twentieth Century Fox Film Corporation
release_year	2010	1977
budget_adj	4.25e+08	3.95756e+07
revenue_adj	1.10876e+07	2.78971e+09
profit	-4.13912e+08	2.75014e+09

Star wars come on top of high profit movies we notice the production year 1977 which mean that although its an old production; the revenues were very high to win maximum profit.

In [41]:
```
# check min vs max budget movies
min_max("budget_adj")
```

```
Lowest budget_adj is Love, Wedding, Marriage movie.
Highest budget_adj is The Warrior's Way movie.
```

Out[41]:

	3581	2244
popularity	0.52043	0.25054
original_title	Love, Wedding, Marriage	The Warrior's Way
cast	Mandy Moore|Kellan Lutz|Jessica Szohr|Autumn F...	Kate Bosworth|Jang Dong-gun|Geoffrey Rush|Dann...
director	Dermot Mulroney	Sngmoo Lee
runtime	90	100
genres	Comedy|Romance	Adventure|Fantasy|Action|Western|Thriller
production_companies	120dB Films|Scion Films|Voodoo Production Serv...	Boram Entertainment Inc.
release_year	2011	2010
budget_adj	0.969398	4.25e+08
revenue_adj	1335.83	1.10876e+07
profit	1334.86	-4.13912e+08

The Warrior's way comes in the top highest budget movies but didn't make the biggest profits, i beleive its a huge production Movie, I'm cerious to watch this movie myself to rate it!

In [42]:
```python
# check min vs max revenue movies
min_max("revenue_adj")
```

```
Lowest revenue_adj is Shattered Glass movie.
Highest revenue_adj is Avatar movie.
```

Out[42]:

	5067	1386
popularity	0.462609	9.43277
original_title	Shattered Glass	Avatar
cast	Hayden Christensen|Peter Sarsgaard|ChloÃ« Sevi...	Sam Worthington|Zoe Saldana|Sigourney Weaver|S...
director	Billy Ray	James Cameron
runtime	94	162
genres	Drama|History	Action|Adventure|Fantasy|Science Fiction
production_companies	Lions Gate Films|Cruise/Wagner Productions|Bau...	Ingenious Film Partners|Twentieth Century Fox ...
release_year	2003	2009
budget_adj	7.11212e+06	2.40887e+08
revenue_adj	2.37071	2.82712e+09
profit	-7.11211e+06	2.58624e+09

Avatar is the highest Revenue Movie, however Avatar isn't the top profit movie due to high budget spent on animations and production of this great movie.

In [43]:
```
# check min vs max runtime movies
min_max("runtime")
```

```
Lowest runtime is Kid's Story movie.
Highest runtime is Carlos movie.
```

Out[43]:

	5162	2107
popularity	0.208637	0.534192
original_title	Kid's Story	Carlos
cast	Clayton Watson|Keanu Reeves|Carrie-Anne Moss|K...	Edgar RamÃrez|Alexander Scheer|Fadi Abi Samra...
director	Shinichiro Watanabe	Olivier Assayas
runtime	15	338
genres	Science Fiction|Animation	Crime|Drama|Thriller|History
production_companies	Studio 4Â°C	Egoli Tossell Film AG|Canal+|Arte France|Films...
release_year	2003	2010
budget_adj	11.8535	1.8e+07
revenue_adj	5.92676	871279
profit	-5.92676	-1.71287e+07

The Kid's story animation movie has the shortest runtime duration with 15 miniutes, while Carlos has the longest runtime of 338 miniutes

In [44]:
```
# check min vs max popularity movies
min_max("popularity")
```

```
Lowest popularity is Ð¡Ñ‚Ð°Ð»Ð¸Ð½Ð³Ñ€Ð°Ð´ movie.
Highest popularity is Jurassic World movie.
```

Out[44]:

	6065	0
popularity	0.010335	32.9858
original_title	Ð¡Ñ‚Ð°Ð»Ð¸Ð½Ð³Ñ€Ð°Ð´	Jurassic World
cast	Thomas Kretschmann|Yanina Studilina|Philippe R...	Chris Pratt|Bryce Dallas Howard|Irrfan Khan|Vi...
director	Fyodor Bondarchuk	Colin Trevorrow
runtime	131	124
genres	War|Action	Action|Adventure|Science Fiction|Thriller
production_companies	Art Pictures Studio	Universal Studios|Amblin Entertainment|Legenda...
release_year	2013	2015
budget_adj	2.8081e+07	1.38e+08
revenue_adj	6.37715e+07	1.39245e+09
profit	3.56905e+07	1.25445e+09

Jurassic World is the most popular movie of our datset, No surprises for this result as the smart idea of Dinosaurs existance, compined with huge production of 138 Million USD was a great popular movie.

Q-5: Check the properities of Top 100 Revenue Movies ?

In [27]:
```
# create a datframe sorted by top revenue movies
# drop unwanted columns

df_revenue = pd.DataFrame(df.sort_values(["revenue_adj"], ascending=False, ign
ore_index= True))
df_revenue.drop(["original_title", "cast", "director", "genres", "production_c
ompanies", "release_year"], axis = 1, inplace = True)
df_revenue.head()
```

Out[27]:

	popularity	runtime	budget_adj	revenue_adj	profit
0	9.432768	162.0	2.408869e+08	2.827124e+09	2.586237e+09
1	12.037933	121.0	3.957559e+07	2.789712e+09	2.750137e+09
2	4.355219	194.0	2.716921e+08	2.506406e+09	2.234714e+09
3	2.010733	122.0	3.928928e+07	2.167325e+09	2.128036e+09
4	2.563191	124.0	2.836275e+07	1.907006e+09	1.878643e+09

In [28]:
```
# check top 100 high revnue movies popularity, runtime, bugdet and profit prop
erities
df_revenue[:100].describe()
```

Out[28]:

	popularity	runtime	budget_adj	revenue_adj	profit
count	100.000000	100.000000	1.000000e+02	1.000000e+02	1.000000e+02
mean	4.458492	131.630000	1.324182e+08	1.070078e+09	9.376597e+08
std	3.846122	26.168319	7.743329e+07	4.028286e+08	4.109621e+08
min	0.142486	78.000000	1.235601e+07	7.214689e+08	5.535378e+08
25%	2.210300	115.000000	6.517483e+07	8.078311e+08	6.737869e+08
50%	3.642131	132.500000	1.366043e+08	9.600996e+08	8.241871e+08
75%	5.760471	146.500000	1.872243e+08	1.141442e+09	1.032382e+09
max	32.985763	201.000000	3.683713e+08	2.827124e+09	2.750137e+09

In [29]:
```
# Create dataframe to compare mean values of Top 100 Revenue Movies VS the mea
n values of all Movies

df_revenue_top_100 = pd.DataFrame([df_revenue[:100].mean(), df_revenue.mean
()])
df_revenue_top_100.head()
```

Out[29]:

	popularity	runtime	budget_adj	revenue_adj	profit
0	4.458492	131.630000	1.324182e+08	1.070078e+09	9.376597e+08
1	1.203784	109.351117	4.471977e+07	1.387159e+08	9.399617e+07

In [30]:
```
# divide budget_adj, revenue_adj, profit columns by 1000000 to get values in M
illion USD

df_revenue_top_100["budget_adj"] = df_revenue_top_100["budget_adj"]/1000000
df_revenue_top_100["revenue_adj"] = df_revenue_top_100["revenue_adj"]/1000000
df_revenue_top_100["profit"] = df_revenue_top_100["profit"]/1000000
df_revenue_top_100.head()
```

Out[30]:

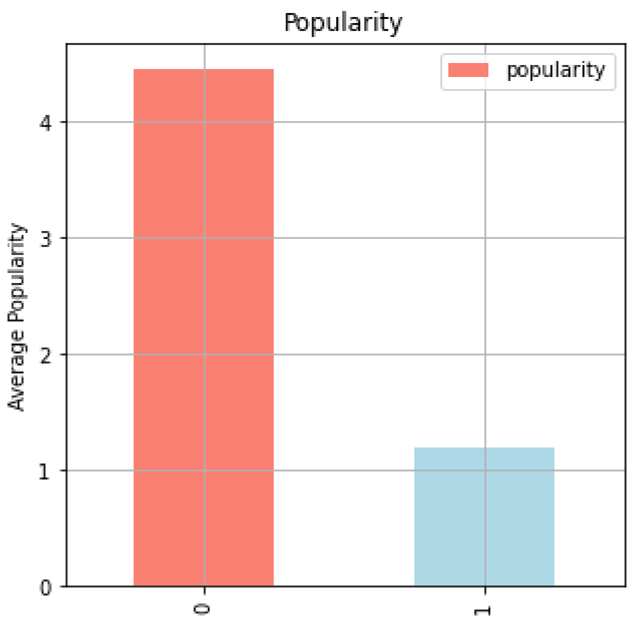
	popularity	runtime	budget_adj	revenue_adj	profit
0	4.458492	131.630000	132.418197	1070.077848	937.659652
1	1.203784	109.351117	44.719765	138.715934	93.996169

In [31]:
```
# Transpose the Dataframe to compare values
df_revenue_top_100.T
```

Out[31]:

	0	1
popularity	4.458492	1.203784
runtime	131.630000	109.351117
budget_adj	132.418197	44.719765
revenue_adj	1070.077848	138.715934
profit	937.659652	93.996169

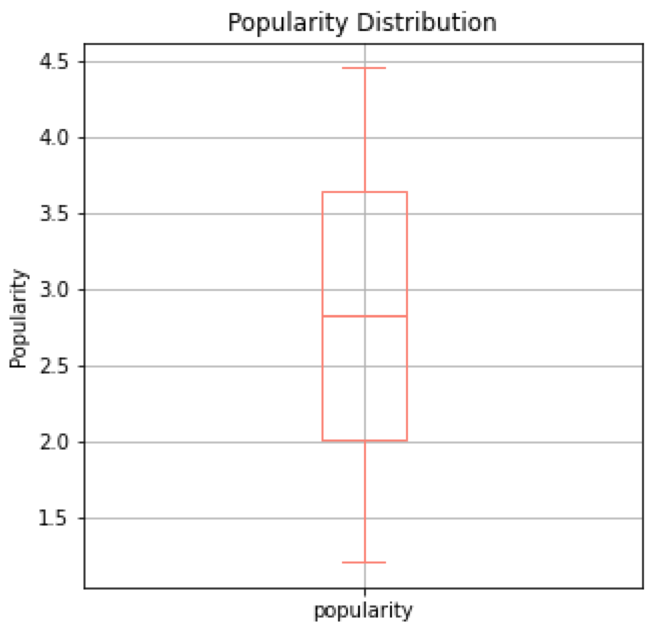
```
In [37]: # compare popularity
df_revenue_top_100.popularity.plot(kind = "bar",
                                figsize = (5,5),
                                color=["salmon", "lightblue"],
                                title = "Popularity",
                                ylabel = "Average Popularity",
                                 legend =True,
                                   grid = True);
```



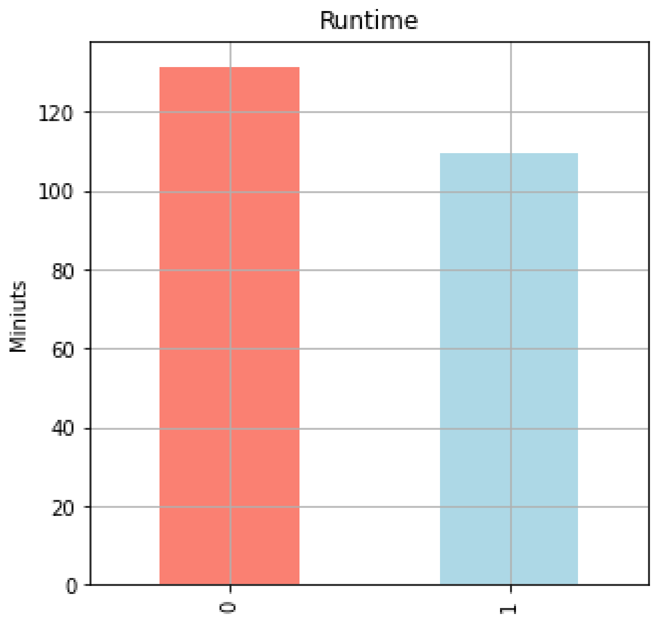
Top 100 revenue movies Average Popularity is 4.4 - (4 times higher than an average movie)

In [38]:
```
# popularity disribution of the Top 100 revenue movies

df_revenue_top_100.popularity.plot(kind = "box",
                                figsize = (5,5),
                                color="salmon",
                                title = "Popularity Distribution",
                                ylabel = "Popularity",
                                   grid = True);
```



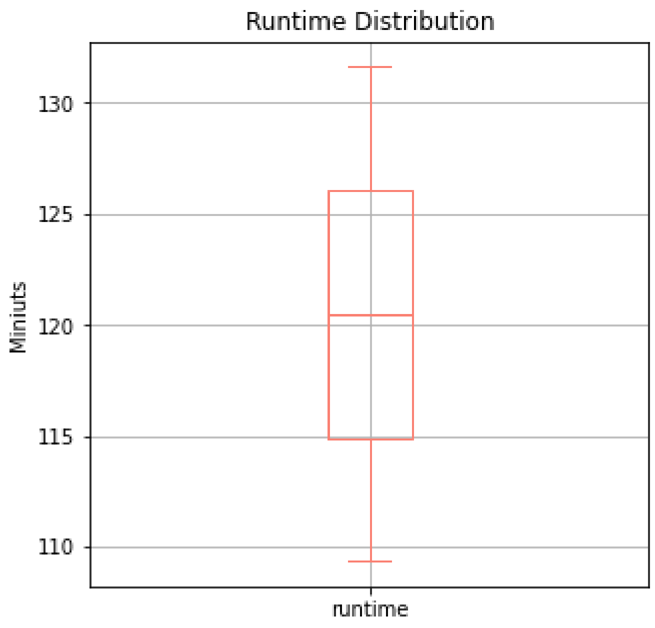
In [36]:
```
# Compare runtime
df_revenue_top_100.runtime.plot(kind = "bar",
                            figsize = (5,5),
                                color=["salmon", "lightblue"],
                                title = "Runtime",
                                ylabel = "Miniuts",
                                grid = True);
```



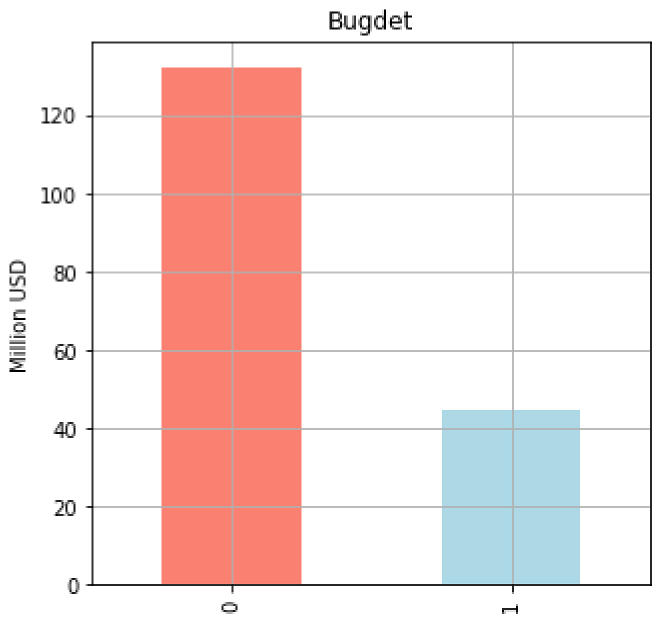
Top 100 Revenue movies Average Runtime is 131 min - (22 miniutes longer than an average movie)

In [35]:
```
# Runtime disribution of the Top 100 revenue movies

df_revenue_top_100.runtime.plot(kind = "box",
                               figsize = (5,5),
                               color="salmon",
                               title = "Runtime Distribution",
                               ylabel = "Miniuts",
                               grid = True);
```



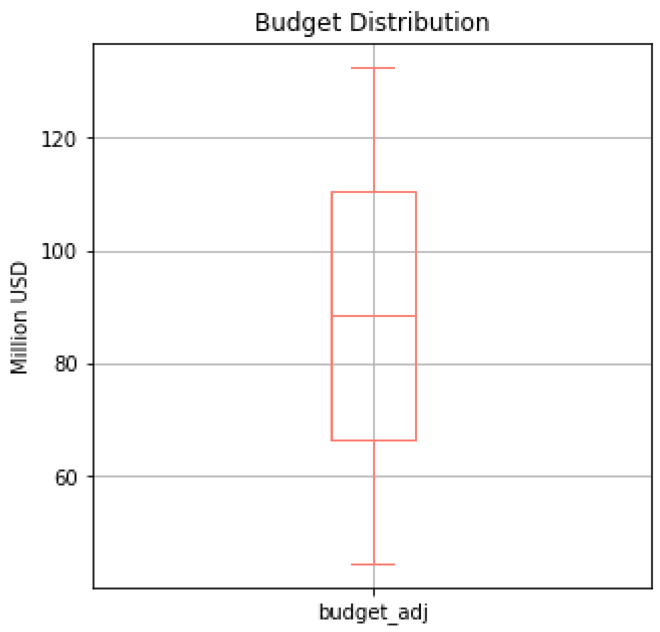
In [39]:
```
# Compare Budgets
df_revenue_top_100.budget_adj.plot(kind = "bar",
                               figsize = (5,5),
                               color=["salmon", "lightblue"],
                               title = "Bugdet",
                               ylabel = "Million USD",
                                  grid = True);
```



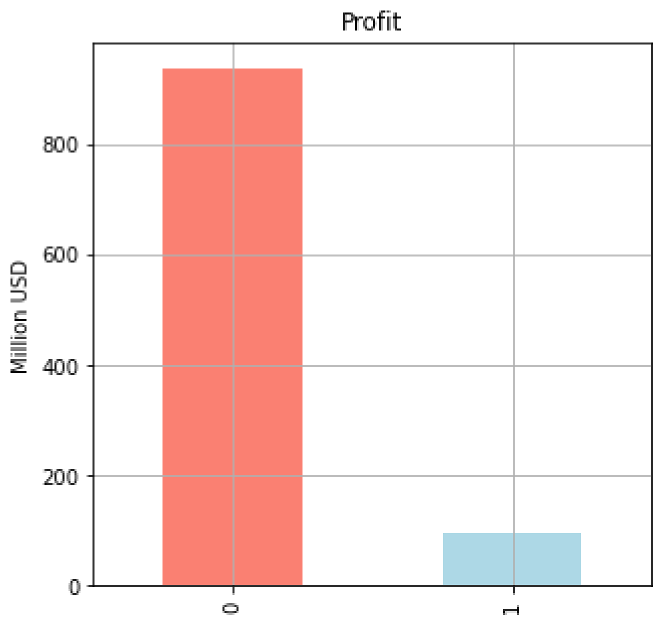
Average Budget is 130 million USD - (4 times higher than an average movie) - this result indicate the relation between high budget movies are connected with high revenue movies.

In [40]:
```
# Budget disribution of the Top 100 revenue movies

df_revenue_top_100.budget_adj.plot(kind = "box",
                               figsize = (5,5),
                               color="salmon",
                               title = "Budget Distribution",
                               ylabel = "Million USD",
                                  grid = True);
```



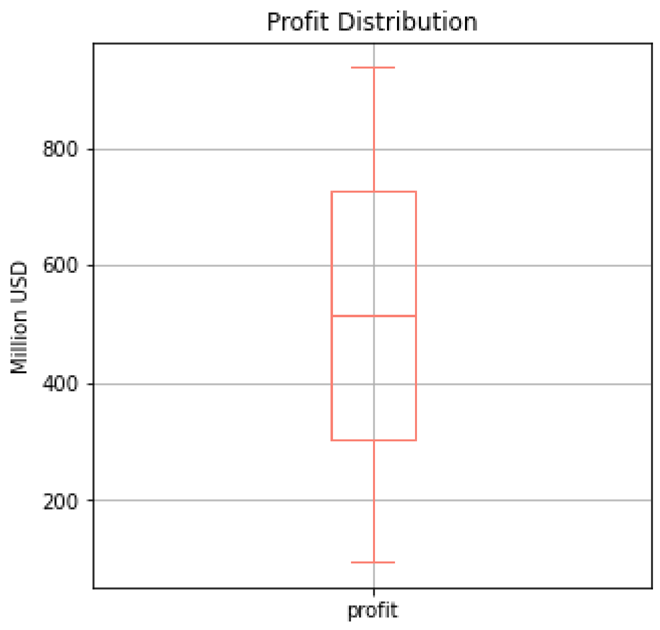
In [41]:
```
# Compare Profits
df_revenue_top_100.profit.plot(kind = "bar",
                               figsize = (5,5),
                               color=["salmon", "lightblue"],
                               title = "Profit",
                               ylabel = "Million USD",
                              grid = True);
```



Average Profit is 930 million USD - (10 Times higher than an average movie)

In [42]:
```
# Profit disribution of the Top 100 revenue movies

df_revenue_top_100.profit.plot(kind = "box",
                               figsize = (5,5),
                               color="salmon",
                               title = "Profit Distribution",
                               ylabel = "Million USD",
                              grid = True);
```



Conculisions and Interesting Findings

- Biggest Production Companies: Universal pictures, Warners Bros, Paramont Pictures.
- Best Directors: Steven Spielberg, Clint Eastwood, Ridly Scott.
- Best Actor: Roberts De Niro, Bruce Willis, Samuel L. jackson.
- Best Movie Genres: Drama, Comedy, Thriller.
- Movies popularity started increasing quickly after year 2005.
- Thriller genres is present in top popularity genres year 2009, 2010, 2012, 2013, 2015.
- Lowest profit is The Warrior's Way movie and Highest profit is Star Wars movie.
- Lowest budget_adj is Love, Wedding, Marriage movie and Highest budget_adj is The Warrior's Way movie.
- Lowest revenue_adj is Shattered Glass movie and Highest revenue_adj is Avatar movie.
- shortest runtime is Kid's Story movie and Longest runtime is Carlos movie.

Top 100 Revenue movies have the following properites:

1. Average Popularity is 4.4 - (4 times higher than an average movie)
2. Average Runtime is 131 min - (22 miniutes longer than an average movie)
3. Average Budget is 130 million USD - (4 times higher than an average movie)
4. Average Profit is 930 million USD - (10 Times higher than an average movie)

Limitation:

- The dataset contains a huge amount of 0 and NaN values; which forced us to drop over 6000 movies, which can mislead final results.
- We use (budget_adj, revenue_adj) columns to account for inflation over time, if (budget, revenue) columns are used different results will appear.

```
In [ ]:
```