```
from google.colab import drive
drive.mount('/content/drive')
```

```
  Mounted at /content/drive
```

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

```
# from google.colab import files


# uploaded = files.upload()
```

```
data = pd.read_csv("/content/drive/ MyDrive/BIProject/vgsales.csv")
data.head(5)
```

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales	JP_S
0	Wii Sports	Wii	2006.0	Sports	Nintendo	41.36	28.96	
1	Super Mario Bros.	NES	1985.0	Platform	Nintendo	29.08	3.58	
2	Mario Kart Wii	Wii	2008.0	Racing	Nintendo	15.68	12.76	
3	Wii Sports Resort	Wii	2009.0	Sports	Nintendo	15.61	10.93	
4	Pokemon Red/Pokemon Blue	GB	1996.0	Role-Playing	Nintendo	11.27	8.89	1

```
print(data.isnull().sum())
```

```
  Name                  2
  Platform              0
  Year_of_Release     269
  Genre                 2
  Publisher            54
  NA_Sales              0
  EU_Sales              0
  JP_Sales              0
  Other_Sales           0
  Global_Sales          0
  Critic_Score       8582
  Critic_Count       8582
  User_Score         6704
```

```
User_Count         9129
Developer          6623
Rating             6769
dtype: int64
```

```
data = data.dropna()
data.dtypes
data['User_Score'] = data['User_Score'].apply(pd.to_numeric)
data.dtypes
```

```
Name                object
Platform            object
Year_of_Release    float64
Genre               object
Publisher           object
NA_Sales           float64
EU_Sales           float64
JP_Sales           float64
Other_Sales        float64
Global_Sales       float64
Critic_Score       float64
Critic_Count       float64
User_Score         float64
User_Count         float64
Developer           object
Rating              object
dtype: object
```

```
data.describe()
```

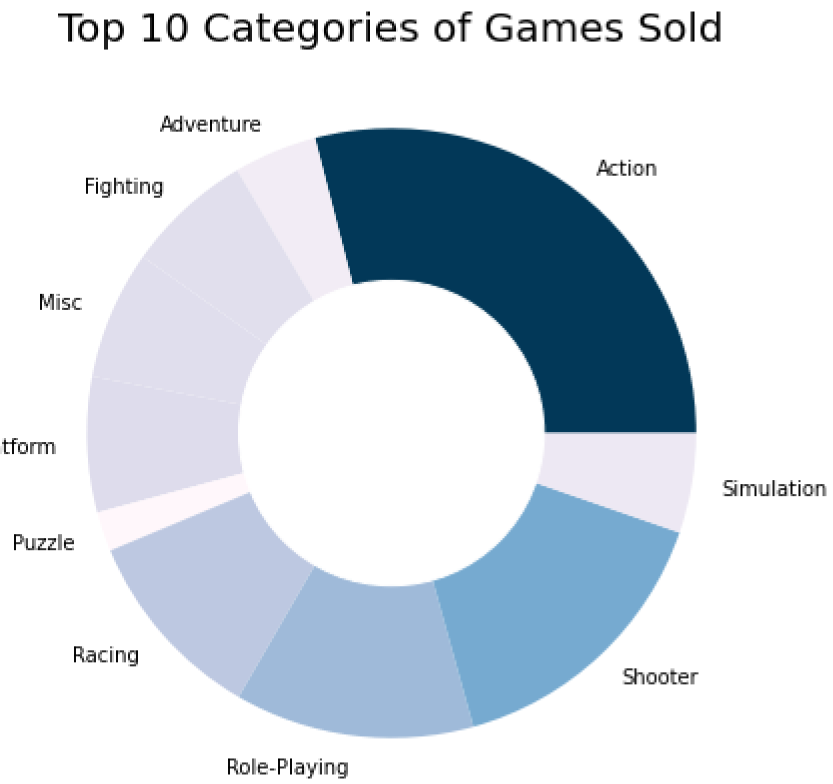
	Year_of_Release	NA_Sales	EU_Sales	JP_Sales	Other_Sales	Global_Sales
count	6825.000000	6825.000000	6825.000000	6825.000000	6825.000000	6825.000000
mean	2007.436777	0.394484	0.236089	0.064158	0.082677	0.777590
std	4.211248	0.967385	0.687330	0.287570	0.269871	1.963443
min	1985.000000	0.000000	0.000000	0.000000	0.000000	0.010000
25%	2004.000000	0.060000	0.020000	0.000000	0.010000	0.110000
50%	2007.000000	0.150000	0.060000	0.000000	0.020000	0.290000
75%	2011.000000	0.390000	0.210000	0.010000	0.070000	0.750000
max	2016.000000	41.360000	28.960000	6.500000	10.570000	82.530000

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

```
Action          1630
Sports           943
Shooter          864
```

```
Role-Playing     712
Racing           581
Platform         403
Misc             384
Fighting         378
Simulation       297
Strategy         267
Adventure        248
Puzzle           118
Name: Genre, dtype: int64
```

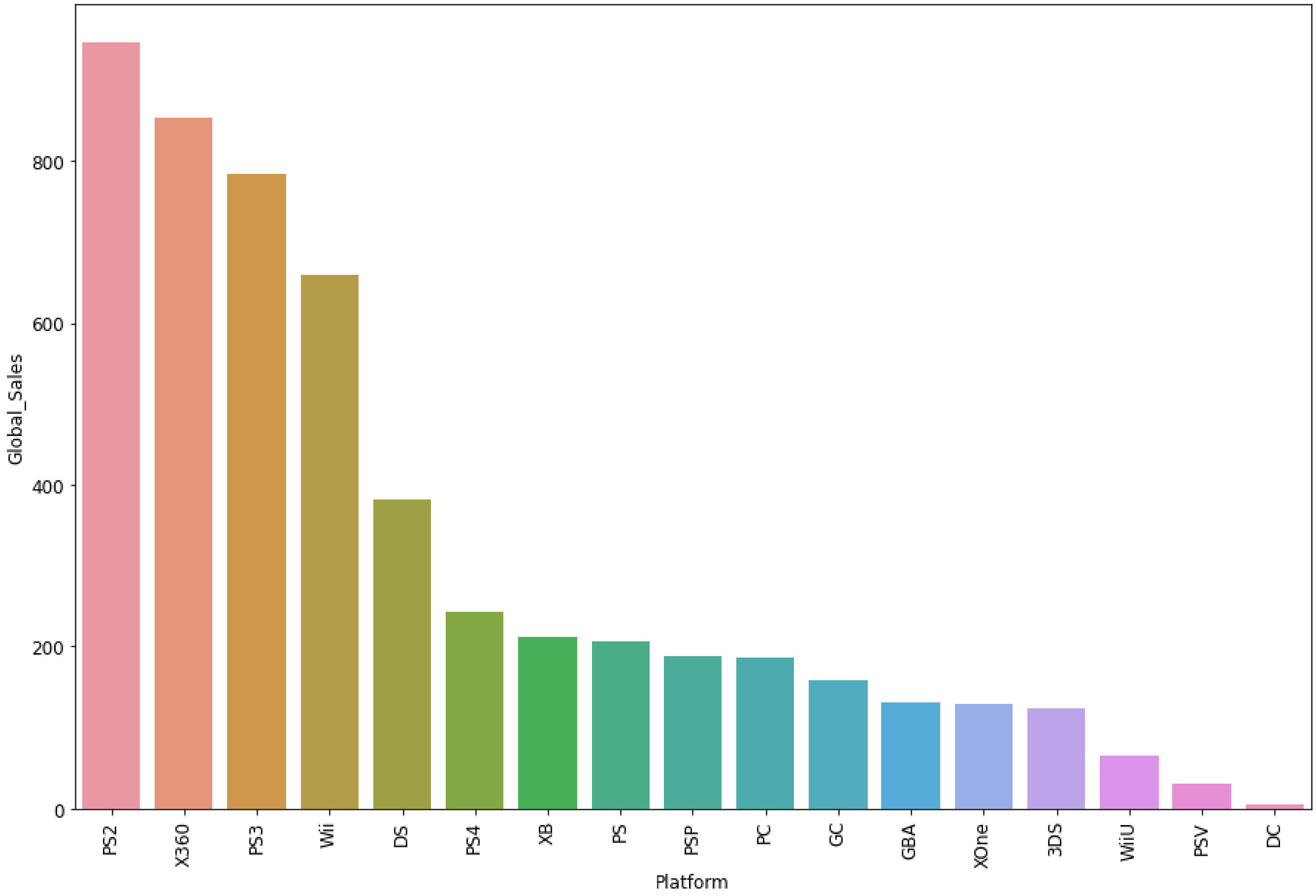
```
import matplotlib as mpl
game = data.groupby("Genre")["Global_Sales"].count().head(10)
custom_colors = mpl.colors.Normalize(vmin=min(game), vmax=max(game))
colours = [mpl.cm.PuBu(custom_colors(i)) for i in game]
plt.figure(figsize=(7,7))
plt.pie(game, labels=game.index, colors=colours)
central_circle = plt.Circle((0, 0), 0.5, color='white')
fig = plt.gcf()
fig.gca().add_artist(central_circle)
plt.rc('font', size=12)
plt.title("Top 10 Categories of Games Sold", fontsize=20)
plt.show()
```



```
data_platform = data.groupby(by=['Platform'])['Global_Sales'].sum()
data_platform = data_platform.reset_index()
data_platform = data_platform.sort_values(by=['Global_Sales'], ascending=False)
```

```
plt.figure(figsize=(15, 10))
sns.barplot(x="Platform", y="Global_Sales", data=data_platform)
plt.xticks(rotation=90)
```

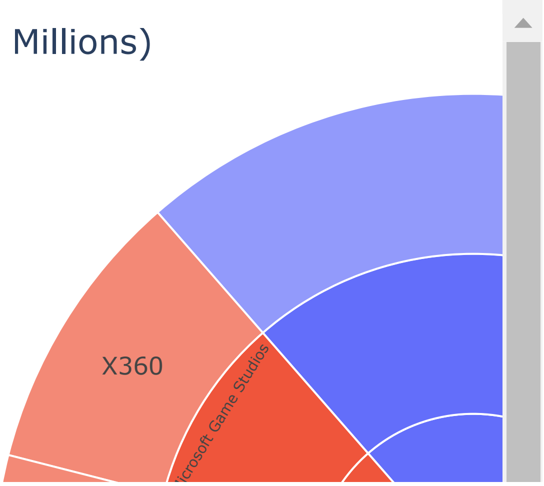
```
(array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16]),
 <a list of 17 Text major ticklabel objects>)
```



```
from plotly import express as px
top_sales = data.sort_values(by=['NA_Sales', 'EU_Sales', 'JP_Sales', 'Other_Sales'], ascen

# ['NA_Sales', '', '', '']
dicts_name = {
    'NA_Sales' : "North America Sales ( In Millions)",
    'EU_Sales' : "Europe Sales ( In Millions)",
    'JP_Sales' : "Japan Sales ( In Millions)",
    'Other_Sales' : "Other Sales ( In Millions)",
}

```

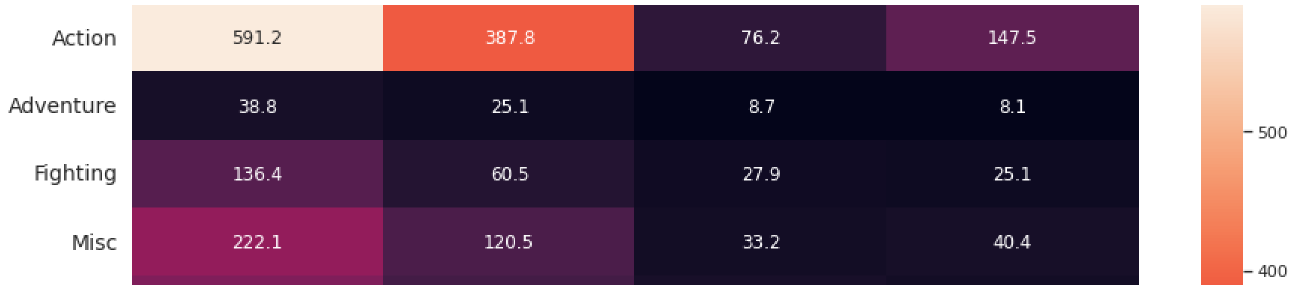
```
for (key, title) in dicts_name.items():

    fig = px.sunburst(top_sales, path=['Genre', 'Publisher', 'Platform'], values=key, titl

    fig.update_layout(
        grid= dict(columns=2, rows=2),
        margin = dict(t=40, l=2, r=2, b=5)
    )

    fig.show()
```

Top Selling by North America Sales (In Millions)



```

comp_genre = data[['Genre', 'NA_Sales', 'EU_Sales', 'JP_Sales', 'Other_Sales']]
# comp_genre
comp_map = comp_genre.groupby(by=['Genre']).sum()
# comp_map
```

```
plt.figure(figsize=(15, 10))
sns.set(font_scale=1)
sns.heatmap(comp_map, annot=True, fmt = '.1f')

plt.xticks(fontsize=14)
plt.yticks(fontsize=14)
plt.show()
```

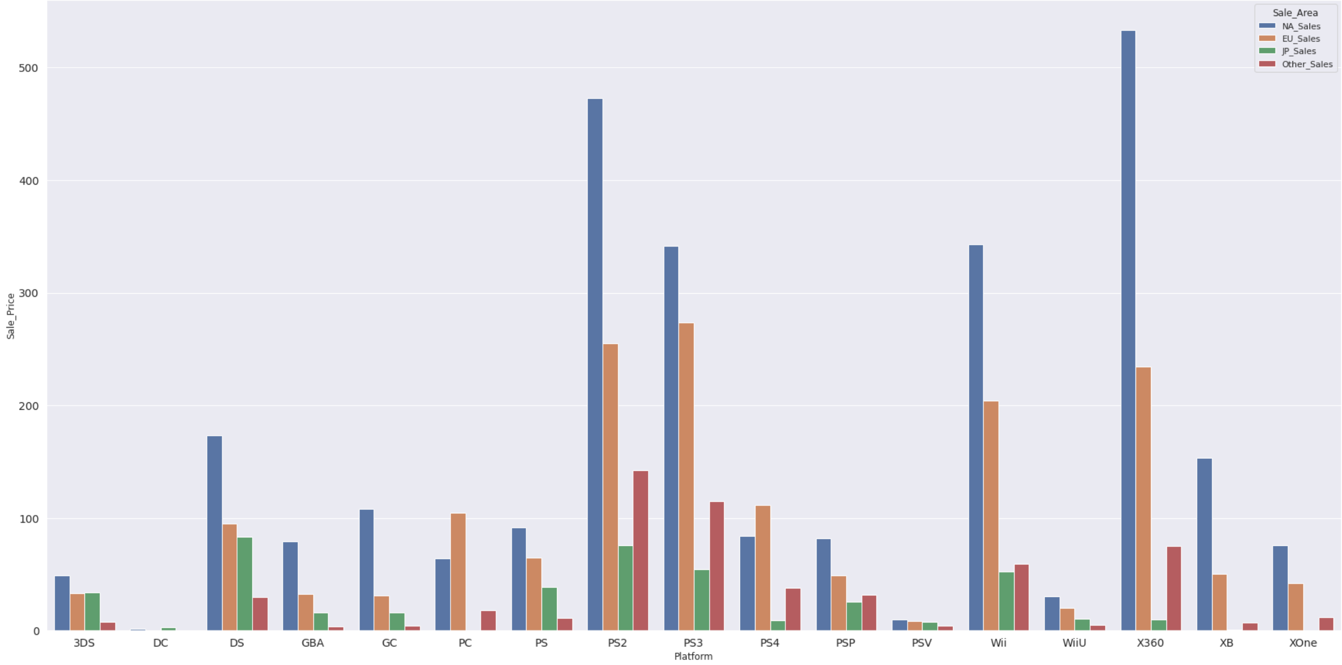


```
rating = data[['Rating', 'NA_Sales', 'EU_Sales', 'JP_Sales', 'Other_Sales']]
# comp_genre
comp_rat = rating.groupby(by=['Rating']).sum()
```

Racing
225.6
164.7
27.8
58.3

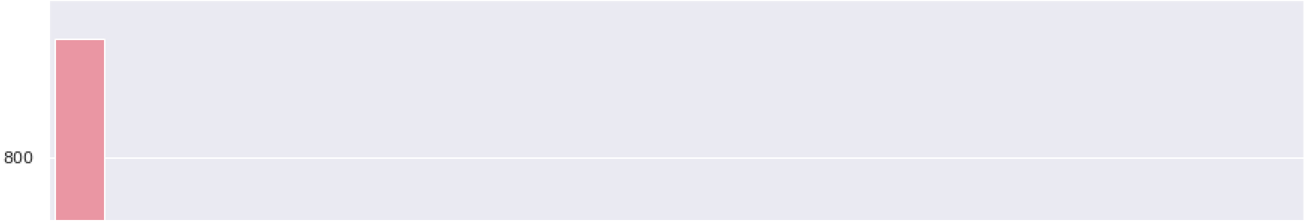
```
plt.figure(figsize=(15, 10))
sns.set(font_scale=1)
sns.heatmap(comp_rat, annot=True, fmt = '.1f')

plt.xticks(fontsize=14)
plt.yticks(fontsize=14)
plt.show()
```

```
comp_platform = data[['Platform', 'NA_Sales', 'EU_Sales', 'JP_Sales', 'Other_Sales']]
comp_platform.head()
comp_platform = comp_platform.groupby(by=['Platform']).sum().reset_index()
comp_table = pd.melt(comp_platform, id_vars=['Platform'], value_vars=['NA_Sales', 'EU_Sale
comp_table.head()
plt.figure(figsize=(30, 15))
sns.barplot(x='Platform', y='Sale_Price', hue='Sale_Area', data=comp_table)
plt.xticks(fontsize=14)
plt.yticks(fontsize=14)
plt.show()
```



```
top_publisher = data.groupby(by=['Publisher'])['Year_of_Release'].count().sort_values(asce
top_publisher = pd.DataFrame(top_publisher).reset_index()
plt.figure(figsize=(15, 10))
sns.countplot(x="Publisher", data=data, order = data.groupby(by=['Publisher'])['Year_of_Re
plt.xticks(rotation=90)
```

```
(array([ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12, 13, 14, 15, 16,
        17, 18, 19]), <a list of 20 Text major ticklabel objects>)
```



```
top_sale_reg = data[['NA_Sales', 'EU_Sales', 'JP_Sales', 'Other_Sales']]
# pd.DataFrame(top_sale_reg.sum(), columns=['a', 'b'])
top_sale_reg = top_sale_reg.sum().reset_index()
top_sale_reg = top_sale_reg.rename(columns={"index": "region", 0: "sale"})
top_sale_reg

labels = top_sale_reg['region']
sizes = top_sale_reg['sale']
plt.figure(figsize=(10, 8))
plt.pie(sizes, labels=labels, autopct='%1.1f%%', shadow=True, startangle=90)
```

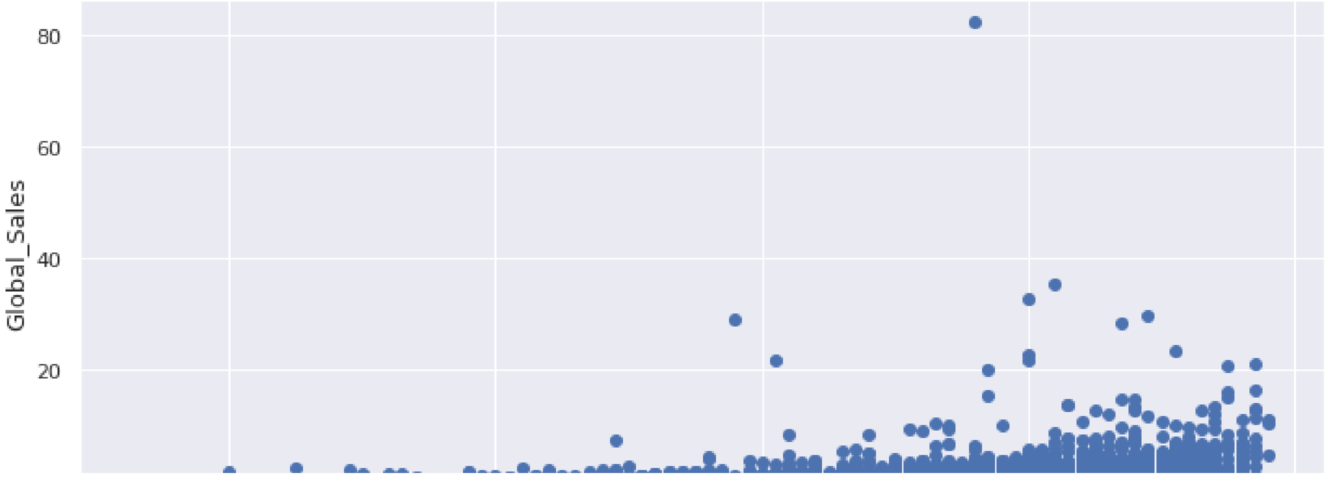
```
([<matplotlib.patches.Wedge at 0x7ff1a5756a90>,
  <matplotlib.patches.Wedge at 0x7ff1a57562d0>,
  <matplotlib.patches.Wedge at 0x7ff1a574f610>,
  <matplotlib.patches.Wedge at 0x7ff1a9029590>],
```

```
#data = data.drop(data[data['Global_Sales']>60].index)
```

```
  Text(0.8801245340527122, 0.6598339219519532, 'JP Sales'),
```

```
corrmat = data.corr()
top_corr_features = corrmat.index
plt.figure(figsize=(10,10))
#Plotting heat map
g=sns.heatmap(data[top_corr_features].corr(),annot=True,linewidths=.5)
b, t = plt.ylim() # Finding the values for bottom and top
b += 0.5
t -= 0.5
plt.ylim(b, t)
plt.show()
```

```
feat=['Critic_Score', 'User_Score','User_Count','Critic_Count','Year_of_Release']
for i in feat:
  fig, ax = plt.subplots(1,1, figsize=(12,5))
  ax.scatter(x = data[i], y = data['Global_Sales'])
  plt.ylabel('Global_Sales', fontsize=13)
  plt.xlabel(i, fontsize=13)
  plt.show()
  sns.regplot(x=i, y="Global_Sales", data=data,truncate=True, x_bins=15, color="#75556c").
```



```
def rm_outliers(df, list_of_keys):
    df_out = df
    for key in list_of_keys:
        # Calculate first and third quartile
        first_quartile = df_out[key].describe()["25%"]
        third_quartile = df_out[key].describe()["75%"]

        # Interquartile range
        iqr = third_quartile - first_quartile

        # Remove outliers
        removed = df_out[(df_out[key] <= (first_quartile - 1.5 * iqr)) |
                        (df_out[key] >= (third_quartile + 1.5 * iqr))]
        df_out = df_out[(df_out[key] > (first_quartile - 1.5 * iqr)) &
                        (df_out[key] < (third_quartile + 1.5 * iqr))]
    return df_out, removed
```

```
data2, outliers = rm_outliers(data, ["Global_Sales"])
```

```
data2
```

	Name	Platform	Year_of_Release	Genre	Publisher	NA_Sales	EU_Sales
1050	Deal or No Deal	DS	2007.0	Misc	Mindscape	1.15	0.40
1052	Portal 2	PS3	2011.0	Shooter	Valve	0.83	0.60

```
counts = data['Publisher'].value_counts()

data['Publisher'] = data['Publisher'].apply(lambda x: 'Small Publisher' if counts[x] < 50

counts = data2['Publisher'].value_counts()

data2['Publisher'] = data2['Publisher'].apply(lambda x: 'Small Publisher' if counts[x] < 5

counts = outliers['Publisher'].value_counts()

outliers['Publisher'] = outliers['Publisher'].apply(lambda x: 'Small Publisher' if counts[
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:7: SettingWithCopyWarning:


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_

/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:11: SettingWithCopyWarning


A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_
```

```
features=["Critic_Score","User_Count","Critic_Count"]
d1=data.copy()
d2=data2.copy()
d3=outliers.copy()
feature = ["Platform","Genre","Rating","Publisher"]
y1 = data["Global_Sales"]
y2 = data2["Global_Sales"]
y3 = outliers["Global_Sales"]
features
```

```
['Critic_Score', 'User_Count', 'Critic_Count']
```

```
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
```

```
import numpy as np

le = LabelEncoder()
for col in feature:
    d1[col]=le.fit_transform(d1[col])
    d2[col]=le.fit_transform(d2[col])
    d3[col]=le.fit_transform(d3[col])

```

```
features.extend(feature)
```

```
X = d1[features]
y = data['Global_Sales']
X2 = d2[features]
y2 = data2['Global_Sales']
X3 = d3[features]
y3 = outliers['Global_Sales']
```

```
X
```

	Critic_Score	User_Count	Critic_Count	Platform	Genre	Rating	Publisher
0	76.0	322.0	51.0	12	10	1	15
2	82.0	709.0	73.0	12	6	1	15
3	80.0	192.0	73.0	12	10	1	15
6	89.0	431.0	65.0	2	4	1	15
7	58.0	129.0	41.0	12	3	1	15
...	...	...	...	...	...	...	...
16667	46.0	21.0	4.0	3	0	1	19
16677	81.0	9.0	12.0	3	2	4	13
16696	80.0	412.0	20.0	5	0	4	10
16700	61.0	43.0	12.0	5	8	6	19
16706	60.0	13.0	12.0	5	11	2	19

6825 rows × 7 columns

```
from sklearn.model_selection import train_test_split
x_train,x_test,y_train,y_test = train_test_split(X,y,test_size=0.2,random_state=0)
x2_train,x2_test,y2_train,y2_test = train_test_split(X2,y2,test_size=0.2,random_state=0)
x3_train,x3_test,y3_train,y3_test = train_test_split(X3,y3,test_size=0.2,random_state=0)
```

```
## Training the multiple linear regression on the training set
from sklearn.linear_model import LinearRegression
regressor_MultiLinear1 = LinearRegression()
regressor_MultiLinear2 = LinearRegression()
regressor_MultiLinear3 = LinearRegression()
regressor_MultiLinear1.fit(x_train,y_train)
regressor_MultiLinear2.fit(x2_train,y2_train)
regressor_MultiLinear3.fit(x3_train,y3_train)
```

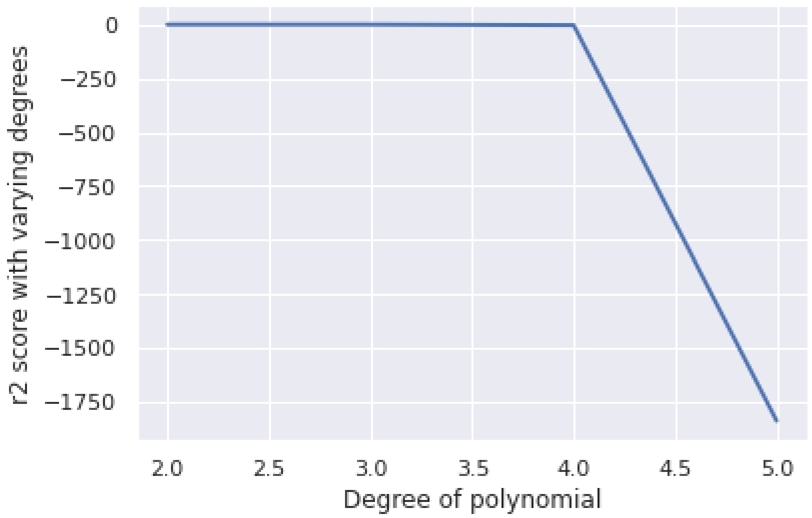
```
LinearRegression()
```

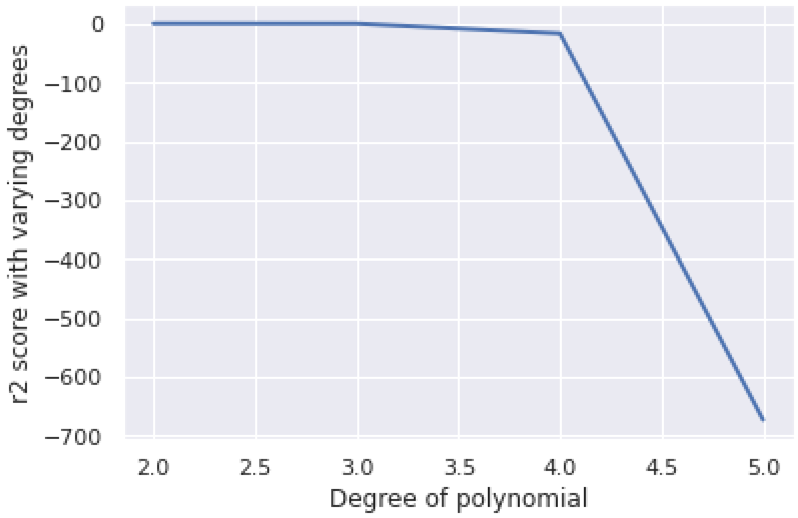
```
y_pred1 = regressor_MultiLinear1.predict(x_test)
#print("for all dataset ",y_pred1)
y_pred2 = regressor_MultiLinear2.predict(x2_test)
#print("for dataset with removed outliers ",y_pred2)
y_pred3 = regressor_MultiLinear3.predict(x3_test)
#print("for outlier dataset ",y_pred3)
```

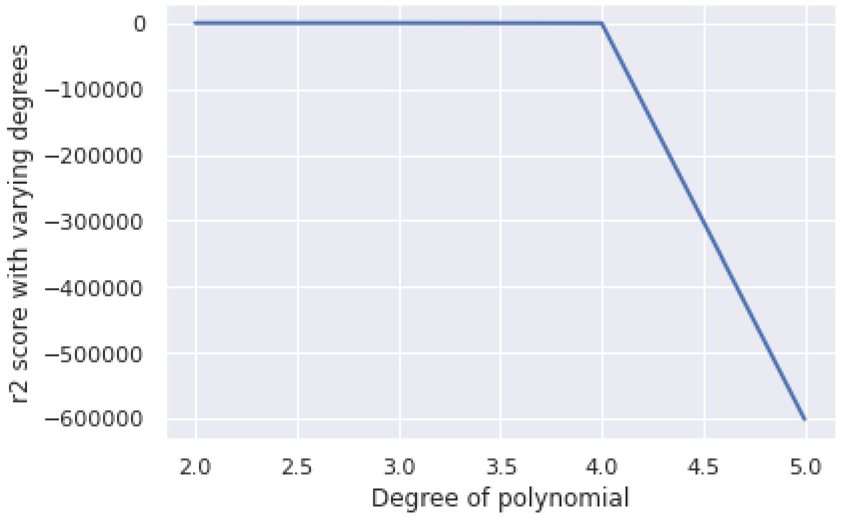
```
# Calculating r2 score
from sklearn.metrics import r2_score
r2_MultiLinear = r2_score(y_test,y_pred1)
print(r2_MultiLinear)
r2_MultiLinear = r2_score(y2_test,y_pred2)
print(r2_MultiLinear)
r2_MultiLinear = r2_score(y3_test,y_pred3)
print(r2_MultiLinear)
```

```
0.10492455277481427
0.20209660390201634
0.06377777866553735
```

```
## Finding out the optimal degree of polynomial regression
from sklearn.preprocessing import PolynomialFeatures
sns.set_style('darkgrid')
def polyplot(xtrain,ytrain,xtest,ytest):
  scores_list = []
  pRange = range(2,6)
  for i in pRange :
      poly_reg = PolynomialFeatures(degree=i)
      x_poly = poly_reg.fit_transform(xtrain)
      poly_regressor = LinearRegression()
      poly_regressor.fit(x_poly,ytrain)
      y_pred = poly_regressor.predict(poly_reg.fit_transform(xtest))
      scores_list.append(r2_score(ytest,y_pred))
  plt.plot(pRange,scores_list,linewidth=2)
  plt.xlabel('Degree of polynomial')
  plt.ylabel('r2 score with varying degrees')
  plt.show()
polyplot(x_train,y_train ,x_test,y_test)
polyplot(x2_train,y2_train ,x2_test,y2_test)
polyplot(x3_train,y3_train ,x3_test,y3_test)
```



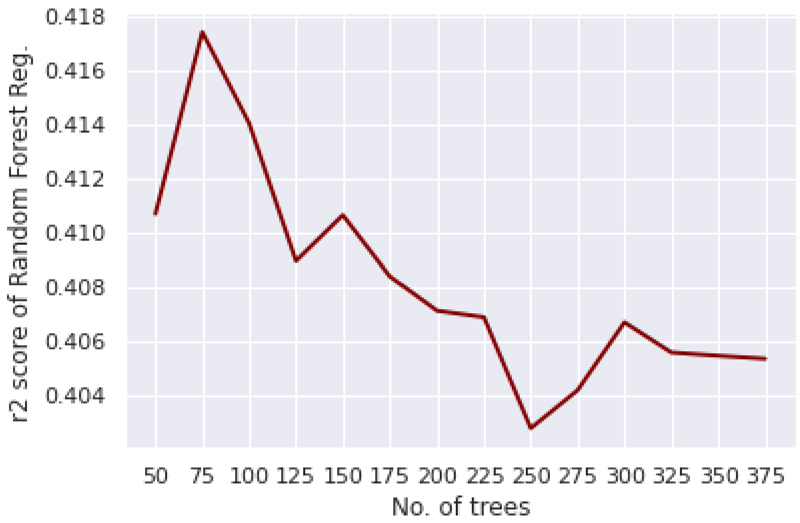


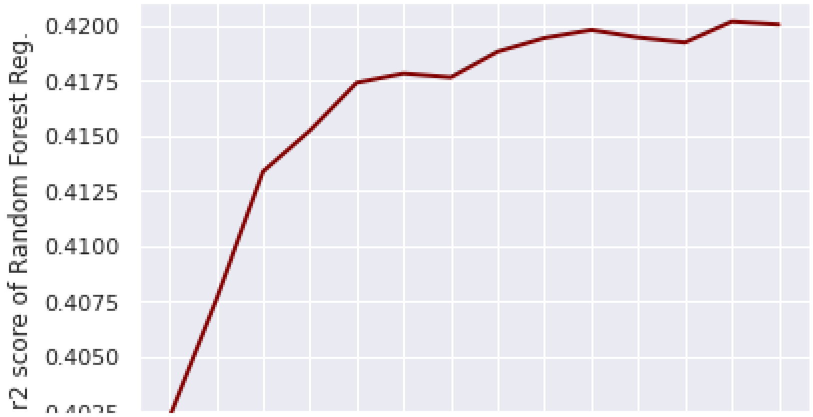


```
## Training the polynomial regression on the training model
def poly(xtrain, ytrain , xtest ,ytest):
  poly_reg = PolynomialFeatures(degree=2)
  x_poly = poly_reg.fit_transform(xtrain)
  poly_regressor = LinearRegression()
  poly_regressor.fit(x_poly,ytrain)
  y_pred = poly_regressor.predict(poly_reg.fit_transform(xtest))
  r2_poly = r2_score(ytest,y_pred)
  return r2_poly
print(poly(x_train,y_train ,x_test,y_test))
print(poly(x2_train,y2_train ,x2_test,y2_test))
print(poly(x3_train,y3_train ,x3_test,y3_test))
```

```
0.21695986796292321
0.24684587182313034
0.15610619368864342
```

```
# Finding out the optimal number of trees for Random Forest Regression
from sklearn.ensemble import RandomForestRegressor
forestRange=range(50,300,25)
def forests(xtrain,ytrain,xtest,ytest):
  scores_list=[]
  for i in forestRange:
      regressor_Forest = RandomForestRegressor(n_estimators=i,random_state=0)
      regressor_Forest.fit(xtrain,ytrain)
      y_pred = regressor_Forest.predict(xtest)
      scores_list.append(r2_score(ytest,y_pred))
  plt.plot(forestRange,scores_list,linewidth=2,color='maroon')
  plt.xticks(forestRange)
  plt.xlabel('No. of trees')
  plt.ylabel('r2 score of Random Forest Reg.')
  plt.show()
forests(x_train,y_train ,x_test,y_test)
forests(x2_train,y2_train ,x2_test,y2_test)
forests(x3_train,y3_train ,x3_test,y3_test)
```





```
# Training the Random Forest regression on the training model
def forest(xtrain, ytrain , xtest ,ytest,est):
  regressor_Forest = RandomForestRegressor(n_estimators=est,random_state=0)
  regressor_Forest.fit(xtrain,ytrain)
  y_pred = regressor_Forest.predict(xtest)
  r2_forest = r2_score(ytest,y_pred)
  return r2_forest
print(forest(x_train,y_train ,x_test,y_test,75))
print(forest(x2_train,y2_train ,x2_test,y2_test,350))
print(forest(x3_train,y3_train ,x3_test,y3_test,275))
```

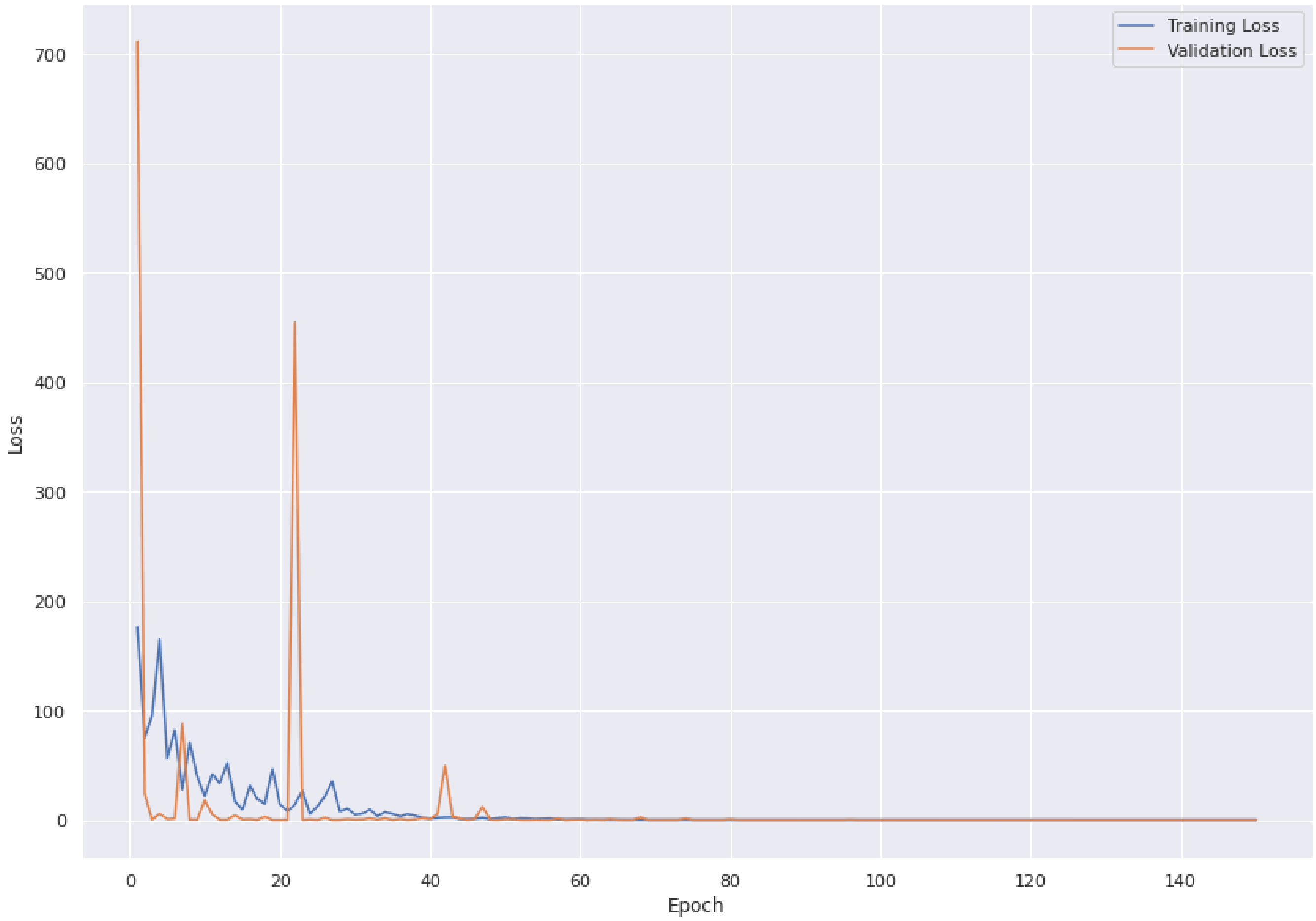
```
  0.4173995514782516
  0.42019352237037844
  0.1209474383767134
```

```
  ## Applying XGBoost Regression model on the training set
from xgboost import XGBRegressor
def xgb(xtrain, ytrain , xtest ,ytest):
    regressor_xgb = XGBRegressor(objective ='reg:squarederror')
    regressor_xgb.fit(xtrain,ytrain)
    ## Predicting test results
    y_pred = regressor_xgb.predict(xtest)
    ## Calculating r2 score
    r2_xgb = r2_score(ytest,y_pred)
    return (r2_xgb)
print(xgb(x_train,y_train ,x_test,y_test))
print(xgb(x2_train,y2_train ,x2_test,y2_test))
print(xgb(x3_train,y3_train ,x3_test,y3_test))
```

```
0.3766346103180298
0.42063805335977456
0.19319476303447647
```

```
import numpy as np
from keras.models import Sequential
from keras.layers import Dense, Dropout, Activation
from keras.utils import np_utils
from sklearn import metrics
import tensorflow as tf

inputs = tf.keras.Input(shape=(7,))
x = tf.keras.layers.Dense(128, activation='relu')(inputs)
x = tf.keras.layers.Dense(128, activation='relu')(x)
outputs = tf.keras.layers.Dense(1)(x)

model = tf.keras.Model(inputs=inputs, outputs=outputs)


optimizer = tf.keras.optimizers.RMSprop(0.001)

model.compile(
    optimizer=optimizer,
    loss='mse'
)


batch_size = 64
epochs = 150

history = model.fit(
    x2_train,
    y2_train,
    validation_split=0.2,
    batch_size=batch_size,
    epochs=epochs,
    verbose=0
)
```

```
plt.figure(figsize=(14, 10))

epochs_range = range(1, epochs + 1)
train_loss = history.history['loss']
val_loss = history.history['val_loss']

plt.plot(epochs_range, train_loss, label="Training Loss")
plt.plot(epochs_range, val_loss, label="Validation Loss")

plt.xlabel("Epoch")
plt.ylabel("Loss")
plt.legend()

plt.show()
```



```
np.argmin(val_loss)
```

```
93
```

```
!pip install tensorflow_addons
```

```
Collecting tensorflow_addons
  Downloading tensorflow_addons-0.16.1-cp37-cp37m-manylinux_2_12_x86_64.manylinux2010_x
     |████████████████████████████████| 1.1 MB 8.0 MB/s
Requirement already satisfied: typeguard>=2.7 in /usr/local/lib/python3.7/dist-packages
```

```
Installing collected packages: tensorflow-addons
Successfully installed tensorflow-addons-0.16.1
```

```
from tensorflow_addons.metrics import RSquare
y_pred = np.squeeze(model.predict(x_test))

result = RSquare()
result.update_state(y_test, y_pred)

print("R^2 Score:", result.result())
```

```
R^2 Score: tf.Tensor(0.038393497, shape=(), dtype=float32)
```

```
model.evaluate(x_test, y_test)
```

```
43/43 [==============================] - 0s 2ms/step - loss: 4.0662
4.066182613372803
```