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Importing the data

```
!wget https://d2beiqkhq929f0.cloudfront.net/public_assets/assets/000/021/299/original/final_vg1_-_final_vg_%281%29.csv?16708
```

```
--2024-02-06 16:33:16--  https://d2beiqkhq929f0.cloudfront.net/public_assets/assets/000/021/299/original/final_vg1_-_fin
Resolving d2beiqkhq929f0.cloudfront.net (d2beiqkhq929f0.cloudfront.net)... 18.172.139.94, 18.172.139.46, 18.172.139.61,
Connecting to d2beiqkhq929f0.cloudfront.net (d2beiqkhq929f0.cloudfront.net)|18.172.139.94|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 2041483 (1.9M) [text/plain]
Saving to: 'vgsales.csv'

vgsales.csv         100%[===================>]   1.95M  --.-KB/s    in 0.07s

2024-02-06 16:33:16 (28.3 MB/s) - 'vgsales.csv' saved [2041483/2041483]
```

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
data = pd.read_csv('vgsales.csv')
data.head()
```

	Rank	Name	Platform	Year	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sal
0	2061	1942	NES	1985.0	Shooter	Capcom	4.569217	3.033887	3.439352	1.9916
1	9137	¡Shin Chan Flipa en colores!	DS	2007.0	Platform	505 Games	2.076955	1.493442	3.033887	0.3948
2	14279	.hack: Sekai no Mukou ni + Versus	PS3	2012.0	Action	Namco Bandai Games	1.145709	1.762339	1.493442	0.4086
3	8359	.hack//G.U. Vol.1//Rebirth	PS2	2006.0	Role-Playing	Namco Bandai Games	2.031986	1.389856	3.228043	0.3948
4	7109	.hack//G.U. Vol.2//Reminisce	PS2	2006.0	Role-Playing	Namco Bandai Games	2.792725	2.592054	1.440483	1.4934

```
data.describe()
```

	Rank	Year	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales
count	16652.000000	16381.000000	16652.000000	16652.000000	16652.000000	16652.000000	16652.000000
mean	8283.409620	2006.390513	2.752314	1.996875	2.499677	1.151829	8.457873
std	4794.471477	5.863261	1.327002	1.322972	1.164023	1.054813	3.717756
min	1.000000	1980.000000	0.140000	0.010000	0.000000	-0.474276	0.240000
25%	4129.750000	2003.000000	1.781124	1.087977	1.781124	0.394830	5.580341
50%	8273.500000	2007.000000	2.697415	1.714664	2.480356	0.491870	7.536614
75%	12436.250000	2010.000000	3.677290	2.795123	3.176299	1.781124	11.227334
max	16600.000000	2020.000000	8.725452	8.367985	12.722984	7.358020	30.555862

Bivariate Data Visualization

Continous-Continous

So far we have been analyzing only a single feature.

But what if we want to visualize two features at once?

What kind of questions can we ask regarding a continous-continous pair of features?

- Maybe show relation between two features, like **how does the sales vary over the years**?
- Or show **how are the features associated, positively or negatively**?

...And so on

Let's go back to the line plot we plotted at the very beginning

Line Plot

How can we plot the sales trend over the years for the longest running game?

First, let's find the longest running game first

```
data['Name'].value_counts()
```

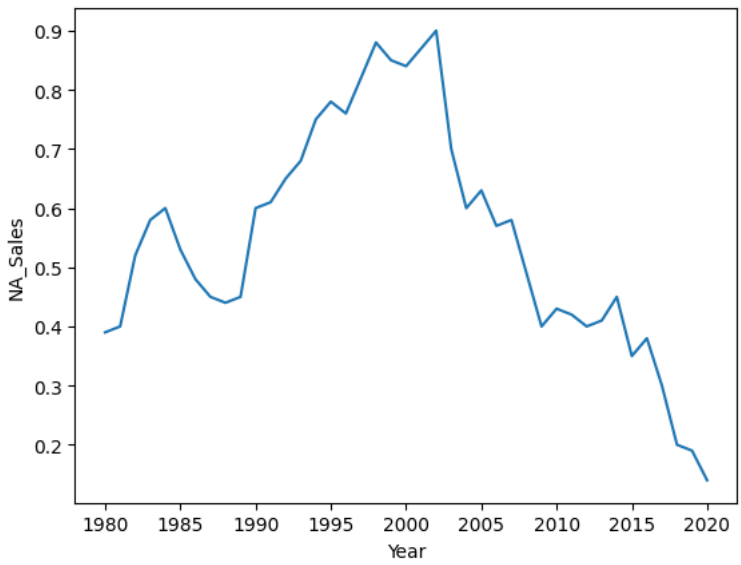
```
Ice Hockey                                    41
Baseball                                      17
Need for Speed: Most Wanted                   12
Ratatouille                                    9
FIFA 14                                        9
                                              ..
Indy 500                                       1
Indy Racing 2000                               1
Indycar Series 2005                            1
inFAMOUS                                       1
Zyuden Sentai Kyoryuger: Game de Gaburincho!!  1
Name: Name, Length: 11493, dtype: int64
```

Great, so `Ice Hockey` is longer running than most games

Let's try to find the sales trend in North America of the same across the years

```
ih = data.loc[data['Name']=='Ice Hockey']
sns.lineplot(x='Year', y='NA_Sales', data=ih)
```

```
<Axes: xlabel='Year', ylabel='NA_Sales'>
```



What can we infer from this graph?

- The sales across North America seem to have been boosted in the years of 1995-2005

- Post 2010 though, the sales seem to have taken a dip

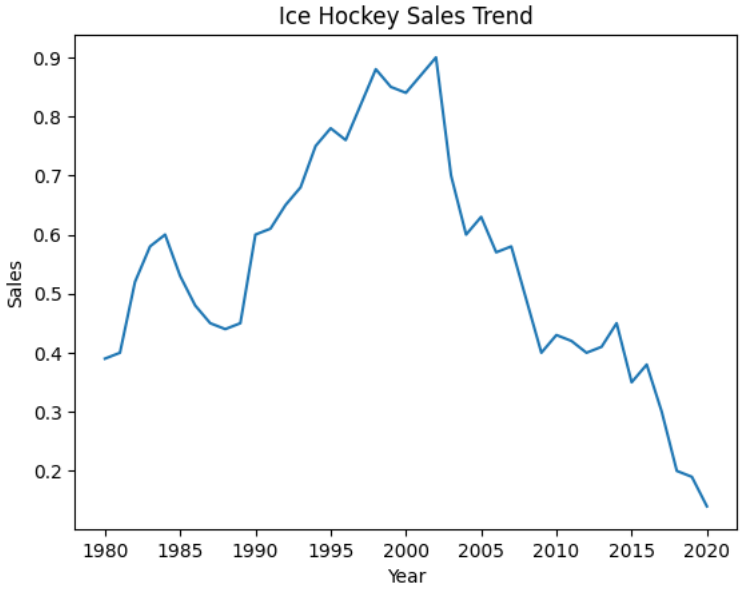
Line plot are great to represending trends such as above, over time

Style and Labelling

We already learnt in barplot how to add **titles, x-label and y-label**

Let's add the same here

```
plt.title('Ice Hockey Sales Trend')
plt.xlabel('Year')
plt.ylabel('Sales')
sns.lineplot(x='Year', y='NA_Sales', data=ih)
plt.show()
```



Now what if we want to change the colour of the curve ?

`sns.lineplot()` contains an argument **color**

- It takes as argument a matplotlib color

  OR

- as string for some defined colours like:
  - black: `k` / `black`
  - red: `r` / `red` etc

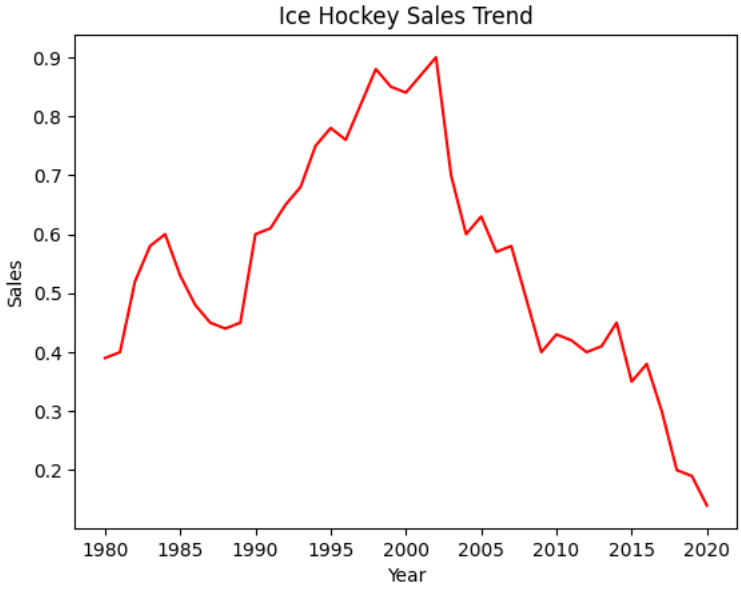
But what all colours can we use ?

Matplotlib provides a lot of colours

Check the documentation for more colours

https://matplotlib.org/2.0.2/api/colors_api.html

```
plt.title('Ice Hockey Sales Trend')
plt.xlabel('Year')
plt.ylabel('Sales')
sns.lineplot(x='Year', y='NA_Sales', data=ih, color='r')
plt.show()
```



Now, lets say we only want to show the values from years 1990-2000

- How can we limit our plot to only the last decade of 20th century?

This requires changing the range of x-axis

But how can we change the range of an axis in matplotlib ?

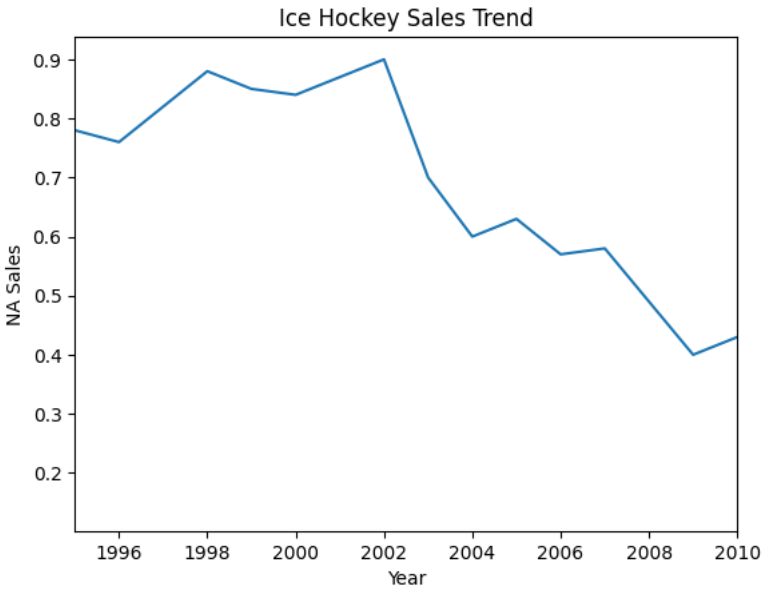
We can use:

- `plt.xlim()` : x-axis
- `plt.ylim()` : y-axis

These funcs take same 2 args:

1. `left` : Starting point of range
2. `right` : End point of range

```
plt.title('Ice Hockey Sales Trend')
plt.xlabel('Year')
plt.ylabel('NA Sales')
plt.xlim(left=1995,right=2010)
sns.lineplot(x='Year', y='NA_Sales', data=ih)
plt.show()
```



So far we have visualised a single plot to understand it

What if we want to compare it with some other plot?

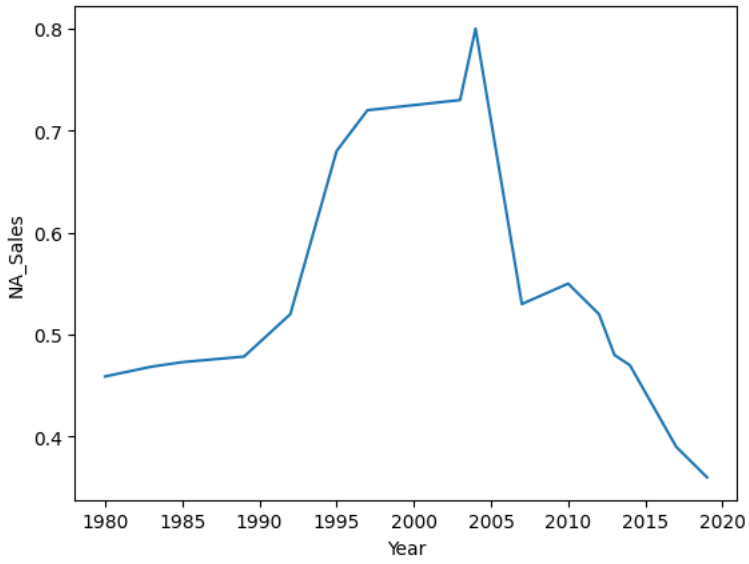
Say, we want to compare the same sales trend between two games

- Ice Hockey
- Baseball

Let's first plot the trend for "Baseball"

```
baseball = data.loc[data['Name']=='Baseball']
sns.lineplot(x='Year', y='NA_Sales', data=baseball)
```

```
<Axes: xlabel='Year', ylabel='NA_Sales'>
```

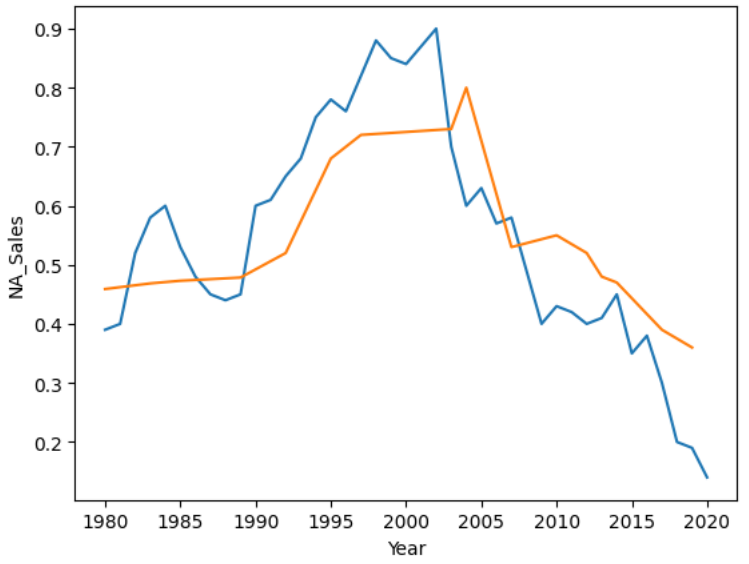


Now, to compare these, so we will have to draw these plots in the same figure

How can we plot multiple plots in the same figure ?

```
sns.lineplot(x='Year', y='NA_Sales', data=ih)
sns.lineplot(x='Year', y='NA_Sales', data=baseball)
```

```
<Axes: xlabel='Year', ylabel='NA_Sales'>
```



We can use multiple `sns.lineplot()` funcs

Observe:

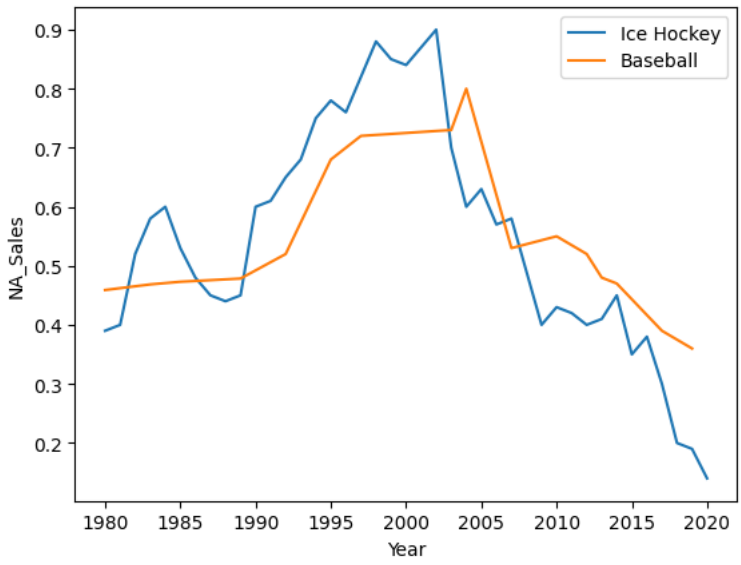
Seaborn automatically created 2 plots with **different colors**

However how can we know which colour is of which plot ?

- sns.lineplot() has another argument **label** to do so
- We can simply set the label of each plot

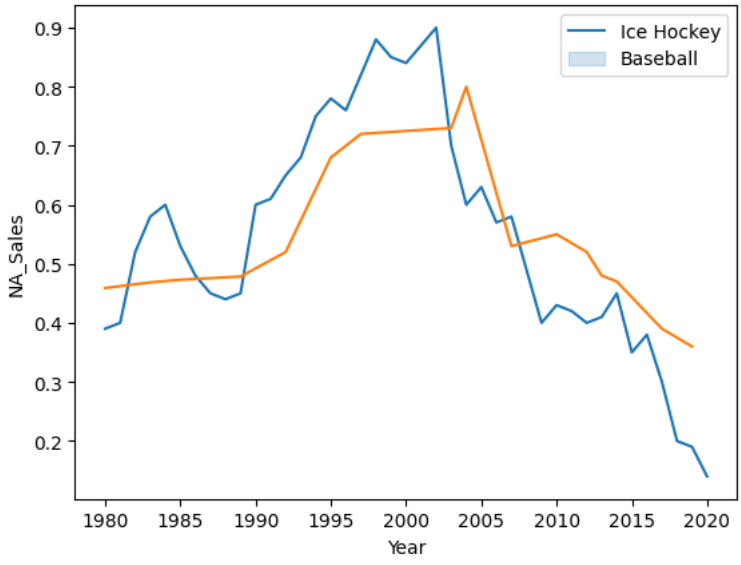
```
sns.lineplot(x='Year', y='NA_Sales', data=ih, label='Ice Hockey')
sns.lineplot(x='Year', y='NA_Sales', data=baseball, label='Baseball')
```

```
<Axes: xlabel='Year', ylabel='NA_Sales'>
```



We can also pass these labels in plt.legend() as a list in the order plots are done

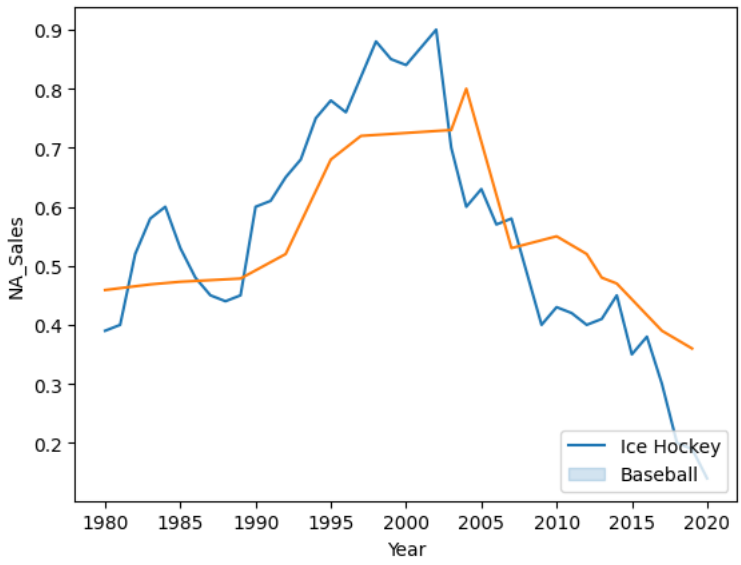
```
sns.lineplot(x='Year', y='NA_Sales', data=ih)
sns.lineplot(x='Year', y='NA_Sales', data=baseball)
plt.legend(['Ice Hockey','Baseball'])
plt.show()
```



Now can we change the position of the legend, say, to bottom-right corner?

- Matplotlib automatically decides the best position for the legends
- But we can also change it using the `loc` parameter
- `loc` takes input as 1 of following strings:
  - upper center
  - upper left
  - upper right
  - lower right ... etc

```
sns.lineplot(x='Year', y='NA_Sales', data=ih)
sns.lineplot(x='Year', y='NA_Sales', data=baseball)
plt.legend(['Ice Hockey','Baseball'], loc='lower right')
plt.show()
```

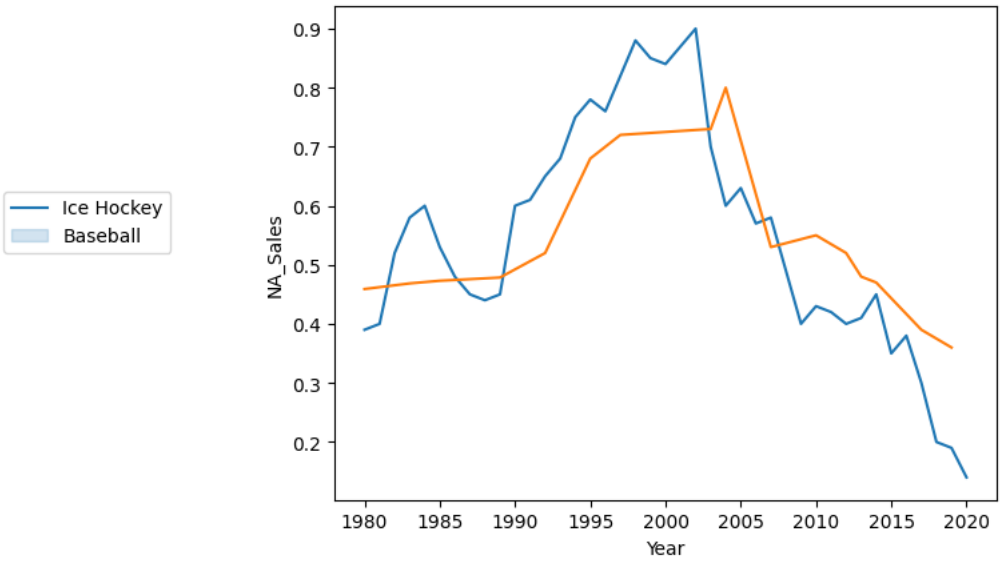


Now what if we want the legend to be outside the plot?

Maybe the plot is too congested to show the legend

We can use the same `loc` parameter for this too

```
sns.lineplot(x='Year', y='NA_Sales', data=ih)
sns.lineplot(x='Year', y='NA_Sales', data=baseball)
plt.legend(['Ice Hockey','Baseball'], loc=(-0.5,0.5))
plt.show()
```



The pair of floats signify the (x,y) coordinates for the legend

==> From this we can conclude `loc` takes **two types of arguments**:

- The location in the **form of string**
- The location in the **form of coordinates**

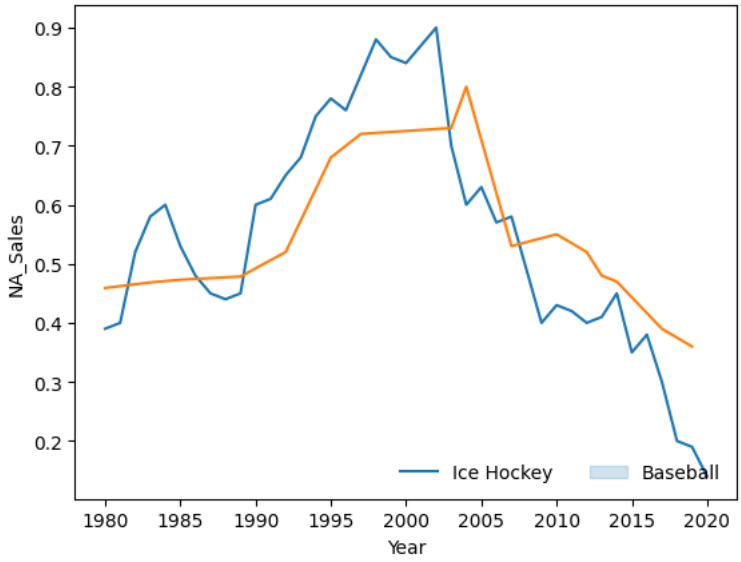
What if we want to add other stylings to legends ?

For eg:

- Specify the **number of rows/cols**
  - Uses parameter `ncols` for this
  - The number of **rows are decided automatically**
- Decide if we want the box of legends to be displayed
  - Use the bool param `frameon`

and so on.

```
sns.lineplot(x='Year', y='NA_Sales', data=ih)
sns.lineplot(x='Year', y='NA_Sales', data=baseball)
plt.legend(['Ice Hockey','Baseball'], loc='lower right', ncol = 2, frameon = False)
plt.show()
```



Now say we want to highlight a point on our curve.

For e.g.

- How can we highlight the maximum "Ice Hockey" sales across all years ?

Let's first find this point

```
print(max(ih['NA_Sales']))
```

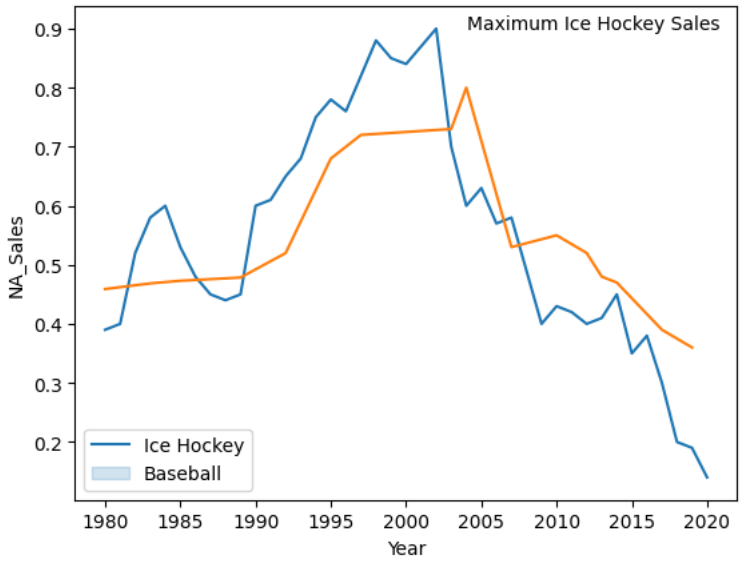
```
0.9
```

If we observe, this point lies in the year 2004-5 around

Now we need to add text to this point (2004,0.9)

- How can we add text to a point in a figure ?

```
sns.lineplot(x='Year', y='NA_Sales', data=ih)
sns.lineplot(x='Year', y='NA_Sales', data=baseball)
plt.legend(['Ice Hockey','Baseball'], loc='lower left')
plt.text(2004,max(ih['NA_Sales']), 'Maximum Ice Hockey Sales')
plt.show()
```

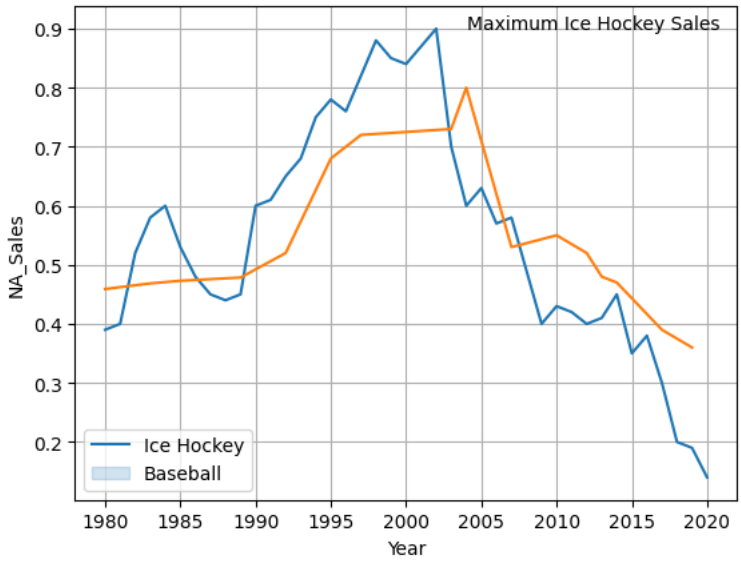


By using `plt.text()`

- Pass in the **x and y coordinates** where we want the text to appear
- Pass in the **text string**

We can also use `plt.grid()` to show the grid layout in the background

```
sns.lineplot(x='Year', y='NA_Sales', data=ih)
sns.lineplot(x='Year', y='NA_Sales', data=baseball)
plt.legend(['Ice Hockey','Baseball'], loc='lower left')
plt.text(2004,max(ih['NA_Sales']), 'Maximum Ice Hockey Sales')
plt.grid()
plt.show()
```



Note:

We can **pass in parameters inside `plt.grid()` to control its density, colour of grid lines, etc.**

You can look it up later on how to customize the grid

https://matplotlib.org/stable/api/_as_gen/matplotlib.pyplot.grid.html

Scatter Plot

Now suppose we want to find the relation between `Rank` and `Sales` of all games.

Are `Rank` and `Sales` positively or negatively correlated?

In this case, unlike line plot, there maybe multiple points in y-axis for each point in x-axis

```
data.head()
```

	Rank	Name	Platform	Year	Genre	Publisher	NA_Sales	EU_Sales	JP_Sales	Other_Sal
0	2061	1942	NES	1985.0	Shooter	Capcom	4.569217	3.033887	3.439352	1.9916
1	9137	¡Shin Chan Flipa en colores!	DS	2007.0	Platform	505 Games	2.076955	1.493442	3.033887	0.3948
2	14279	.hack: Sekai no Mukou ni + Versus	PS3	2012.0	Action	Namco Bandai Games	1.145709	1.762339	1.493442	0.4086
3	8359	.hack//G.U. Vol.1//Rebirth	PS2	2006.0	Role-Playing	Namco Bandai Games	2.031986	1.389856	3.228043	0.3948
4	7109	.hack//G.U. Vol.2//Reminisce	PS2	2006.0	Role-Playing	Namco Bandai Games	2.792725	2.592054	1.440483	1.4934

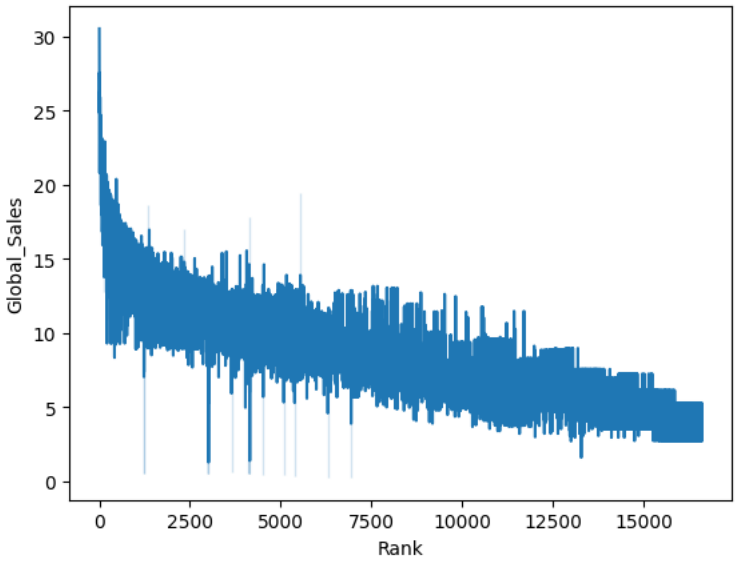
How can we plot the relation between `Rank` and `Global Sales`?

Can we use lineplot?

Let's try it out

```
sns.lineplot(data=data, x='Rank', y='Global_Sales')
```

```
<Axes: xlabel='Rank', ylabel='Global_Sales'>
```



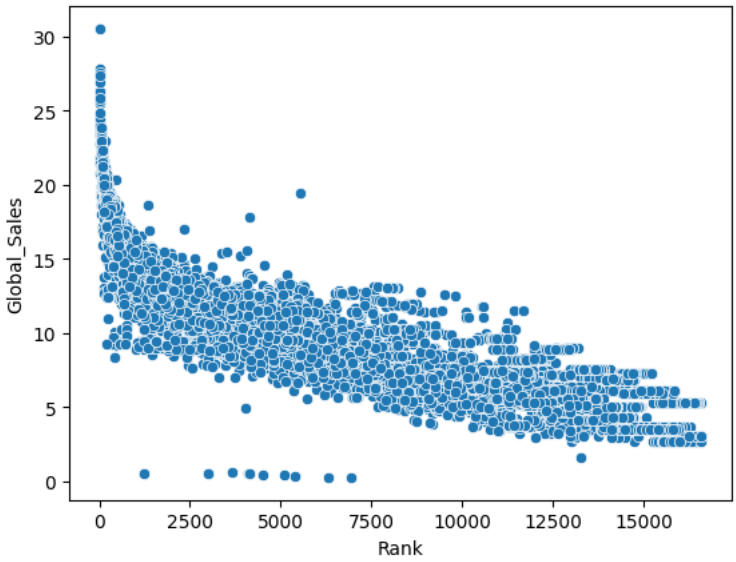
The plot itself looks very messy and it's hard to find any patterns from it.

Is there any other way we can visualize this relation?

Use scatter plot

```
sns.scatterplot(data=data, x='Rank', y='Global_Sales')
```

```
<Axes: xlabel='Rank', ylabel='Global_Sales'>
```



Compared to lineplot, we are able to see the patterns and points more distinctly now!

Notice,

- The two variables are negatively correlated with each other
- With increase in ranks, the sales tend to go down, implying, lower ranked games have higher sales overall!

Scatter plots help us visualize these relations and find any patterns in the data

Key Takeaways:

- For Continuous-Continuous Data => Scatter Plot, Line Plot

Sometimes, people also like to display the linear trend between two variables - Regression Plot, do check that

If you notice, `Genres`, `Publisher` and `Platform` are categorical values

Since we have a lot of categories of each of them, we will use top 3 of each to make our analysis easier

```
top3_pub = data['Publisher'].value_counts().index[:3]
top3_gen = data['Genre'].value_counts().index[:3]
top3_plat = data['Platform'].value_counts().index[:3]
top3_data = data.loc[(data["Publisher"].isin(top3_pub)) & (data["Platform"].isin(top3_plat)) & (data['Genre'].isin(top3_gen)
top3_data
```

	Rank	Name	Platform	Year	Genre	Publisher	NA_Sales	EU_Sales	JP_Sal
2	14279	.hack: Sekai no Mukou ni + Versus	PS3	2012.0	Action	Namco Bandai Games	1.145709	1.762339	1.4934
13	2742	[Prototype 2]	PS3	2012.0	Action	Activision	3.978349	3.727034	0.8488
16	1604	[Prototype]	PS3	2009.0	Action	Activision	4.569217	4.108402	1.1872
19	1741	007: Quantum of Solace	PS3	2008.0	Action	Activision	4.156030	4.346074	1.0879
21	4501	007: Quantum of Solace	PS2	2008.0	Action	Activision	3.228043	2.738800	2.5855
...	...	...	...	...	...	...	...	...	...
16438	14938	Yes! Precure 5 Go Go Zenin Shu Go! Dream Festival	DS	2008.0	Action	Namco Bandai Games	1.087977	0.592445	1.0879
16479	10979	Young Justice: Legacy	PS3	2013.0	Action	Namco Bandai Games	2.186589	1.087977	3.4090
16601	11802	ZhuZhu Pets: Quest for Zhu	DS	2011.0	Misc	Activision	2.340740	1.525543	3.1038
16636	9196	Zoobles! Spring to Life!	DS	2011.0	Misc	Activision	2.697415	1.087977	2.7607
16640	9816	Zubo	DS	2008.0	Misc	Electronic Arts	2.592054	1.493442	1.4934

617 rows × 11 columns

Categorical-Categorical

Earlier we saw how to work with continous-continuous pair of data

Now let's come to the second type of pair of data: **Categorical-Categorical**

What questions comes to your mind when we say categorical-categorical pair?

Questions related to distribution of a category within another category

- What is the **distribution of genres for top-3 publishers**?
- Which **platforms do these top publishers use?**

Which plot can we use to show distribution of one category with respect to another?

-> We can have can **have multiple bars for each category**

- These multiple bars can be stacked together - **Stacked Countplot**

Or

- Can be placed next to each other - **Dodged Countplot**

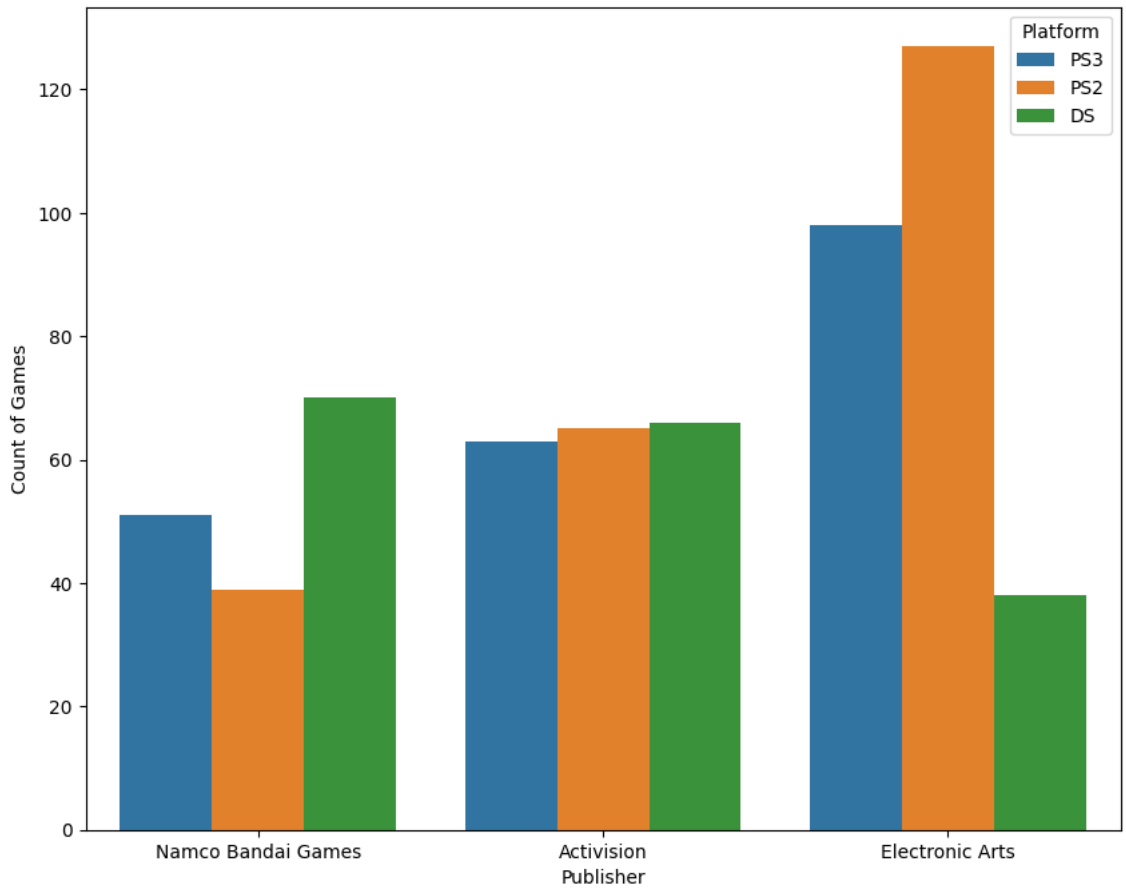
Dodged Count Plot

How can we compare the top 3 platforms these publishers use?

We can use a dodged countplot in this case

```
plt.figure(figsize=(10,8))
sns.countplot(x='Publisher',hue='Platform',data=top3_data)
plt.ylabel('Count of Games')
```

```
Text(0, 0.5, 'Count of Games')
```



What can we infer from the dodged countplot?

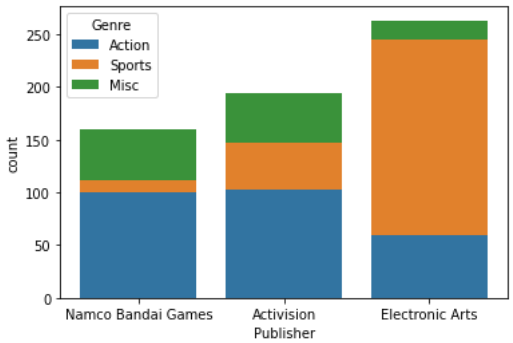
- EA releases PS2 games way more than any other publisher, or even platform!
- Activision has almost the same count of games for all 3 platforms
- EA is leading in PS3 and PS2, but Namco leads when it comes to DS platform

Stacked Countplot

How can we visualize the distribution of genres for top-3 publishers?

We can use a `stacked countplot`

Do refer the postread for the code on how to plot it



But stacked countplots can be misleading

Some may find it difficult to understand if it starts from baseline or from on top of the bottom area

How do we decide between a Stacked countplot and Dodged countlot?

- Stacked countplots are a good way to represent totals

- While dodged countplots helps us to comapare values between various categories, and within the category itself too

Continous-Categorical

Now let's look at our 3rd type of data pair

What kind of questions we may have regarding a continuous-categorical pair?

- We might to want calculate some numbers category wise
  - Like **What is the average sales for every genre?**
- Or we might be interested in checking the distribution of the data category-wise
  - **What is the distribution of sales for the top3 publishers?**

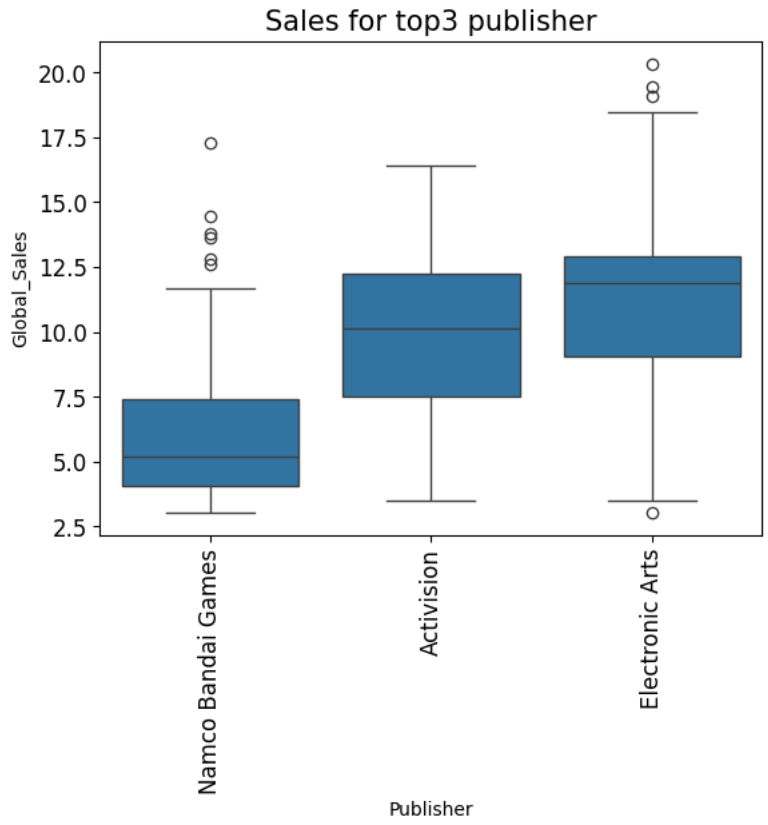
What kind of plot can we make for every category?

-> Either KDE plot or Box Plot per category

Boxplot

What is the distribution of sales for the top3 publishers?

```
sns.boxplot(x='Publisher', y='Global_Sales', data=top3_data)
plt.xticks(rotation=90,fontsize=12)
plt.yticks(fontsize=12)
plt.title('Sales for top3 publisher', fontsize=15)
plt.show()
```



What can we infer from this plot?

- The overall sales of EA is higher, with a much larger spread than other publishers
- Activision doesn't have many outliers, and if you notice, even thought the spread is lesser than EA, the median is almost the same

Barplot

What if we want to compare the sales between the genres?

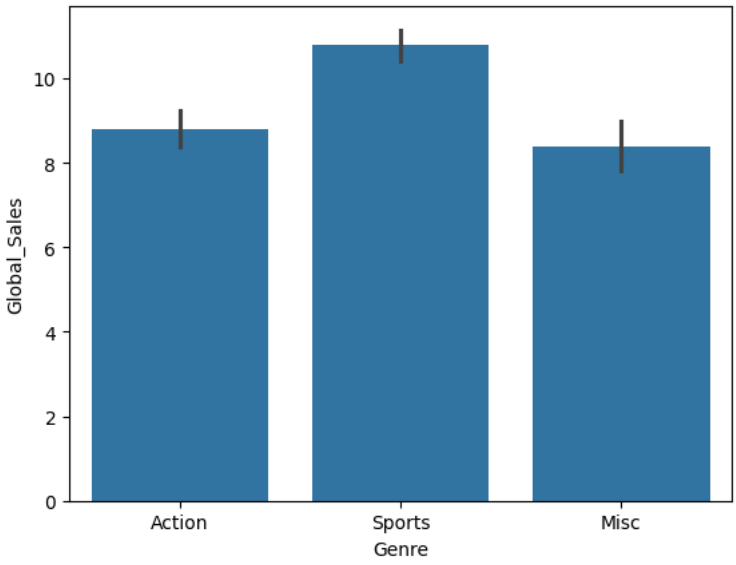
We have to use:

- Genre (categorical)
- Mean of global sales per genre (numerical)

How to visualize which genres bring higher average global sales?

```
sns.barplot(data=top3_data, x="Genre", y="Global_Sales", estimator=np.mean)
```

```
<Axes: xlabel='Genre', ylabel='Global_Sales'>
```



If you remember, we had earlier seen EA had a larger market share of sales

Along with this fact, majority of games EA made was sports

This ultimately proves the fact that Sports has a high market share in the industry, as shown in the barchart

Subplots

So far we have **shown only 1 plot** using `plt.show()`

Say, we want to plot the trend of NA and every other region separately in a single figure

How can we plot multiple smaller plots at the same time?

We will use **subplots**, i.e., **divide the figure into smaller plots**

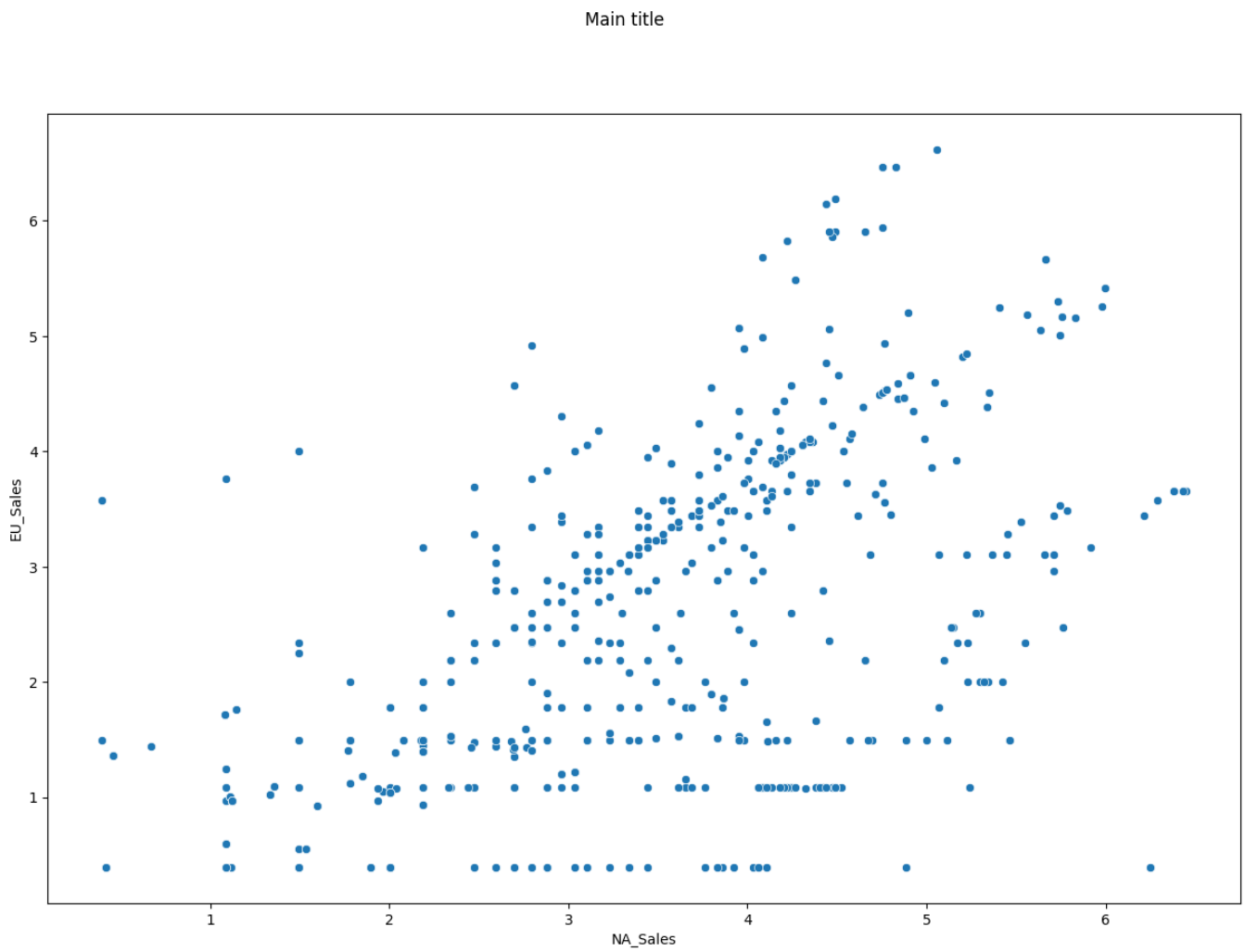
We will be using `plt.subplots()` It takes mainly 2 arguments:

1. **No. of rows** we want to **divide our figure** into
2. **No. of columns** we want to **divide our figure** into

It returns 2 things:

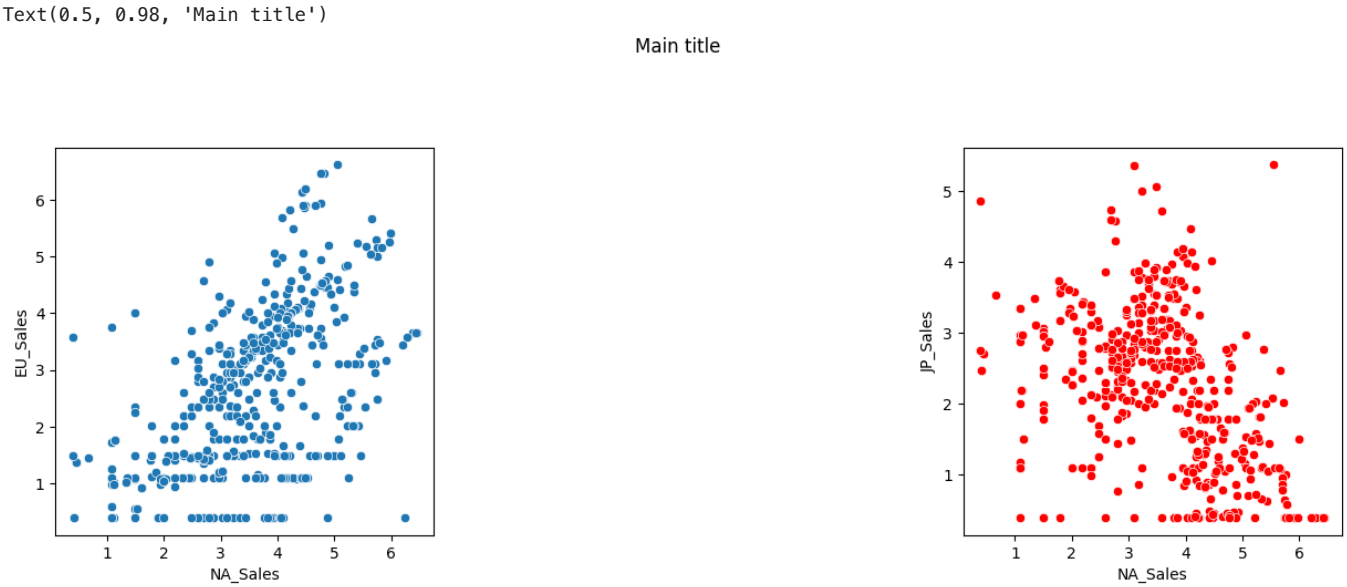
- Figure
- Numpy Matrix of subplots

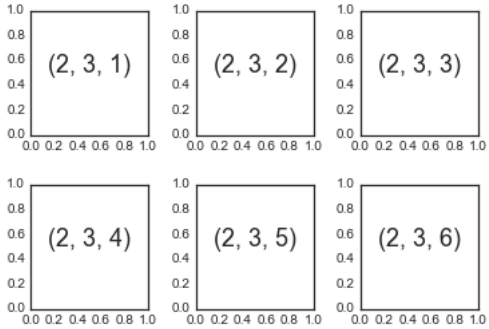
```
fig = plt.figure(figsize=(15,10))
sns.scatterplot(x=top3_data['NA_Sales'], y=top3_data['EU_Sales'])
fig.suptitle('Main title')
plt.show()
```




```
fig = plt.figure(figsize=(15,10))

plt.subplot(2, 3, 1)
sns.scatterplot(x='NA_Sales', y='EU_Sales', data=top3_data)


plt.subplot(2, 3, 3)
sns.scatterplot(x='NA_Sales', y='JP_Sales', data=top3_data, color='red')

fig.suptitle('Main title')
```

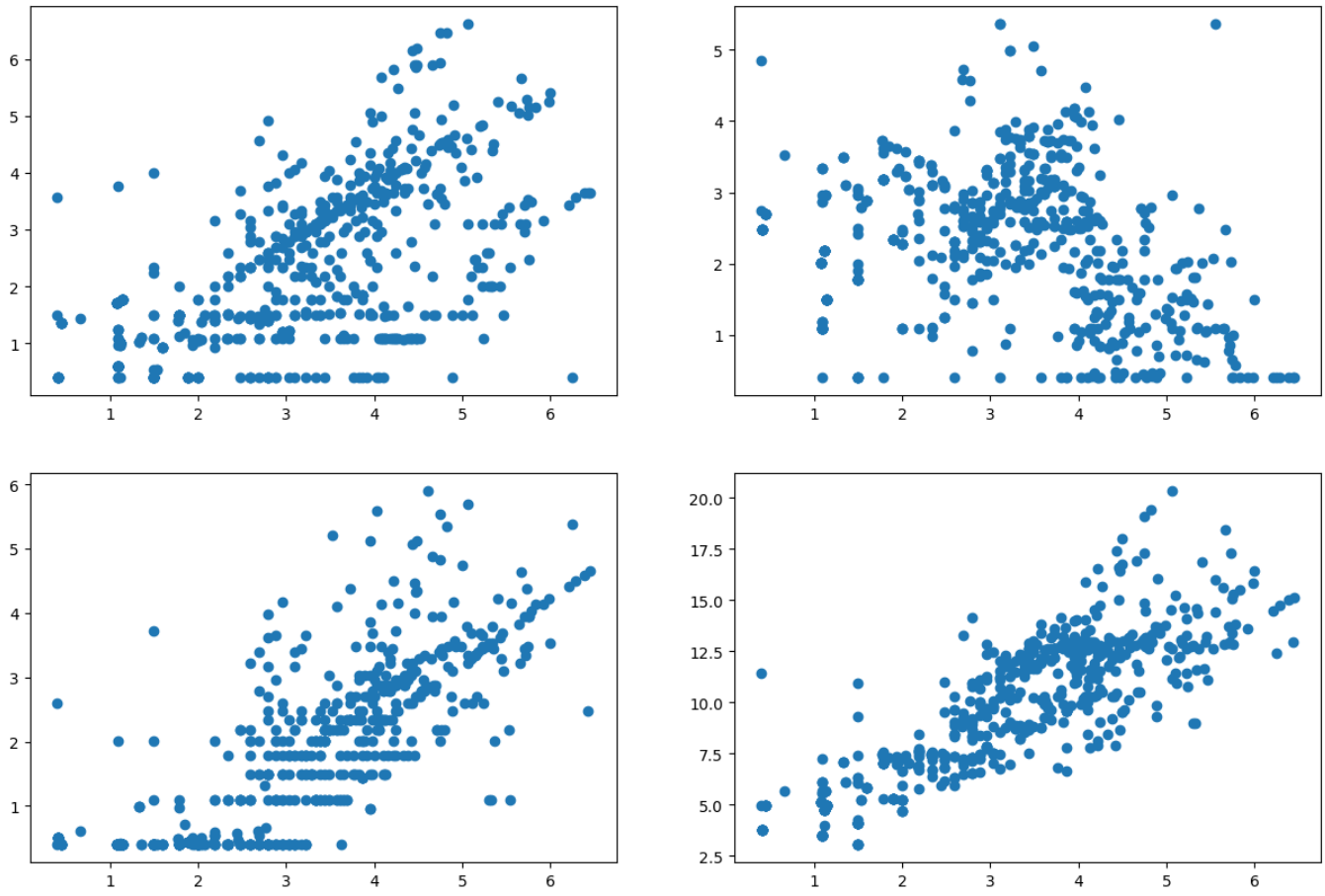
```
Text(0.5, 0.98, 'Main title')
```






```
fig, ax = plt.subplots(2, 2, figsize=(15,10))
ax[0,0].scatter(top3_data['NA_Sales'], top3_data['EU_Sales'])
ax[0,1].scatter(top3_data['NA_Sales'], top3_data['JP_Sales'])
ax[1,0].scatter(top3_data['NA_Sales'], top3_data['Other_Sales'])
ax[1,1].scatter(top3_data['NA_Sales'], top3_data['Global_Sales'])
```

```
<matplotlib.collections.PathCollection at 0x7f0a8e08b370>
```



Notice, we are using 2 numbers during each plotting

Think of subplots as a 2x2 grids, with the two numbers denoting `x,y` / `row,column` coordinate of each subplot

What is this `ax` parameter exactly?

```
print(ax)
```

```
[[<Axes: > <Axes: >]
 [<Axes: > <Axes: >]]
```

Notice,

- It's a 2x2 matrix of multiple axes objects

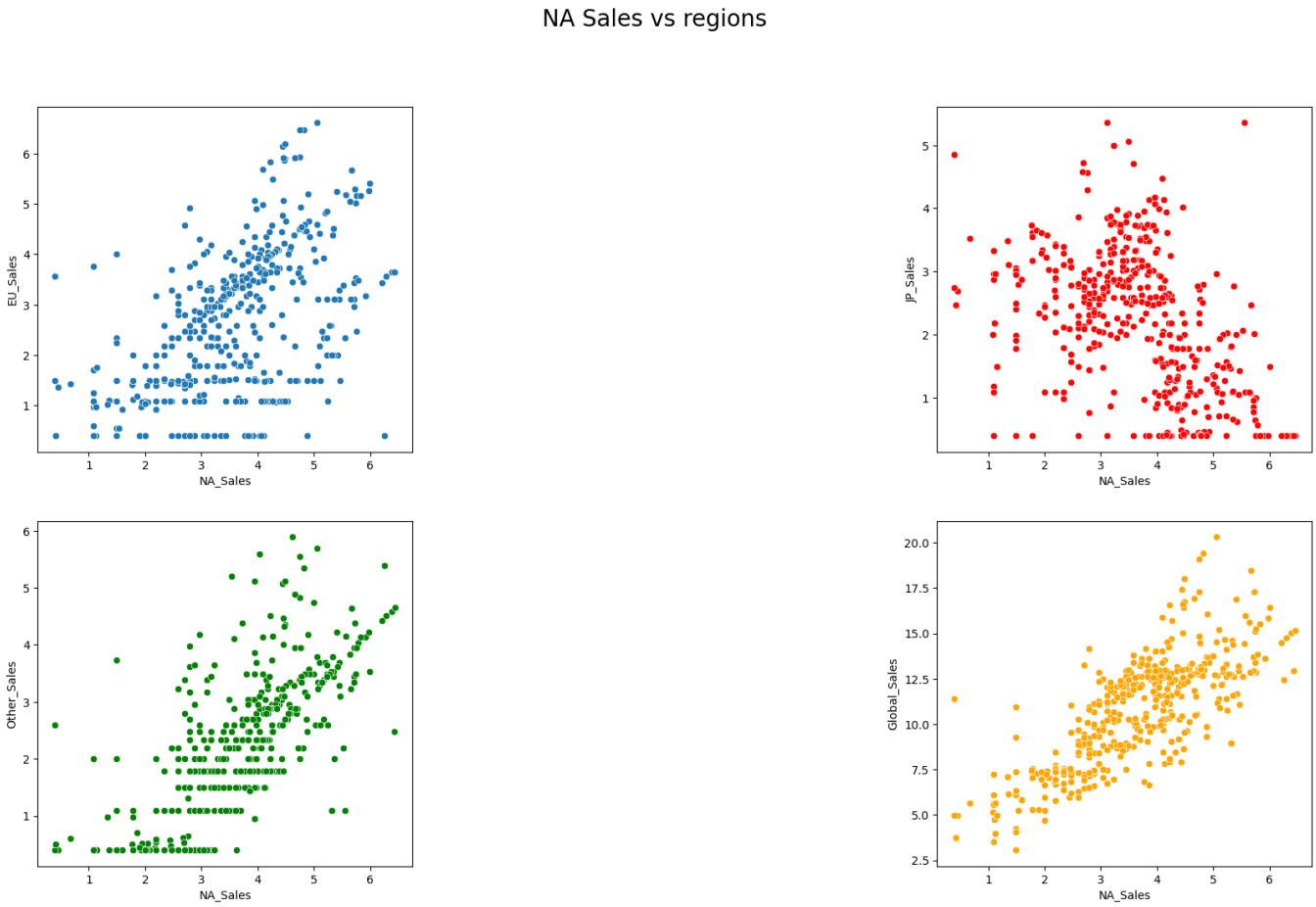
We are plotting each plot on a single `axes` object.

Hence, we are using a 2D notation to access each grid/axes object of the subplot

Instead of accesing the individual axes using `ax[0, 0]`, `ax[1, 0]`, there is another method we can use too

```
import matplotlib.pyplot as plt
import numpy as np

plt.figure(figsize=(20,12)).suptitle("NA Sales vs regions",fontsize=20)
# Using a 2x3 subplot
plt.subplot(2, 3, 1)
sns.scatterplot(x='NA_Sales', y='EU_Sales', data=top3_data)


plt.subplot(2, 3, 3)
sns.scatterplot(x='NA_Sales', y='JP_Sales', data=top3_data, color='red')
```

```
plt.subplot(2, 3, 4)
sns.scatterplot(x='NA_Sales', y='Other_Sales', data=top3_data, color='green')

plt.subplot(2, 3, 6)
sns.scatterplot(x='NA_Sales', y='Global_Sales', data=top3_data, color='orange')

plt.show()
```



`Suptitle` adds a title to the whole figure

We need to observe a few things here

1. The 3rd paramter defines the position of the plot
2. The position/numbering starts from 1
3. It goes on row-wise from start of row to its finish
4. Empty subplots don't show any axes

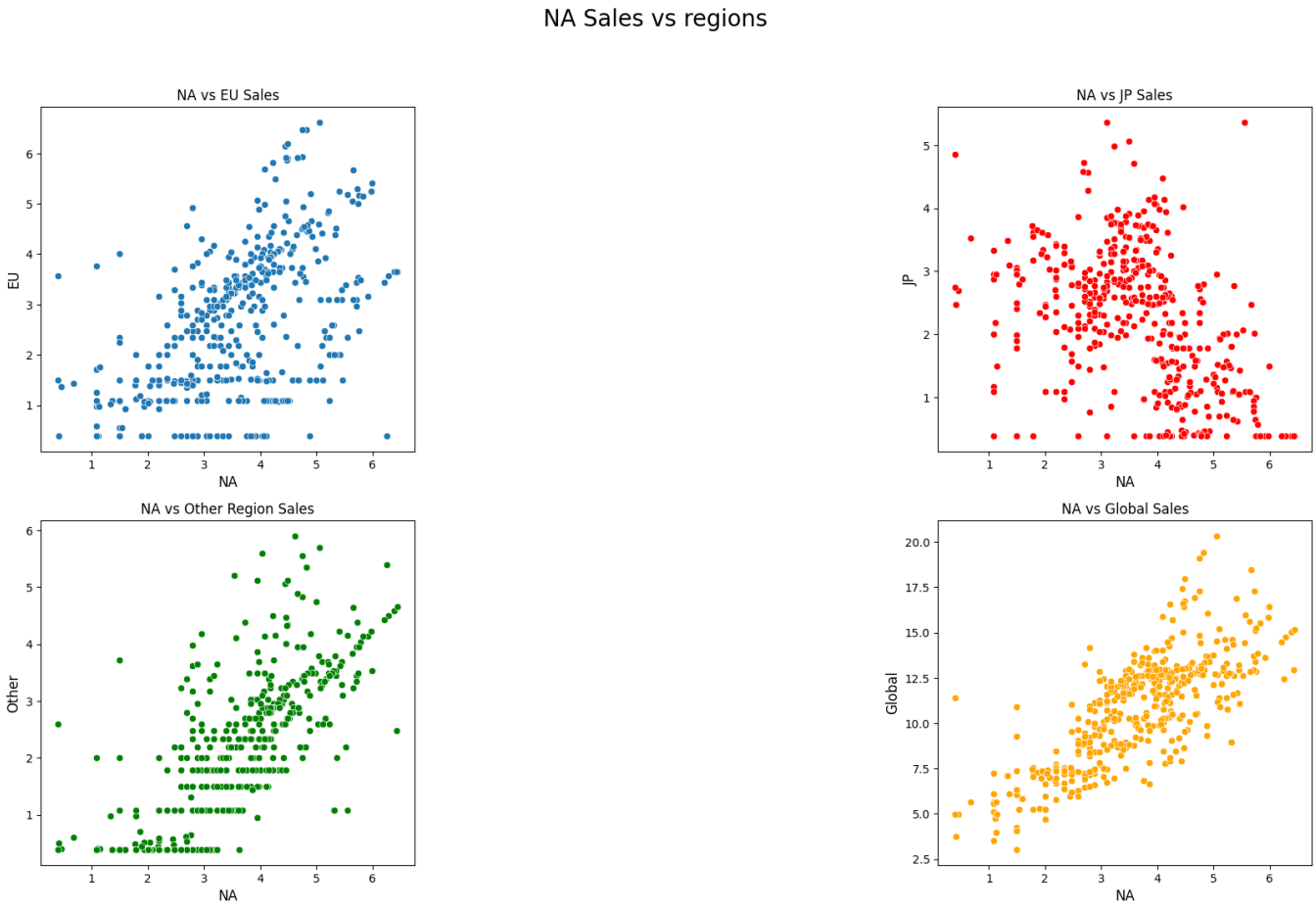
But how do we know which plot belongs to which category?

Basically the context of each plot

We can use `title`, `x/y label` and every other functionality for the subplots too

```
plt.figure(figsize=(20,12)).suptitle("NA Sales vs regions",fontsize=20)
# Using a 2x3 subplot
plt.subplot(2, 3, 1)
```

```
sns.scatterplot(x='NA_Sales', y='EU_Sales', data=top3_data)
plt.title('NA vs EU Sales', fontsize=12)
plt.xlabel('NA', fontsize=12)
plt.ylabel('EU', fontsize=12)

plt.subplot(2, 3, 3)
sns.scatterplot(x='NA_Sales', y='JP_Sales', data=top3_data, color='red')
plt.title('NA vs JP Sales', fontsize=12)
plt.xlabel('NA', fontsize=12)
plt.ylabel('JP', fontsize=12)


plt.subplot(2, 3, 4)
sns.scatterplot(x='NA_Sales', y='Other_Sales', data=top3_data, color='green')
plt.title('NA vs Other Region Sales', fontsize=12)
plt.xlabel('NA', fontsize=12)
plt.ylabel('Other', fontsize=12)

plt.subplot(2, 3, 6)
sns.scatterplot(x='NA_Sales', y='Global_Sales', data=top3_data, color='orange')
plt.title('NA vs Global Sales', fontsize=12)
plt.xlabel('NA', fontsize=12)
plt.ylabel('Global', fontsize=12)

plt.show()
```



What if we want to span a plot across the full length of the plot?

Think of this in **terms of a grid.**

Currently we are **dividing our plot into 2 rows and 3 columns**

But we want our plot to be across the middle column, with grids 2 and 5

This can be said as a **single column**

So, this problem can be simplified to plotting the plot across **second column in a 1 row 3 column subplot**

```
plt.figure(figsize=(20,12)).suptitle("Video Games Sales Dashboard",fontsize=20)
# Using a 2x3 subplot
plt.subplot(2, 3, 1)
sns.scatterplot(x='NA_Sales', y='EU_Sales', data=top3_data)
plt.title('NA vs EU Sales', fontsize=12)
plt.xlabel('NA', fontsize=12)
plt.ylabel('EU', fontsize=12)
```