Introduction

This report contains an analysis of sales for different video games over time. We strive to show how the industry of video games has evolved from the year 1971 to 2024. The data we have used to carry out the research has various fields that enable us to conduct various investigations and get findings. The data has different game titles whose sales information is broken down to different regions and the ultimate total sales. The different attributes of each game is also given in the data, that is, the critic score of the game, the genre of the game, the console to which the game is made and more. These attributes are probable factors that affect how successful a game is, for instance the higher the critic score the higher the sales are expected to be. We are going to do a step-by-step analysis to ascertain or dispute the assumptions.

```
'''We import the necessary libraries to be used in the analysis'''
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

# this sets to display all the columns in our data
pd.set_option('display.max_columns',500)

# We import our data as a DataFrame and assign it to a variable named
df.
df = pd.read_csv('vgchartz-2024.csv')
df.head() # displays the first five rows of our data
```

```
                                                img
title  \
0  /games/boxart/full_6510540AmericaFrontccc.jpg           Grand Theft
Auto V
1  /games/boxart/full_5563178AmericaFrontccc.jpg           Grand Theft
Auto V
2                    /games/boxart/827563ccc.jpg  Grand Theft Auto:
Vice City
3  /games/boxart/full_9218923AmericaFrontccc.jpg           Grand Theft
Auto V
4  /games/boxart/full_4990510AmericaFrontccc.jpg    Call of Duty:
Black Ops 3

  console    genre       publisher       developer  critic_score
total_sales  \
0     PS3   Action  Rockstar Games  Rockstar North           9.4
20.32
1     PS4   Action  Rockstar Games  Rockstar North           9.7
19.39
2     PS2   Action  Rockstar Games  Rockstar North           9.6
16.15
3    X360   Action  Rockstar Games  Rockstar North           NaN
15.86
```

```
4     PS4  Shooter      Activision        Treyarch           8.1
15.09

   na_sales  jp_sales  pal_sales  other_sales release_date last_update

0      6.37      0.99       9.85         3.12   2013-09-17         NaN

1      6.06      0.60       9.71         3.02   2014-11-18  2018-01-03

2      8.41      0.47       5.49         1.78   2002-10-28         NaN

3      9.06      0.06       5.33         1.42   2013-09-17         NaN

4      6.18      0.41       6.05         2.44   2015-11-06  2018-01-14
```

```
print(f'We have a data that contains {df.shape[0]} rows and
{df.shape[1]} columns')
```

```
We have a data that contains 64016 rows and 14 columns
```

```
# To confirm the content of the data
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 64016 entries, 0 to 64015
Data columns (total 14 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   img           64016 non-null  object
 1   title         64016 non-null  object
 2   console       64016 non-null  object
 3   genre         64016 non-null  object
 4   publisher     64016 non-null  object
 5   developer     63999 non-null  object
 6   critic_score  6678 non-null   float64
 7   total_sales   18922 non-null  float64
 8   na_sales      12637 non-null  float64
 9   jp_sales      6726 non-null   float64
 10  pal_sales     12824 non-null  float64
 11  other_sales   15128 non-null  float64
 12  release_date  56965 non-null  object
 13  last_update   17879 non-null  object
dtypes: float64(6), object(8)
memory usage: 6.8+ MB
```

From the information provided above under the Non-Null count column, it can be seen that a number of columns have null entries. It is not practical to use null values in our research. Therefore, for this analysis we dropped the null values respective for the different analysis in order to improve on the accuracy of the results.

```
# A description of what all the columns contain
df2 = pd.read_csv('vg_data_dictionary.csv')
df2
```

```
           Field                                        Description
0            img       URL slug for the box art at vgchartz.com
1          title                                         Game title
2        console                Console the game was released for
3          genre                                    Genre of the game
4      publisher                              Publisher of the game
5      developer                              Developer of the game
6   critic_score                    Metacritic score (out of 10)
7    total_sales                 Global sales of copies in millions
8       na_sales      North American sales of copies in millions
9       jp_sales             Japanese sales of copies in millions
10     pal_sales  European & African sales of copies in millions
11   other_sales       Rest of world sales of copies in millions
12  release_date                    Date the game was released on
13   last_update                  Date the data was last updated
```

1. Top-Selling Titles Worldwide

The first analysis was to get top-selling video games and identify factors that led to their outstanding performance.

```
# drop the null values in the dataset
df_clean = df.dropna()
df_clean
```

```
                                                  img  \
1      /games/boxart/full_5563178AmericaFrontccc.jpg
4      /games/boxart/full_4990510AmericaFrontccc.jpg
7      /games/boxart/full_4653215AmericaFrontccc.jpg
8      /games/boxart/full_1977964AmericaFrontccc.jpg
9      /games/boxart/full_4649679AmericaFrontccc.png
...                                              ...
11794  /games/boxart/full_2874583AmericaFrontccc.jpg
11920  /games/boxart/full_4489495AmericaFrontccc.jpg
12216  /games/boxart/full_5524695AmericaFrontccc.jpg
13198  /games/boxart/full_5198003AmericaFrontccc.jpg
15044      /games/boxart/full_8777680PALFrontccc.png

                            title console             genre  \
1                Grand Theft Auto V     PS4            Action
4         Call of Duty: Black Ops 3     PS4           Shooter
7             Red Dead Redemption 2     PS4  Action-Adventure
8        Call of Duty: Black Ops II    X360           Shooter
9        Call of Duty: Black Ops II     PS3           Shooter
...                             ...     ...               ...
```

```
11794                RPG Maker: Fes     3DS      Role-Playing
11920    BlazBlue: Cross Tag Battle      NS          Fighting
12216            Disgaea 1 Complete      NS      Role-Playing
13198                  GrimGrimoire     PS2          Strategy
15044  Tenkai Knights: Brave Battle     3DS            Action

                publisher             developer  critic_score
total_sales  \
1          Rockstar Games        Rockstar North           9.7
19.39
4              Activision              Treyarch           8.1
15.09
7          Rockstar Games        Rockstar Games           9.8
13.94
8              Activision              Treyarch           8.4
13.86
9              Activision              Treyarch           8.0
13.80
...                   ...                   ...           ...
...
11794          NIS America        Kadokawa Games           7.0
0.07
11920    Arc System Works      Arc System Works           8.0
0.07
12216          NIS America  Nippon Ichi Software           8.0
0.06
13198          NIS America           Vanillaware           7.7
0.05
15044  Namco Bandai Games         Delta Factory           4.5
0.02

       na_sales  jp_sales  pal_sales  other_sales release_date
last_update
1          6.06      0.60       9.71         3.02   2014-11-18  2018-
01-03
4          6.18      0.41       6.05         2.44   2015-11-06  2018-
01-14
7          5.26      0.21       6.21         2.26   2018-10-26  2018-
11-02
8          8.27      0.07       4.32         1.20   2012-11-13  2018-
04-07
9          4.99      0.65       5.88         2.28   2012-11-13  2018-
04-07
...         ...       ...        ...          ...          ...
...
11794      0.03      0.02       0.00         0.00   2017-06-27  2018-
04-22
11920      0.04      0.01       0.01         0.01   2018-06-05  2018-
06-06
```

```
12216      0.03      0.01       0.01         0.00   2018-10-09  2019-
02-19
13198      0.01      0.03       0.01         0.00   2007-06-26  2019-
01-10
15044      0.01      0.00       0.01         0.00   2014-10-07  2019-
01-24

[282 rows x 14 columns]
```

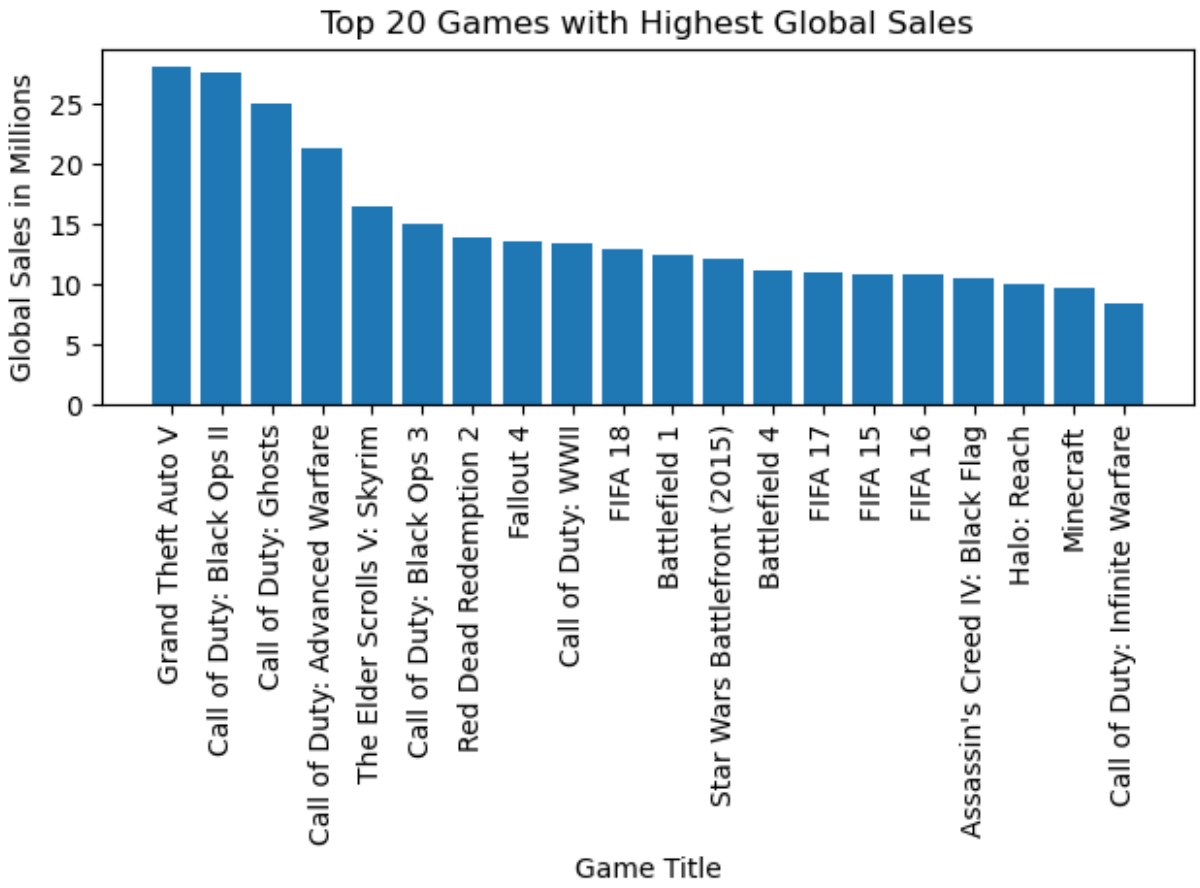
```
# creating a dataframe of each game ranked from highest to lowest on
total sales
top_games = df_clean.groupby(['title'])
['total_sales'].sum().sort_values(ascending = False)
top_20_games = pd.DataFrame(top_games[:20]) # top 20 games
top_20_games
```

title	total_sales
Grand Theft Auto V	28.11
Call of Duty: Black Ops II	27.66
Call of Duty: Ghosts	25.06
Call of Duty: Advanced Warfare	21.36
The Elder Scrolls V: Skyrim	16.52
Call of Duty: Black Ops 3	15.09
Red Dead Redemption 2	13.94
Fallout 4	13.51
Call of Duty: WWII	13.40
FIFA 18	12.90
Battlefield 1	12.39
Star Wars Battlefront (2015)	12.18
Battlefield 4	11.12
FIFA 17	10.94
FIFA 15	10.88
FIFA 16	10.77
Assassin's Creed IV: Black Flag	10.47
Halo: Reach	9.97
Minecraft	9.69
Call of Duty: Infinite Warfare	8.48

The **top_20_games** DataFrame above contains the top 20 games with highest sales. A list of all games with their total sales is in the **top_games** DataFrame. The game with the highest sales is **Grand Theft Auto** with $ 28.11 million total sales. **Call of Duty** and **FIFA** games are featured multiple times in the top games. The bar graph below shows how each of the top 20 games performed.

```
# a plot of the top games
fig, ax  = plt.subplots()
ax.bar(top_20_games.index,top_20_games['total_sales'])
ax.set_ylabel('Global Sales in Millions')
```

```
ax.set_xlabel('Game Title')
ax.set_title('Top 20 Games with Highest Global Sales')
plt.xticks(rotation = 90)
plt.tight_layout();
```



After establishing the top-selling games it is prudent to investigate if any or all of the various game attributes have an impact on the sales. First we investigate the critic score.

```
# Get the critc scores of the top 20 games
highest_sales = df_clean[df_clean['title'].isin(top_20_games.index)]
highest_score = pd.DataFrame(highest_sales.groupby(['title'])
['critic_score'].mean())
highest_score
```

title	critic_score
Assassin's Creed IV: Black Flag	8.500000
Battlefield 1	9.200000
Battlefield 4	8.566667
Call of Duty: Advanced Warfare	8.750000
Call of Duty: Black Ops 3	8.100000
Call of Duty: Black Ops II	8.200000

```
Call of Duty: Ghosts                    7.675000
Call of Duty: Infinite Warfare          7.900000
Call of Duty: WWII                      8.100000
FIFA 15                                 7.500000
FIFA 16                                 8.750000
FIFA 17                                 8.900000
FIFA 18                                 7.050000
Fallout 4                               8.500000
Grand Theft Auto V                      9.350000
Halo: Reach                             9.300000
Minecraft                               8.033333
Red Dead Redemption 2                   9.800000
Star Wars Battlefront (2015)            7.000000
The Elder Scrolls V: Skyrim             8.966667
```

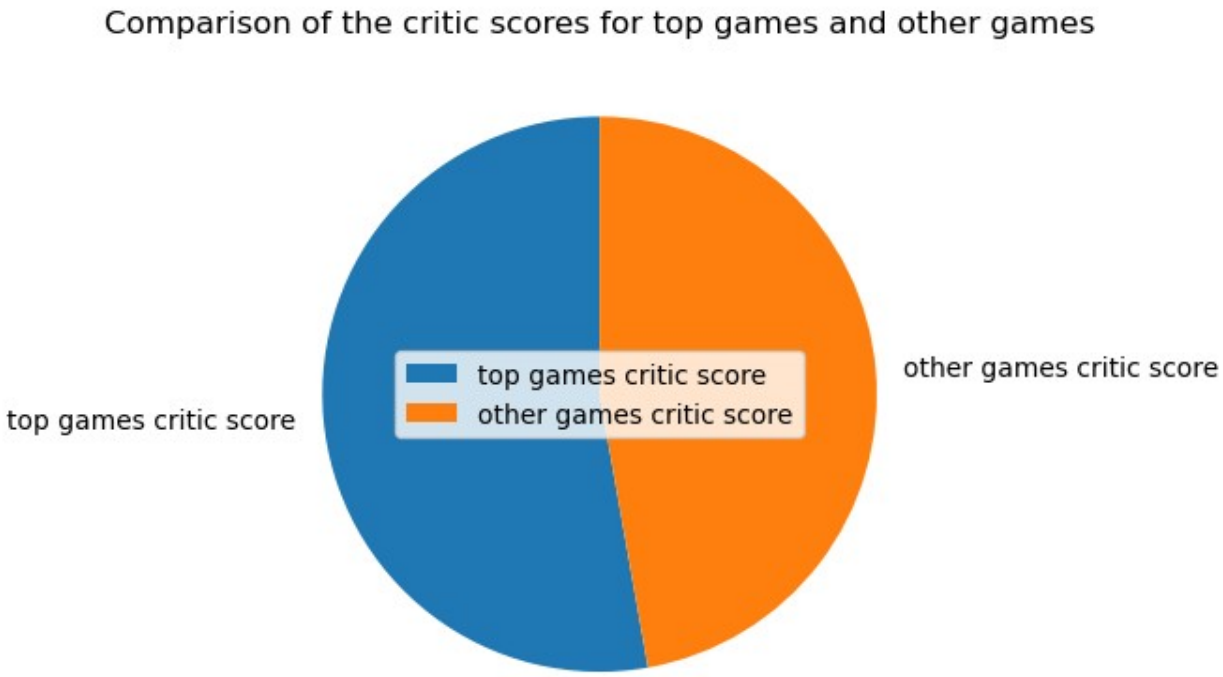
```
# get the critic scores of the games outside top 20 games
other_sales = df_clean[~df_clean['title'].isin(top_20_games.index)]
lowest_score = pd.DataFrame(other_sales.groupby(['title'])
['critic_score'].mean())
lowest_score.head()
```

title	critic_score
2014 FIFA World Cup Brazil	7.6
7th Dragon III Code: VFD	7.5
Animal Crossing: Amiibo Festival	4.8
Ape Escape	9.3
Ape Escape 2	8.0

```
# plot the difference in critic scores
scores = [highest_score.mean().iloc[0],lowest_score.mean().iloc[0]]
my_labels = ['top games critic score','other games critic score']

fig, ax = plt.subplots()
ax.pie(scores,labels = my_labels,startangle = 90)
ax.legend()
ax.set_title('Comparison of the critic scores for top games and other
games');

print(f'''From the results and as visualized in the pie chart below,
the
top 20 games have a higher average critic score of
{round(highest_score.mean().iloc[0],2)} compared to
the other games that have an average critic score of
{round(lowest_score.mean().iloc[0],2)}.
This confirms that the critic score affects the sales of a game. The
higher the critic score the more the sales''')
```

```
From the results and as visualized in the pie chart below, the
top 20 games have a higher average critic score of 8.41 compared to
```

```
the other games that have an average critic score of 7.52.
This confirms that the critic score affects the sales of a game. The
higher the critic score the more the sales
```



After establishing that the critic score affects the sales. We head on to investigate the effect of genre on the sales.

```
genre = highest_sales[['title','genre']].drop_duplicates()
genre
```

	title	genre
1	Grand Theft Auto V	Action
4	Call of Duty: Black Ops 3	Shooter
7	Red Dead Redemption 2	Action-Adventure
8	Call of Duty: Black Ops II	Shooter
11	Call of Duty: WWII	Shooter
15	FIFA 18	Sports
17	FIFA 17	Sports
20	Call of Duty: Ghosts	Shooter
22	Halo: Reach	Shooter
27	The Elder Scrolls V: Skyrim	Role-Playing
29	Call of Duty: Infinite Warfare	Shooter
30	Fallout 4	Role-Playing
31	FIFA 16	Sports
32	Star Wars Battlefront (2015)	Shooter
36	Call of Duty: Advanced Warfare	Shooter

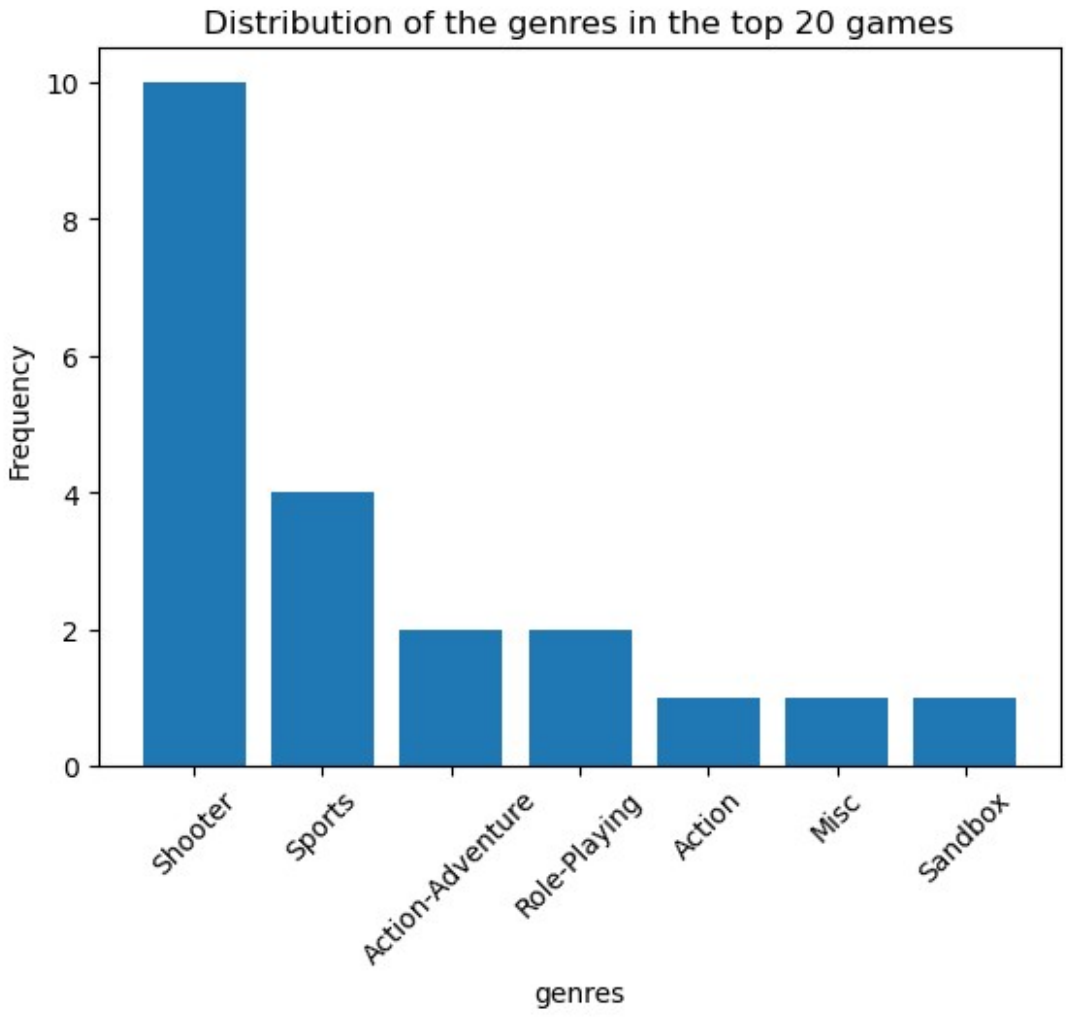
```
40                      Battlefield 1           Shooter
54                          Minecraft              Misc
55                            FIFA 15            Sports
158                     Battlefield 4           Shooter
159  Assassin's Creed IV: Black Flag  Action-Adventure
571                         Minecraft           Sandbox
```

```
top_genres = genre['genre'].value_counts()
top_genres
```

```
genre
Shooter              10
Sports                4
Action-Adventure      2
Role-Playing          2
Action                1
Misc                  1
Sandbox               1
Name: count, dtype: int64
```

The most selling genre is shooter, in the top 20 games, half of the games are of the shooter genre.

```
#plot of the top genres
fig,ax = plt.subplots()
ax.bar(top_genres.index,top_genres)
ax.set_xlabel('genres')
ax.set_ylabel('Frequency')
ax.set_title('Distribution of the genres in the top 20 games')
plt.xticks(rotation = 45);
```




```
console = highest_sales[['title','console']].drop_duplicates()
console
```

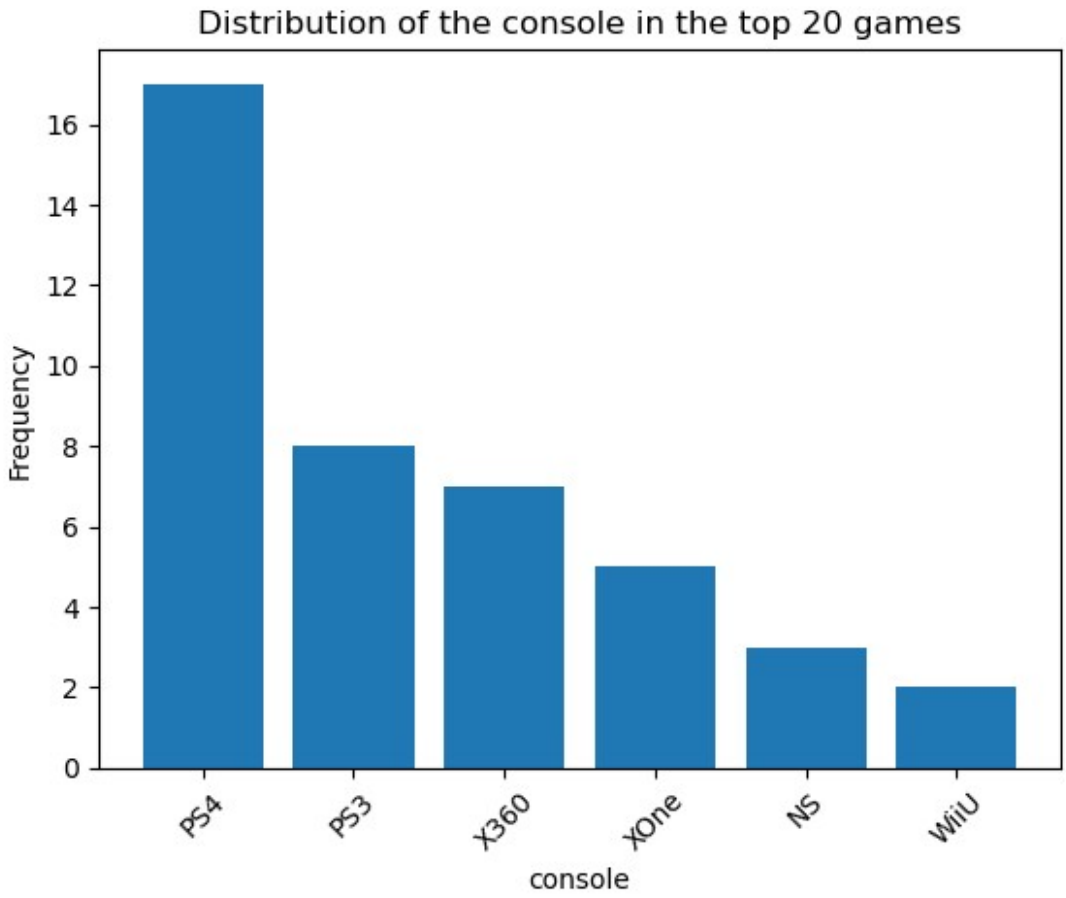
	title	console
1	Grand Theft Auto V	PS4
4	Call of Duty: Black Ops 3	PS4
7	Red Dead Redemption 2	PS4
8	Call of Duty: Black Ops II	X360
9	Call of Duty: Black Ops II	PS3
11	Call of Duty: WWII	PS4
15	FIFA 18	PS4
17	FIFA 17	PS4
20	Call of Duty: Ghosts	X360
21	Call of Duty: Ghosts	PS3
22	Halo: Reach	X360
27	The Elder Scrolls V: Skyrim	X360
28	Grand Theft Auto V	XOne
29	Call of Duty: Infinite Warfare	PS4
30	Fallout 4	PS4

```
31                              FIFA 16     PS4
32        Star Wars Battlefront (2015)     PS4
36     Call of Duty: Advanced Warfare     PS4
40                         Battlefield 1     PS4
53          The Elder Scrolls V: Skyrim     PS3
54                             Minecraft     PS4
55                              FIFA 15     PS4
76     Call of Duty: Advanced Warfare    XOne
78                         Battlefield 1    XOne
88                             Fallout 4    XOne
109                             FIFA 15     PS3
123    Call of Duty: Advanced Warfare    X360
127    Call of Duty: Advanced Warfare     PS3
134               Call of Duty: Ghosts     PS4
138       Star Wars Battlefront (2015)    XOne
158                        Battlefield 4     PS4
159   Assassin's Creed IV: Black Flag     PS3
174                        Battlefield 4     PS3
190                        Battlefield 4    X360
219   Assassin's Creed IV: Black Flag    X360
234   Assassin's Creed IV: Black Flag     PS4
350                             FIFA 16     PS3
571                            Minecraft      NS
849                            Minecraft    WiiU
1224      The Elder Scrolls V: Skyrim      NS
1299                            FIFA 18      NS
4644              Call of Duty: Ghosts    WiiU
```

```
top_console = console['console'].value_counts()
top_console
```

```
console
PS4     17
PS3      8
X360     7
XOne     5
NS       3
WiiU     2
Name: count, dtype: int64
```

```
#plot of the top consoles
fig,ax = plt.subplots()
ax.bar(top_console.index,top_console)
ax.set_xlabel('console')
ax.set_ylabel('Frequency')
ax.set_title('Distribution of the console in the top 20 games')
plt.xticks(rotation = 45);
```



The top console is PS4 indicating that the console affects the sales.

In conclusion the critic score, the genre and the console for which the game is made for affects the sales of a game. This is in line with the assumptions that the more a game is rated highely the more it will sell. A genre that is most liked will definately sell more and finally the console that is most owned and most liked will have games made for them highly purchased.

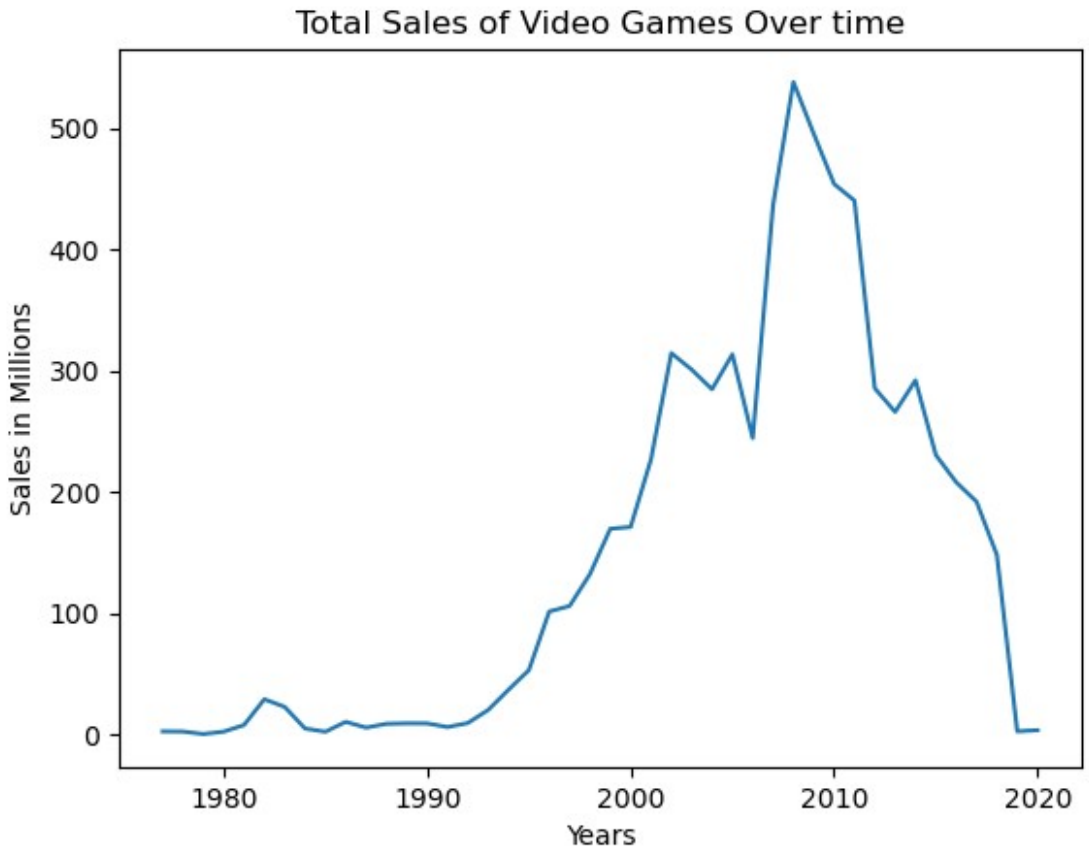
2. Sales Trend Overtime

The second point of investigation is to analyze how the video games sales have improved over time.

```
# create a DataFrame with the total sales per year
sales_by_year = df[['total_sales','release_date']].dropna()
sales_by_year.loc[:,'release_date'] =
sales_by_year.loc[:,'release_date'].str[:4].astype('int')
sales_by_year.head()
```

```
   total_sales release_date
0        20.32         2013
1        19.39         2014
2        16.15         2002
```

```
3         15.86          2013
4         15.09          2015

sales_trend = sales_by_year.groupby(['release_date'])
['total_sales'].sum()

fig, ax  = plt.subplots()
ax.plot(sales_trend.index,sales_trend)
ax.set_title('Total Sales of Video Games Over time')
ax.set_xlabel('Years')
ax.set_ylabel('Sales in Millions');
```



The line graph above shows the trend of the sales of the games over time from the 70s to 2024. There was a steady rise in the sale of the games from the 1970s and it peaked at around 2010. But it has since experienced steady decline since then, hitting a low in 2020 during the pandemic.

3. Console Specialization in Genres

Here we investigate whether consoles specialize in a particular genre.

```
# A data frame of genres and consoles
genre_console = df[['genre','console']]
genre_console.head()
```

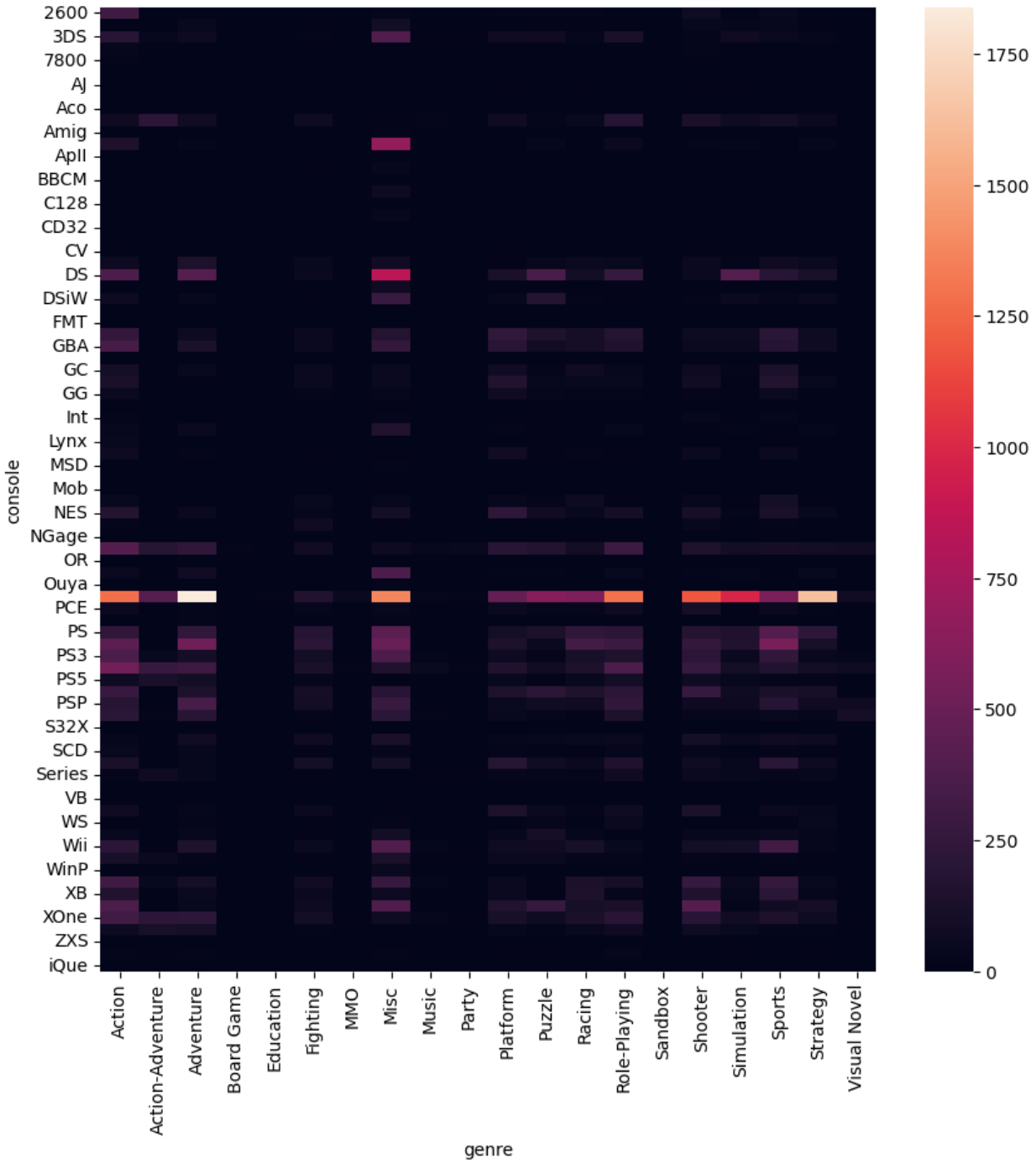
```
     genre console
0   Action     PS3
1   Action     PS4
2   Action     PS2
3   Action    X360
4  Shooter     PS4
```

```
# different genres classified to each console
g_c = pd.crosstab(index = genre_console['console'], columns =
genre_console['genre'])
g_c
```

```
genre    Action  Action-Adventure  Adventure  Board Game  Education
Fighting  \
console

2600        302                 0          3           0          0
3
3DO          12                 0         43           0          0
13
3DS         198                34         63           0          1
18
5200         26                 0          2           0          0
0
7800         21                 0          0           0          0
3
...         ...               ...        ...         ...        ...
...
XOne        309               211        216           2          1
91
XS           63               121         94           1          0
18
ZXS           5                 0          0           0          0
0
iOS          20                14         16           0          0
0
iQue          2                 0          1           0          0
1

genre    MMO  Misc  Music  Party  Platform  Puzzle  Racing  Role-
Playing  \
console

2600       0    21      0      0        17      19      19
4
3DO        0    88      0      0         7      13      10
```

```
10
3DS          1   382     11      8         76       78       22
125
5200         0     0      0      0          9        6        2
0
7800         0     0      0      0          6        3        3
0
...        ...   ...    ...    ...        ...      ...      ...          .
..
XOne        10    67     27     10        120       67      129
197
XS           4     5      5      5         35       17       36
75
ZXS          0    13      0      0          1        0        0
0
iOS          0    21      1      0          9       13        4
24
iQue         0     0      0      0          2        2        4
2

genre    Sandbox  Shooter  Simulation  Sports  Strategy  Visual Novel

console

2600           0       68           4      39         2             0

3DO            0       37          23      35        14             0

3DS            0       20          75      49        26             5

5200           0       20           1       7         0             0

7800           0        9           2      12         0             0

...          ...      ...         ...     ...       ...           ...

XOne           3      201          81     137        71            13

XS             0       65          37      16        20             3

ZXS            0        0           0       0         0             0

iOS            0        7          11       3        11             1

iQue           0        2           1       0         0             0


[81 rows x 20 columns]
```

```
plt.figure(figsize = (10,10))
sns.heatmap(g_c);
```



The heatmap above indicates that very few consoles have specialized in a particular genre. PC is one console that is shown to majorly specialize in Action, Strategy and Misc genres. Most consoles however take all genres shown.

4. Regional Popularity and Flops

Lastly we look into the games performance regionally to investigate any variance.

```
popularity = df.groupby(['title']
                        )
[['na_sales','jp_sales','pal_sales','other_sales','total_sales']].sum(
).sort_values(
                         by = 'total_sales',ascending = False)
popularity = popularity[popularity['total_sales']>0]
popularity.head()
```

title	na_sales	jp_sales	pal_sales	other_sales	total_sales
Grand Theft Auto V	26.19	1.66	28.14	8.32	64.29
Call of Duty: Black Ops	17.65	0.59	9.45	3.31	30.99
Call of Duty: Modern Warfare 3	15.57	0.62	11.26	3.26	30.71
Call of Duty: Black Ops II	14.12	0.72	11.08	3.67	29.59
Call of Duty: Ghosts	15.06	0.49	9.60	3.65	28.80

```
popularity['disparity'] =
popularity[['na_sales','jp_sales','pal_sales','other_sales']].std(axis
= 1)
popularity.head()
```

title	na_sales	jp_sales	pal_sales	other_sales	total_sales
Grand Theft Auto V	26.19	1.66	28.14	8.32	64.29
Call of Duty: Black Ops	17.65	0.59	9.45	3.31	30.99
Call of Duty: Modern Warfare 3	15.57	0.62	11.26	3.26	30.71
Call of Duty: Black Ops II	14.12	0.72	11.08	3.67	29.59
Call of Duty: Ghosts	15.06	0.49	9.60	3.65	28.80

```
                                  total_sales  disparity
title
Grand Theft Auto V                      64.29  13.112458
Call of Duty: Black Ops                 30.99   7.569218
Call of Duty: Modern Warfare 3          30.71   6.938983
Call of Duty: Black Ops II              29.59   6.251295
Call of Duty: Ghosts                    28.80   6.459262
```

```
title_variation = popularity[popularity['disparity']>3].sort_values(by
= 'disparity', ascending = False)
title_variation
```

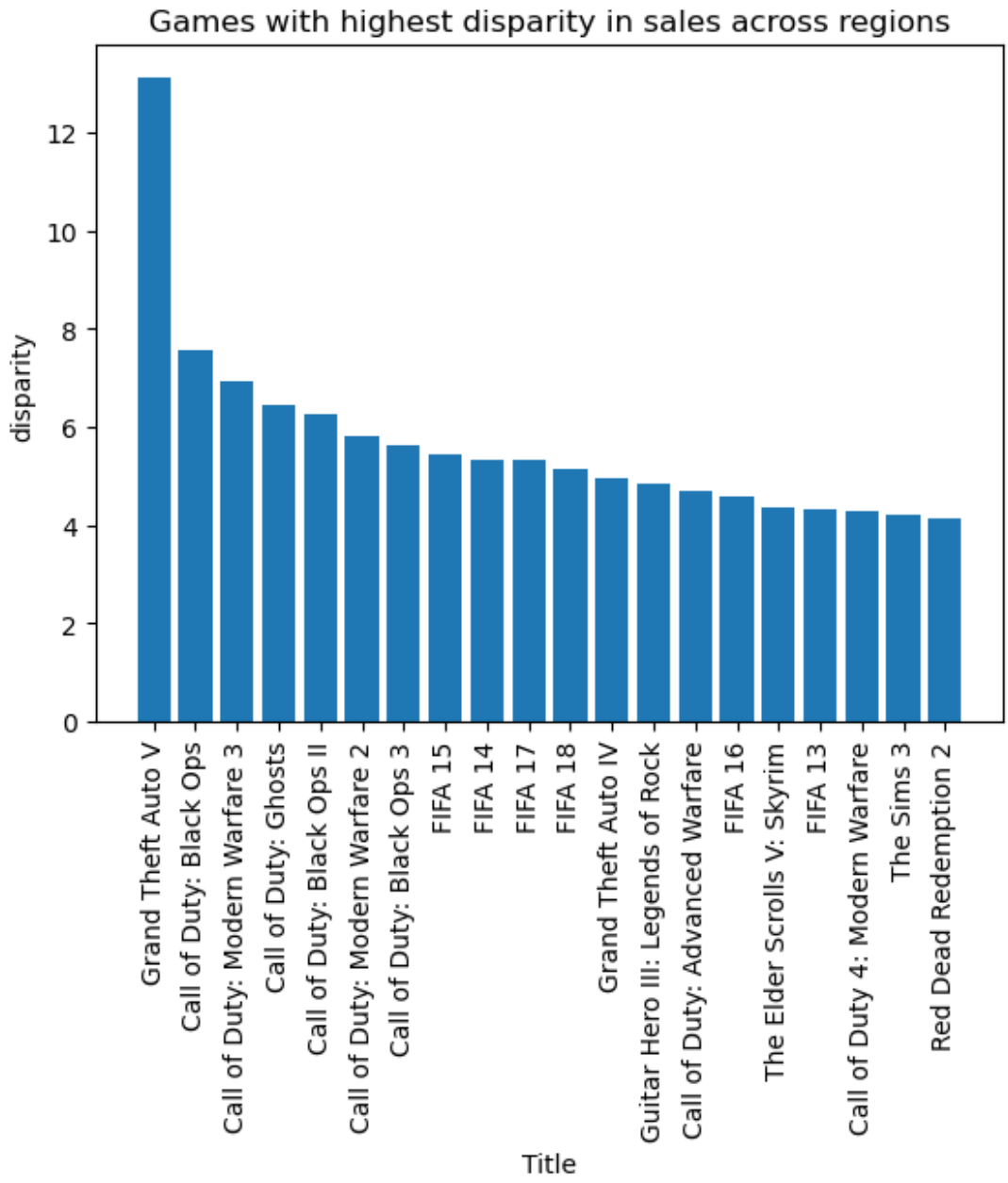
```
                                   na_sales  jp_sales  pal_sales
other_sales  \
title

Grand Theft Auto V                    26.19      1.66      28.14
8.32
Call of Duty: Black Ops               17.65      0.59       9.45
3.31
Call of Duty: Modern Warfare 3        15.57      0.62      11.26
3.26
Call of Duty: Ghosts                  15.06      0.49       9.60
3.65
Call of Duty: Black Ops II            14.12      0.72      11.08
3.67
Call of Duty: Modern Warfare 2        13.54      0.46       8.08
2.95
Call of Duty: Black Ops 3             12.82      0.50       9.76
3.63
FIFA 15                                3.19      0.15      12.45
2.21
FIFA 14                                2.88      0.21      12.14
2.09
FIFA 17                                2.64      0.16      12.07
2.15
FIFA 18                                2.71      0.29      11.78
2.13
Grand Theft Auto IV                   11.60      0.58       7.64
2.72
Guitar Hero III: Legends of Rock      11.14      0.04       2.57
2.64
Call of Duty: Advanced Warfare        10.66      0.35       7.99
2.81
FIFA 16                                3.16      0.12      10.56
1.99
The Elder Scrolls V: Skyrim            9.52      0.41       8.08
2.50
FIFA 13                                2.67      0.18      10.11
```

```
2.42
Call of Duty 4: Modern Warfare        10.06      0.42        5.80
2.06
The Sims 3                             4.31      0.05        9.55
1.29
Red Dead Redemption 2                  9.02      0.21        7.68
2.80
Call of Duty: World at War             9.38      0.00        4.72
1.83
Call of Duty: WWII                     8.49      0.40        8.23
2.70
FIFA 19                                1.58      0.16        8.93
1.56
LEGO Star Wars: The Complete Saga      8.95      0.00        4.82
1.57
Minecraft                              9.07      2.50        9.48
2.96
Battlefield 3                          8.22      0.41        6.50
2.19
Madden NFL 06                          7.68      0.02        0.46
0.86
FIFA Soccer 12                         2.08      0.15        8.51
2.31
Grand Theft Auto: Vice City            8.41      0.47        5.52
1.78
Madden NFL 08                          7.13      0.00        0.23
0.78
FIFA Soccer 11                         1.95      0.09        7.99
2.47
Madden NFL 2005                        6.85      0.01        0.53
0.21
LEGO Batman: The Videogame             7.67      0.00        3.95
1.91
Halo: Reach                            7.08      0.08        2.01
0.80
Madden NFL 10                          6.55      0.00        0.34
0.68
Grand Theft Auto III                   6.99      0.30        4.52
1.30
Call of Duty: Black Ops IIII           7.37      0.50        4.47
1.96

                                  total_sales  disparity
title
Grand Theft Auto V                      64.29  13.112458
Call of Duty: Black Ops                 30.99   7.569218
Call of Duty: Modern Warfare 3          30.71   6.938983
Call of Duty: Ghosts                    28.80   6.459262
Call of Duty: Black Ops II              29.59   6.251295
```

```
Call of Duty: Modern Warfare 2           25.02   5.799623
Call of Duty: Black Ops 3                26.72   5.617855
FIFA 15                                  18.03   5.449318
FIFA 14                                  17.31   5.325743
FIFA 17                                  17.02   5.319226
FIFA 18                                  16.92   5.139600
Grand Theft Auto IV                      22.53   4.954846
Guitar Hero III: Legends of Rock         16.38   4.848287
Call of Duty: Advanced Warfare           21.78   4.710813
FIFA 16                                  15.82   4.576260
The Elder Scrolls V: Skyrim              20.51   4.365389
FIFA 13                                  15.36   4.324107
Call of Duty 4: Modern Warfare           18.33   4.288539
The Sims 3                               15.20   4.230256
Red Dead Redemption 2                    19.71   4.127383
Call of Duty: World at War               15.94   4.089437
Call of Duty: WWII                       19.82   4.043715
FIFA 19                                  12.22   3.971032
LEGO Star Wars: The Complete Saga        15.33   3.956889
Minecraft                                24.01   3.787122
Battlefield 3                            17.32   3.641749
Madden NFL 06                             9.03   3.632901
FIFA Soccer 12                           13.06   3.629944
Grand Theft Auto: Vice City              16.19   3.612003
Madden NFL 08                             8.14   3.412394
FIFA Soccer 11                           12.53   3.400446
Madden NFL 2005                           7.60   3.306942
LEGO Batman: The Videogame               13.55   3.281985
Halo: Reach                               9.97   3.160310
Madden NFL 10                             7.57   3.117385
Grand Theft Auto III                     13.11   3.060636
Call of Duty: Black Ops IIII             14.30   3.014791
```

The table above shows the games with the most variation with Grand Theft Auto V on top of the list with a standard deviation of $ 13 million. The sales in Japan and other parts of the world apart from North America, Europe and Africa, were low. This can be attributed to population differences. This is the case for most of the other differences. The effect of availability factor or preferences is not significant on the sales. Most of the games had a standard deviation below 2 million showing that most did not experience disparities across regions.

```
fig,ax = plt.subplots()
ax.bar(title_variation.index[:20],title_variation['disparity'][:20])
ax.set_title('Games with highest disparity in sales across regions')
ax.set_xlabel('Title')
ax.set_ylabel('disparity')
plt.xticks(rotation = 90);
```



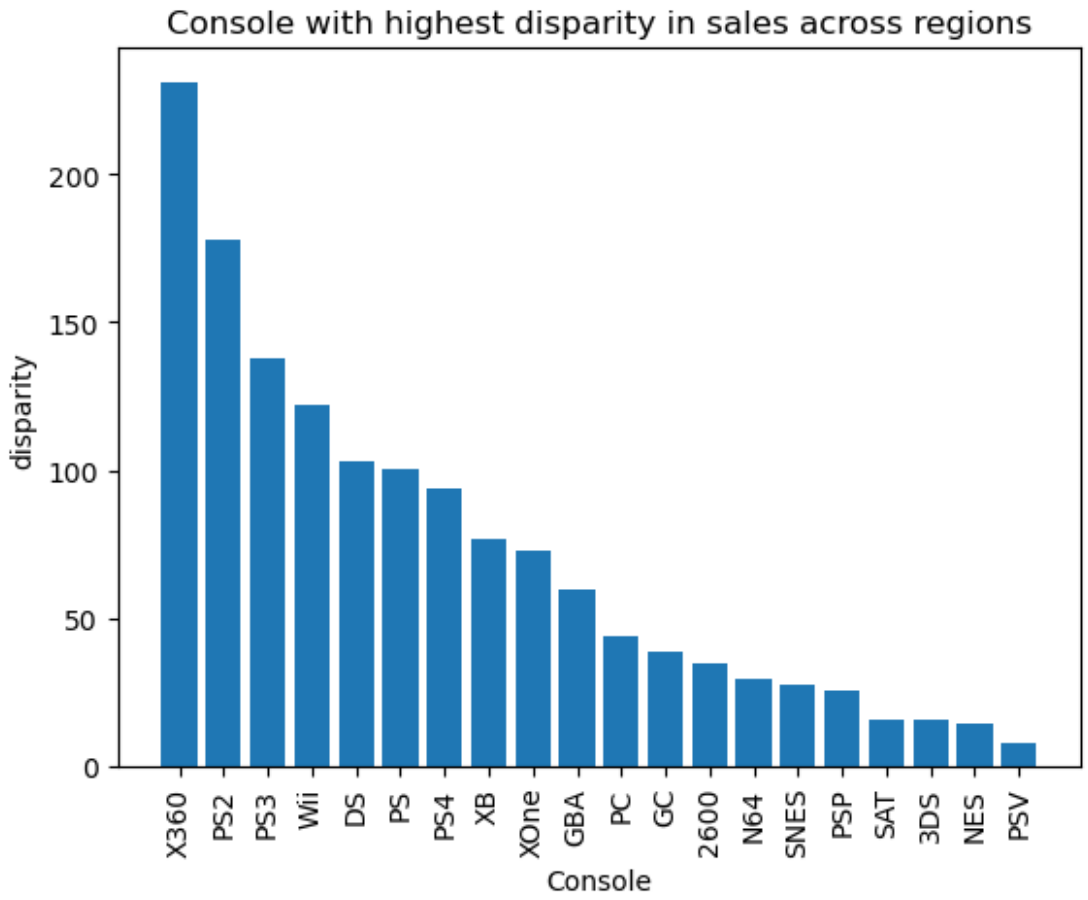

```
popularity1 = df.groupby(['console']
                         )
[['na_sales','jp_sales','pal_sales','other_sales','total_sales']].sum(
).sort_values(
                          by = 'total_sales',ascending = False)
popularity1 = popularity1[popularity1['total_sales']>0]
popularity1.head()
```

console	na_sales	jp_sales	pal_sales	other_sales	total_sales
PS2	489.96	87.63	296.37	153.94	1027.76

```
X360        528.40     10.16     244.50        76.74        859.79
PS3         351.10     67.68     302.22       118.93        839.70
PS          263.26     88.32     163.73        31.10        546.25
PS4         192.18     30.69     233.40        83.55        539.92

popularity1['disparity'] =
popularity1[['na_sales','jp_sales','pal_sales','other_sales']].std(axi
s = 1)
popularity1.head()

          na_sales  jp_sales  pal_sales  other_sales  total_sales
disparity
console

PS2         489.96     87.63     296.37       153.94       1027.76
178.071069
X360        528.40     10.16     244.50        76.74        859.79
231.059194
PS3         351.10     67.68     302.22       118.93        839.70
137.795095
PS          263.26     88.32     163.73        31.10        546.25
100.399205
PS4         192.18     30.69     233.40        83.55        539.92
93.949956

console_variation =
popularity1[popularity1['disparity']>3].sort_values(by = 'disparity',
ascending = False)
console_variation

          na_sales  jp_sales  pal_sales  other_sales  total_sales
disparity
console

X360        528.40     10.16     244.50        76.74        859.79
231.059194
PS2         489.96     87.63     296.37       153.94       1027.76
178.071069
PS3         351.10     67.68     302.22       118.93        839.70
137.795095
Wii         285.42     16.84     117.72        38.85        459.44
121.770605
DS          264.84     64.20      94.33        33.88        458.17
103.341631
PS          263.26     88.32     163.73        31.10        546.25
100.399205
PS4         192.18     30.69     233.40        83.55        539.92
93.949956
XB          166.88      0.83      55.62         8.17        232.05
76.620045
```

```
XOne       164.53      0.38      79.44         24.53       268.96
72.820753
GBA        140.41     23.94      54.86          4.47       224.48
60.026401
PC          58.61      0.00      96.02         13.51       168.99
43.854790
GC          86.31      6.09      23.77          2.90       119.53
38.796524
2600        70.62      0.00       4.25          0.69        75.66
34.536911
N64         66.36      8.44      16.67          2.10        93.79
29.259448
SNES         6.84     57.14       1.46          0.26        65.71
27.293723
PSP         96.56     52.29      59.79         36.59       245.29
25.412016
SAT          0.72     32.34       0.54          0.07        33.67
15.950687
3DS         30.37     41.74      22.24          4.88        99.27
15.506432
NES         13.37     31.96       2.24          0.36        47.93
14.503155
PSV         13.04     26.95      15.18          7.81        63.02
8.086048
GB           1.84     16.87       1.00          0.14        19.84
7.968615
NS          17.71      4.26      11.63          2.75        36.46
6.934947
WiiU        16.44      3.84      12.39          2.73        35.42
6.650669
GEN         12.55      2.05       3.64          0.61        18.83
5.369546
DC           4.50      7.37       1.22          0.20        13.31
3.262886
```

```
fig,ax = plt.subplots()
ax.bar(console_variation.index[:20],console_variation['disparity']
[:20])
ax.set_title('Console with highest disparity in sales across regions')
ax.set_xlabel('Console')
ax.set_ylabel('disparity')
plt.xticks(rotation = 90);
```



Similar to the games, the consoles sales disparity is attributed to the population density differences. X360 has the highest disparity.

```
popularity2 = df.groupby(['genre']
                         )
[['na_sales','jp_sales','pal_sales','other_sales','total_sales']].sum(
).sort_values(
                          by = 'total_sales',ascending = False)
popularity2 = popularity2[popularity2['total_sales']>0]
popularity2.head()
```

genre	na_sales	jp_sales	pal_sales	other_sales	total_sales
Sports	607.47	109.27	341.92	128.19	1187.51
Action	589.69	80.30	342.52	112.41	1125.89
Shooter	528.27	33.99	324.74	108.43	995.50
Misc	295.66	56.24	146.71	58.52	557.79
Racing	269.72	20.23	179.14	56.44	525.75

```
popularity2['disparity'] =
popularity2[['na_sales','jp_sales','pal_sales','other_sales']].std(axi
```

```
s = 1)
popularity2.head()
```

```
         na_sales  jp_sales  pal_sales  other_sales  total_sales
disparity
genre

Sports     607.47    109.27     341.92       128.19      1187.51
232.485459
Action     589.69     80.30     342.52       112.41      1125.89
236.486147
Shooter    528.27     33.99     324.74       108.43       995.50
223.396079
Misc       295.66     56.24     146.71        58.52       557.79
112.439211
Racing     269.72     20.23     179.14        56.44       525.75
114.585193
```

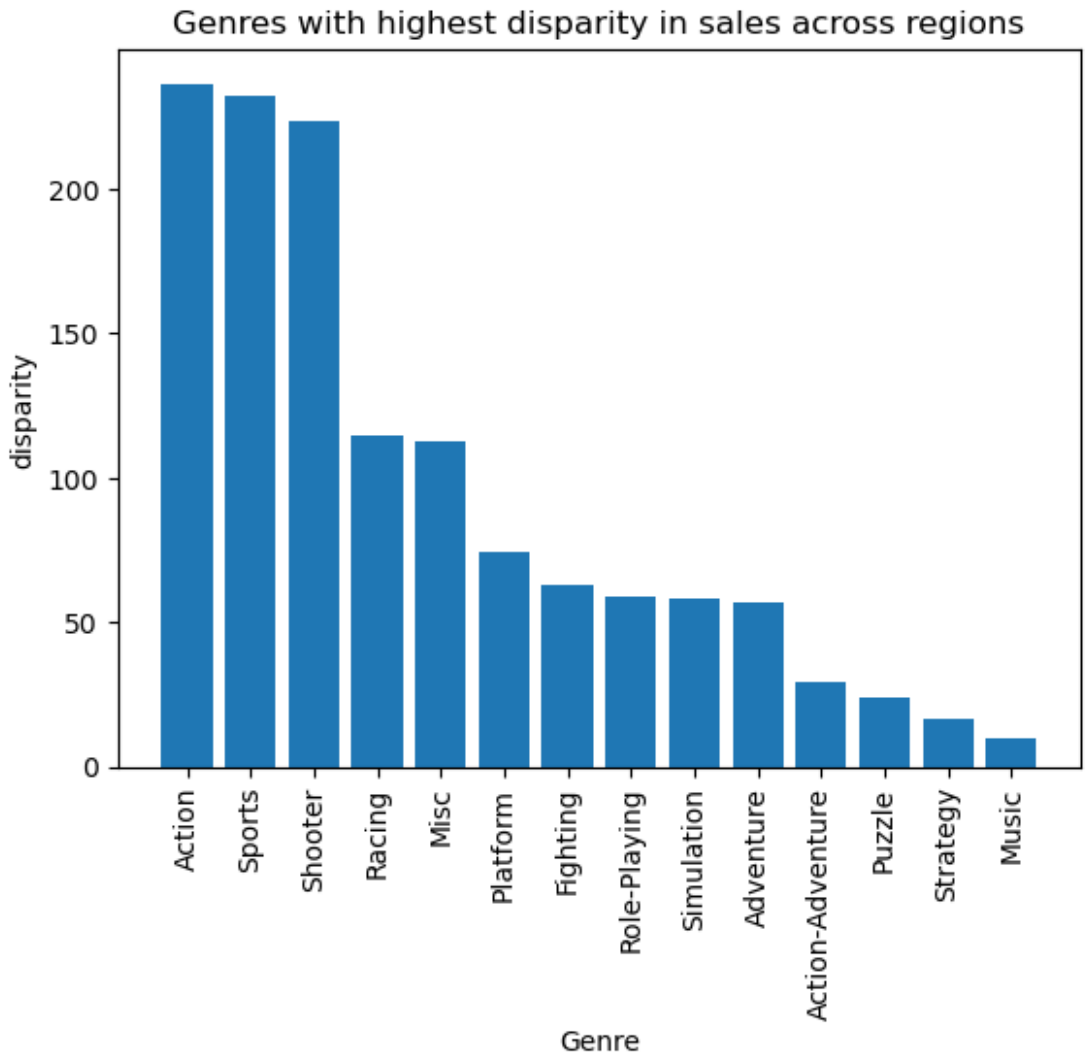
```
genre_variation =
popularity2[popularity2['disparity']>3].sort_values(by = 'disparity',
ascending = False)
genre_variation
```

```
                  na_sales  jp_sales  pal_sales  other_sales
total_sales  \
genre

Action               589.69     80.30     342.52       112.41
1125.89
Sports               607.47    109.27     341.92       128.19
1187.51
Shooter              528.27     33.99     324.74       108.43
995.50
Racing               269.72     20.23     179.14        56.44
525.75
Misc                 295.66     56.24     146.71        58.52
557.79
Platform             187.96     31.08      99.39        30.38
349.15
Fighting             173.96     58.61      79.84        28.65
341.13
Role-Playing         171.67    130.56      91.02        33.75
426.80
Simulation           152.84     35.98      86.86        24.34
300.65
Adventure            157.26     46.11      91.52        30.11
325.39
Action-Adventure      65.09      5.46      59.52        18.40
148.52
Puzzle                64.36     29.27      25.78         7.38
```

```
127.28
Strategy              47.06     36.80      27.05          7.29
118.31
Music                 25.97      5.84      15.02          4.93
51.75
```

```
                    disparity
genre
Action             236.486147
Sports             232.485459
Shooter            223.396079
Racing             114.585193
Misc               112.439211
Platform            74.563486
Fighting            62.748123
Role-Playing        58.759270
Simulation          58.562562
Adventure           56.959378
Action-Adventure    29.647231
Puzzle              23.798384
Strategy            16.940289
Music                9.809475
```

```
fig,ax = plt.subplots()
ax.bar(genre_variation.index[:20],genre_variation['disparity'][:20])
ax.set_title('Genres with highest disparity in sales across regions')
ax.set_xlabel('Genre')
ax.set_ylabel('disparity')
plt.xticks(rotation = 90);
```



Action genre has the highest disparity. Most sales are in North America as that is where most of the video games are produced. Otherwise,the population differences mainly leads to the disparity in sales.

Conclusion

The analysis clarifies most of the general assumptions and we discovered more findings in the course of the analysis.