project3

April 19, 2024

1 Import Lib

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import statsmodels.api as sm
from sklearn.impute import KNNImputer
from sklearn.feature_selection import SelectKBest, f_regression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error, r2_score,mean_absolute_error
from sklearn.ensemble import RandomForestRegressor
from sklearn.neighbors import KNeighborsRegressor
from sklearn.neural_network import MLPRegressor
```

2 Reading Dataset

[2]:
```
df=pd.read_excel(r"C:\Users\ganesh\Desktop\Sample - Superstore (1).xlsx")  #␣
 ↪reading excel file
pd.set_option("display.max_column",22)
df.head()     #to display top 5 rows
```

[2]:

	Row ID	Order ID	Order Date	Ship Date	Ship Mode	Customer ID	Customer Name	Segment	Country	City	State
0	1.0	CA-2016-152156	2016-11-08	2016-11-11	Second Class	CG-12520	Claire Gute	Consumer	United States	Henderson	Kentucky
1	2.0	CA-2016-152156	2016-11-08	2016-11-11	Second Class	CG-12520	Claire Gute	Consumer	United States	Henderson	Kentucky
2	3.0	CA-2016-138688	2016-06-12	2016-06-16	Second Class	DV-13045	Darrin Van Huff	Corporate	United States	Los Angeles	California
3	4.0	US-2015-108966	2015-10-11	2015-10-18	Standard Class	SO-20335	Sean O'Donnell	Consumer	United States	Fort Lauderdale	Florida
4	5.0	US-2015-108966	2015-10-11	2015-10-18	Standard Class	SO-20335	Sean O'Donnell	Consumer	United States	Fort Lauderdale	Florida

```
   Postal Code Region       Product ID         Category Sub-Category  \
0      42420.0  South  FUR-BO-10001798        Furniture    Bookcases
1      42420.0  South  FUR-CH-10000454        Furniture       Chairs
2      90036.0   West  OFF-LA-10000240  Office Supplies       Labels
3      33311.0  South  FUR-TA-10000577        Furniture       Tables
4      33311.0  South  OFF-ST-10000760  Office Supplies      Storage

                                        Product Name     Sales  Quantity  \
0                  Bush Somerset Collection Bookcase    261.96       2.0
1  Hon Deluxe Fabric Upholstered Stacking Chairs,…    731.94       3.0
2  Self-Adhesive Address Labels for Typewriters b…     14.62       2.0
3      Bretford CR4500 Series Slim Rectangular Table  957.5775       5.0
4                     Eldon Fold 'N Roll Cart System    22.368       2.0

   Discount    Profit
0      0.00   41.9136
1      0.00  219.5820
2      0.00    6.8714
3      0.45 -383.0310
4      0.20    2.5164
```

[3]:
```
df.shape    #shape of dataframe
```

[3]:
```
(9994, 21)
```

[4]:
```
df.info()  #information of dataframe
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9994 entries, 0 to 9993
Data columns (total 21 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Row ID         9985 non-null   float64
 1   Order ID       9981 non-null   object
 2   Order Date     9981 non-null   datetime64[ns]
 3   Ship Date      9979 non-null   datetime64[ns]
 4   Ship Mode      9975 non-null   object
 5   Customer ID    9968 non-null   object
 6   Customer Name  9937 non-null   object
 7   Segment        9942 non-null   object
 8   Country        9930 non-null   object
 9   City           9949 non-null   object
 10  State          9937 non-null   object
 11  Postal Code    9957 non-null   float64
 12  Region         9954 non-null   object
 13  Product ID     9956 non-null   object
 14  Category       9965 non-null   object
```

```
 15  Sub-Category    9952 non-null   object
 16  Product Name    9936 non-null   object
 17  Sales           9932 non-null   object
 18  Quantity        9948 non-null   float64
 19  Discount        9957 non-null   float64
 20  Profit          9944 non-null   float64
dtypes: datetime64[ns](2), float64(5), object(14)
memory usage: 1.6+ MB
```

[5]:
```
df.isnull().sum() #finding number of null values in each column
```

[5]:
```
Row ID           9
Order ID        13
Order Date      13
Ship Date       15
Ship Mode       19
Customer ID     26
Customer Name   57
Segment         52
Country         64
City            45
State           57
Postal Code     37
Region          40
Product ID      38
Category        29
Sub-Category    42
Product Name    58
Sales           62
Quantity        46
Discount        37
Profit          50
dtype: int64
```

[6]:
```
df.isnull().sum()/df.shape[0]*100   #percentage of missing values in each␣
 ↪columns
```

[6]:
```
Row ID          0.090054
Order ID        0.130078
Order Date      0.130078
Ship Date       0.150090
Ship Mode       0.190114
Customer ID     0.260156
Customer Name   0.570342
Segment         0.520312
Country         0.640384
City            0.450270
```

```
State            0.570342
Postal Code      0.370222
Region           0.400240
Product ID       0.380228
Category         0.290174
Sub-Category     0.420252
Product Name     0.580348
Sales            0.620372
Quantity         0.460276
Discount         0.370222
Profit           0.500300
dtype: float64
```

[7]:
```
df.duplicated().sum()  #duplicate rows
```

[7]:
```
10
```

[8]:
```
for i in df.select_dtypes(include="object").columns:   #counts number of unique values
   print(df[i].value_counts())
   print("***"*10)
```

```
CA-2017-100111    14
CA-2017-157987    12
US-2016-108504    11
CA-2016-165330    11
US-2015-126977    10
                  ..
US-2017-107636     1
US-2014-165862     1
CA-2016-101448     1
US-2017-117331     1
CA-2017-119914     1
Name: Order ID, Length: 5000, dtype: int64
******************************
Standard Class    5958
Second Class      1940
First Class       1534
Same Day           543
Name: Ship Mode, dtype: int64
******************************
WB-21850    37
AP-10915    35
PP-18955    34
JL-15835    34
MA-17560    34
            ..
```

```
LD-16855     1
AO-10810     1
CJ-11875     1
RE-19405     1
JR-15700     1
Name: Customer ID, Length: 793, dtype: int64
******************************
William Brown        37
Arthur Prichep       35
John Lee             34
Paul Prost           34
Matt Abelman         34
                     ..
Lela Donovan          1
Jocasta Rupert        1
Carl Jackson          1
Anthony O'Donnell     1
Ricardo Emerson       1
Name: Customer Name, Length: 792, dtype: int64
******************************
Consumer       5171
Corporate      2997
Home Office    1774
Name: Segment, dtype: int64
******************************
United States    9930
Name: Country, dtype: int64
******************************
New York City     913
Los Angeles       744
Philadelphia      529
San Francisco     507
Seattle           428
                  …
Cedar Rapids        1
Palatine            1
Jefferson City      1
Waterloo            1
Iowa City           1
Name: City, Length: 530, dtype: int64
******************************
California            1991
New York              1122
Texas                  975
Pennsylvania           578
Washington             506
                       …
31.744                   1
```

```
18.180000000000003       1
471.92                   1
89.584                   1
12.624                   1
Name: State, Length: 68, dtype: int64
******************************
West       3197
East       2828
Central    2305
South      1605
0            11
0.2           6
0.7           1
0.1           1
Name: Region, dtype: int64
******************************
OFF-PA-10001970    19
TEC-AC-10003832    18
FUR-FU-10004270    16
FUR-CH-10001146    15
TEC-AC-10002049    15
                   ..
TEC-MA-10002937     1
TEC-PH-10003535     1
OFF-AP-10002734     1
TEC-MA-10003353     1
OFF-ST-10001627     1
Name: Product ID, Length: 1878, dtype: int64
******************************
Office Supplies    6003
Furniture          2116
Technology         1846
Name: Category, dtype: int64
******************************
Binders        1512
Paper          1367
Furnishings     956
Phones          890
Storage         843
Art             787
Accessories     774
Chairs          612
Appliances      464
Labels          363
Tables          317
Envelopes       252
Bookcases       228
Fasteners       217
```

```
Supplies        190
Machines        114
Copiers          66
Name: Sub-Category, dtype: int64
*****************************
Staple envelope                                                   48
Easy-staple paper                                                 46
Staples                                                           46
Avery Non-Stick Binders                                           20
Staples in misc. colors                                           18
                                                                  ..
Eldon File Chest Portable File                                     1
Hewlett-Packard Deskjet D4360 Printer                              1
Jiffy Padded Mailers with Self-Seal Closure                        1
Hunt BOSTON Model 1606 High-Volume Electric Pencil Sharpener, Beige    1
Eldon Jumbo ProFile Portable File Boxes Graphite/Black             1
Name: Product Name, Length: 1857, dtype: int64
*****************************
12.960     54
15.552     39
19.440     39
10.368     35
32.400     28
           ..
487.920     1
25.920      1
95.736      1
3.392       1
275.880     1
Name: Sales, Length: 6128, dtype: int64
*****************************
```

#Converting DataType of sales from object to float (datatype was object because there were some string values in column,this process convert string to nan)

[9]:
```
df["Sales"]=pd.to_numeric(df["Sales"],errors='coerce')
pro=df[df["Sales"].isna()]
print(pro)
```

```
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
193    194.0  CA-2015-102281 2015-10-12 2015-10-14     First Class
194    195.0  CA-2015-131457 2015-10-31 2015-11-06  Standard Class
195    196.0  CA-2014-140004 2014-03-21 2014-03-25  Standard Class
196    197.0  CA-2014-140004 2014-03-21 2014-03-25  Standard Class
197    198.0  CA-2017-107720 2017-11-06 2017-11-13  Standard Class
…        …              …          …          …              …
7177  7187.0  CA-2017-133102 2017-08-17 2017-08-24  Standard Class
7178  7188.0  CA-2017-133102 2017-08-17 2017-08-24  Standard Class
```

```
7179  7189.0  CA-2017-133102 2017-08-17 2017-08-24  Standard Class
7180  7190.0  CA-2016-164399 2016-11-12 2016-11-15     First Class
7181  7191.0  CA-2016-164399 2016-11-12 2016-11-15     First Class

     Customer ID      Customer Name      Segment        Country  \
193     MP-17470        Mark Packer  Home Office  United States
194     MZ-17515          Mary Zewe    Corporate  United States
195     CB-12025  Cassandra Brandow     Consumer  United States
196     CB-12025  Cassandra Brandow     Consumer  United States
197     VM-21685    Valerie Mitchum  Home Office  United States
…          …                …           …             …
7177    ED-13885       Emily Ducich  Home Office  United States
7178    ED-13885       Emily Ducich  Home Office  United States
7179    ED-13885       Emily Ducich  Home Office  United States
7180    DW-13480      Dianna Wilson  Home Office  United States
7181    DW-13480      Dianna Wilson  Home Office  United States

               City       State  Postal Code   Region       Product ID  \
193   New York City    New York      10035.0     East              NaN
194        Redlands  California      92374.0     West              NaN
195        Hamilton        Ohio      45011.0     East              NaN
196        Hamilton        Ohio      45011.0     East              NaN
197       Westfield  New Jersey       7090.0     East              NaN
…             …          …          …       …               …
7177        Houston       Texas      77095.0  Central  FUR-CH-10002017
7178        Houston       Texas      77095.0  Central  FUR-FU-10003247
7179        Houston       Texas      77095.0  Central  OFF-AP-10001563
7180      San Diego  California      92024.0     West  TEC-PH-10004908
7181      San Diego  California      92024.0     West  FUR-TA-10003392

             Category Sub-Category Product Name  Sales  Quantity  Discount  \
193               NaN          NaN          NaN    NaN       NaN       NaN
194               NaN          NaN          NaN    NaN       NaN       NaN
195               NaN          NaN          NaN    NaN       NaN       NaN
196               NaN          NaN          NaN    NaN       NaN       NaN
197               NaN          NaN          NaN    NaN       NaN       NaN
…                 …            …          …      …         …         …
7177        Furniture       Chairs          NaN    NaN       NaN       NaN
7178        Furniture  Furnishings          NaN    NaN       NaN       NaN
7179  Office Supplies   Appliances          NaN    NaN       NaN       NaN
7180       Technology       Phones          NaN    NaN       NaN       NaN
7181        Furniture       Tables          NaN    NaN       NaN       NaN

      Profit
193      NaN
194      NaN
195      NaN
196      NaN
```

```
197      NaN
…        …
7177     NaN
7178     NaN
7179     NaN
7180     NaN
7181     NaN

[83 rows x 21 columns]
```

[10]:
```
df.isnull().sum() #checking number of null values for eah column
```

[10]:
```
Row ID           9
Order ID        13
Order Date      13
Ship Date       15
Ship Mode       19
Customer ID     26
Customer Name   57
Segment         52
Country         64
City            45
State           57
Postal Code     37
Region          40
Product ID      38
Category        29
Sub-Category    42
Product Name    58
Sales           83
Quantity        46
Discount        37
Profit          50
dtype: int64
```

[11]:
```
df[df["Row ID"]==6858] #checking row that has changed from string to nan
```

[11]:
```
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6857  6858.0  CA-2017-128965 2017-04-17 2017-04-22  Standard Class

     Customer ID Customer Name   Segment        Country         City  \
6857    PS-18760  Pamela Stobb  Consumer  United States  Los Angeles

           State  Postal Code Region       Product ID         Category  \
6857  California      90008.0   West  OFF-PA-10004911  Office Supplies

     Sub-Category Product Name  Sales  Quantity  Discount  Profit
```

```
6857        Paper        Paper     NaN      28.14        3.0      0.0
```

[12]:
```
df.dropna(subset=["Sales"],inplace=True)  #droping null values of sales(we cant␣
↪impute data in sales(dependent variable) because it creates a arbitary␣
↪values whih affects model prediction)
```

[13]:
```
df.shape #shape of dataframe
```

[13]:
```
(9911, 21)
```

[14]:
```
df["Sales"].dtypes #cheking dataframe of sales column
```

[14]:
```
dtype('float64')
```

[15]:
```
df.isnull().sum() #checking number of null values
```

[15]:
```
Row ID            9
Order ID         13
Order Date       13
Ship Date        15
Ship Mode        19
Customer ID      26
Customer Name    46
Segment          41
Country          53
City             45
State            51
Postal Code      31
Region           31
Product ID       11
Category          2
Sub-Category      4
Product Name      4
Sales             0
Quantity          0
Discount          0
Profit           13
dtype: int64
```

[16]:
```
df["City"].isnull().sum() #cheking number of null values in city
```

[16]:
```
45
```

[17]:
```
df["City"].unique() #hecking unique values in city column
```

[17]:
```
array(['Henderson', 'Los Angeles', 'Fort Lauderdale', 'Concord',
       'Seattle', 'Fort Worth', 'Madison', 'West Jordan', 'San Francisco',
```

'Fremont', 'Philadelphia', 'Orem', 'Houston', 'Richardson',
'Naperville', 'Melbourne', 'Eagan', 'Westland', 'Dover',
'New Albany', 'New York City', 'Troy', 'Chicago', 'Gilbert',
'Springfield', 'Jackson', 'Memphis', 'Decatur', 'Durham',
'Columbia', 'Rochester', nan, 'Aurora', 'Charlotte', 'Orland Park',
'Urbandale', 'Columbus', 'Bristol', 'Wilmington', 'Bloomington',
'Phoenix', 'Roseville', 'Independence', 'Pasadena', 'Newark',
'Franklin', 'Scottsdale', 'San Jose', 'Edmond', 'Carlsbad',
'San Antonio', 'Monroe', 'Fairfield', 'Grand Prairie', 'Denver',
'Dallas', 'Whittier', 'Saginaw', 'Medina', 'Detroit', 'Tampa',
'Santa Clara', 'Lakeville', 'San Diego', 'Brentwood',
'Chapel Hill', 'Morristown', 'Cincinnati', 'Inglewood', 'Portland',
'Tamarac', 'Colorado Springs', 'Belleville', 'Taylor', 'Lakewood',
'Arlington', 'Arvada', 'Hackensack', 'Saint Petersburg',
'Long Beach', 'Hesperia', 'Murfreesboro', 'Austin', 'Lowell',
'Manchester', 'Harlingen', 'Tucson', 'Quincy', 'Pembroke Pines',
'Des Moines', 'Peoria', 'Las Vegas', 'Warwick', 'Miami',
'Huntington Beach', 'Richmond', 'Louisville', 'Lawrence', 'Canton',
'New Rochelle', 'Gastonia', 'Jacksonville', 'Auburn', 'Akron',
'Norman', 'Park Ridge', 'Amarillo', 'Lindenhurst', 'Huntsville',
'Fayetteville', 'Costa Mesa', 'Parker', 'Atlanta', 'Gladstone',
'Great Falls', 'Montgomery', 'Mesa', 'Green Bay', 'Anaheim',
'Marysville', 'Salem', 'Laredo', 'Grove City', 'Dearborn',
'Warner Robins', 'Vallejo', 'Minneapolis', 'Mission Viejo',
'Rochester Hills', 'Plainfield', 'Sierra Vista', 'Vancouver',
'Cleveland', 'Tyler', 'Burlington', 'Waynesboro', 'Chester',
'Cary', 'Palm Coast', 'Mount Vernon', 'Hialeah', 'Oceanside',
'Evanston', 'Trenton', 'Cottage Grove', 'Bossier City',
'Lancaster', 'Asheville', 'Lake Elsinore', 'Omaha', 'Edmonds',
'Santa Ana', 'Milwaukee', 'Florence', 'Lorain', 'Linden',
'Salinas', 'New Brunswick', 'Garland', 'Norwich', 'Alexandria',
'Toledo', 'Farmington', 'Riverside', 'Torrance', 'Round Rock',
'Boca Raton', 'Virginia Beach', 'Murrieta', 'Olympia',
'Washington', 'Jefferson City', 'Saint Peters', 'Rockford',
'Brownsville', 'Yonkers', 'Oakland', 'Clinton', 'Encinitas',
'Roswell', 'Jonesboro', 'Antioch', 'Homestead', 'La Porte',
'Lansing', 'Cuyahoga Falls', 'Reno', 'Harrisonburg', 'Escondido',
'Royal Oak', 'Rockville', 'Coral Springs', 'Buffalo',
'Boynton Beach', 'Gulfport', 'Fresno', 'Greenville', 'Macon',
'Cedar Rapids', 'Providence', 'Pueblo', 'Saint Paul', 'Deltona',
'Murray', 'Middletown', 'Freeport', 'Pico Rivera', 'Provo',
'Pleasant Grove', 'Smyrna', 'Parma', 'Mobile', 'New Bedford',
'Irving', 'Vineland', 'Glendale', 'Niagara Falls', 'Thomasville',
'Westminster', 'Coppell', 'Pomona', 'North Las Vegas', 'Allentown',
'Tempe', 'Laguna Niguel', 'Bridgeton', 'Everett', 'Watertown',
'Appleton', 'Bellevue', 'Allen', 'El Paso', 'Grapevine',
'Carrollton', 'Kent', 'Lafayette', 'Tigard', 'Skokie', 'Plano',

'Suffolk', 'Indianapolis', 'Bayonne', 'Dublin', 'Greensboro',
'Baltimore', 'Kenosha', 'Olathe', 'Tulsa', 'Redmond', 'Raleigh',
'Muskogee', 'Meriden', 'Bowling Green', 'South Bend', 'Spokane',
'Keller', 'Port Orange', 'Medford', 'Charlottesville', 'Missoula',
'Apopka', 'Reading', 'Broomfield', 'Paterson', 'Oklahoma City',
'Chesapeake', 'Lubbock', 'Johnson City', 'San Bernardino',
'Leominster', 'Bozeman', 'Perth Amboy', 'Ontario',
'Rancho Cucamonga', 'Moorhead', 'Mesquite', 'Redlands', 'Stockton',
'Ormond Beach', 'Sunnyvale', 'York', 'College Station',
'Saint Louis', 'Manteca', 'San Angelo', 'Salt Lake City',
'Knoxville', 'Little Rock', 'Lincoln Park', 'Marion', 'Littleton',
'Bangor', 'Southaven', 'New Castle', 'Midland', 'Sioux Falls',
'Fort Collins', 'Clarksville', 'Sacramento', 'Thousand Oaks',
'Malden', 'Holyoke', 'Albuquerque', 'Sparks', 'Coachella',
'Elmhurst', 'Passaic', 'North Charleston', 'Newport News',
'Jamestown', 'Mishawaka', 'Westfield', 'La Quinta', 'Tallahassee',
'Nashville', 'Bellingham', 'Woodstock', 'Haltom City', 'Wheeling',
'Summerville', 'Hot Springs', 'Englewood', 'Las Cruces', 'Hoover',
'Frisco', 'Vacaville', 'Waukesha', 'Bakersfield', 'Pompano Beach',
'Corpus Christi', 'Redondo Beach', 'Orlando', 'Orange',
'Lake Charles', 'Highland Park', 'Hempstead', 'Noblesville',
'Apple Valley', 'Mount Pleasant', 'Sterling Heights', 'Eau Claire',
'Pharr', 'Billings', 'Gresham', 'Chattanooga', 'Meridian',
'Bolingbrook', 'Lakeland', 'Maple Grove', 'Woodland',
'Missouri City', 'Pearland', 'San Mateo', 'Grand Rapids',
'Visalia', 'Overland Park', 'Temecula', 'Yucaipa', 'Revere',
'Conroe', 'Tinley Park', 'Dubuque', 'Dearborn Heights', 'Santa Fe',
'Hickory', 'Carol Stream', 'Saint Cloud', 'North Miami',
'Plantation', 'Port Saint Lucie', 'Rock Hill', 'Odessa',
'West Allis', 'Chula Vista', 'Manhattan', 'Altoona', 'Thornton',
'Champaign', 'Texarkana', 'Edinburg', 'Baytown', 'Greenwood',
'Woonsocket', 'Superior', 'Bedford', 'Covington', 'Broken Arrow',
'Miramar', 'Hollywood', 'Deer Park', 'Wichita', 'Mcallen',
'Iowa City', 'Boise', 'Cranston', 'Port Arthur', 'Citrus Heights',
'The Colony', 'Daytona Beach', 'Bullhead City', 'Portage', 'Fargo',
'Elkhart', 'San Gabriel', 'Hamilton', 'Margate', 'Sandy Springs',
'Mentor', 'Lawton', 'Hampton', 'Rome', 'La Crosse', 'Lewiston',
'Hattiesburg', 'Danville', 'Logan', 'Waterbury', 'Athens',
'Avondale', 'Marietta', 'Yuma', 'Wausau', 'Pasco', 'Oak Park',
'Pensacola', 'League City', 'Gaithersburg', 'Lehi', 'Tuscaloosa',
'Moreno Valley', 'Georgetown', 'Loveland', 'Chandler', 'Helena',
'Kirkwood', 'Waco', 'Frankfort', 'Bethlehem', 'Grand Island',
'Woodbury', 'Rogers', 'Clovis', 'Jupiter', 'Santa Barbara',
'Cedar Hill', 'Norfolk', 'Draper', 'Ann Arbor', 'La Mesa',
'Pocatello', 'Holland', 'Milford', 'Buffalo Grove', 'Lake Forest',
'Redding', 'Chico', 'Utica', 'Conway', 'Cheyenne', 'Owensboro',
'Caldwell', 'Kenner', 'Nashua', 'Bartlett', 'Redwood City',

```
       'Lebanon', 'Santa Maria', 'Des Plaines', 'Longview',
       'Hendersonville', 'Waterloo', 'Cambridge', 'Palatine', 'Beverly',
       'Eugene', 'Oxnard', 'Renton', 'Glenview', 'Delray Beach',
       'Commerce City', 'Texas City', 'Wilson', 'Rio Rancho', 'Goldsboro',
       'Montebello', 'El Cajon', 'West Palm Beach', 'Abilene', 'Normal',
       'Saint Charles', 'Camarillo', 'Hillsboro', 'Burbank', 'Modesto',
       'Garden City', 'Atlantic City', 'Longmont', 'Davis', 'Morgan Hill',
       'Clifton', 'Sheboygan', 'East Point', 'Rapid City', 'Andover',
       'Kissimmee', 'Shelton', 'Danbury', 'Sanford', 'San Marcos',
       'Greeley', 'Mansfield', 'Elyria', 'Twin Falls', 'Coral Gables',
       'Romeoville', 'Marlborough', 'Laurel', 'Bryan', 'Pine Bluff',
       'Aberdeen', 'Hagerstown', 'East Orange', 'Arlington Heights',
       'Oswego', 'Beaumont', 'Coon Rapids', 'San Clemente',
       'San Luis Obispo', 'Springdale', 'Lodi', 'Mason'], dtype=object)
```

[18]:
```
df.dropna(subset=["City"],inplace=True) #droped nan values in city
```

[19]:
```
df.isnull().sum() #checking null values
```

[19]:
```
Row ID           5
Order ID         9
Order Date       9
Ship Date       11
Ship Mode        8
Customer ID      5
Customer Name   23
Segment         18
Country         21
City             0
State            6
Postal Code      0
Region           0
Product ID       2
Category         2
Sub-Category     4
Product Name     4
Sales            0
Quantity         0
Discount         0
Profit          13
dtype: int64
```

[20]:
```
df.shape #shape of dataframe
```

[20]:
```
(9866, 21)
```

[21]:
```
df["State"].isnull().sum() #checking null values in state
```

[21]:
```
6
```

[22]:
```
df["State"].unique() #finding unique values in state column
```

[22]:
```
array(['Kentucky', 'California', 'Florida', 'North Carolina',
       'Washington', 'Texas', 'Wisconsin', 'Utah', 'Nebraska',
       'Pennsylvania', 'Illinois', 'Minnesota', 'Michigan', 'Delaware',
       'Indiana', 'New York', 'Arizona', 'Virginia', 'Tennessee',
       'Alabama', 'South Carolina', 'Colorado', 'Iowa', 'Ohio',
       'Missouri', 'Oklahoma', 'New Mexico', 'Louisiana', 'Connecticut',
       'New Jersey', 'Oregon', 'Massachusetts', 'Georgia', 'Nevada',
       'Rhode Island', nan, 'Mississippi', 'Arkansas', 'Montana',
       'New Hampshire', 'Maryland', 'District of Columbia', 'Kansas',
       'Vermont', 'Maine', 'South Dakota', 'Idaho', 'North Dakota',
       'Wyoming', 24.849999999999998, 12.624, 89.584, 471.92,
       18.180000000000003, 31.744, 5.904, 621.7600000000001, 59.98, 48.87,
       154.9, 5.92, 30.18, 24.1, 8.78, 376.74, 29.52, 11.96,
       26.400000000000002, 'West Virginia'], dtype=object)
```

[23]:
```
state_city=df[["State","City"]]  #created dataframe for state, city
unique_state_city=state_city.drop_duplicates() #drop dupliates
unique_state_city.head(10)  #hecking respective city name for state to change␣
 ↪errors in state column
```

[23]:

	State	City
0	Kentucky	Henderson
2	California	Los Angeles
3	Florida	Fort Lauderdale
12	North Carolina	Concord
13	Washington	Seattle
14	Texas	Fort Worth
16	Wisconsin	Madison
17	Utah	West Jordan
18	California	San Francisco
21	Nebraska	Fremont

[24]:
```
a=[24.849999999999998, 12.624, 89.584, 471.92,
       18.180000000000003, 31.744, 5.904, 621.7600000000001, 59.98, 48.87,
       154.9, 5.92, 30.18, 24.1, 8.78, 376.74, 29.52, 11.96,
       26.400000000000002]   #values are errors in state column
for i in a:
    print(df[df["State"]==i])
```

```
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6972  6973.0  CA-2017-153822 2017-09-19 2017-09-25  Standard Class

     Customer ID  Customer Name    Segment        Country     City  State  \
```

```
6972    AB-10105  Adrian Barton  Consumer  United States  Phoenix  24.85

     Postal Code Region Product ID    Category Sub-Category  \
6972         5.0      0     7.7035  Technology       Phones

                                 Product Name   Sales  Quantity  Discount  \
6972  Polycom VoiceStation 500 Conference phone  471.92       2.0       0.2

     Profit
6972  29.495
     Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6973  6974.0  CA-2017-153822 2017-09-19 2017-09-25  Standard Class

    Customer ID  Customer Name   Segment        Country     City   State  \
6973    AB-10105  Adrian Barton  Consumer  United States  Phoenix  12.624

     Postal Code Region Product ID         Category Sub-Category  \
6973         2.0    0.2    -2.5248  Office Supplies      Binders

              Product Name  Sales  Quantity  Discount  Profit
6973  Plastic Binding Combs  18.18       4.0       0.7 -13.938
     Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6974  6975.0  CA-2017-146185 2017-09-15 2017-09-19  Standard Class

    Customer ID     Customer Name   Segment        Country     City   State  \
6974    CC-12145  Charles Crestani  Consumer  United States  Houston  89.584

     Postal Code Region Product ID         Category Sub-Category  \
6974         2.0    0.2     4.4792  Office Supplies          Art

                   Product Name   Sales  Quantity  Discount  Profit
6974  Prismacolor Color Pencil Set  31.744       2.0       0.2  8.3328
     Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6975  6976.0  CA-2015-112144 2015-06-28 2015-07-02  Standard Class

    Customer ID Customer Name    Segment        Country     City   State  \
6975    CY-12745  Craig Yedwab  Corporate  United States  Gilbert  471.92

     Postal Code Region Product ID         Category Sub-Category  \
6975         2.0    0.2     29.495  Office Supplies       Labels

    Product Name  Sales  Quantity  Discount  Profit
6975    Avery 501  5.904       2.0       0.2  1.9926
     Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6976  6977.0  CA-2015-112144 2015-06-28 2015-07-02  Standard Class

    Customer ID Customer Name    Segment        Country     City  State  \
6976    CY-12745  Craig Yedwab  Corporate  United States  Gilbert  18.18
```

```
     Postal Code Region Product ID   Category Sub-Category  \
6976         4.0    0.7    -13.938  Furniture  Furnishings

                       Product Name   Sales  Quantity  Discount  Profit
6976  Electrix Halogen Magnifier Lamp  621.76       4.0       0.2  46.632
      Row ID        Order ID Order Date  Ship Date    Ship Mode Customer ID  \
6977  6978.0  US-2016-119298 2016-11-25 2016-11-28  First Class    EP-13915

     Customer Name   Segment        Country       City   State  Postal Code  \
6977    Emily Phan  Consumer  United States  Jonesboro  31.744          2.0

     Region Product ID    Category Sub-Category  \
6977    0.2     8.3328  Technology       Phones

                                        Product Name  Sales  Quantity  \
6977  OtterBox Defender Series Case - Samsung Galaxy S4  59.98       2.0

      Discount  Profit
6977       0.0  17.994
      Row ID        Order ID Order Date  Ship Date     Ship Mode Customer ID  \
6978  6979.0  CA-2017-155159 2017-11-25 2017-11-29  Second Class    DL-13315

          Customer Name   Segment        Country     City  State  Postal Code  \
6978  Delfina Latchford  Consumer  United States  Atlanta  5.904          2.0

     Region Product ID         Category Sub-Category  \
6978    0.2     1.9926  Office Supplies        Paper

                          Product Name  Sales  Quantity  Discount   Profit
6978  Wirebound Message Book, 4 per Page  48.87       9.0       0.0  23.9463
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6979  6980.0  CA-2017-149076 2017-01-14 2017-01-19  Standard Class

     Customer ID   Customer Name   Segment        Country         City  \
6979    SO-20335  Sean O'Donnell  Consumer  United States  Los Angeles

       State  Postal Code Region Product ID         Category Sub-Category  \
6979  621.76          4.0    0.2     46.632  Office Supplies        Paper

     Product Name  Sales  Quantity  Discount  Profit
6979     Xerox 19  154.9       5.0       0.0  69.705
      Row ID        Order ID Order Date  Ship Date    Ship Mode Customer ID  \
6980  6981.0  CA-2014-146990 2014-11-07 2014-11-08  First Class    BP-11095

     Customer Name    Segment        Country           City  State  \
6980  Bart Pistole  Corporate  United States  New York City  59.98
```

```
      Postal Code Region Product ID         Category Sub-Category  \
6980          2.0      0     17.994  Office Supplies    Fasteners

             Product Name  Sales  Quantity  Discount  Profit
6980  Binder Clips by OIC   5.92       4.0       0.0  2.8416
      Row ID        Order ID Order Date  Ship Date    Ship Mode Customer ID  \
6981  6982.0  CA-2014-146990 2014-11-07 2014-11-08  First Class    BP-11095

     Customer Name    Segment        Country           City  State  \
6981  Bart Pistole  Corporate  United States  New York City  48.87

      Postal Code Region Product ID         Category Sub-Category  \
6981          9.0      0    23.9463  Office Supplies        Paper

                                    Product Name  Sales  Quantity  Discount  \
6981  Riverleaf Stik-Withit Designer Note Cubes  30.18       3.0       0.0

       Profit
6981  13.8828
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6982  6983.0  CA-2016-116526 2016-09-01 2016-09-05  Standard Class

     Customer ID Customer Name   Segment        Country     City  State  \
6982    JA-15970  Joseph Airdo  Consumer  United States  Detroit  154.9

      Postal Code Region Product ID         Category Sub-Category  \
6982          5.0      0     69.705  Office Supplies      Binders

                                         Product Name  Sales  Quantity  \
6982  Wilson Jones Turn Tabs Binder Tool for Ring Bi…   24.1       5.0

      Discount  Profit
6982       0.0  11.086
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6983  6984.0  CA-2016-116526 2016-09-01 2016-09-05  Standard Class

     Customer ID Customer Name   Segment        Country     City State  \
6983    JA-15970  Joseph Airdo  Consumer  United States  Detroit  5.92

      Postal Code Region Product ID    Category Sub-Category  \
6983          4.0      0     2.8416  Technology       Phones

                                         Product Name  Sales  Quantity  \
6983  Belkin Grip Candy Sheer Case / Cover for iPhon…   8.78       1.0

      Discount  Profit
6983       0.0  2.2828
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
```

```
6984  6985.0  CA-2016-116526 2016-09-01 2016-09-05  Standard Class

     Customer ID Customer Name   Segment        Country     City  State  \
6984    JA-15970  Joseph Airdo  Consumer  United States  Detroit  30.18

      Postal Code Region Product ID         Category Sub-Category  \
6984          3.0      0    13.8828  Office Supplies   Appliances

                                          Product Name   Sales  Quantity  \
6984  Eureka The Boss Plus 12-Amp Hard Box Upright V…  376.74       4.0

      Discount  Profit
6984       0.1  71.162
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6985  6986.0  CA-2016-116526 2016-09-01 2016-09-05  Standard Class

     Customer ID Customer Name   Segment        Country     City State  \
6985    JA-15970  Joseph Airdo  Consumer  United States  Detroit  24.1

      Postal Code Region Product ID         Category Sub-Category  \
6985          5.0      0     11.086  Office Supplies      Binders

                 Product Name  Sales  Quantity  Discount   Profit
6985  GBC Plastic Binding Combs  29.52       4.0       0.0  14.4648
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6986  6987.0  CA-2016-116526 2016-09-01 2016-09-05  Standard Class

     Customer ID Customer Name   Segment        Country     City State  \
6986    JA-15970  Joseph Airdo  Consumer  United States  Detroit  8.78

      Postal Code Region Product ID         Category Sub-Category  \
6986          1.0      0     2.2828  Office Supplies          Art

     Product Name  Sales  Quantity  Discount  Profit
6986   Newell 315  11.96       2.0       0.0    2.99
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
6987  6988.0  CA-2016-116526 2016-09-01 2016-09-05  Standard Class

     Customer ID Customer Name   Segment        Country     City   State  \
6987    JA-15970  Joseph Airdo  Consumer  United States  Detroit  376.74

      Postal Code Region Product ID         Category Sub-Category  \
6987          4.0    0.1     71.162  Office Supplies      Binders

                                    Product Name  Sales  Quantity  \
6987  Wilson Jones 1" Hanging DublLock Ring Binders   26.4       5.0

      Discount  Profit
```

```
6987       0.0  12.672
      Row ID        Order ID Order Date  Ship Date     Ship Mode Customer ID  \
6988  6989.0  CA-2017-158561 2017-11-11 2017-11-16  Second Class    BB-11545

      Customer Name    Segment        Country             City  State  \
6988  Brenda Bowman  Corporate  United States  Fort Lauderdale  29.52

      Postal Code Region Product ID         Category Sub-Category  \
6988         4.0      0    14.4648  Office Supplies   Appliances

                            Product Name    Sales  Quantity  Discount  \
6988  Hoover Upright Vacuum With Dirt Cup  1158.12       5.0       0.2

        Profit
6988  130.2885
      Row ID        Order ID Order Date  Ship Date    Ship Mode Customer ID  \
6989  6990.0  CA-2017-165099 2017-12-11 2017-12-13  First Class    DK-13375

     Customer Name   Segment        Country     City  State  Postal Code  \
6989   Dennis Kane  Consumer  United States  Abilene  11.96          2.0

     Region Product ID         Category Sub-Category  \
6989      0       2.99  Office Supplies   Appliances

                                    Product Name  Sales  Quantity  Discount  \
6989  Hoover Commercial Lightweight Upright Vacuum  1.392       2.0       0.8

      Profit
6989 -3.7584
      Row ID        Order ID Order Date  Ship Date     Ship Mode Customer ID  \
6990  6991.0  CA-2015-109386 2015-11-08 2015-11-13  Second Class    RH-19600

     Customer Name   Segment        Country     City State  Postal Code  \
6990  Rob Haberlin  Consumer  United States  Hampton  26.4          5.0

     Region Product ID         Category Sub-Category  \
6990      0     12.672  Office Supplies   Appliances

                                        Product Name  Sales  Quantity  \
6990  Holmes Replacement Filter for HEPA Air Cleaner…  44.43       3.0

      Discount   Profit
6990       0.0  18.6606
```

[25]:
```
df[df["State"].isnull()] #checking nul values in state
```

[25]:
```
     Row ID        Order ID Order Date  Ship Date       Ship Mode Customer ID  \
416   417.0  CA-2017-122105 2017-06-24 2017-06-28  Standard Class    CJ-12010
423   424.0  CA-2017-125388 2017-10-19 2017-10-23             NaN    MP-17965
428   429.0  CA-2017-152275 2017-10-01 2017-10-08  Standard Class    KH-16630
430   431.0  US-2016-123750 2016-04-15 2016-04-21  Standard Class    RB-19795
486   487.0  CA-2017-140963 2017-06-10 2017-06-13     First Class    MT-18070
659   660.0  CA-2015-146563 2015-08-24 2015-08-28  Standard Class    CB-12025

       Customer Name      Segment        Country              City State  \
416  Caroline Jumper     Consumer  United States  Huntington Beach   NaN
423    Michael Paige    Corporate  United States          Lawrence   NaN
428       Ken Heidel    Corporate  United States       San Antonio   NaN
430       Ross Baird  Home Office  United States          Gastonia   NaN
486    Michelle Tran  Home Office  United States       Los Angeles   NaN
659              NaN     Consumer  United States         Arlington   NaN

     Postal Code   Region       Product ID         Category Sub-Category  \
416      92646.0     West  OFF-AR-10004344              NaN          Art
423       1841.0     East  OFF-ST-10000918  Office Supplies      Storage
428      78207.0  Central  OFF-AR-10000369              NaN          Art
430      28052.0    South  TEC-AC-10004659       Technology          NaN
486      90045.0     West  TEC-PH-10001924       Technology       Phones
659      76017.0  Central  OFF-ST-10001490  Office Supplies          NaN

                                        Product Name    Sales  Quantity  \
416              Bulldog Vacuum Base Pencil Sharpener   95.920       8.0
423                                     Crate-A-Files   32.700       3.0
428                      Design Ebony Sketching Pencil    6.672       6.0
430  Imation Secure+ Hardware Encrypted USB 2.0 Fla…  408.744       7.0
486                                               NaN  279.960       5.0
659                    Hot File 7-Pocket, Floor Stand  999.432       7.0

     Discount    Profit
416       0.0   25.8984
423       0.0    8.5020
428       0.2    0.5004
430       0.2   76.6395
486       0.2   17.4975
659       0.2  124.9290
```

[26]:
```
df[df["City"]=="Huntington Beach"].head(2) #checkin city name to replace nan␣
↪with respective state name
```

[26]:
```
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
416    417.0  CA-2017-122105 2017-06-24 2017-06-28  Standard Class
1890  1891.0  CA-2014-157623 2014-03-14 2014-03-18  Standard Class
```

```
     Customer ID    Customer Name    Segment        Country             City  \
416     CJ-12010  Caroline Jumper   Consumer  United States  Huntington Beach
1890    DK-13225        Dean Katz  Corporate  United States  Huntington Beach

           State  Postal Code Region       Product ID         Category  \
416          NaN      92646.0   West  OFF-AR-10004344              NaN
1890  California      92646.0   West  OFF-PA-10001204  Office Supplies

     Sub-Category                          Product Name  Sales  Quantity  \
416           Art  Bulldog Vacuum Base Pencil Sharpener  95.92       8.0
1890        Paper                            Xerox 1972  10.56       2.0

      Discount   Profit
416        0.0  25.8984
1890       0.0   4.7520
```

[27]:
```
df[df["State"]=="Maryland"].head(3)
```

[27]:
```
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
887    888.0  CA-2017-150707 2017-10-14 2017-10-19  Standard Class
1093  1094.0  CA-2015-165085 2015-12-27 2015-12-31  Standard Class
1094  1095.0  CA-2015-165085 2015-12-27 2015-12-31  Standard Class

     Customer ID Customer Name      Segment        Country      City  \
887     EL-13735     Ed Ludwig  Home Office  United States  Columbia
1093    BT-11485   Brad Thomas  Home Office  United States   Clinton
1094    BT-11485   Brad Thomas  Home Office  United States   Clinton

         State  Postal Code Region       Product ID         Category  \
887   Maryland      21044.0   East  OFF-BI-10001078  Office Supplies
1093  Maryland      20735.0   East  OFF-PA-10000605  Office Supplies
1094  Maryland      20735.0   East  OFF-AP-10002518  Office Supplies

     Sub-Category                                        Product Name   Sales  \
887       Binders  Acco PRESSTEX Data Binder with Storage Hooks, …   37.66
1093        Paper                                          Xerox 1950   28.90
1094   Appliances       Kensington 7 Outlet MasterPiece Power Center  355.96

      Quantity  Discount    Profit
887        7.0       0.0   18.4534
1093       5.0       0.0   14.1610
1094       2.0       0.0  103.2284
```

[28]:
```
city_to_state = {
    'Phoenix': 'Arizona',
    'Houston': 'Texas',
    'Gilbert': 'Arizona',
```

```
    'Jonesboro': 'Arkansas',
    'Atlanta': 'Georgia',
    'Los Angeles': 'California',
    'New York City': 'New York',
    'Detroit': 'Michigan',
    'Fort Lauderdale': 'Florida',
    'Hampton': 'Virginia',
    'Arlington':'Virginia',
    'Gastonia':'North Carolina',
    'San Antonio':'Texas',
    'Lawrence':'Massachusetts',
    'Huntington Beach':'California'
}

# Update 'State' column for cities in city_to_state dictionary
df['State'] = df['City'].map(city_to_state).fillna(df['State'])

print(df)
```

```
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
0        1.0  CA-2016-152156 2016-11-08 2016-11-11    Second Class
1        2.0  CA-2016-152156 2016-11-08 2016-11-11    Second Class
2        3.0  CA-2016-138688 2016-06-12 2016-06-16    Second Class
3        4.0  US-2015-108966 2015-10-11 2015-10-18  Standard Class
4        5.0  US-2015-108966 2015-10-11 2015-10-18  Standard Class
…        …              …         …          …              …
9989     NaN             NaN        NaT        NaT  Standard Class
9990     NaN             NaN        NaT        NaT    Second Class
9991     NaN             NaN        NaT        NaT  Standard Class
9992     NaN             NaN        NaT        NaT  Standard Class
9993     NaN             NaN        NaT        NaT    Second Class

     Customer ID    Customer Name      Segment        Country  \
0       CG-12520      Claire Gute     Consumer  United States
1       CG-12520      Claire Gute     Consumer  United States
2       DV-13045  Darrin Van Huff    Corporate  United States
3       SO-20335   Sean O'Donnell     Consumer  United States
4       SO-20335   Sean O'Donnell     Consumer  United States
…          …              …          …             …
9989    SR-20425   Sharelle Roach  Home Office  United States
9990    AG-10330     Alex Grayson     Consumer  United States
9991    BP-11095              NaN          NaN            NaN
9992    JW-16075              NaN          NaN            NaN
9993    LH-16900              NaN          NaN            NaN

                City           State  Postal Code   Region       Product ID  \
0          Henderson        Kentucky      42420.0    South  FUR-BO-10001798
```

```
1           Henderson        Kentucky      42420.0    South  FUR-CH-10000454
2         Los Angeles      California      90036.0     West  OFF-LA-10000240
3     Fort Lauderdale         Florida      33311.0    South  FUR-TA-10000577
4     Fort Lauderdale         Florida      33311.0    South  OFF-ST-10000760
…                 …               …           …        …              …
9989       Tuscaloosa         Alabama      35401.0    South  FUR-CH-10002647
9990             Mesa         Arizona      85204.0     West  FUR-TA-10003008
9991     Jacksonville  North Carolina      28540.0    South  OFF-PA-10004071
9992          Chicago        Illinois      60610.0  Central  OFF-AP-10004980
9993         Columbus         Georgia      31907.0    South  FUR-FU-10000747

             Category Sub-Category  \
0           Furniture    Bookcases
1           Furniture      Chairs
2     Office Supplies       Labels
3           Furniture       Tables
4     Office Supplies      Storage
…                 …            …
9989        Furniture       Chairs
9990        Furniture       Tables
9991  Office Supplies        Paper
9992  Office Supplies   Appliances
9993        Furniture  Furnishings

                                          Product Name     Sales  Quantity  \
0                    Bush Somerset Collection Bookcase  261.9600       2.0
1     Hon Deluxe Fabric Upholstered Stacking Chairs,…  731.9400       3.0
2     Self-Adhesive Address Labels for Typewriters b…   14.6200       2.0
3         Bretford CR4500 Series Slim Rectangular Table  957.5775       5.0
4                       Eldon Fold 'N Roll Cart System   22.3680       2.0
…                                                  …       …       …
9989         Situations Contoured Folding Chairs, 4/Set  141.9600       2.0
9990  Lesro Round Back Collection Coffee Table, End …  182.5500       2.0
9991  Eaton Premium Continuous-Feed Paper, 25% Cotto…   88.7680       2.0
9992  3M Replacement Filter for Office Air Cleaner f…   53.0880       7.0
9993  Tenex B1-RE Series Chair Mats for Low Pile Car…  275.8800       6.0

      Discount    Profit
0         0.00   41.9136
1         0.00  219.5820
2         0.00    6.8714
3         0.45 -383.0310
4         0.20    2.5164
…            …         …
9989      0.00   35.4900
9990      0.50 -135.0870
9991      0.20   31.0688
9992      0.80 -108.8304
```

```
9993      0.00   46.8996

[9866 rows x 21 columns]
```

[29]:
```
#checking changes
df[df["City"]=="Huntington Beach"].head(2)
```

[29]:
```
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
416    417.0  CA-2017-122105 2017-06-24 2017-06-28  Standard Class
1890  1891.0  CA-2014-157623 2014-03-14 2014-03-18  Standard Class

     Customer ID    Customer Name    Segment        Country              City  \
416     CJ-12010  Caroline Jumper   Consumer  United States  Huntington Beach
1890    DK-13225        Dean Katz  Corporate  United States  Huntington Beach

           State  Postal Code Region       Product ID         Category  \
416   California      92646.0   West  OFF-AR-10004344              NaN
1890  California      92646.0   West  OFF-PA-10001204  Office Supplies

     Sub-Category                          Product Name  Sales  Quantity  \
416           Art  Bulldog Vacuum Base Pencil Sharpener  95.92       8.0
1890        Paper                            Xerox 1972  10.56       2.0

      Discount   Profit
416        0.0  25.8984
1890       0.0   4.7520
```

[30]:
```
df["State"].isnull().sum() #cheking number of nulls in state
```

[30]:
```
0
```

[31]:
```
#now null also chnaged
df[df["Row ID"]==107]
```

[31]:
```
     Row ID        Order ID Order Date  Ship Date       Ship Mode Customer ID  \
106   107.0  CA-2017-119004 2017-11-23 2017-11-28  Standard Class    JM-15250

    Customer Name   Segment        Country       City           State  \
106  Janet Martin  Consumer  United States  Charlotte  North Carolina

     Postal Code Region       Product ID    Category Sub-Category  \
106      28205.0  South  TEC-AC-10003499  Technology  Accessories

                                        Product Name   Sales  Quantity  \
106  Memorex Mini Travel Drive 8 GB USB 2.0 Flash D…  74.112       8.0

     Discount   Profit
```

```
106        0.2  17.6016
```

[32]:
```
#drop 11.96 due to no name of state
df.drop(df[df["State"]==11.96].index,axis=0,inplace=True)
```

[33]:
```
df["State"].unique() #now rechecking uniques values in state
```

[33]:
```
array(['Kentucky', 'California', 'Florida', 'North Carolina',
       'Washington', 'Texas', 'Wisconsin', 'Utah', 'Nebraska',
       'Pennsylvania', 'Illinois', 'Minnesota', 'Michigan', 'Delaware',
       'Indiana', 'New York', 'Arizona', 'Virginia', 'Tennessee',
       'Alabama', 'South Carolina', 'Colorado', 'Iowa', 'Ohio',
       'Missouri', 'Oklahoma', 'New Mexico', 'Louisiana', 'Connecticut',
       'New Jersey', 'Oregon', 'Massachusetts', 'Georgia', 'Nevada',
       'Rhode Island', 'Mississippi', 'Arkansas', 'Montana',
       'New Hampshire', 'Maryland', 'District of Columbia', 'Kansas',
       'Vermont', 'Maine', 'South Dakota', 'Idaho', 'North Dakota',
       'Wyoming', 'West Virginia'], dtype=object)
```

[34]:
```
df["Region"].unique() #hecking unique values in region(found some errors)
```

[34]:
```
array(['South', 'West', 'Central', 'East', 0, 0.2, 0.7, 0.1], dtype=object)
```

[35]:
```
df["Region"].isnull().sum() #checking nan values in region column
```

[35]:
```
0
```

[36]:
```
a = [0, 0.2, 0.7, 0.1]
cities_by_region = {}

for i in a:
    filtered_df = df[df["Region"] == i]
    cities_by_region[i] = filtered_df["City"].tolist()

print(cities_by_region)
```

```
{0: ['Phoenix', 'New York City', 'New York City', 'Detroit', 'Detroit',
'Detroit', 'Detroit', 'Detroit', 'Fort Lauderdale', 'Hampton'], 0.2: ['Phoenix',
'Houston', 'Gilbert', 'Jonesboro', 'Atlanta', 'Los Angeles'], 0.7: ['Gilbert'],
0.1: ['Detroit']}
```

[37]:
```
df[df["City"]=="Huntington Beach"].head(2) #checking region for city
```

[37]:
```
       Row ID        Order ID Order Date  Ship Date       Ship Mode  \
416     417.0  CA-2017-122105 2017-06-24 2017-06-28  Standard Class
1890   1891.0  CA-2014-157623 2014-03-14 2014-03-18  Standard Class
```

```
     Customer ID    Customer Name    Segment        Country             City  \
416     CJ-12010  Caroline Jumper   Consumer  United States  Huntington Beach
1890    DK-13225        Dean Katz  Corporate  United States  Huntington Beach

           State  Postal Code Region       Product ID         Category  \
416   California      92646.0   West  OFF-AR-10004344              NaN
1890  California      92646.0   West  OFF-PA-10001204  Office Supplies

     Sub-Category                          Product Name  Sales  Quantity  \
416           Art  Bulldog Vacuum Base Pencil Sharpener  95.92       8.0
1890        Paper                            Xerox 1972  10.56       2.0

      Discount   Profit
416        0.0  25.8984
1890       0.0   4.7520
```

[38]:
```
city_to_region = {
    'Phoenix': 'West',
    'Houston': 'Central',
    'Gilbert': 'West',
    'Jonesboro': 'South',
    'Atlanta': 'South',
    'Los Angeles': 'West',
    'New York City': 'East',
    'Detroit': 'Central',
    'Fort Lauderdale': 'South',
    'Hampton': 'South'
}

# Update 'Region' column permanently
df['Region'] = df['City'].map(city_to_region).fillna(df['Region'])
```

[39]:
```
df["Region"].unique() #cheking unique values in region
```

[39]:
```
array(['South', 'West', 'Central', 'East'], dtype=object)
```

[40]:
```
df.shape #cheking shape of dataframe
```

[40]:
```
(9865, 21)
```

[41]:
```
df.dropna(subset=["Order Date","Ship Date"],inplace=True) #droping null values␣
↪in order date,ship date
```

[42]:
```
df.isnull().sum() #checking null values in columns
```

[42]:
```
Row ID           0
Order ID         0
```

```
Order Date        0
Ship Date         0
Ship Mode         4
Customer ID       1
Customer Name    19
Segment          15
Country          18
City              0
State             0
Postal Code       0
Region            0
Product ID        2
Category          2
Sub-Category      4
Product Name      4
Sales             0
Quantity          0
Discount          0
Profit           13
dtype: int64
```

[43]:
```
#data formating(creating new columns from existing data)
df["Order Date"] = pd.to_datetime(df["Order Date"], format="%d/%m/%Y")
df["Ship Date"] = pd.to_datetime(df["Ship Date"], format="%d/%m/%Y")

df["order_year"]=df["Order Date"].dt.year
df["order_month"]=df["Order Date"].dt.month
df["order_date"]=df["Order Date"].dt.day

df["Ship_year"]=df["Ship Date"].dt.year
df["Ship_month"]=df["Ship Date"].dt.month
df["Ship_date"]=df["Ship Date"].dt.day
```

[44]:
```
df["Postal Code"].isnull().sum() #sum of null values in Postal code
```

[44]:
```
0
```

[45]:
```
s=df["Postal Code"].astype(int) #unique postal code
s.unique()
```

[45]:
```
array([42420, 90036, 33311, 90032, 28027, 98103, 76106, 53711, 84084,
       94109, 68025, 19140, 84057, 90049, 77095, 75080, 77041, 60540,
       32935, 55122, 48185, 19901, 47150, 10024, 12180, 90004, 60610,
       85234, 22153, 10009, 49201, 38109, 77070, 35601, 94122, 27707,
       60623, 29203, 55901, 80013, 28205, 60462, 10035, 50322, 43229,
       37620, 19805, 61701, 85023, 95661, 64055, 91104, 43055, 53132,
       85254, 95123, 98105, 98115, 73034, 90045, 19134, 88220, 78207,
```

77036, 62521, 71203, 6824, 75051, 80219, 75220, 37064, 90604,
48601, 44256, 48227, 38401, 33614, 95051, 55044, 92037, 77506,
94513, 27514, 7960, 45231, 94110, 90301, 97206, 33319, 80906,
 7109, 48180, 8701, 22204, 80004, 7601, 33710, 19143, 90805,
92345, 37130, 78745, 1852, 31907, 6040, 78550, 85705, 62301,
 2038, 33024, 98198, 61604, 89115, 2886, 33180, 28403, 92646,
40475, 80027, 1841, 39212, 48187, 10801, 28052, 32216, 47201,
13021, 44312, 73071, 94521, 60068, 79109, 11757, 90008, 92024,
77340, 14609, 72701, 92627, 80134, 30318, 64118, 59405, 48234,
36116, 85204, 60653, 54302, 45503, 92804, 98270, 97301, 78041,
19120, 75217, 43123, 10011, 48126, 31088, 94591, 55407, 92691,
48307, 7060, 85635, 98661, 60505, 76017, 40214, 75081, 44105,
75701, 27217, 22980, 19013, 27511, 32137, 10550, 48205, 33012,
11572, 92105, 60201, 48183, 55016, 71111, 50315, 93534, 23223,
28806, 92530, 68104, 98026, 92704, 53209, 41042, 44052, 7036,
93905, 8901, 17602, 3301, 21044, 75043, 6360, 22304, 43615,
87401, 92503, 90503, 78664, 92054, 33433, 23464, 92563, 28540,
52601, 98502, 20016, 65109, 63376, 61107, 33142, 78521, 10701,
94601, 28110, 20735, 30076, 72401, 47374, 94509, 33030, 46350,
48911, 44221, 89502, 22801, 92025, 48073, 20852, 33065, 14215,
33437, 39503, 93727, 27834, 11561, 35630, 31204, 52402, 2908,
81001, 94533, 55106, 32725, 42071, 6457, 11520, 90660, 84604,
84062, 30080, 24153, 44134, 36608, 2740, 75061, 8360, 85301,
14304, 27360, 92683, 38301, 75019, 91767, 89031, 18103, 19711,
85281, 92677, 8302, 2149, 13601, 54915, 98006, 75002, 79907,
76051, 75007, 37167, 98031, 70506, 97224, 60076, 75023, 23434,
46203, 7002, 43017, 28314, 27405, 21215, 53142, 66062, 98002,
74133, 97756, 27604, 74403, 6450, 42104, 46614, 6010, 89015,
99207, 76248, 45014, 32127, 97504, 22901, 59801, 33178, 29501,
97477, 32712, 19601, 80020, 65807, 7501, 73120, 23320, 79424,
65203, 37604, 36830, 92404, 1453, 59715, 85345, 44107, 8861,
91761, 91730, 56560, 75150, 92374, 95207, 32174, 94086, 3820,
17403, 77840, 63116, 2169, 95336, 44240, 76903, 84106, 35810,
37918, 72209, 48146, 43302, 80122, 5408, 4401, 38671, 47362,
48640, 57103, 80525, 47905, 37042, 95823, 91360, 2148, 1040,
87105, 89431, 92236, 60126, 7055, 29406, 23602, 14701, 46544,
43402, 7090, 92253, 32303, 37211, 98226, 60098, 76117, 60090,
29483, 71901, 80112, 43130, 88001, 35244, 75034, 95687, 84107,
53186, 93309, 33068, 45373, 78415, 90278, 32839, 7050, 70601,
60035, 11550, 46060, 55124, 29464, 48310, 54703, 78577, 59102,
97030, 37421, 83642, 92307, 60440, 33801, 55369, 95695, 77489,
77581, 94403, 49505, 93277, 66212, 92592, 92399, 2151, 77301,
60477, 52001, 48127, 87505, 28601, 60188, 56301, 33161, 46226,
33317, 34952, 29730, 79762, 53214, 91911, 66502, 16602, 80229,
61821, 47401, 71854, 78539, 77520, 46142, 90712, 2895, 54880,
76021, 98042, 74012, 33023, 33021, 77536, 67212, 78501, 52240,
83704, 2920, 61032, 77642, 95610, 75056, 98052, 32114, 86442,

```
       46368, 58103, 46514, 91776, 45011, 33063, 30328, 44060, 73505,
       23666, 13440, 54601, 83501, 39401, 94526, 48858, 84321,  6708,
       30605,  4240, 61832, 85323, 30062, 85364, 54401, 99301, 60302,
       32503, 77573, 20877, 84043, 35401, 92553, 40324, 80538, 85224,
       59601, 63122, 76706, 48066, 60423, 18018, 55113, 68801, 55125,
       48237, 72756, 88101, 33458, 93101, 75104, 68701, 84020, 48104,
       91941, 83201, 49423,  6460, 60089, 92630, 96003, 95928, 13501,
       72032, 82001, 42301, 83605, 70065,  3060, 38134, 94061, 37087,
       93454, 60016, 98632, 37075, 50701,  2138, 60067,  1915, 97405,
       93030, 98059, 60025, 33445, 80022, 77590, 27893, 87124, 27534,
       98208, 90640, 92020, 33407,     5,     2,     4,     9,     3,
           1, 61761, 60174, 93010, 97123, 91505, 95351, 67846,  8401,
       80501, 95616, 26003, 95037,  7011, 53081, 30344, 57701,  1810,
       34741,  6484,  6810, 52302, 32771, 78666, 80634, 76063, 44035,
       83301, 63301, 33134, 60441,  1752, 20707, 77803, 71603, 57401,
       21740,  7017, 60004, 60543, 77705, 55433, 92672, 94568, 93405,
       72762, 95240, 77571, 45040, 30188])
```

[46]:
```
a=[5,2,4,9,3,1] #errors in postal code
c=df[df["Postal Code"].isin(a)]
c
```

[46]:

	Row ID	Order ID	Order Date	Ship Date	Ship Mode	\
6972	6973.0	CA-2017-153822	2017-09-19	2017-09-25	Standard Class	
6973	6974.0	CA-2017-153822	2017-09-19	2017-09-25	Standard Class	
6974	6975.0	CA-2017-146185	2017-09-15	2017-09-19	Standard Class	
6975	6976.0	CA-2015-112144	2015-06-28	2015-07-02	Standard Class	
6976	6977.0	CA-2015-112144	2015-06-28	2015-07-02	Standard Class	
6977	6978.0	US-2016-119298	2016-11-25	2016-11-28	First Class	
6978	6979.0	CA-2017-155159	2017-11-25	2017-11-29	Second Class	
6979	6980.0	CA-2017-149076	2017-01-14	2017-01-19	Standard Class	
6980	6981.0	CA-2014-146990	2014-11-07	2014-11-08	First Class	
6981	6982.0	CA-2014-146990	2014-11-07	2014-11-08	First Class	
6982	6983.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6983	6984.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6984	6985.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6985	6986.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6986	6987.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6987	6988.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6988	6989.0	CA-2017-158561	2017-11-11	2017-11-16	Second Class	
6990	6991.0	CA-2015-109386	2015-11-08	2015-11-13	Second Class	

	Customer ID	Customer Name	Segment	Country	\
6972	AB-10105	Adrian Barton	Consumer	United States	
6973	AB-10105	Adrian Barton	Consumer	United States	
6974	CC-12145	Charles Crestani	Consumer	United States	
6975	CY-12745	Craig Yedwab	Corporate	United States	

```
      Customer ID     Customer Name    Segment        Country
6976    CY-12745       Craig Yedwab  Corporate  United States
6977    EP-13915         Emily Phan   Consumer  United States
6978    DL-13315  Delfina Latchford   Consumer  United States
6979    SO-20335     Sean O'Donnell   Consumer  United States
6980    BP-11095       Bart Pistole  Corporate  United States
6981    BP-11095       Bart Pistole  Corporate  United States
6982    JA-15970       Joseph Airdo   Consumer  United States
6983    JA-15970       Joseph Airdo   Consumer  United States
6984    JA-15970       Joseph Airdo   Consumer  United States
6985    JA-15970       Joseph Airdo   Consumer  United States
6986    JA-15970       Joseph Airdo   Consumer  United States
6987    JA-15970       Joseph Airdo   Consumer  United States
6988    BB-11545      Brenda Bowman  Corporate  United States
6990    RH-19600       Rob Haberlin   Consumer  United States

                City       State  … \
6972          Phoenix     Arizona  …
6973          Phoenix     Arizona  …
6974          Houston       Texas  …
6975          Gilbert     Arizona  …
6976          Gilbert     Arizona  …
6977        Jonesboro    Arkansas  …
6978          Atlanta     Georgia  …
6979      Los Angeles  California  …
6980    New York City    New York  …
6981    New York City    New York  …
6982          Detroit    Michigan  …
6983          Detroit    Michigan  …
6984          Detroit    Michigan  …
6985          Detroit    Michigan  …
6986          Detroit    Michigan  …
6987          Detroit    Michigan  …
6988  Fort Lauderdale     Florida  …
6990          Hampton    Virginia  …

                                                Product Name     Sales Quantity  \
6972          Polycom VoiceStation 500 Conference phone   471.920      2.0
6973                                Plastic Binding Combs    18.180      4.0
6974                         Prismacolor Color Pencil Set    31.744      2.0
6975                                             Avery 501     5.904      2.0
6976                      Electrix Halogen Magnifier Lamp   621.760      4.0
6977  OtterBox Defender Series Case - Samsung Galaxy S4    59.980      2.0
6978                  Wirebound Message Book, 4 per Page    48.870      9.0
6979                                             Xerox 19   154.900      5.0
6980                                Binder Clips by OIC     5.920      4.0
6981          Riverleaf Stik-Withit Designer Note Cubes    30.180      3.0
6982  Wilson Jones Turn Tabs Binder Tool for Ring Bi…    24.100      5.0
```

6983	Belkin Grip Candy Sheer Case / Cover for iPhon…	8.780	1.0
6984	Eureka The Boss Plus 12-Amp Hard Box Upright V…	376.740	4.0
6985	GBC Plastic Binding Combs	29.520	4.0
6986	Newell 315	11.960	2.0
6987	Wilson Jones 1" Hanging DublLock Ring Binders	26.400	5.0
6988	Hoover Upright Vacuum With Dirt Cup	1158.120	5.0
6990	Holmes Replacement Filter for HEPA Air Cleaner…	44.430	3.0

	Discount	Profit	order_year	order_month	order_date	Ship_year	\
6972	0.2	29.4950	2017	9	19	2017	
6973	0.7	-13.9380	2017	9	19	2017	
6974	0.2	8.3328	2017	9	15	2017	
6975	0.2	1.9926	2015	6	28	2015	
6976	0.2	46.6320	2015	6	28	2015	
6977	0.0	17.9940	2016	11	25	2016	
6978	0.0	23.9463	2017	11	25	2017	
6979	0.0	69.7050	2017	1	14	2017	
6980	0.0	2.8416	2014	11	7	2014	
6981	0.0	13.8828	2014	11	7	2014	
6982	0.0	11.0860	2016	9	1	2016	
6983	0.0	2.2828	2016	9	1	2016	
6984	0.1	71.1620	2016	9	1	2016	
6985	0.0	14.4648	2016	9	1	2016	
6986	0.0	2.9900	2016	9	1	2016	
6987	0.0	12.6720	2016	9	1	2016	
6988	0.2	130.2885	2017	11	11	2017	
6990	0.0	18.6606	2015	11	8	2015	

	Ship_month	Ship_date
6972	9	25
6973	9	25
6974	9	19
6975	7	2
6976	7	2
6977	11	28
6978	11	29
6979	1	19
6980	11	8
6981	11	8
6982	9	5
6983	9	5
6984	9	5
6985	9	5
6986	9	5
6987	9	5
6988	11	16
6990	11	13

[18 rows x 27 columns]

[47]:
```
#finding most frequent postal code for city
cities = ["Phoenix", "Houston", "Gilbert", "Jonesboro", "Atlanta", "Los␣
 ↪Angeles", "New York City", "Detroit", "Fort Lauderdale", "Abilene",␣
 ↪"Hampton"]

for city in cities:
    filtered_df = df[df["City"] == city]
    if filtered_df.empty:
        print(f"No rows found for city: {city}")
    else:
        postal_code_mode = filtered_df["Postal Code"].mode()[0]
        print(f"Most frequent postal code for city {city}: {postal_code_mode}")
```

```
Most frequent postal code for city Phoenix: 85023.0
Most frequent postal code for city Houston: 77041.0
Most frequent postal code for city Gilbert: 85234.0
Most frequent postal code for city Jonesboro: 72401.0
Most frequent postal code for city Atlanta: 30318.0
Most frequent postal code for city Los Angeles: 90049.0
Most frequent postal code for city New York City: 10035.0
Most frequent postal code for city Detroit: 48227.0
Most frequent postal code for city Fort Lauderdale: 33311.0
No rows found for city: Abilene
Most frequent postal code for city Hampton: 23666.0
```

[48]:
```
city_to_region = {
    'Phoenix': 85023.0,
    'Houston': 77041.0,
    'Gilbert': 85234.0,
    'Jonesboro': 72401.0,
    'Atlanta': 30318.0,
    'Los Angeles': 90049.0,
    'New York City': 10035.0,
    'Detroit': 48227.0,
    'Fort Lauderdale': 33311.0,
    'Abilene': 77041.0,
    'Hampton': 23666.0
}

# Update 'Region' column permanently
c['Postal Code'] = c['City'].map(city_to_region).fillna(c['Postal Code'])
```

```
C:\Users\ganesh\AppData\Local\Temp\ipykernel_49052\1011837133.py:16:
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_guide/indexing.html#returning-a-view-versus-a-copy
  c['Postal Code'] = c['City'].map(city_to_region).fillna(c['Postal Code'])
```

[49]:
```
c
```

[49]:

	Row ID	Order ID	Order Date	Ship Date	Ship Mode	\
6972	6973.0	CA-2017-153822	2017-09-19	2017-09-25	Standard Class	
6973	6974.0	CA-2017-153822	2017-09-19	2017-09-25	Standard Class	
6974	6975.0	CA-2017-146185	2017-09-15	2017-09-19	Standard Class	
6975	6976.0	CA-2015-112144	2015-06-28	2015-07-02	Standard Class	
6976	6977.0	CA-2015-112144	2015-06-28	2015-07-02	Standard Class	
6977	6978.0	US-2016-119298	2016-11-25	2016-11-28	First Class	
6978	6979.0	CA-2017-155159	2017-11-25	2017-11-29	Second Class	
6979	6980.0	CA-2017-149076	2017-01-14	2017-01-19	Standard Class	
6980	6981.0	CA-2014-146990	2014-11-07	2014-11-08	First Class	
6981	6982.0	CA-2014-146990	2014-11-07	2014-11-08	First Class	
6982	6983.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6983	6984.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6984	6985.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6985	6986.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6986	6987.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6987	6988.0	CA-2016-116526	2016-09-01	2016-09-05	Standard Class	
6988	6989.0	CA-2017-158561	2017-11-11	2017-11-16	Second Class	
6990	6991.0	CA-2015-109386	2015-11-08	2015-11-13	Second Class	

	Customer ID	Customer Name	Segment	Country	\
6972	AB-10105	Adrian Barton	Consumer	United States	
6973	AB-10105	Adrian Barton	Consumer	United States	
6974	CC-12145	Charles Crestani	Consumer	United States	
6975	CY-12745	Craig Yedwab	Corporate	United States	
6976	CY-12745	Craig Yedwab	Corporate	United States	
6977	EP-13915	Emily Phan	Consumer	United States	
6978	DL-13315	Delfina Latchford	Consumer	United States	
6979	SO-20335	Sean O'Donnell	Consumer	United States	
6980	BP-11095	Bart Pistole	Corporate	United States	
6981	BP-11095	Bart Pistole	Corporate	United States	
6982	JA-15970	Joseph Airdo	Consumer	United States	
6983	JA-15970	Joseph Airdo	Consumer	United States	
6984	JA-15970	Joseph Airdo	Consumer	United States	
6985	JA-15970	Joseph Airdo	Consumer	United States	
6986	JA-15970	Joseph Airdo	Consumer	United States	
6987	JA-15970	Joseph Airdo	Consumer	United States	
6988	BB-11545	Brenda Bowman	Corporate	United States	

```
6990    RH-19600       Rob Haberlin   Consumer  United States

                City       State  …  \
6972          Phoenix     Arizona  …
6973          Phoenix     Arizona  …
6974          Houston       Texas  …
6975          Gilbert     Arizona  …
6976          Gilbert     Arizona  …
6977        Jonesboro    Arkansas  …
6978          Atlanta     Georgia  …
6979      Los Angeles  California  …
6980    New York City    New York  …
6981    New York City    New York  …
6982          Detroit    Michigan  …
6983          Detroit    Michigan  …
6984          Detroit    Michigan  …
6985          Detroit    Michigan  …
6986          Detroit    Michigan  …
6987          Detroit    Michigan  …
6988  Fort Lauderdale     Florida  …
6990          Hampton    Virginia  …

                                              Product Name     Sales Quantity  \
6972          Polycom VoiceStation 500 Conference phone   471.920      2.0
6973                              Plastic Binding Combs    18.180      4.0
6974                      Prismacolor Color Pencil Set    31.744      2.0
6975                                        Avery 501     5.904      2.0
6976                    Electrix Halogen Magnifier Lamp   621.760      4.0
6977  OtterBox Defender Series Case - Samsung Galaxy S4    59.980      2.0
6978                Wirebound Message Book, 4 per Page    48.870      9.0
6979                                        Xerox 19   154.900      5.0
6980                                Binder Clips by OIC     5.920      4.0
6981          Riverleaf Stik-Withit Designer Note Cubes    30.180      3.0
6982  Wilson Jones Turn Tabs Binder Tool for Ring Bi…    24.100      5.0
6983  Belkin Grip Candy Sheer Case / Cover for iPhon…     8.780      1.0
6984  Eureka The Boss Plus 12-Amp Hard Box Upright V…   376.740      4.0
6985                           GBC Plastic Binding Combs    29.520      4.0
6986                                        Newell 315    11.960      2.0
6987     Wilson Jones 1" Hanging DublLock Ring Binders    26.400      5.0
6988                Hoover Upright Vacuum With Dirt Cup  1158.120      5.0
6990  Holmes Replacement Filter for HEPA Air Cleaner…    44.430      3.0

     Discount    Profit order_year  order_month  order_date  Ship_year  \
6972      0.2   29.4950       2017            9          19       2017
6973      0.7  -13.9380       2017            9          19       2017
6974      0.2    8.3328       2017            9          15       2017
6975      0.2    1.9926       2015            6          28       2015
```

```
6976       0.2   46.6320       2015             6          28       2015
6977       0.0   17.9940       2016            11          25       2016
6978       0.0   23.9463       2017            11          25       2017
6979       0.0   69.7050       2017             1          14       2017
6980       0.0    2.8416       2014            11           7       2014
6981       0.0   13.8828       2014            11           7       2014
6982       0.0   11.0860       2016             9           1       2016
6983       0.0    2.2828       2016             9           1       2016
6984       0.1   71.1620       2016             9           1       2016
6985       0.0   14.4648       2016             9           1       2016
6986       0.0    2.9900       2016             9           1       2016
6987       0.0   12.6720       2016             9           1       2016
6988       0.2  130.2885       2017            11          11       2017
6990       0.0   18.6606       2015            11           8       2015

      Ship_month  Ship_date
6972           9         25
6973           9         25
6974           9         19
6975           7          2
6976           7          2
6977          11         28
6978          11         29
6979           1         19
6980          11          8
6981          11          8
6982           9          5
6983           9          5
6984           9          5
6985           9          5
6986           9          5
6987           9          5
6988          11         16
6990          11         13

[18 rows x 27 columns]
```

[50]:
```
df = pd.concat([df, c], ignore_index=True) #conactinating the new dataframe␣
↪with existing dataframe df
```

[51]:
```
df.shape #shape of data frame
```

[51]:
```
(9872, 27)
```

[52]:
```
df.drop(df[df["Postal Code"].isin(a)].index,inplace=True) #droping rows that␣
↪have error in postal code after imputing with correct values
```

[53]:
```
df[df["Row ID"]==6973]
```

[53]:
```
      Row ID        Order ID Order Date  Ship Date       Ship Mode  \
9854  6973.0  CA-2017-153822 2017-09-19 2017-09-25  Standard Class

     Customer ID  Customer Name    Segment        Country     City    State  \
9854    AB-10105  Adrian Barton  Consumer  United States  Phoenix  Arizona

      …                                 Product Name   Sales Quantity  \
9854  …  Polycom VoiceStation 500 Conference phone  471.92      2.0

     Discount  Profit order_year  order_month  order_date  Ship_year  \
9854      0.2  29.495       2017            9          19       2017

      Ship_month  Ship_date
9854           9         25

[1 rows x 27 columns]
```

[54]:
```
df["Postal Code"].unique() #unique values in data frame
```

[54]:
```
array([42420., 90036., 33311., 90032., 28027., 98103., 76106., 53711.,
       84084., 94109., 68025., 19140., 84057., 90049., 77095., 75080.,
       77041., 60540., 32935., 55122., 48185., 19901., 47150., 10024.,
       12180., 90004., 60610., 85234., 22153., 10009., 49201., 38109.,
       77070., 35601., 94122., 27707., 60623., 29203., 55901., 80013.,
       28205., 60462., 10035., 50322., 43229., 37620., 19805., 61701.,
       85023., 95661., 64055., 91104., 43055., 53132., 85254., 95123.,
       98105., 98115., 73034., 90045., 19134., 88220., 78207., 77036.,
       62521., 71203.,  6824., 75051., 80219., 75220., 37064., 90604.,
       48601., 44256., 48227., 38401., 33614., 95051., 55044., 92037.,
       77506., 94513., 27514.,  7960., 45231., 94110., 90301., 97206.,
       33319., 80906.,  7109., 48180.,  8701., 22204., 80004.,  7601.,
       33710., 19143., 90805., 92345., 37130., 78745.,  1852., 31907.,
        6040., 78550., 85705., 62301.,  2038., 33024., 98198., 61604.,
       89115.,  2886., 33180., 28403., 92646., 40475., 80027.,  1841.,
       39212., 48187., 10801., 28052., 32216., 47201., 13021., 44312.,
       73071., 94521., 60068., 79109., 11757., 90008., 92024., 77340.,
       14609., 72701., 92627., 80134., 30318., 64118., 59405., 48234.,
       36116., 85204., 60653., 54302., 45503., 92804., 98270., 97301.,
       78041., 19120., 75217., 43123., 10011., 48126., 31088., 94591.,
       55407., 92691., 48307.,  7060., 85635., 98661., 60505., 76017.,
       40214., 75081., 44105., 75701., 27217., 22980., 19013., 27511.,
       32137., 10550., 48205., 33012., 11572., 92105., 60201., 48183.,
       55016., 71111., 50315., 93534., 23223., 28806., 92530., 68104.,
       98026., 92704., 53209., 41042., 44052.,  7036., 93905.,  8901.,
       17602.,  3301., 21044., 75043.,  6360., 22304., 43615., 87401.,
```

92503., 90503., 78664., 92054., 33433., 23464., 92563., 28540.,
52601., 98502., 20016., 65109., 63376., 61107., 33142., 78521.,
10701., 94601., 28110., 20735., 30076., 72401., 47374., 94509.,
33030., 46350., 48911., 44221., 89502., 22801., 92025., 48073.,
20852., 33065., 14215., 33437., 39503., 93727., 27834., 11561.,
35630., 31204., 52402., 2908., 81001., 94533., 55106., 32725.,
42071., 6457., 11520., 90660., 84604., 84062., 30080., 24153.,
44134., 36608., 2740., 75061., 8360., 85301., 14304., 27360.,
92683., 38301., 75019., 91767., 89031., 18103., 19711., 85281.,
92677., 8302., 2149., 13601., 54915., 98006., 75002., 79907.,
76051., 75007., 37167., 98031., 70506., 97224., 60076., 75023.,
23434., 46203., 7002., 43017., 28314., 27405., 21215., 53142.,
66062., 98002., 74133., 97756., 27604., 74403., 6450., 42104.,
46614., 6010., 89015., 99207., 76248., 45014., 32127., 97504.,
22901., 59801., 33178., 29501., 97477., 32712., 19601., 80020.,
65807., 7501., 73120., 23320., 79424., 65203., 37604., 36830.,
92404., 1453., 59715., 85345., 44107., 8861., 91761., 91730.,
56560., 75150., 92374., 95207., 32174., 94086., 3820., 17403.,
77840., 63116., 2169., 95336., 44240., 76903., 84106., 35810.,
37918., 72209., 48146., 43302., 80122., 5408., 4401., 38671.,
47362., 48640., 57103., 80525., 47905., 37042., 95823., 91360.,
 2148., 1040., 87105., 89431., 92236., 60126., 7055., 29406.,
23602., 14701., 46544., 43402., 7090., 92253., 32303., 37211.,
98226., 60098., 76117., 60090., 29483., 71901., 80112., 43130.,
88001., 35244., 75034., 95687., 84107., 53186., 93309., 33068.,
45373., 78415., 90278., 32839., 7050., 70601., 60035., 11550.,
46060., 55124., 29464., 48310., 54703., 78577., 59102., 97030.,
37421., 83642., 92307., 60440., 33801., 55369., 95695., 77489.,
77581., 94403., 49505., 93277., 66212., 92592., 92399., 2151.,
77301., 60477., 52001., 48127., 87505., 28601., 60188., 56301.,
33161., 46226., 33317., 34952., 29730., 79762., 53214., 91911.,
66502., 16602., 80229., 61821., 47401., 71854., 78539., 77520.,
46142., 90712., 2895., 54880., 76021., 98042., 74012., 33023.,
33021., 77536., 67212., 78501., 52240., 83704., 2920., 61032.,
77642., 95610., 75056., 98052., 32114., 86442., 46368., 58103.,
46514., 91776., 45011., 33063., 30328., 44060., 73505., 23666.,
13440., 54601., 83501., 39401., 94526., 48858., 84321., 6708.,
30605., 4240., 61832., 85323., 30062., 85364., 54401., 99301.,
60302., 32503., 77573., 20877., 84043., 35401., 92553., 40324.,
80538., 85224., 59601., 63122., 76706., 48066., 60423., 18018.,
55113., 68801., 55125., 48237., 72756., 88101., 33458., 93101.,
75104., 68701., 84020., 48104., 91941., 83201., 49423., 6460.,
60089., 92630., 96003., 95928., 13501., 72032., 82001., 42301.,
83605., 70065., 3060., 38134., 94061., 37087., 93454., 60016.,
98632., 37075., 50701., 2138., 60067., 1915., 97405., 93030.,
98059., 60025., 33445., 80022., 77590., 27893., 87124., 27534.,
98208., 90640., 92020., 33407., 61761., 60174., 93010., 97123.,

```
       91505., 95351., 67846.,  8401., 80501., 95616., 26003., 95037.,
        7011., 53081., 30344., 57701.,  1810., 34741.,  6484.,  6810.,
       52302., 32771., 78666., 80634., 76063., 44035., 83301., 63301.,
       33134., 60441.,  1752., 20707., 77803., 71603., 57401., 21740.,
        7017., 60004., 60543., 77705., 55433., 92672., 94568., 93405.,
       72762., 95240., 77571., 45040., 30188.])
```

[55]:
```
df[df["Postal Code"].isin(a)] #rechecking is there any error in postal code
```

[55]:
```
Empty DataFrame
Columns: [Row ID, Order ID, Order Date, Ship Date, Ship Mode, Customer ID,
Customer Name, Segment, Country, City, State, Postal Code, Region, Product ID,
Category, Sub-Category, Product Name, Sales, Quantity, Discount, Profit,
order_year, order_month, order_date, Ship_year, Ship_month, Ship_date]
Index: []

[0 rows x 27 columns]
```

[56]:
```
df.isnull().sum() #checking sum of null values
```

[56]:
```
Row ID           0
Order ID         0
Order Date       0
Ship Date        0
Ship Mode        4
Customer ID      1
Customer Name    19
Segment          15
Country          18
City             0
State            0
Postal Code      0
Region           0
Product ID       2
Category         2
Sub-Category     4
Product Name     4
Sales            0
Quantity         0
Discount         0
Profit           13
order_year       0
order_month      0
order_date       0
Ship_year        0
Ship_month       0
Ship_date        0
```

```
dtype: int64
```

[57]:
```
# filled with united states as it has only one country
df['Country'].fillna('United States', inplace=True)
```

[58]:
```
#filling nan values in object dtype columns with mode
for i in df.select_dtypes(include="object"):
    df[i].fillna(df[i].mode()[0],inplace=True)
```

[59]:
```
#used knnimputer to impute null values in numerical columns except sales(as it␣
 ↪is dependent variable)
impute=KNNImputer()
for i in df.select_dtypes(include="number").columns:
    if i != 'Sales':
        df[i] = impute.fit_transform(df[[i]])
```

[60]:
```
df.isnull().sum() #checking sum of null values
```

[60]:
```
Row ID           0
Order ID         0
Order Date       0
Ship Date        0
Ship Mode        0
Customer ID      0
Customer Name    0
Segment          0
Country          0
City             0
State            0
Postal Code      0
Region           0
Product ID       0
Category         0
Sub-Category     0
Product Name     0
Sales            0
Quantity         0
Discount         0
Profit           0
order_year       0
order_month      0
order_date       0
Ship_year        0
Ship_month       0
Ship_date        0
dtype: int64
```

[61]:
```
df.dtypes #checking dtypes
```

[61]:
```
Row ID                 float64
Order ID                object
Order Date      datetime64[ns]
Ship Date       datetime64[ns]
Ship Mode               object
Customer ID             object
Customer Name           object
Segment                 object
Country                 object
City                    object
State                   object
Postal Code            float64
Region                  object
Product ID              object
Category                object
Sub-Category            object
Product Name            object
Sales                  float64
Quantity               float64
Discount               float64
Profit                 float64
order_year             float64
order_month            float64
order_date             float64
Ship_year              float64
Ship_month             float64
Ship_date              float64
dtype: object
```

[62]:
```
df.dropna(inplace=True) #dropping all nan value rows
```

[63]:
```
df.isnull().sum() #cheking null values in columns
```

[63]:
```
Row ID          0
Order ID        0
Order Date      0
Ship Date       0
Ship Mode       0
Customer ID     0
Customer Name   0
Segment         0
Country         0
City            0
State           0
Postal Code     0
```

```
Region          0
Product ID      0
Category        0
Sub-Category    0
Product Name    0
Sales           0
Quantity        0
Discount        0
Profit          0
order_year      0
order_month     0
order_date      0
Ship_year       0
Ship_month      0
Ship_date       0
dtype: int64
```

[64]:
```
df.shape #checking shape
```

[64]:
```
(9854, 27)
```

[65]:
```
((9994-9854)/9994)*100 #checking perecntage of rows i deleted
```

[65]:
```
1.4008405043025816
```

[66]:
```
df.duplicated().sum() #checking number of duplicate rows
```

[66]:
```
10
```

[67]:
```
df.drop_duplicates(inplace=True) #droping duplicate rows
```

[68]:
```
for i in df.columns:
    print(f"{i}:{df[i].unique()}\n")  #checking all unique values for each␣
 ↪column
```

```
Row ID:[1.000e+00 2.000e+00 3.000e+00 … 6.988e+03 6.989e+03 6.991e+03]

Order ID:['CA-2016-152156' 'CA-2016-138688' 'US-2015-108966' …
'CA-2014-146990'
 'CA-2016-116526' 'CA-2017-158561']

Order Date:['2016-11-08T00:00:00.000000000' '2016-06-12T00:00:00.000000000'
 '2015-10-11T00:00:00.000000000' … '2016-06-03T00:00:00.000000000'
 '2015-04-12T00:00:00.000000000' '2014-01-21T00:00:00.000000000']

Ship Date:['2016-11-11T00:00:00.000000000' '2016-06-16T00:00:00.000000000'
 '2015-10-18T00:00:00.000000000' … '2015-05-23T00:00:00.000000000'
```

```
 '2014-01-23T00:00:00.000000000' '2017-03-03T00:00:00.000000000']

Ship Mode:['Second Class' 'Standard Class' 'First Class' 'Same Day']

Customer ID:['CG-12520' 'DV-13045' 'SO-20335' 'BH-11710' 'AA-10480' 'IM-15070'
 'HP-14815' 'PK-19075' 'AG-10270' 'ZD-21925' 'KB-16585' 'SF-20065'
 'EB-13870' 'EH-13945' 'TB-21520' 'MA-17560' 'GH-14485' 'SN-20710'
 'LC-16930' 'RA-19885' 'ES-14080' 'ON-18715' 'PO-18865' 'LH-16900'
 'DP-13000' 'JM-15265' 'TB-21055' 'KM-16720' 'PS-18970' 'BS-11590'
 'KD-16270' 'HM-14980' 'JE-15745' 'KB-16600' 'SC-20770' 'DN-13690'
 'JC-16105' 'CS-12400' 'PG-18895' 'GM-14455' 'JS-15685' 'RB-19465'
 'GZ-14470' 'LC-16870' 'JM-15250' 'PA-19060' 'CV-12805' 'CL-12565'
 'RC-19960' 'DK-13090' 'GG-14650' 'SC-20725' 'AD-10180' 'PF-19165'
 'TS-21610' 'LS-16975' 'DW-13585' 'LC-16885' 'JD-15895' 'SH-19975'
 'SG-20080' 'HA-14920' 'MG-17680' 'JE-16165' 'TW-21025' 'SP-20650'
 'NK-18490' 'DB-13060' 'NP-18670' 'TT-21070' 'EM-13960' 'RD-19900'
 'MJ-17740' 'BM-11140' 'CS-12130' 'JB-15400' 'SJ-20500' 'JK-15640'
 'DK-13150' 'RM-19675' 'SK-19990' 'FM-14290' 'AM-10360' 'MP-17470'
 'BS-11755' 'LC-17140' 'HK-14890' 'LE-16810' 'JH-15985' 'MS-17980'
 'VW-21775' 'JH-15910' 'DS-13180' 'VD-21670' 'EA-14035' 'DB-13120'
 'KL-16645' 'DW-13480' 'LH-17155' 'KC-16540' 'DL-13315' 'DR-12880'
 'CC-12670' 'Dl-13600' 'SB-20290' 'RC-19825' 'AH-10210' 'CB-12535'
 'CA-12310' 'KH-16690' 'BB-10990' 'AG-10495' 'JO-15280' 'AH-10195'
 'NZ-18565' 'KL-16555' 'AS-10225' 'CR-12625' 'SH-20395' 'BP-11185'
 'TS-21205' 'AG-10525' 'SP-20860' 'NM-18445' 'FA-14230' 'GK-14620'
 'DJ-13510' 'PO-18850' 'JL-15850' 'DB-13615' 'CC-12550' 'TD-20995'
 'AB-10060' 'JL-15505' 'VB-21745' 'KW-16435' 'JD-16060' 'MK-17905'
 'GT-14755' 'AG-10900' 'MM-18280' 'AR-10405' 'RA-19915' 'AS-10285'
 'LA-16780' 'DO-13435' 'DK-13225' 'NG-18430' 'MV-18190' 'JG-15115'
 'BP-11095' 'VP-21730' 'SS-20140' 'AG-10675' 'LF-17185' 'RF-19840'
 'KH-16510' 'KC-16675' 'CJ-12010' 'PB-19150' 'MP-17965' 'NF-18385'
 'SD-20485' 'KH-16630' 'RB-19795' 'MK-18160' 'PO-19180' 'BB-11545'
 'TB-21595' 'RB-19360' 'EB-13705' 'SC-20095' 'TN-21040' 'JS-15940'
 'MH-17785' 'JP-15520' 'JE-15475' 'JG-15805' 'XP-21865' 'EM-14065'
 'MT-18070' 'SA-20830' 'CW-11905' 'AJ-10960' 'SS-20590' 'RO-19780'
 'MD-17350' 'MY-17380' 'CM-12385' 'LS-17245' 'BN-11515' 'DB-13210'
 'MC-17605' 'BD-11605' 'MG-18145' 'KB-16240' 'JC-15340' 'RL-19615'
 'AA-10375' 'EP-13915' 'DK-12985' 'BD-11500' 'LM-17065' 'AS-10135'
 'BD-11320' 'GT-14710' 'AJ-10945' 'OT-18730' 'LP-17080' 'CA-12775'
 'JF-15490' 'FP-14320' 'EB-13840' 'JF-15415' 'SF-20200' 'TG-21640'
 'WB-21850' 'CC-12145' 'DV-13465' 'BD-11725' 'ZC-21910' 'MS-17830'
 'LR-16915' 'TP-21130' 'CK-12205' 'AS-10240' 'AR-10510' 'NB-18655'
 'GD-14590' 'CK-12595' 'NG-18355' 'CA-12265' 'SF-20965' 'MO-17800'
 'AT-10735' 'FM-14380' 'DJ-13420' 'ME-17725' 'JD-16150' 'JL-15835'
 'SC-20305' 'CC-12430' 'AR-10825' 'SR-20740' 'CR-12730' 'EH-14125'
 'CB-12025' 'SP-20545' 'TH-21235' 'RP-19390' 'RB-19570' 'CD-11980'
 'DJ-13630' 'GT-14635' 'MC-17845' 'RA-19285' 'NP-18325' 'AB-10165'
 'JO-15550' 'JK-15370' 'BN-11470' 'DP-13165' 'TH-21550' 'AP-10915'
```

'RS-19765' 'SV-20365' 'CK-12325' 'RD-19810' 'MR-17545' 'SC-20695'
'JF-15355' 'EG-13900' 'DS-13030' 'PO-19195' 'SS-20875' 'PB-19105'
'RF-19735' 'YC-21895' 'DC-13285' 'CP-12340' 'BF-11020' 'LH-17020'
'CS-12250' 'AJ-10795' 'BV-11245' 'DL-12865' 'BM-11785' 'LT-17110'
'JK-15730' 'ES-14020' 'RH-19495' 'CD-11920' 'HW-14935' 'MC-18130'
'GM-14440' 'PJ-19015' 'BW-11110' 'TR-21325' 'PG-18820' 'JL-15175'
'BM-11650' 'EM-14095' 'AF-10885' 'GA-14725' 'CK-12760' 'DP-13105'
'BK-11260' 'SJ-20125' 'CM-12445' 'AJ-10780' 'LS-16945' 'GP-14740'
'PK-18910' 'SM-20005' 'AG-10765' 'PM-19135' 'LL-16840' 'JS-15595'
'EL-13735' 'PC-18745' 'HL-15040' 'MS-17365' 'GB-14530' 'JR-16210'
'BE-11335' 'SC-20050' 'RW-19630' 'SE-20110' 'AH-10075' 'JM-15535'
'JJ-15760' 'RK-19300' 'CG-12040' 'RP-19270' 'KC-16255' 'KH-16360'
'GH-14665' 'SW-20275' 'JA-15970' 'DL-12925' 'LW-16990' 'TB-21190'
'BS-11800' 'RW-19690' 'TZ-21580' 'AS-10630' 'TS-21340' 'SL-20155'
'MW-18235' 'RD-19585' 'RA-19945' 'MT-17815' 'VG-21790' 'JS-15880'
'KM-16225' 'HR-14770' 'DE-13255' 'AG-10390' 'JJ-15445' 'JH-15430'
'RD-19660' 'MO-17500' 'NS-18640' 'DG-13300' 'NF-18595' 'MG-17650'
'TS-21160' 'BD-11620' 'CM-12160' 'SN-20560' 'EH-14005' 'FO-14305'
'MS-17710' 'CC-12100' 'DW-13540' 'BT-11395' 'CY-12745' 'BT-11485'
'PS-19045' 'PV-18985' 'NM-18520' 'DL-13495' 'CS-12355' 'FH-14275'
'NC-18340' 'AA-10315' 'LT-16765' 'AP-10720' 'PM-18940' 'AT-10435'
'CA-12055' 'HR-14830' 'BT-11530' 'LH-16750' 'SW-20755' 'SP-20620'
'BF-11170' 'KT-16480' 'BG-11695' 'GM-14680' 'EJ-14155' 'NP-18700'
'MH-18115' 'JR-15700' 'SM-20950' 'CC-12220' 'PF-19225' 'DC-12850'
'BD-11770' 'GM-14500' 'TB-21355' 'JH-16180' 'EB-13975' 'QJ-19255'
'TC-21535' 'CS-12460' 'HG-14965' 'LW-16825' 'MC-17575' 'LP-17095'
'EB-14170' 'GZ-14545' 'CP-12085' 'FG-14260' 'LD-17005' 'AB-10255'
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'JG-15160' 'MC-17275' 'NW-18400' 'TB-21280' 'BS-11380' 'FH-14365'
'VM-21685' 'HH-15010' 'CD-12280' 'TH-21100' 'MM-18055' 'NS-18505'
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'BE-11455' 'JF-15565' 'PB-19210' 'BT-11680' 'JL-15235' 'CH-12070'
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 'TC-20980' 'BF-11080' 'MM-17260' 'AH-10120' 'BW-11200' 'SW-20245'
 'BS-11665' 'RF-19345' 'TB-21625' 'AF-10870' 'RB-19435' 'CS-11950'
 'KF-16285' 'JH-15820' 'IL-15100' 'PB-18805' 'RH-19600' 'AW-10930'
 'RB-19705' 'ML-17410' 'DB-13555' 'MH-17620' 'DK-13375' 'BT-11440'
 'DB-13405' 'TG-21310' 'BF-11005' 'JM-16195' 'MZ-17335' 'MW-18220'
 'MV-17485' 'SM-20320' 'TP-21415' 'JK-15625' 'PJ-18835' 'RS-19420'
 'SV-20935' 'BC-11125' 'EM-13825' 'BM-11575' 'KN-16705' 'KW-16570'
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 'JF-15295' 'TT-21265' 'SB-20170' 'CL-12700' 'HG-15025' 'NL-18310'
 'RR-19525' 'TC-21295' 'SV-20785' 'BE-11410' 'SC-20680' 'DF-13135'
 'FH-14350' 'MS-17530' 'RH-19555' 'GA-14515' 'JP-16135' 'Dp-13240'
 'MO-17950' 'ER-13855' 'DL-13330' 'MH-18025' 'DR-12940' 'DM-13015'
 'CA-11965' 'AC-10660' 'DM-13345' 'VF-21715' 'CC-12370' 'BF-11275'
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 'JB-16045' 'MG-17875' 'SR-20425' 'JB-16000' 'DM-12955' 'TC-21475'
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 'KE-16420' 'DH-13675' 'PF-19120' 'VT-21700' 'MG-17695' 'SP-20920'
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 'Daniel Byrd' 'Thomas Thornton' 'Lori Olson' 'Ken Dana' 'Nicole Brennan'
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 'Bruce Geld' 'Laurel Beltran' 'Candace McMahon' 'Evan Henry' 'Tony Sayre'
 'Patrick Ryan' 'Liz Carlisle' 'Cindy Schnelling' 'Dave Hallsten'
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Segment:['Consumer' 'Corporate' 'Home Office']

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'Sierra Vista' 'Vancouver' 'Cleveland' 'Tyler' 'Burlington' 'Waynesboro'
'Chester' 'Cary' 'Palm Coast' 'Mount Vernon' 'Hialeah' 'Oceanside'
'Evanston' 'Trenton' 'Cottage Grove' 'Bossier City' 'Lancaster'
'Asheville' 'Lake Elsinore' 'Omaha' 'Edmonds' 'Santa Ana' 'Milwaukee'
'Florence' 'Lorain' 'Linden' 'Salinas' 'New Brunswick' 'Garland'
'Norwich' 'Alexandria' 'Toledo' 'Farmington' 'Riverside' 'Torrance'
'Round Rock' 'Boca Raton' 'Virginia Beach' 'Murrieta' 'Olympia'
'Washington' 'Jefferson City' 'Saint Peters' 'Rockford' 'Brownsville'
'Yonkers' 'Oakland' 'Clinton' 'Encinitas' 'Roswell' 'Jonesboro' 'Antioch'
'Homestead' 'La Porte' 'Lansing' 'Cuyahoga Falls' 'Reno' 'Harrisonburg'
'Escondido' 'Royal Oak' 'Rockville' 'Coral Springs' 'Buffalo'
'Boynton Beach' 'Gulfport' 'Fresno' 'Greenville' 'Macon' 'Cedar Rapids'
'Providence' 'Pueblo' 'Saint Paul' 'Deltona' 'Murray' 'Middletown'
'Freeport' 'Pico Rivera' 'Provo' 'Pleasant Grove' 'Smyrna' 'Parma'
'Mobile' 'New Bedford' 'Irving' 'Vineland' 'Glendale' 'Niagara Falls'
'Thomasville' 'Westminster' 'Coppell' 'Pomona' 'North Las Vegas'
'Allentown' 'Tempe' 'Laguna Niguel' 'Bridgeton' 'Everett' 'Watertown'
'Appleton' 'Bellevue' 'Allen' 'El Paso' 'Grapevine' 'Carrollton' 'Kent'
'Lafayette' 'Tigard' 'Skokie' 'Plano' 'Suffolk' 'Indianapolis' 'Bayonne'
'Dublin' 'Greensboro' 'Baltimore' 'Kenosha' 'Olathe' 'Tulsa' 'Redmond'
'Raleigh' 'Muskogee' 'Meriden' 'Bowling Green' 'South Bend' 'Spokane'
'Keller' 'Port Orange' 'Medford' 'Charlottesville' 'Missoula' 'Apopka'
'Reading' 'Broomfield' 'Paterson' 'Oklahoma City' 'Chesapeake' 'Lubbock'
'Johnson City' 'San Bernardino' 'Leominster' 'Bozeman' 'Perth Amboy'
'Ontario' 'Rancho Cucamonga' 'Moorhead' 'Mesquite' 'Redlands' 'Stockton'
'Ormond Beach' 'Sunnyvale' 'York' 'College Station' 'Saint Louis'
'Manteca' 'San Angelo' 'Salt Lake City' 'Knoxville' 'Little Rock'
'Lincoln Park' 'Marion' 'Littleton' 'Bangor' 'Southaven' 'New Castle'

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 'Midland' 'Sioux Falls' 'Fort Collins' 'Clarksville' 'Sacramento'
 'Thousand Oaks' 'Malden' 'Holyoke' 'Albuquerque' 'Sparks' 'Coachella'
 'Elmhurst' 'Passaic' 'North Charleston' 'Newport News' 'Jamestown'
 'Mishawaka' 'Westfield' 'La Quinta' 'Tallahassee' 'Nashville'
 'Bellingham' 'Woodstock' 'Haltom City' 'Wheeling' 'Summerville'
 'Hot Springs' 'Englewood' 'Las Cruces' 'Hoover' 'Frisco' 'Vacaville'
 'Waukesha' 'Bakersfield' 'Pompano Beach' 'Corpus Christi' 'Redondo Beach'
 'Orlando' 'Orange' 'Lake Charles' 'Highland Park' 'Hempstead'
 'Noblesville' 'Apple Valley' 'Mount Pleasant' 'Sterling Heights'
 'Eau Claire' 'Pharr' 'Billings' 'Gresham' 'Chattanooga' 'Meridian'
 'Bolingbrook' 'Lakeland' 'Maple Grove' 'Woodland' 'Missouri City'
 'Pearland' 'San Mateo' 'Grand Rapids' 'Visalia' 'Overland Park'
 'Temecula' 'Yucaipa' 'Revere' 'Conroe' 'Tinley Park' 'Dubuque'
 'Dearborn Heights' 'Santa Fe' 'Hickory' 'Carol Stream' 'Saint Cloud'
 'North Miami' 'Plantation' 'Port Saint Lucie' 'Rock Hill' 'Odessa'
 'West Allis' 'Chula Vista' 'Manhattan' 'Altoona' 'Thornton' 'Champaign'
 'Texarkana' 'Edinburg' 'Baytown' 'Greenwood' 'Woonsocket' 'Superior'
 'Bedford' 'Covington' 'Broken Arrow' 'Miramar' 'Hollywood' 'Deer Park'
 'Wichita' 'Mcallen' 'Iowa City' 'Boise' 'Cranston' 'Port Arthur'
 'Citrus Heights' 'The Colony' 'Daytona Beach' 'Bullhead City' 'Portage'
 'Fargo' 'Elkhart' 'San Gabriel' 'Hamilton' 'Margate' 'Sandy Springs'
 'Mentor' 'Lawton' 'Hampton' 'Rome' 'La Crosse' 'Lewiston' 'Hattiesburg'
 'Danville' 'Logan' 'Waterbury' 'Athens' 'Avondale' 'Marietta' 'Yuma'
 'Wausau' 'Pasco' 'Oak Park' 'Pensacola' 'League City' 'Gaithersburg'
 'Lehi' 'Tuscaloosa' 'Moreno Valley' 'Georgetown' 'Loveland' 'Chandler'
 'Helena' 'Kirkwood' 'Waco' 'Frankfort' 'Bethlehem' 'Grand Island'
 'Woodbury' 'Rogers' 'Clovis' 'Jupiter' 'Santa Barbara' 'Cedar Hill'
 'Norfolk' 'Draper' 'Ann Arbor' 'La Mesa' 'Pocatello' 'Holland' 'Milford'
 'Buffalo Grove' 'Lake Forest' 'Redding' 'Chico' 'Utica' 'Conway'
 'Cheyenne' 'Owensboro' 'Caldwell' 'Kenner' 'Nashua' 'Bartlett'
 'Redwood City' 'Lebanon' 'Santa Maria' 'Des Plaines' 'Longview'
 'Hendersonville' 'Waterloo' 'Cambridge' 'Palatine' 'Beverly' 'Eugene'
 'Oxnard' 'Renton' 'Glenview' 'Delray Beach' 'Commerce City' 'Texas City'
 'Wilson' 'Rio Rancho' 'Goldsboro' 'Montebello' 'El Cajon'
 'West Palm Beach' 'Normal' 'Saint Charles' 'Camarillo' 'Hillsboro'
 'Burbank' 'Modesto' 'Garden City' 'Atlantic City' 'Longmont' 'Davis'
 'Morgan Hill' 'Clifton' 'Sheboygan' 'East Point' 'Rapid City' 'Andover'
 'Kissimmee' 'Shelton' 'Danbury' 'Sanford' 'San Marcos' 'Greeley'
 'Mansfield' 'Elyria' 'Twin Falls' 'Coral Gables' 'Romeoville'
 'Marlborough' 'Laurel' 'Bryan' 'Pine Bluff' 'Aberdeen' 'Hagerstown'
 'East Orange' 'Arlington Heights' 'Oswego' 'Beaumont' 'Coon Rapids'
 'San Clemente' 'San Luis Obispo' 'Springdale' 'Lodi' 'Mason']

State:['Kentucky' 'California' 'Florida' 'North Carolina' 'Washington' 'Texas'
 'Wisconsin' 'Utah' 'Nebraska' 'Pennsylvania' 'Illinois' 'Minnesota'
 'Michigan' 'Delaware' 'Indiana' 'New York' 'Arizona' 'Virginia'
 'Tennessee' 'Alabama' 'South Carolina' 'Colorado' 'Iowa' 'Ohio'
 'Missouri' 'Oklahoma' 'New Mexico' 'Louisiana' 'Connecticut' 'New Jersey'
```

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 'Oregon' 'Massachusetts' 'Georgia' 'Nevada' 'Rhode Island' 'Mississippi'
 'Arkansas' 'Montana' 'New Hampshire' 'Maryland' 'District of Columbia'
 'Kansas' 'Vermont' 'Maine' 'South Dakota' 'Idaho' 'North Dakota'
 'Wyoming' 'West Virginia']

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Region:['South' 'West' 'Central' 'East']

Product ID:['FUR-BO-10001798' 'FUR-CH-10000454' 'OFF-LA-10000240' …
 71.16199999999998 14.4648 12.672]

Category:['Furniture' 'Office Supplies' 'Technology']

Sub-Category:['Bookcases' 'Chairs' 'Labels' 'Tables' 'Storage' 'Furnishings'
'Art'
 'Phones' 'Binders' 'Appliances' 'Paper' 'Accessories' 'Envelopes'
 'Fasteners' 'Supplies' 'Machines' 'Copiers']

Product Name:['Bush Somerset Collection Bookcase'
 'Hon Deluxe Fabric Upholstered Stacking Chairs, Rounded Back'
 'Self-Adhesive Address Labels for Typewriters by Universal' …
 'Hoover Commercial Lightweight Upright Vacuum' 'LG G2'
 'Eldon Jumbo ProFile Portable File Boxes Graphite/Black']

Sales:[261.96 731.94  14.62 …   8.78 376.74  44.43]

Quantity:[ 2.  3.  5.  7.  4.  6.  9.  1.  8. 14. 11. 13. 10. 12.]

Discount:[0.   0.45 0.2  0.8  0.3  0.5  0.7  0.6  0.32 0.1  0.4  0.15]

Profit:[ 41.9136 219.582    6.8714 …   2.99   130.2885  18.6606]
```

```
order_year:[2016. 2015. 2014. 2017.]

order_month:[11.  6. 10.  4. 12.  5.  8.  7.  9.  1.  3.  2.]

order_date:[ 8. 12. 11.  9. 15.  5. 22. 13. 27. 16. 25. 17. 19. 10. 20. 18. 24.
30.
  4. 14. 26.  3. 28. 29.  1. 23.  2.  6.  7. 31. 21.]

Ship_year:[2016. 2015. 2014. 2017. 2018.]

Ship_month:[11.  6. 10.  4. 12.  5.  9.  7.  1.  3.  8.  2.]

Ship_date:[11. 16. 18. 14. 20. 10. 26. 15.  1. 13. 30. 21. 23. 31. 22. 25. 17.
5.
  6.  2.  8.  4. 28. 27. 12. 19.  7.  9.  3. 24. 29.]
```

[69]:
```
df.columns #prints all columns
```

[69]:
```
Index(['Row ID', 'Order ID', 'Order Date', 'Ship Date', 'Ship Mode',
       'Customer ID', 'Customer Name', 'Segment', 'Country', 'City', 'State',
       'Postal Code', 'Region', 'Product ID', 'Category', 'Sub-Category',
       'Product Name', 'Sales', 'Quantity', 'Discount', 'Profit', 'order_year',
       'order_month', 'order_date', 'Ship_year', 'Ship_month', 'Ship_date'],
      dtype='object')
```

[70]:
```
#droping columns that are not required for analysis
df.drop(columns=['Row ID', 'Order ID',
       'Customer ID', 'Customer Name',
       'Postal Code', 'Product ID','Order Date','Ship␣
 ↪Date'],axis=1,inplace=True)
```

[71]:
```
df.sample(5) #display random 5 samples
```

[71]:

	Ship Mode	Segment	Country	City	\
1938	Standard Class	Consumer	United States	Oklahoma City	
4419	First Class	Home Office	United States	Aurora	
7769	Standard Class	Consumer	United States	Morgan Hill	
6763	Standard Class	Corporate	United States	Springfield	
1296	First Class	Corporate	United States	Jacksonville	

	State	Region	Category	Sub-Category	\
1938	Oklahoma	Central	Technology	Phones	
4419	Colorado	West	Office Supplies	Paper	
7769	California	West	Office Supplies	Art	
6763	Virginia	South	Technology	Accessories	
1296	North Carolina	South	Technology	Machines	

```
                                          Product Name    Sales  Quantity  \
1938          Jabra Supreme Plus Driver Edition Headset  479.960       4.0
4419                                       Xerox 1992   14.352       3.0
7769           Rogers Handheld Barrel Pencil Sharpener   21.920       8.0
6763                 Imation 30456 USB Flash Drive 8GB   20.700       3.0
1296  Cisco CP-7937G Unified IP Conference Station P…  695.700       2.0

      Discount    Profit  order_year  order_month  order_date  Ship_year  \
1938       0.0  134.3888      2014.0         12.0         3.0     2014.0
4419       0.2    5.2026      2017.0          9.0        28.0     2017.0
7769       0.0    5.9184      2016.0         12.0         3.0     2016.0
6763       0.0    1.6560      2016.0          9.0        12.0     2016.0
1296       0.5  -27.8280      2017.0          1.0         2.0     2017.0

      Ship_month  Ship_date
1938        12.0        9.0
4419        10.0        1.0
7769        12.0        7.0
6763         9.0       17.0
1296         1.0        4.0
```

[72]:
```
#data descriptive
df.describe()
```

[72]:
```
              Sales     Quantity     Discount       Profit   order_year  \
count   9844.000000  9844.000000  9844.000000  9844.000000  9844.000000
mean     230.386939     3.790431     0.155312    28.970794  2015.719829
std      626.024933     2.224033     0.205817   235.713664     1.123452
min        0.444000     1.000000     0.000000 -6599.978000  2014.000000
25%       17.310000     2.000000     0.000000     1.757325  2015.000000
50%       54.804000     3.000000     0.200000     8.709500  2016.000000
75%      209.970000     5.000000     0.200000    29.460650  2017.000000
max    22638.480000    14.000000     0.800000  8399.976000  2017.000000

       order_month   order_date    Ship_year   Ship_month    Ship_date
count  9844.000000  9844.000000  9844.000000  9844.000000  9844.000000
mean      7.811560    15.460585  2015.735270     7.742686    15.854429
std       3.284929     8.756378     1.126109     3.342078     8.807584
min       1.000000     1.000000  2014.000000     1.000000     1.000000
25%       5.000000     8.000000  2015.000000     5.000000     8.000000
50%       9.000000    15.000000  2016.000000     9.000000    16.000000
75%      11.000000    23.000000  2017.000000    11.000000    24.000000
max      12.000000    31.000000  2018.000000    12.000000    31.000000
```

[73]:
```
# df.to_excel('C:/Users/ganesh/Downloads/cleanedata1.xlsx', index=False)
```

3 Outlier Analysis

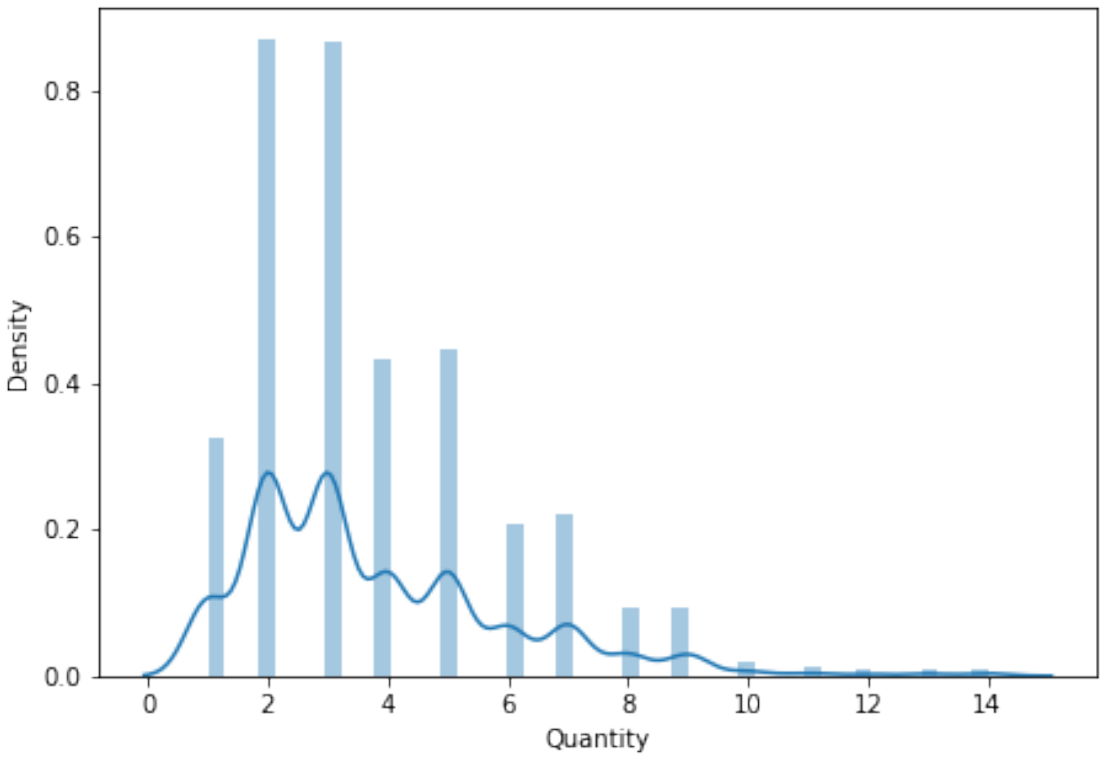
4 Quantity Outlier Analysis

[74]:
```
#unique values
df["Quantity"].unique()
```

[74]:
```
array([ 2.,  3.,  5.,  7.,  4.,  6.,  9.,  1.,  8., 14., 11., 13., 10.,
       12.])
```

[75]:
```
#distribution graph for quantity
plt.figure(figsize=(16,5))
plt.subplot(1,2,2)
sns.distplot(df["Quantity"])
plt.show()
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
```



[76]:
```
#right skew
df["Quantity"].skew()
```

[76]:
```
1.272389553355905
```

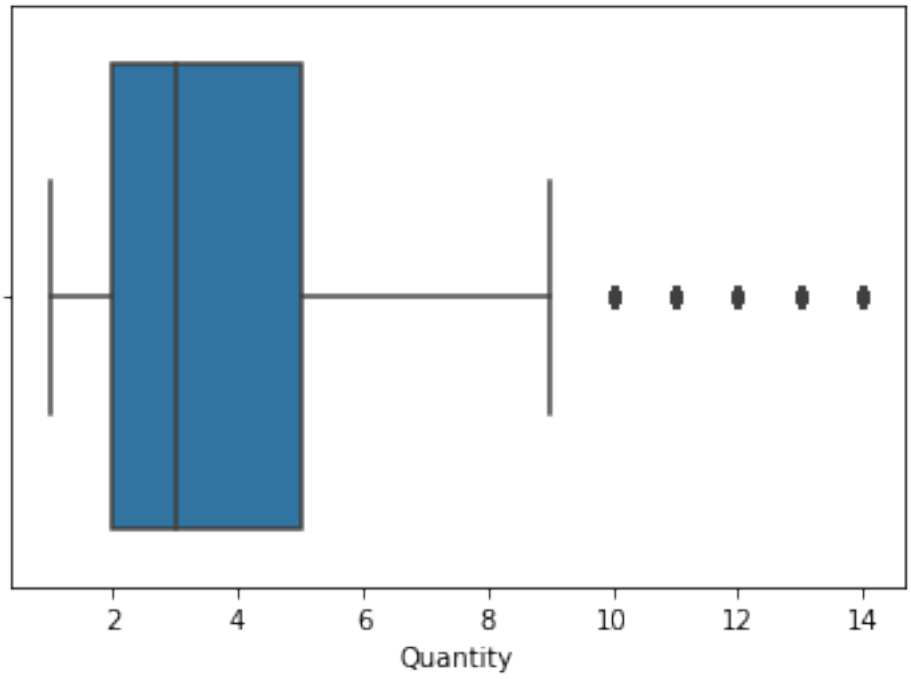
[77]:
```
df["Quantity"].describe()
```

[77]:
```
count    9844.000000
mean        3.790431
std         2.224033
min         1.000000
25%         2.000000
50%         3.000000
75%         5.000000
max        14.000000
Name: Quantity, dtype: float64
```

[78]:
```
#box plot
sns.boxplot(df["Quantity"])
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```

[78]:
```
<AxesSubplot:xlabel='Quantity'>
```



[79]:
```
#Percentile Method
low=df["Quantity"].quantile(0.05)
high=df["Quantity"].quantile(0.95)
low,high
```

[79]: (1.0, 8.0)

[80]:
```
df[df["Quantity"]>high]
```

[80]:

	Ship Mode	Segment	Country	City	State	Region	Category	Sub-Category
10	Standard Class	Consumer	United States	Los Angeles	California	West	Furniture	Tables
37	Standard Class	Home Office	United States	Houston	Texas	Central	Office Supplies	Envelopes
102	Second Class	Consumer	United States	Columbus	Ohio			
111	First Class	Consumer	United States	Wilmington	Delaware			
124	Standard Class	Consumer	United States	Roseville	California			
…	…	…	…	…	…			
9801	Standard Class	Consumer	United States	San Francisco	California			
9802	Standard Class	Consumer	United States	Anaheim	California			
9839	Standard Class	Home Office	United States	Los Angeles	California			
9844	Standard Class	Consumer	United States	Long Beach	New York			
9860	Second Class	Consumer	United States	Atlanta	Georgia			

```
102      East  Office Supplies    Fasteners
111      East  Office Supplies    Envelopes
124      West        Furniture  Furnishings
…        …              …          …
9801     West       Technology  Accessories
9802     West  Office Supplies      Storage
9839     West  Office Supplies      Binders
9844     East  Office Supplies       Labels
9860    South  Office Supplies        Paper

                                              Product Name     Sales  Quantity  \
10             Chromcraft Rectangular Conference Tables  1706.184       9.0
37    #10-4 1/8" x 9 1/2" Premium Diagonal Seam Enve…   113.328       9.0
102            OIC Colored Binder Clips, Assorted Sizes    40.096      14.0
111        Globe Weis Peel & Seel First Class Envelopes   115.020       9.0
124                         Longer-Life Soft White Bulbs    43.120      14.0
…                                                      …       …       …
9801  Memorex Mini Travel Drive 16 GB USB 2.0 Flash …   223.580      14.0
9802        Carina Mini System Audio Rack, Model AR050B   998.820       9.0
9839                  Ibico Recycled Linen-Style Covers   437.472      14.0
9844                     Self-Adhesive Removable Labels    31.500      10.0
9860                 Wirebound Message Book, 4 per Page    48.870       9.0

      Discount    Profit  order_year  order_month  order_date  Ship_year  \
10         0.2   85.3092      2014.0          6.0         9.0     2014.0
37         0.2   35.4150      2015.0         12.0        27.0     2015.0
102        0.2   14.5348      2014.0          8.0        25.0     2014.0
111        0.0   51.7590      2016.0          6.0        12.0     2016.0
124        0.0   20.6976      2016.0         10.0        13.0     2016.0
…          …        …           …            …          …          …
9801       0.0   87.1962      2017.0         11.0        24.0     2017.0
9802       0.0   29.9646      2014.0         12.0        28.0     2015.0
9839       0.2  153.1152      2016.0         12.0         6.0     2016.0
9844       0.0   15.1200      2015.0          5.0        17.0     2015.0
9860       0.0   23.9463      2017.0         11.0        25.0     2017.0

      Ship_month  Ship_date
10           6.0       14.0
37          12.0       31.0
102          8.0       27.0
111          6.0       15.0
124         10.0       19.0
…           …          …
9801        11.0       30.0
9802         1.0        3.0
9839        12.0       10.0
9844         5.0       23.0
```

```
9860        11.0       29.0

[418 rows x 19 columns]
```

[81]:
```
#did because felt outliers are valid (so used capping)
```

[82]:
```
#capping outliers
df["Quantity"]=np.where(df["Quantity"]>high,high,np.
 ↪where(df["Quantity"]<low,low,df["Quantity"]))
```

[83]:
```
df.shape
```

[83]:
```
(9844, 19)
```

[84]:
```
df[df["Quantity"]>=5]
```

[84]:

	Ship Mode	Segment	Country	City	State	Region	Category	Sub-Category	Product Name	Sales	Quantity
3	Standard Class	Consumer	United States	Fort Lauderdale	Florida	South	Furniture	Tables	Bretford CR4500 Series Slim Rectangular Table	957.5775	5.0
5	Standard Class	Consumer	United States	Los Angeles	California	West	Furniture	Furnishings	Eldon Expressions Wood and Plastic Desk Access…	48.8600	7.0
7	Standard Class	Consumer	United States	Los Angeles	California	West	Technology	Phones	Mitel 5320 IP Phone VoIP phone	907.1520	6.0
9	Standard Class	Consumer	United States	Los Angeles	California	West	Office Supplies	Appliances	Belkin F5C206VTEL 6 Outlet Surge	114.9000	5.0
10	Standard Class	Consumer	United States	Los Angeles	California	West	Furniture	Tables			
…	…	…	…	…	…	…	…	…			
9860	Second Class	Consumer	United States	Atlanta	Georgia	South	Office Supplies	Paper			
9861	Standard Class	Consumer	United States	Los Angeles	California	West	Office Supplies	Paper			
9864	Standard Class	Consumer	United States	Detroit	Michigan	Central	Office Supplies	Binders			
9869	Standard Class	Consumer	United States	Detroit	Michigan	Central	Office Supplies	Binders			
9870	Second Class	Corporate	United States	Fort Lauderdale	Florida	South	Office Supplies	Appliances			

```
10              Chromcraft Rectangular Conference Tables  1706.1840       8.0
…                                                    …        …       …
9860                 Wirebound Message Book, 4 per Page    48.8700       8.0
9861                                          Xerox 19   154.9000       5.0
9864  Wilson Jones Turn Tabs Binder Tool for Ring Bi…    24.1000       5.0
9869      Wilson Jones 1" Hanging DublLock Ring Binders    26.4000       5.0
9870                 Hoover Upright Vacuum With Dirt Cup  1158.1200       5.0

      Discount    Profit  order_year  order_month  order_date  Ship_year  \
3         0.45 -383.0310      2015.0         10.0        11.0     2015.0
5         0.00   14.1694      2014.0          6.0         9.0     2014.0
7         0.20   90.7152      2014.0          6.0         9.0     2014.0
9         0.00   34.4700      2014.0          6.0         9.0     2014.0
10        0.20   85.3092      2014.0          6.0         9.0     2014.0
…          …       …           …            …           …
9860      0.00   23.9463      2017.0         11.0        25.0     2017.0
9861      0.00   69.7050      2017.0          1.0        14.0     2017.0
9864      0.00   11.0860      2016.0          9.0         1.0     2016.0
9869      0.00   12.6720      2016.0          9.0         1.0     2016.0
9870      0.20  130.2885      2017.0         11.0        11.0     2017.0

      Ship_month  Ship_date
3           10.0       18.0
5            6.0       14.0
7            6.0       14.0
9            6.0       14.0
10           6.0       14.0
…            …          …
9860        11.0       29.0
9861         1.0       19.0
9864         9.0        5.0
9869         9.0        5.0
9870        11.0       16.0

[3053 rows x 19 columns]
```

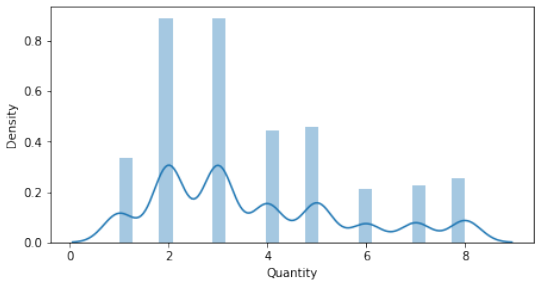
[85]:
```
#distribution and box plot for quantity
plt.figure(figsize=(16,8))
plt.subplot(2,2,1)
sns.distplot(df["Quantity"])

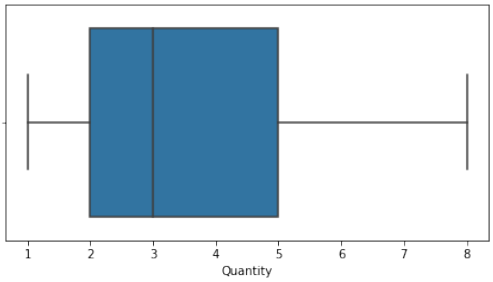
plt.subplot(2,2,2)
sns.boxplot(df["Quantity"])

plt.show()
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
```

```
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```





[86]:
```
#right skew
df["Quantity"].skew()
```

[86]:
```
0.7107622703947052
```

5 Disount Outlier Analysis

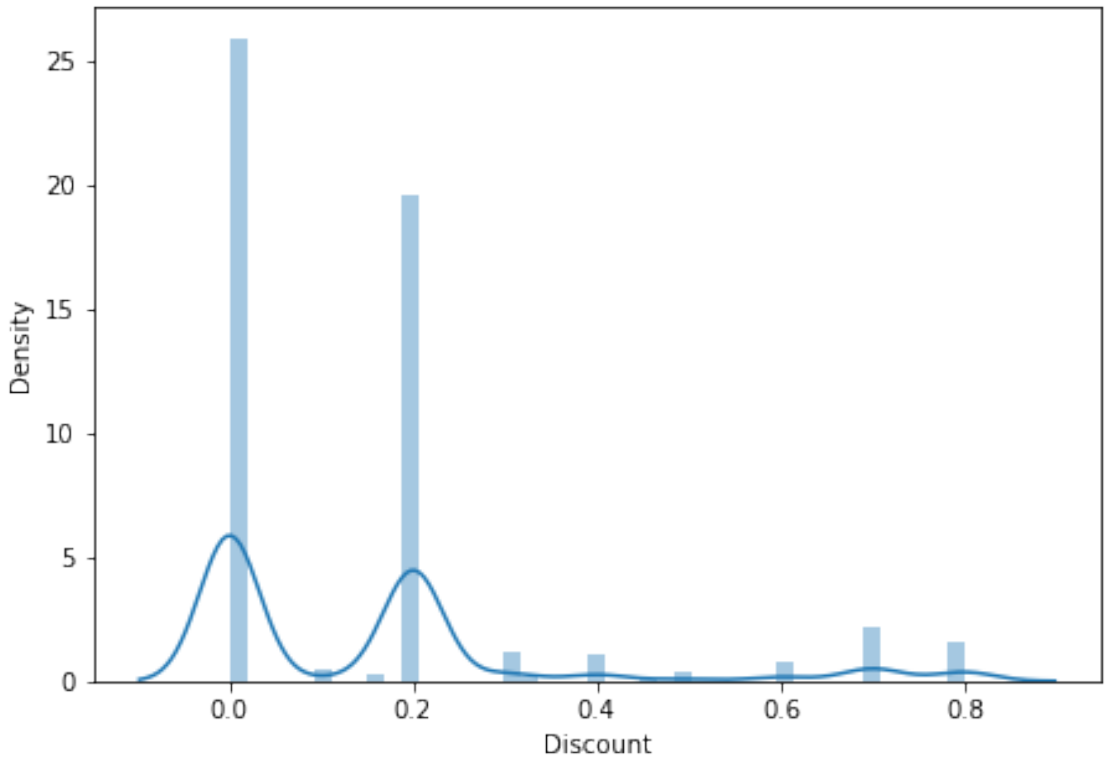
[87]:
```
#unique values in discount
df["Discount"].unique()
```

[87]:
```
array([0.  , 0.45, 0.2 , 0.8 , 0.3 , 0.5 , 0.7 , 0.6 , 0.32, 0.1 , 0.4 ,
       0.15])
```

[88]:
```
#distribution graph for discount
plt.figure(figsize=(16,5))
plt.subplot(1,2,2)
sns.distplot(df["Discount"])
plt.show()
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
```

```
histograms).
  warnings.warn(msg, FutureWarning)
```



[89]:
```
#right skew
df["Discount"].skew()
```

[89]:
```
1.6922053394888577
```

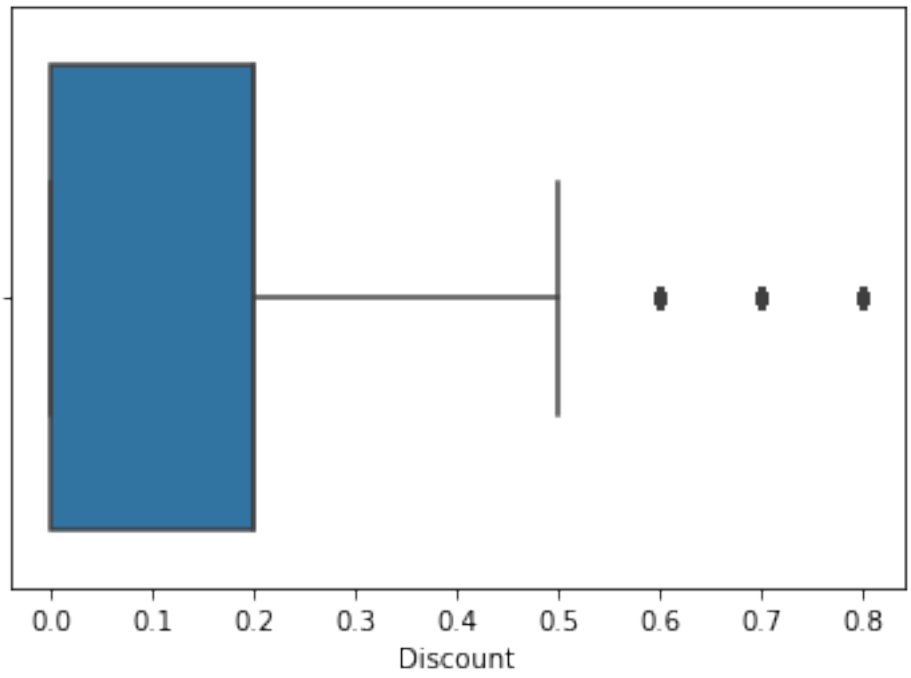
[90]:
```
df["Discount"].describe()
```

[90]:
```
count    9844.000000
mean        0.155312
std         0.205817
min         0.000000
25%         0.000000
50%         0.200000
75%         0.200000
max         0.800000
Name: Discount, dtype: float64
```

[91]:
```
#boxplot
sns.boxplot(df["Discount"])
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```

[91]: <AxesSubplot:xlabel='Discount'>



[92]:
```
per25=df["Discount"].quantile(0.25)
per75=df["Discount"].quantile(0.75)
per25,per75
```

[92]: (0.0, 0.2)

[93]:
```
#IQR(method)
iqr=per75-per25
low=per25-1.5*iqr
high=per75+1.5*iqr
low,high
```

[93]: (-0.30000000000000004, 0.5)

[94]:
```
df[df["Discount"]>high]
```

[94]:

	Ship Mode	Segment	Country	City	State
14	Standard Class	Home Office	United States	Fort Worth	Texas
15	Standard Class	Home Office	United States	Fort Worth	Texas
28	Standard Class	Consumer	United States	Philadelphia	Pennsylvania
32	Standard Class	Consumer	United States	Philadelphia	Pennsylvania
36	First Class	Corporate	United States	Richardson	Texas
…	…	…	…	…	…
9737	First Class	Home Office	United States	Cleveland	Ohio
9763	Standard Class	Consumer	United States	Carrollton	Texas
9780	Standard Class	Corporate	United States	Bryan	Texas
9781	Standard Class	Home Office	United States	Akron	Ohio
9855	Standard Class	Consumer	United States	Phoenix	Arizona

	Region	Category	Sub-Category
14	Central	Office Supplies	Appliances
15	Central	Office Supplies	Binders
28	East	Office Supplies	Binders
32	East	Office Supplies	Binders
36	Central	Furniture	Furnishings
…	…	…	…
9737	East	Office Supplies	Binders
9763	Central	Furniture	Furnishings
9780	Central	Office Supplies	Binders
9781	East	Office Supplies	Binders
9855	West	Office Supplies	Binders

	Product Name	Sales	Quantity
14	Holmes Replacement Filter for HEPA Air Cleaner…	68.810	5.0
15	Storex DuraTech Recycled Plastic Frosted Binders	2.544	3.0
28	Avery Recycled Flexi-View Covers for Binding S…	9.618	2.0
32	Acco Pressboard Covers with Storage Hooks, 14 …	6.858	6.0
36	Electrix Architect's Clamp-On Swing Arm Lamp, …	190.920	5.0
…	…	…	…
9737	Wilson Jones Clip & Carry Folder Binder Tool f…	8.700	5.0
9763	GE General Use Halogen Bulbs, 100 Watts, 1 Bul…	25.128	3.0
9780	GBC Pre-Punched Binding Paper, Plastic, White,…	22.386	7.0
9781	Acco Expandable Hanging Binders	5.742	3.0
9855	Plastic Binding Combs	18.180	4.0

	Discount	Profit	order_year	order_month	order_date	Ship_year
14	0.8	-123.8580	2015.0	11.0	22.0	2015.0
15	0.8	-3.8160	2015.0	11.0	22.0	2015.0
28	0.7	-7.0532	2015.0	9.0	17.0	2015.0
32	0.7	-5.7150	2015.0	9.0	17.0	2015.0
36	0.6	-147.9630	2016.0	12.0	8.0	2016.0
…	…	…	…	…	…	…
9737	0.7	-6.3800	2017.0	4.0	20.0	2017.0

```
9763       0.6   -6.9102      2014.0         11.0        12.0     2014.0
9780       0.8  -35.8176      2016.0          3.0        15.0     2016.0
9781       0.7   -4.5936      2014.0         11.0        24.0     2014.0
9855       0.7  -13.9380      2017.0          9.0        19.0     2017.0

      Ship_month  Ship_date
14          11.0       26.0
15          11.0       26.0
28           9.0       21.0
32           9.0       21.0
36          12.0       10.0
…            …          …
9737         4.0       21.0
9763        11.0       18.0
9780         3.0       19.0
9781        11.0       30.0
9855         9.0       25.0

[834 rows x 19 columns]
```

[95]:
```
#capping outliers with high and low values
df["Discount"]=np.where(df["Discount"]>high,high,np.
 ↪where(df["Discount"]<low,low,df["Discount"]))
```

[96]:
```
df.shape
```

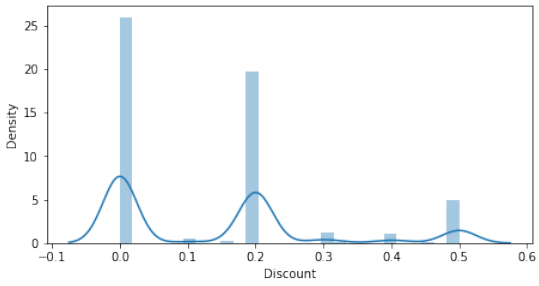
[96]:
```
(9844, 19)
```

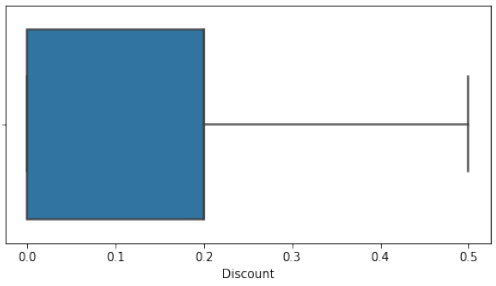
[97]:
```
#distribution and box plot for discount
plt.figure(figsize=(16,8))
plt.subplot(2,2,1)
sns.distplot(df["Discount"])
plt.subplot(2,2,2)
sns.boxplot(df["Discount"])

plt.show()
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
```

```
misinterpretation.
  warnings.warn(
```





[98]:
```
df.shape
```

[98]:
```
(9844, 19)
```

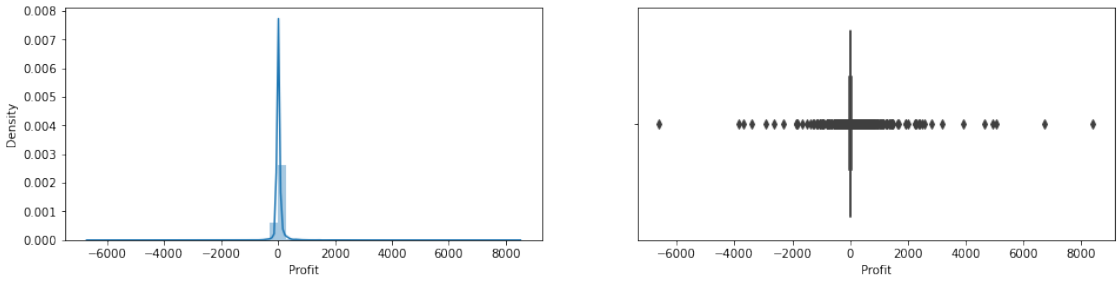
[99]:
```
#right skew
df["Discount"].skew()
```

[99]:
```
0.9644235759205968
```

6 Profit Outlier Analysis

[100]:
```
#distribution and boxplot graph for profit
plt.figure(figsize=(16,8))
plt.subplot(2,2,1)
sns.distplot(df["Profit"])
plt.subplot(2,2,2)
sns.boxplot(df["Profit"])
plt.show()
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```



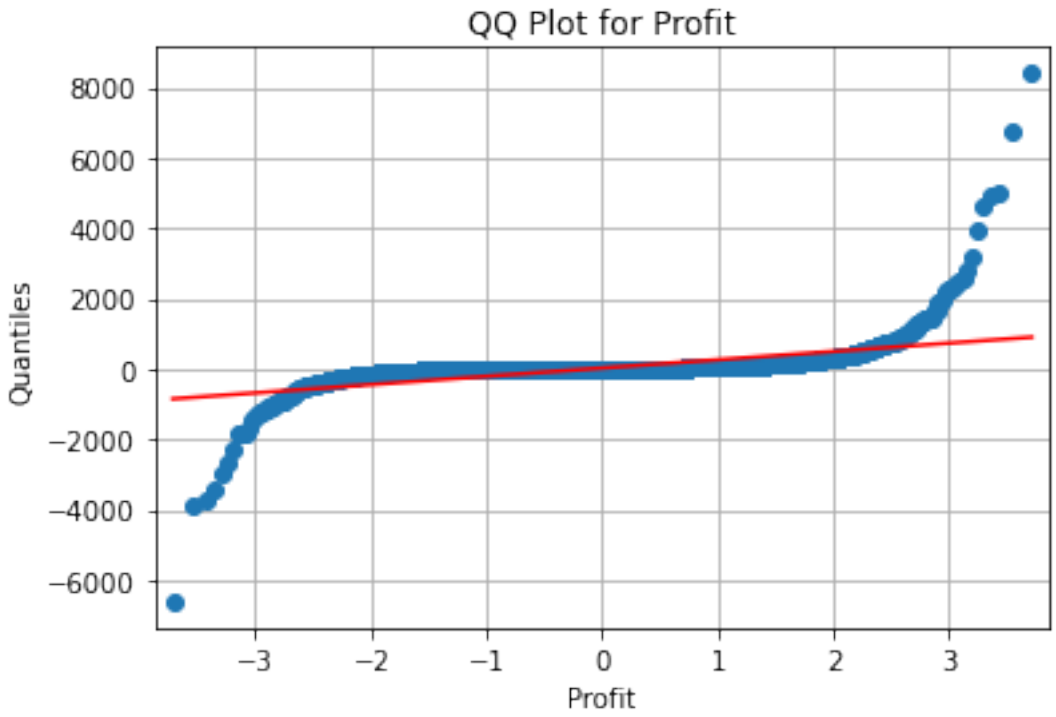
[101]:
```
#right skew
df["Profit"].skew()
```

[101]: 7.532178434791842

[102]:
```
data = df

# Select the column you want to analyze
column_name = 'Profit'
column_data = data[column_name]

# Create the QQ plot using statsmodels.api
sm.qqplot(column_data, line='s')  # 's' for straight reference line
plt.xlabel(column_name)
plt.ylabel('Quantiles')
plt.title('QQ Plot for ' + column_name)
plt.grid(True)
plt.show()
```



[103]:
```
df[df["Profit"]<=0]
```

[103]:

	Ship Mode	Segment	Country	City	State	Region	Category	Sub-Category
3	Standard Class	Consumer	United States	Fort Lauderdale	Florida	South	Furniture	Tables
14	Standard Class	Home Office	United States	Fort Worth	Texas	Central	Office Supplies	Appliances
15	Standard Class	Home Office	United States	Fort Worth	Texas	Central	Office Supplies	Binders
23	Second Class	Consumer	United States	Philadelphia	Pennsylvania	East	Furniture	Chairs
27	Standard Class	Consumer	United States	Philadelphia	Pennsylvania	East	Furniture	Bookcases
…	…	…	…	…	…	…	…	…
9791	Standard Class	Consumer	United States	San Bernardino	California	West	Furniture	Bookcases
9797	Second Class	Corporate	United States	Los Angeles				
9822	First Class	Home Office	United States	Houston				
9837	Standard Class	Home Office	United States	Los Angeles				
9855	Standard Class	Consumer	United States	Phoenix				

```
9797    California     West        Furniture       Tables
9822         Texas  Central        Furniture    Bookcases
9837    California     West  Office Supplies    Fasteners
9855       Arizona     West  Office Supplies      Binders

                                          Product Name      Sales  Quantity  \
3         Bretford CR4500 Series Slim Rectangular Table   957.5775       5.0
14    Holmes Replacement Filter for HEPA Air Cleaner…    68.8100       5.0
15     Storex DuraTech Recycled Plastic Frosted Binders     2.5440       3.0
23                   Global Deluxe Stacking Chair, Gray    71.3720       2.0
27    Riverside Palais Royal Lawyers Bookcase, Royal…  3083.4300       7.0
…                                                  …        …       …
9791    O'Sullivan Living Dimensions 3-Shelf Bookcases   683.3320       4.0
9797       Hon 61000 Series Interactive Training Tables    71.0880       2.0
9822  Bush Heritage Pine Collection 5-Shelf Bookcase…   383.4656       4.0
9837           Alliance Big Bands Rubber Bands, 12/Pack    13.8600       7.0
9855                              Plastic Binding Combs    18.1800       4.0

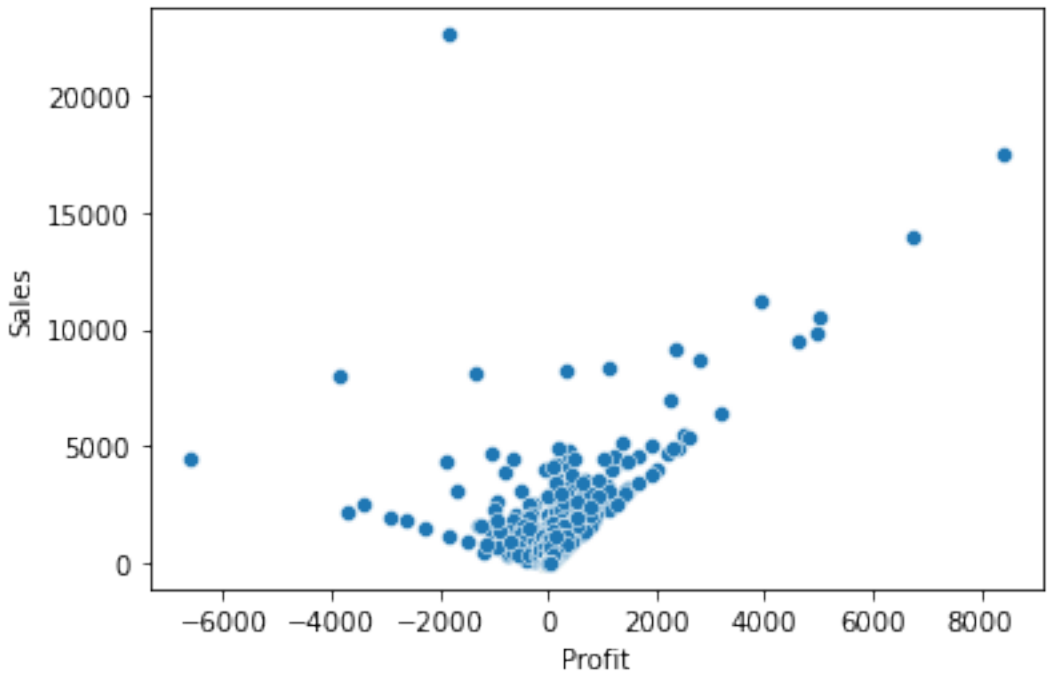
      Discount     Profit  order_year  order_month  order_date  Ship_year  \
3         0.45  -383.0310      2015.0         10.0        11.0     2015.0
14        0.50  -123.8580      2015.0         11.0        22.0     2015.0
15        0.50    -3.8160      2015.0         11.0        22.0     2015.0
23        0.30    -1.0196      2017.0          7.0        16.0     2017.0
27        0.50 -1665.0522      2015.0          9.0        17.0     2015.0
…         …         …          …            …          …
9791      0.15   -40.1960      2015.0         11.0        13.0     2015.0
9797      0.20    -1.7772      2016.0          6.0         3.0     2016.0
9822      0.32   -67.6704      2015.0          3.0        19.0     2015.0
9837      0.00     0.0000      2016.0         12.0         6.0     2016.0
9855      0.50   -13.9380      2017.0          9.0        19.0     2017.0

      Ship_month  Ship_date
3           10.0       18.0
14          11.0       26.0
15          11.0       26.0
23           7.0       18.0
27           9.0       21.0
…           …          …
9791        11.0       17.0
9797         6.0        6.0
9822         3.0       22.0
9837        12.0       10.0
9855         9.0       25.0

[1896 rows x 19 columns]
```

[104]:
```
#scatterplot prfit vs sales
sns.scatterplot(x="Profit",y="Sales",data=df)
```

[104]: <AxesSubplot:xlabel='Profit', ylabel='Sales'>



[105]:
```
df[df["Profit"]<=0]
```

[105]:

	Ship Mode	Segment	Country	City	State	Region	Category	Sub-Category
3	Standard Class	Consumer	United States	Fort Lauderdale	Florida	South	Furniture	Tables
14	Standard Class	Home Office	United States	Fort Worth	Texas	Central	Office Supplies	Appliances
15	Standard Class	Home Office	United States	Fort Worth	Texas	Central	Office Supplies	Binders
23	Second Class	Consumer	United States	Philadelphia	Pennsylvania	East	Furniture	Chairs
27	Standard Class	Consumer	United States	Philadelphia				
…	…	…	…	…				
9791	Standard Class	Consumer	United States	San Bernardino				
9797	Second Class	Corporate	United States	Los Angeles				
9822	First Class	Home Office	United States	Houston				
9837	Standard Class	Home Office	United States	Los Angeles				
9855	Standard Class	Consumer	United States	Phoenix				

```
27    Pennsylvania     East        Furniture    Bookcases
…              …      …              …          …
9791    California     West        Furniture    Bookcases
9797    California     West        Furniture       Tables
9822         Texas  Central        Furniture    Bookcases
9837    California     West  Office Supplies    Fasteners
9855       Arizona     West  Office Supplies      Binders

                                          Product Name      Sales  Quantity  \
3          Bretford CR4500 Series Slim Rectangular Table   957.5775       5.0
14    Holmes Replacement Filter for HEPA Air Cleaner…    68.8100       5.0
15     Storex DuraTech Recycled Plastic Frosted Binders     2.5440       3.0
23                   Global Deluxe Stacking Chair, Gray    71.3720       2.0
27    Riverside Palais Royal Lawyers Bookcase, Royal…  3083.4300       7.0
…                                                  …        …       …
9791     O'Sullivan Living Dimensions 3-Shelf Bookcases   683.3320       4.0
9797       Hon 61000 Series Interactive Training Tables    71.0880       2.0
9822  Bush Heritage Pine Collection 5-Shelf Bookcase…   383.4656       4.0
9837           Alliance Big Bands Rubber Bands, 12/Pack    13.8600       7.0
9855                              Plastic Binding Combs    18.1800       4.0

      Discount     Profit  order_year  order_month  order_date  Ship_year  \
3         0.45  -383.0310      2015.0         10.0        11.0     2015.0
14        0.50  -123.8580      2015.0         11.0        22.0     2015.0
15        0.50    -3.8160      2015.0         11.0        22.0     2015.0
23        0.30    -1.0196      2017.0          7.0        16.0     2017.0
27        0.50 -1665.0522      2015.0          9.0        17.0     2015.0
…            …         …           …            …           …          …
9791      0.15   -40.1960      2015.0         11.0        13.0     2015.0
9797      0.20    -1.7772      2016.0          6.0         3.0     2016.0
9822      0.32   -67.6704      2015.0          3.0        19.0     2015.0
9837      0.00     0.0000      2016.0         12.0         6.0     2016.0
9855      0.50   -13.9380      2017.0          9.0        19.0     2017.0

      Ship_month  Ship_date
3           10.0       18.0
14          11.0       26.0
15          11.0       26.0
23           7.0       18.0
27           9.0       21.0
…            …          …
9791        11.0       17.0
9797         6.0        6.0
9822         3.0       22.0
9837        12.0       10.0
9855         9.0       25.0
```

```
[1896 rows x 19 columns]
```

[106]:
```
EPSILON = 1e-8
positive_profit = df['Profit'] + EPSILON

# Take the absolute value
abs_profit = np.abs(positive_profit)

# Apply the logarithm
log_profit = np.log(abs_profit)

# Restore the sign
transformed_profit = np.sign(df['Profit']) * log_profit

# Replace -0 with 0
transformed_profit = np.where(transformed_profit == -0, 0, transformed_profit)

# Add the transformed profit column to the DataFrame
df['Transformed_Profit'] = transformed_profit
```

[107]:
```
df[df["Profit"]==0]
```

[107]:

	Ship Mode	Segment	Country	City	State	Region	Category	Sub-Category
201	Standard Class	Home Office	United States	Tampa	Florida	South	Furniture	Furnishings
509	Second Class	Consumer	United States	San Francisco	California	West	Furniture	Chairs
520	First Class	Consumer	United States	Seattle	Washington	West	Office Supplies	Fasteners
526	Standard Class	Corporate	United States	Seattle	Washington	West	Furniture	Chairs
775	Standard Class	Consumer	United States	Philadelphia	Pennsylvania	East	Furniture	Chairs
…	…	…	…	…	…	…	…	…
9272	First Class	Consumer	United States	Los Angeles	California	West	Furniture	Chairs
9501	Standard Class	Corporate	United States	Seattle	Washington	West	Office Supplies	Storage
9746	Standard Class	Consumer	United States	Lafayette	Indiana	Central	Office Supplies	Fasteners
9758	Standard Class	Consumer	United States	Fairfield	Ohio	East	Furniture	Furnishings
9837	Standard Class	Home Office	United States	Los Angeles	California	West	Office Supplies	Fasteners

```
                                                Product Name     Sales  Quantity  \
201   Tenex Contemporary Contur Chairmats for Low an…   258.072       3.0
509        HON 5400 Series Task Chairs for Big and Tall  1121.568       2.0
520            Alliance Big Bands Rubber Bands, 12/Pack     3.960       2.0
526              Hon Every-Day Series Multi-Task Chairs   451.152       3.0
775                      Global Leather Executive Chair  1228.465       5.0
…                                                    …       …       …
9272       HON 5400 Series Task Chairs for Big and Tall  2803.920       5.0
9501             Contico 72"H Heavy-Duty Storage System   204.900       5.0
9746           Alliance Big Bands Rubber Bands, 12/Pack     5.940       3.0
9758        Deflect-o EconoMat Nonstudded, No Bevel Mat    82.640       2.0
9837           Alliance Big Bands Rubber Bands, 12/Pack    13.860       7.0

      Discount  Profit  order_year  order_month  order_date  Ship_year  \
201        0.2     0.0      2017.0          4.0         7.0     2017.0
509        0.2     0.0      2016.0          4.0        15.0     2016.0
520        0.0     0.0      2015.0         12.0         7.0     2015.0
526        0.2     0.0      2017.0         10.0         1.0     2017.0
775        0.3     0.0      2014.0          6.0        28.0     2014.0
…          …       …           …            …           …          …
9272       0.2     0.0      2015.0          1.0        27.0     2015.0
9501       0.0     0.0      2014.0          3.0         7.0     2014.0
9746       0.0     0.0      2014.0          1.0        23.0     2014.0
9758       0.2     0.0      2016.0          6.0         6.0     2016.0
9837       0.0     0.0      2016.0         12.0         6.0     2016.0

      Ship_month  Ship_date  Transformed_Profit
201          4.0       12.0                 0.0
509          4.0       17.0                 0.0
520         12.0        9.0                 0.0
526         10.0        8.0                 0.0
775          7.0        2.0                 0.0
…            …          …                   …
9272         1.0       29.0                 0.0
9501         3.0       12.0                 0.0
9746         1.0       27.0                 0.0
9758         6.0       10.0                 0.0
9837        12.0       10.0                 0.0

[65 rows x 20 columns]
```

[108]:
```
# sum of null values
df["Transformed_Profit"].isnull().sum()
```

[108]: 0

[109]:
```
df[df["Transformed_Profit"]<=0]
```

[109]:

	Ship Mode	Segment	Country	City	State	Region	Category	Sub-Category	Product Name	Sales	Quantity	Discount	Profit	order_year	order_month	order_date	Ship_year
3	Standard Class	Consumer	United States	Fort Lauderdale	Florida	South	Furniture	Tables	Bretford CR4500 Series Slim Rectangular Table	957.5775	5.0	0.45	-383.0310	2015.0	10.0	11.0	2015.0
14	Standard Class	Home Office	United States	Fort Worth	Texas	Central	Office Supplies	Appliances	Holmes Replacement Filter for HEPA Air Cleaner…	68.8100	5.0	0.50	-123.8580	2015.0	11.0	22.0	2015.0
15	Standard Class	Home Office	United States	Fort Worth	Texas	Central	Office Supplies	Binders	Storex DuraTech Recycled Plastic Frosted Binders	2.5440	3.0	0.50	-3.8160	2015.0	11.0	22.0	2015.0
23	Second Class	Consumer	United States	Philadelphia	Pennsylvania	East	Furniture	Chairs	Global Deluxe Stacking Chair, Gray	71.3720	2.0	0.30	-1.0196	2017.0	7.0	16.0	2017.0
27	Standard Class	Consumer	United States	Philadelphia	Pennsylvania	East	Furniture	Bookcases	Riverside Palais Royal Lawyers Bookcase, Royal…	3083.4300	7.0	0.50	-1665.0522	2015.0	9.0	17.0	2015.0
…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…	…
9797	Second Class	Corporate	United States	Los Angeles	California	West	Furniture	Tables	Hon 61000 Series Interactive Training Tables	71.0880	2.0	0.30	-1.0196	2017.0	7.0	16.0	2017.0
9804	Second Class	Home Office	United States	Seattle	Washington	West	Office Supplies	Storage	Rogers Jumbo File, Granite	40.7400	3.0	0.30	-1.0196	2017.0	7.0	16.0	2017.0
9822	First Class	Home Office	United States	Houston	Texas	Central	Furniture	Bookcases	Bush Heritage Pine Collection 5-Shelf Bookcase…	383.4656	4.0	0.30	-1.0196	2017.0	7.0	16.0	2017.0
9837	Standard Class	Home Office	United States	Los Angeles	California	West	Office Supplies	Fasteners	Alliance Big Bands Rubber Bands, 12/Pack	13.8600	7.0	0.30	-1.0196	2017.0	7.0	16.0	2017.0
9855	Standard Class	Consumer	United States	Phoenix	Arizona	West	Office Supplies	Binders	Plastic Binding Combs	18.1800	4.0	0.30	-1.0196	2017.0	7.0	16.0	2017.0

```
…         …         …          …            …          …          …
9797      0.20   -1.7772     2016.0          6.0        3.0     2016.0
9804      0.00    0.4074     2015.0          4.0       12.0     2015.0
9822      0.32  -67.6704     2015.0          3.0       19.0     2015.0
9837      0.00    0.0000     2016.0         12.0        6.0     2016.0
9855      0.50  -13.9380     2017.0          9.0       19.0     2017.0

      Ship_month  Ship_date  Transformed_Profit
3           10.0       18.0           -5.948116
14          11.0       26.0           -4.819136
15          11.0       26.0           -1.339203
23           7.0       18.0           -0.019410
27           9.0       21.0           -7.417612
…            …          …                   …
9797         6.0        6.0           -0.575039
9804         4.0       17.0           -0.897960
9822         3.0       22.0           -4.214649
9837        12.0       10.0            0.000000
9855         9.0       25.0           -2.634619

[2123 rows x 20 columns]
```

[110]:
```
df.head() #top 5 rows
```

[110]:
```
        Ship Mode    Segment        Country             City       State  \
0    Second Class   Consumer  United States        Henderson    Kentucky
1    Second Class   Consumer  United States        Henderson    Kentucky
2    Second Class  Corporate  United States      Los Angeles  California
3  Standard Class   Consumer  United States  Fort Lauderdale     Florida
4  Standard Class   Consumer  United States  Fort Lauderdale     Florida

  Region         Category Sub-Category  \
0  South        Furniture    Bookcases
1  South        Furniture       Chairs
2   West  Office Supplies       Labels
3  South        Furniture       Tables
4  South  Office Supplies      Storage

                                        Product Name     Sales  Quantity  \
0                 Bush Somerset Collection Bookcase  261.9600       2.0
1  Hon Deluxe Fabric Upholstered Stacking Chairs,…  731.9400       3.0
2  Self-Adhesive Address Labels for Typewriters b…   14.6200       2.0
3      Bretford CR4500 Series Slim Rectangular Table  957.5775       5.0
4                    Eldon Fold 'N Roll Cart System   22.3680       2.0

   Discount    Profit  order_year  order_month  order_date  Ship_year  \
0      0.00   41.9136      2016.0         11.0         8.0     2016.0
```

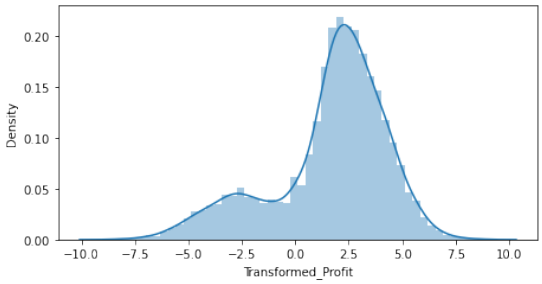
```
1       0.00  219.5820       2016.0          11.0          8.0      2016.0
2       0.00    6.8714       2016.0           6.0         12.0      2016.0
3       0.45 -383.0310       2015.0          10.0         11.0      2015.0
4       0.20    2.5164       2015.0          10.0         11.0      2015.0

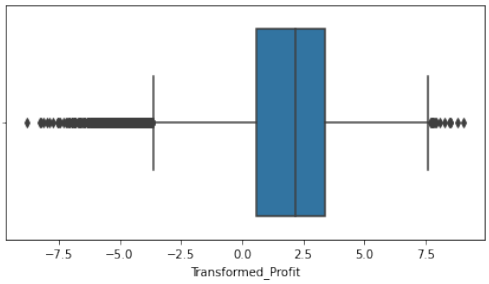
   Ship_month  Ship_date  Transformed_Profit
0        11.0       11.0            3.735610
1        11.0       11.0            5.391726
2         6.0       16.0            1.927368
3        10.0       18.0           -5.948116
4        10.0       18.0            0.922829
```

[111]:
```
#distribution and boxplot for transformed profit
plt.figure(figsize=(16,8))
plt.subplot(2,2,1)
sns.distplot(df["Transformed_Profit"])
plt.subplot(2,2,2)
sns.boxplot(df["Transformed_Profit"])

plt.show()
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```





[112]:
```
#left skew
df["Transformed_Profit"].skew()
```

[112]:
```
-0.8874539960016707
```

[113]:
```
df.shape
```

[113]:
```
(9844, 20)
```

[114]:
```
Q1 = df['Transformed_Profit'].quantile(0.25)
Q3 = df['Transformed_Profit'].quantile(0.75)

# Calculate IQR(Inter Quantile Range)
IQR = Q3 - Q1

# Define lower and upper bounds
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

# Remove outliers
df_no_outliers = df[(df['Transformed_Profit'] >= lower_bound) &␣
 ↪(df['Transformed_Profit'] <= upper_bound)]
```

[115]:
```
df.shape
```

[115]:
```
(9844, 20)
```

[116]:
```
#copying data in df
df=df_no_outliers.copy()
```

[117]:
```
df.shape
```

[117]:
```
(9233, 20)
```

[118]:
```
#sum of null values in transformed profit
df['Transformed_Profit'].isnull().sum()
```

[118]:
```
0
```

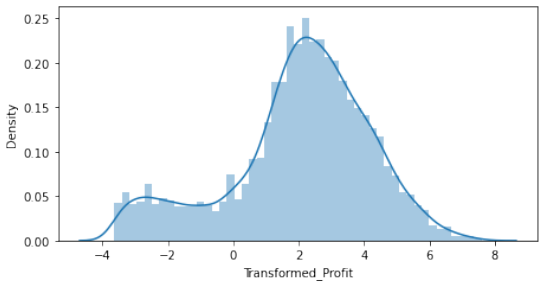
[119]:
```
df.shape
```

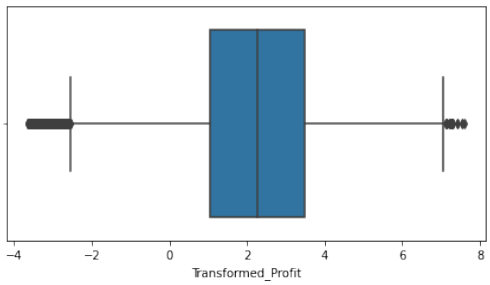
[119]:
```
(9233, 20)
```

[120]:
```
#distribution and box plot for transformed profit
plt.figure(figsize=(16,8))
plt.subplot(2,2,1)
sns.distplot(df["Transformed_Profit"])
plt.subplot(2,2,2)
sns.boxplot(df["Transformed_Profit"])
```

```
plt.show()
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```





[121]:
```
df["Transformed_Profit"].skew()
```

[121]:
```
-0.6187364044245487
```

[122]:
```
#display all columns
df.columns
```

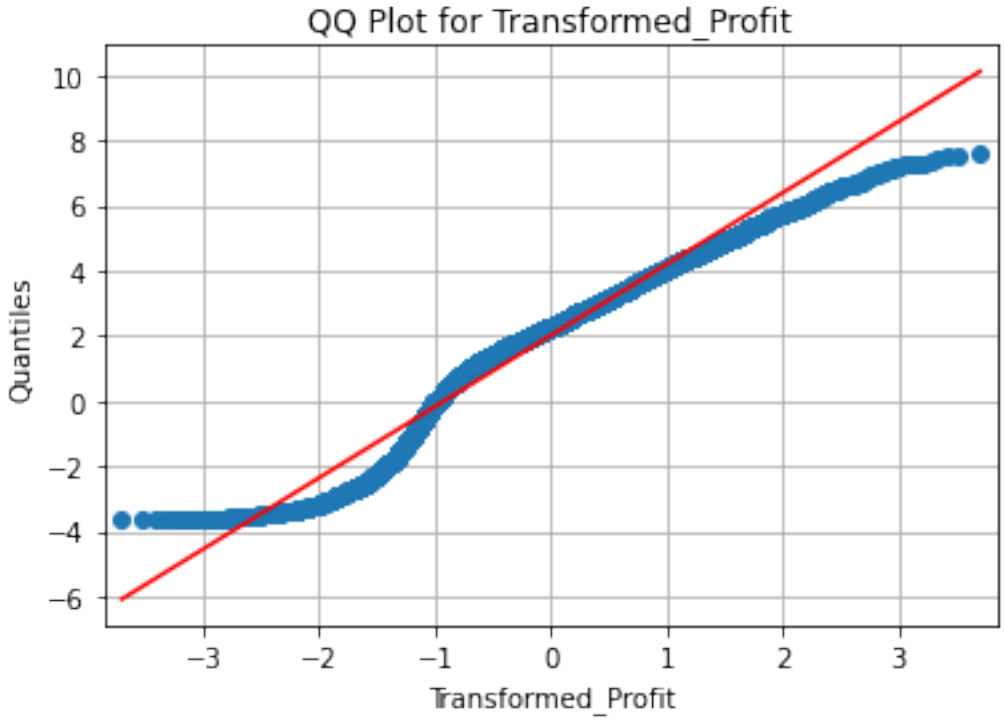
[122]:
```
Index(['Ship Mode', 'Segment', 'Country', 'City', 'State', 'Region',
       'Category', 'Sub-Category', 'Product Name', 'Sales', 'Quantity',
       'Discount', 'Profit', 'order_year', 'order_month', 'order_date',
       'Ship_year', 'Ship_month', 'Ship_date', 'Transformed_Profit'],
      dtype='object')
```

[123]:
```
data = df

# Select the column you want to analyze
column_name = 'Transformed_Profit'
column_data = data[column_name]

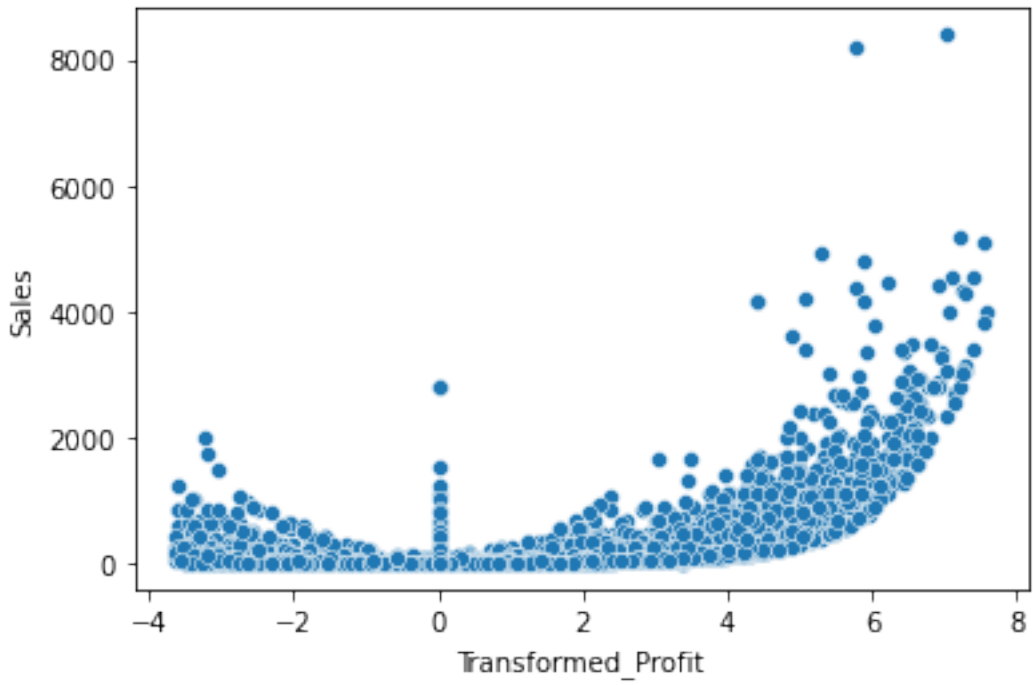
# Create the QQ plot using statsmodels.api
sm.qqplot(column_data, line='s')  # 's' for straight reference line
```

```
plt.xlabel(column_name)
plt.ylabel('Quantiles')
plt.title('QQ Plot for ' + column_name)
plt.grid(True)
plt.show()
```



[124]:
```
#Scatter plot sales vs transformed_profit
sns.scatterplot(x="Transformed_Profit",y="Sales",data=df)
```

[124]: <AxesSubplot:xlabel='Transformed_Profit', ylabel='Sales'>

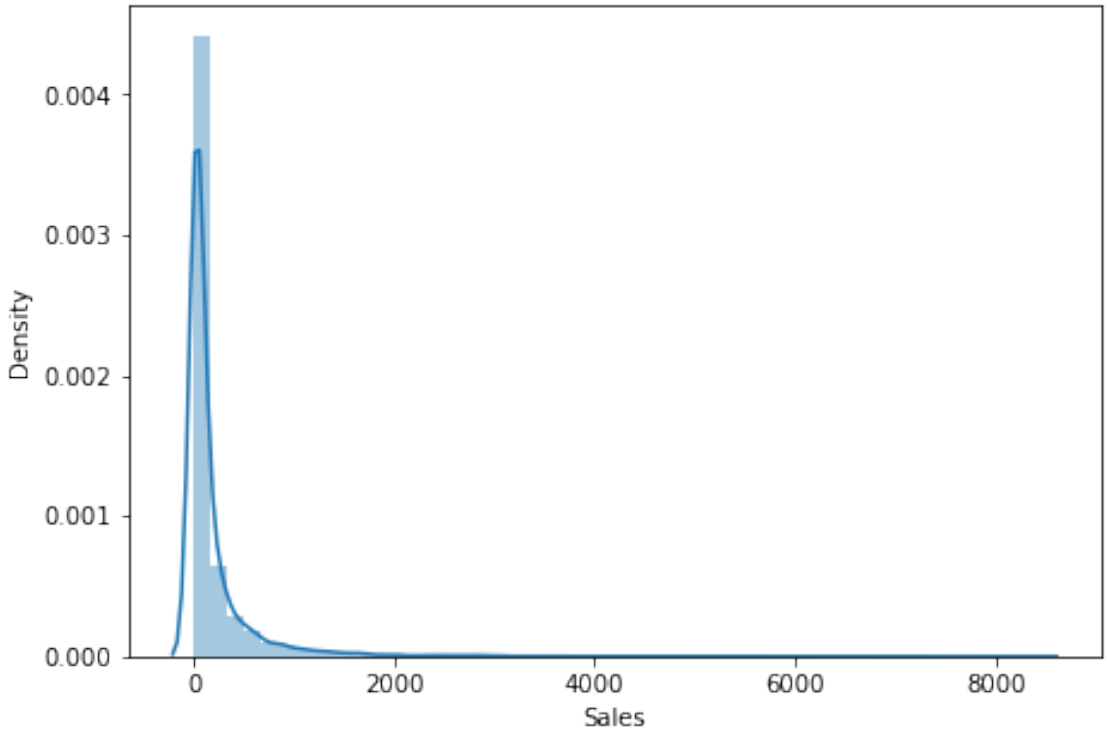


7 Sales Outlier Analysis

[125]:
```
# sales data distribution graph

plt.figure(figsize=(16,5))
plt.subplot(1,2,2)
sns.distplot(df["Sales"])
plt.show()
```

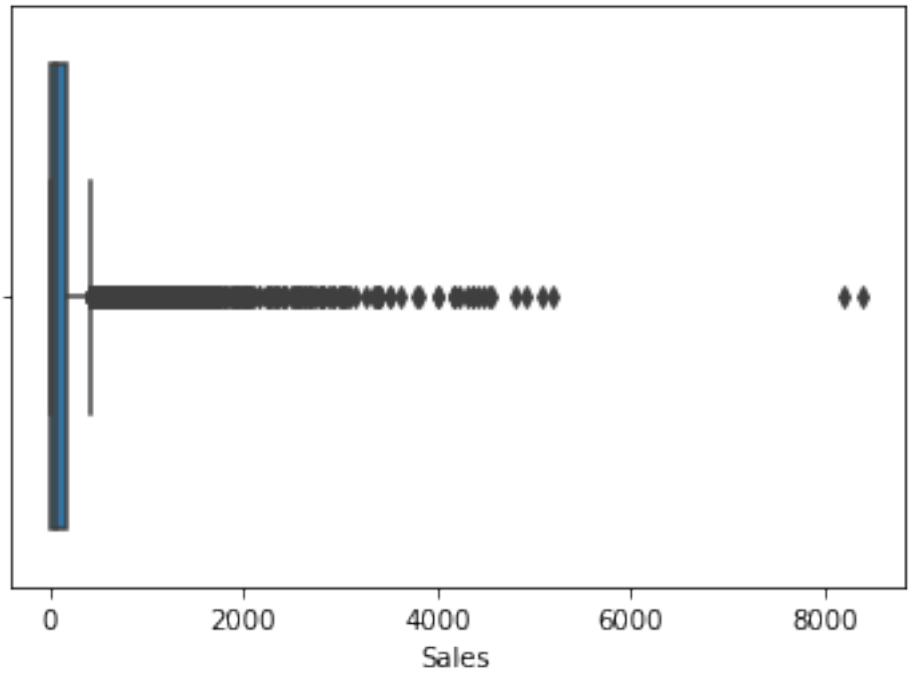
```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
```



[126]:
```
#box plot to check outliers
sns.boxplot(df["Sales"])
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```

[126]: <AxesSubplot:xlabel='Sales'>



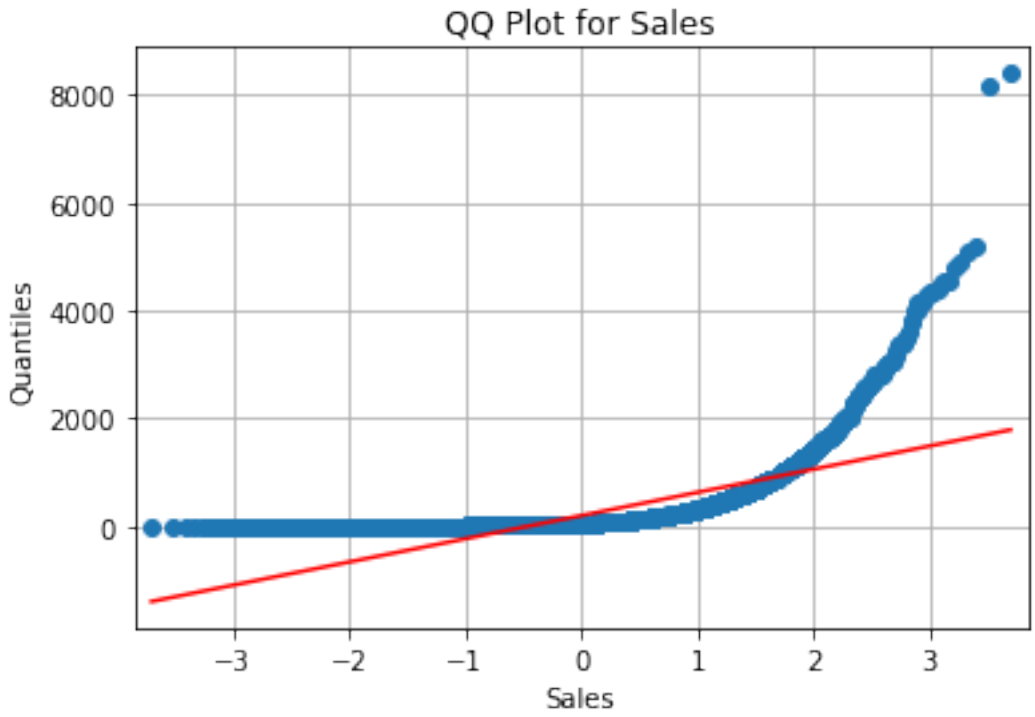
[127]:
```
#checking skewnessin data
df["Sales"].skew() #right skew
```

[127]: 5.945170113821082

[128]:
```
data = df

# Select the column you want to analyze
column_name = 'Sales'
column_data = data[column_name]

# Create the QQ plot using statsmodels.api
sm.qqplot(column_data, line='s')  # 's' for straight reference line
plt.xlabel(column_name)
plt.ylabel('Quantiles')
plt.title('QQ Plot for ' + column_name)
plt.grid(True)
plt.show()
```



[129]:
```
#data transformation using log
df['Transformed_Sales'] = np.log(df['Sales'])
```

[130]:
```
df.head() #top 5 rows display
```

[130]:

	Ship Mode	Segment	Country	City	State	Region	Category	Sub-Category	Product Name	Sales	Quantity
0	Second Class	Consumer	United States	Henderson	Kentucky	South	Furniture	Bookcases	Bush Somerset Collection Bookcase	261.960	2.0
1	Second Class	Consumer	United States	Henderson	Kentucky	South	Furniture	Chairs	Hon Deluxe Fabric Upholstered Stacking Chairs,…	731.940	3.0
2	Second Class	Corporate	United States	Los Angeles	California	West	Office Supplies	Labels	Self-Adhesive Address Labels for Typewriters b…	14.620	2.0
4	Standard Class	Consumer	United States	Fort Lauderdale	Florida	South	Office Supplies	Storage			
5	Standard Class	Consumer	United States	Los Angeles	California	West	Furniture	Furnishings			

```
4                    Eldon Fold 'N Roll Cart System   22.368       2.0
5  Eldon Expressions Wood and Plastic Desk Access…   48.860       7.0

   Discount    Profit  order_year  order_month  order_date  Ship_year  \
0       0.0   41.9136      2016.0         11.0         8.0     2016.0
1       0.0  219.5820      2016.0         11.0         8.0     2016.0
2       0.0    6.8714      2016.0          6.0        12.0     2016.0
4       0.2    2.5164      2015.0         10.0        11.0     2015.0
5       0.0   14.1694      2014.0          6.0         9.0     2014.0

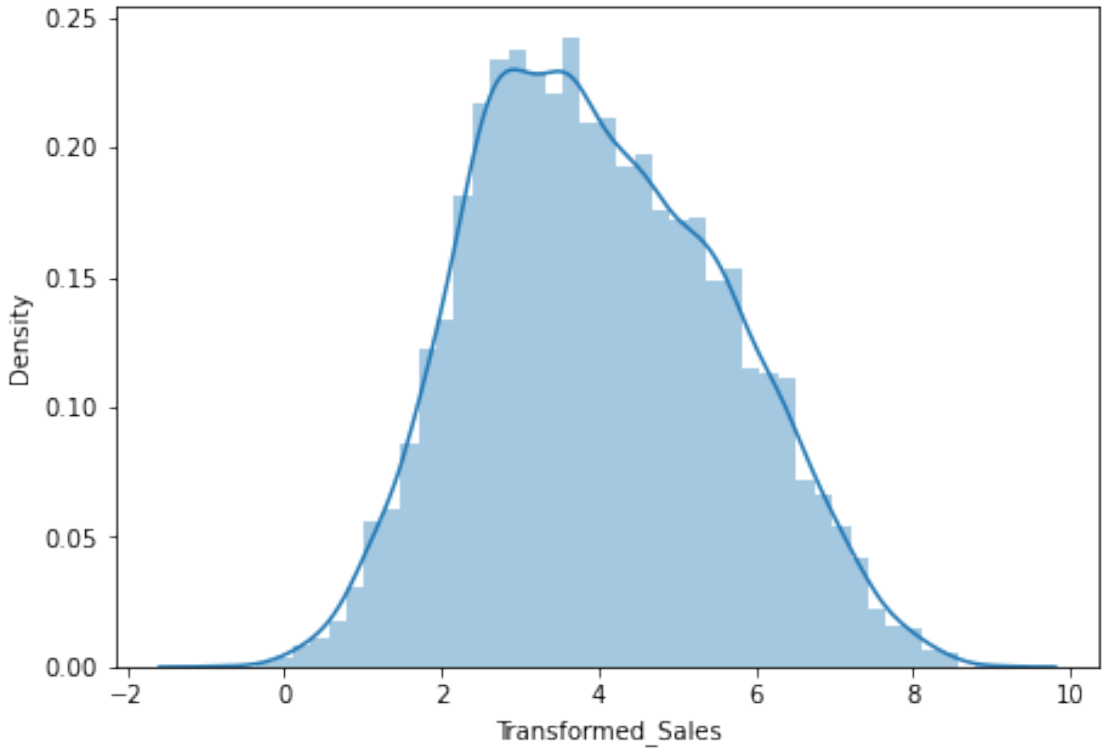
   Ship_month  Ship_date  Transformed_Profit  Transformed_Sales
0        11.0       11.0            3.735610           5.568192
1        11.0       11.0            5.391726           6.595699
2         6.0       16.0            1.927368           2.682390
4        10.0       18.0            0.922829           3.107631
5         6.0       14.0            2.651085           3.888959
```

[131]:
```
df.shape
```

[131]:
```
(9233, 21)
```

[132]:
```
#distribution graph after transformation
plt.figure(figsize=(16,5))
plt.subplot(1,2,2)
sns.distplot(df["Transformed_Sales"])
plt.show()
```

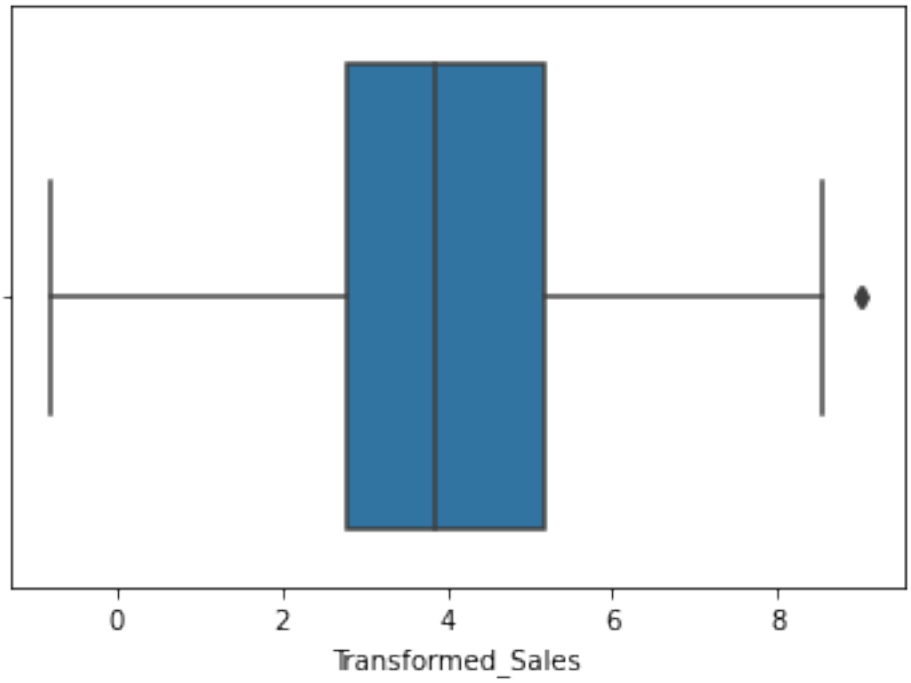
```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
```



[133]:
```
#boxplot
sns.boxplot(df["Transformed_Sales"])
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```

[133]: `<AxesSubplot:xlabel='Transformed_Sales'>`



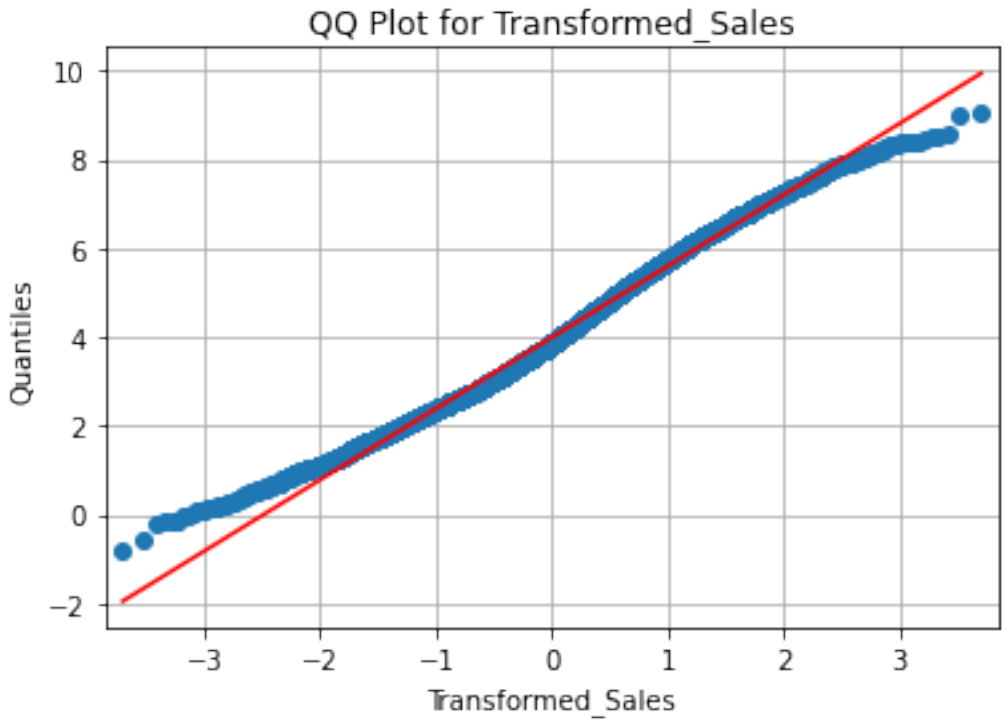
[134]:
```
#right skewness
df["Transformed_Sales"].skew()
```

[134]:
```
0.2193355558713904
```

[135]:
```
import statsmodels.api as sm
data = df

# Select the column you want to analyze
column_name = 'Transformed_Sales'
column_data = data[column_name]

# Create the QQ plot using statsmodels.api
sm.qqplot(column_data, line='s')  # 's' for straight reference line
plt.xlabel(column_name)
plt.ylabel('Quantiles')
plt.title('QQ Plot for ' + column_name)
plt.grid(True)
plt.show()
```



[136]:
```
df.shape
```

[136]: (9233, 21)

[137]:
```
#z_score technique to delete outliers
z_scores = (df['Transformed_Sales'] - df['Transformed_Sales'].mean()) /␣
 ↪df['Transformed_Sales'].std()
outliers = df[np.abs(z_scores) > 3]
```

[138]:
```
#drop outliers
df = df.drop(outliers.index)
```

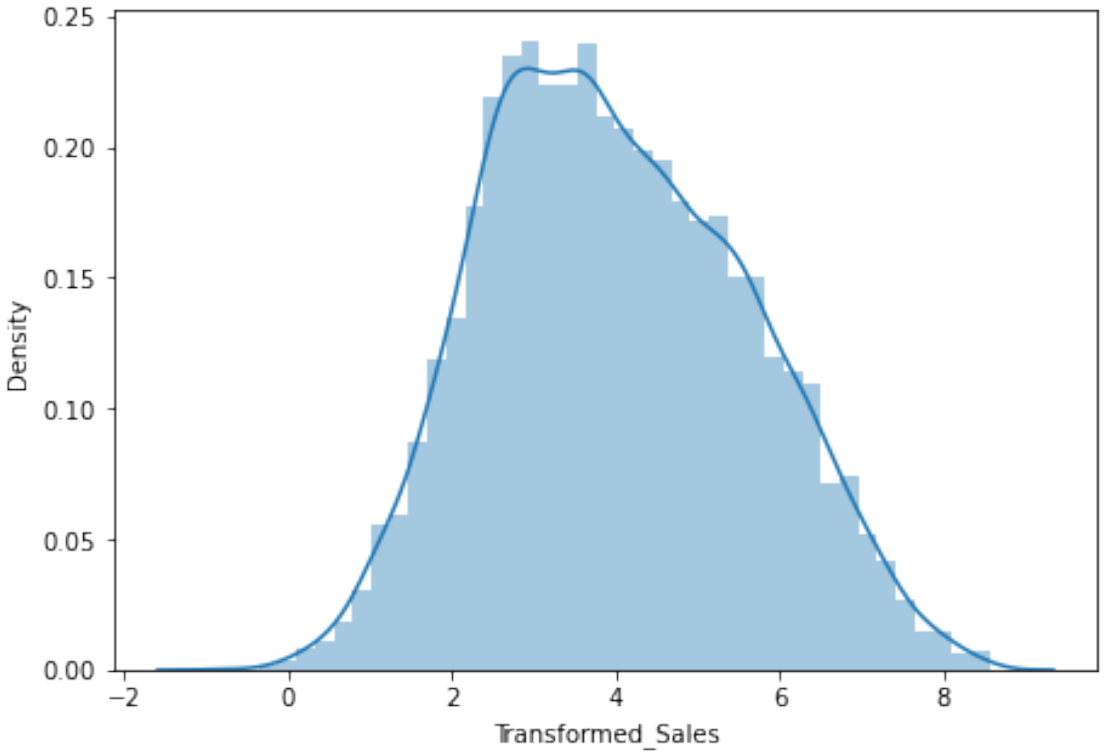
[139]:
```
df.shape
```

[139]: (9231, 21)

[140]:
```
#distribution graph after outlier deletion
plt.figure(figsize=(16,5))
plt.subplot(1,2,2)
sns.distplot(df["Transformed_Sales"])
plt.show()
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\distributions.py:2619:
FutureWarning: `distplot` is a deprecated function and will be removed in a
```

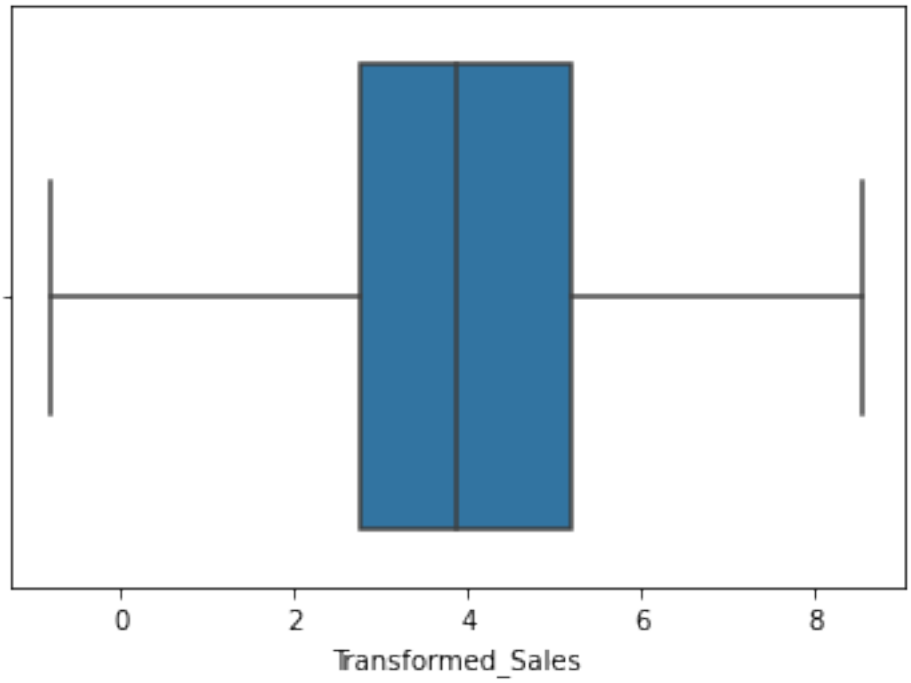
```
future version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `histplot` (an axes-level function for
histograms).
  warnings.warn(msg, FutureWarning)
```



[141]:
```
#box plot
sns.boxplot(df["Transformed_Sales"])
```

```
C:\Users\ganesh\anaconda3\lib\site-packages\seaborn\_decorators.py:36:
FutureWarning: Pass the following variable as a keyword arg: x. From version
0.12, the only valid positional argument will be `data`, and passing other
arguments without an explicit keyword will result in an error or
misinterpretation.
  warnings.warn(
```

[141]:
```
<AxesSubplot:xlabel='Transformed_Sales'>
```



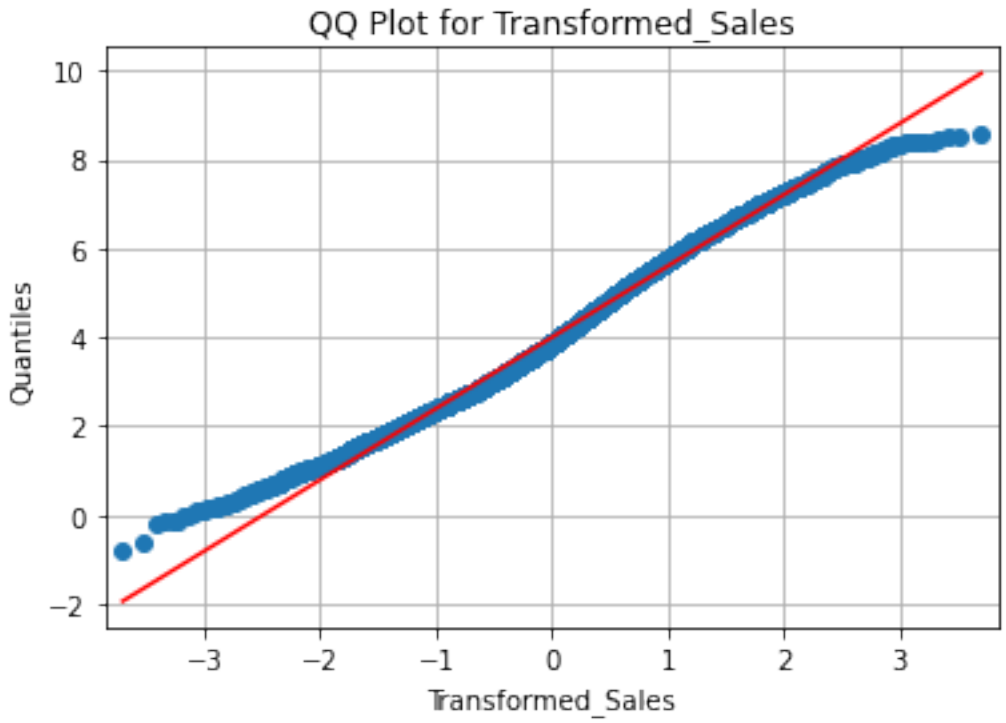
[142]:
```
#skew
df["Transformed_Sales"].skew()
```

[142]:
```
0.21540098687838372
```

[143]:
```
data = df

# Select the column you want to analyze
column_name = 'Transformed_Sales'
column_data = data[column_name]

# Create the QQ plot using statsmodels.api
sm.qqplot(column_data, line='s')  # 's' for straight reference line
plt.xlabel(column_name)
plt.ylabel('Quantiles')
plt.title('QQ Plot for ' + column_name)
plt.grid(True)
plt.show()
```



[144]:
```
df
```

[144]:

	Ship Mode	Segment	Country	City	State	Region	Category	Sub-Category
0	Second Class	Consumer	United States	Henderson	Kentucky	South	Furniture	Bookcases
1	Second Class	Consumer	United States	Henderson	Kentucky	South	Furniture	Chairs
2	Second Class	Corporate	United States	Los Angeles	California	West	Office Supplies	Labels
4	Standard Class	Consumer	United States	Fort Lauderdale	Florida	South	Office Supplies	Storage
5	Standard Class	Consumer	United States	Los Angeles	California	West	Furniture	Furnishings
…	…	…	…	…	…	…	…	…
9867	Standard Class	Consumer	United States	Detroit	Michigan	Central	Office Supplies	Binders
9868	Standard Class	Consumer	United States	Detroit	Michigan			
9869	Standard Class	Consumer	United States	Detroit	Michigan			
9870	Second Class	Corporate	United States	Fort Lauderdale	Florida			
9871	Second Class	Consumer	United States	Hampton	Virginia			

```
9868  Central  Office Supplies          Art
9869  Central  Office Supplies      Binders
9870    South  Office Supplies   Appliances
9871    South  Office Supplies   Appliances

                                          Product Name     Sales  Quantity  \
0                      Bush Somerset Collection Bookcase   261.960       2.0
1     Hon Deluxe Fabric Upholstered Stacking Chairs,…   731.940       3.0
2     Self-Adhesive Address Labels for Typewriters b…    14.620       2.0
4                         Eldon Fold 'N Roll Cart System    22.368       2.0
5     Eldon Expressions Wood and Plastic Desk Access…    48.860       7.0
…                                                  …       …       …
9867                           GBC Plastic Binding Combs    29.520       4.0
9868                                        Newell 315    11.960       2.0
9869     Wilson Jones 1" Hanging DublLock Ring Binders    26.400       5.0
9870                Hoover Upright Vacuum With Dirt Cup  1158.120       5.0
9871  Holmes Replacement Filter for HEPA Air Cleaner…    44.430       3.0

      Discount    Profit  order_year  order_month  order_date  Ship_year  \
0          0.0   41.9136      2016.0         11.0         8.0     2016.0
1          0.0  219.5820      2016.0         11.0         8.0     2016.0
2          0.0    6.8714      2016.0          6.0        12.0     2016.0
4          0.2    2.5164      2015.0         10.0        11.0     2015.0
5          0.0   14.1694      2014.0          6.0         9.0     2014.0
…        …       …          …           …          …         …
9867       0.0   14.4648      2016.0          9.0         1.0     2016.0
9868       0.0    2.9900      2016.0          9.0         1.0     2016.0
9869       0.0   12.6720      2016.0          9.0         1.0     2016.0
9870       0.2  130.2885      2017.0         11.0        11.0     2017.0
9871       0.0   18.6606      2015.0         11.0         8.0     2015.0

      Ship_month  Ship_date  Transformed_Profit  Transformed_Sales
0           11.0       11.0            3.735610           5.568192
1           11.0       11.0            5.391726           6.595699
2            6.0       16.0            1.927368           2.682390
4           10.0       18.0            0.922829           3.107631
5            6.0       14.0            2.651085           3.888959
…          …         …                 …                  …
9867         9.0        5.0            2.671718           3.385068
9868         9.0        5.0            1.095273           2.481568
9869         9.0        5.0            2.539395           3.273364
9870        11.0       16.0            4.869751           7.054553
9871        11.0       13.0            2.926414           3.793915

[9231 rows x 21 columns]
```

8 Feature Engineering:

9 Identify relevant features that could impact sales, like trend or seasonality.

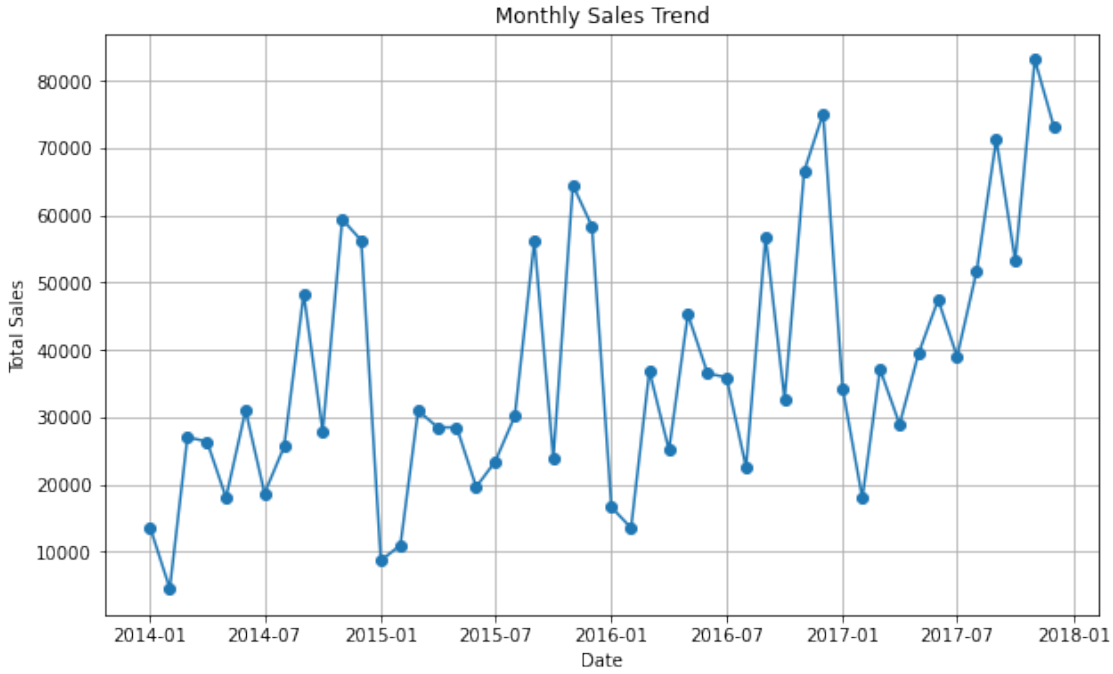
[145]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

# Assuming you have loaded your sales data into a pandas DataFrame named␣
 ↪'sales_data' with columns 'Order_year', 'Order_month', and 'sales'
dfs=df.copy()
# Convert 'Order_year' and 'Order_month' to integers
dfs['Order_year'] = dfs['order_year'].astype(int)
dfs['Order_month'] = dfs['order_month'].astype(int)

# Create a new column for 'order_date' combining year and month
dfs['order_date'] = pd.to_datetime(dfs['order_year'] * 100 +␣
 ↪dfs['order_month'], format='%Y%m')

# Group by 'order_date' and calculate total sales
monthly_sales = dfs.groupby('order_date')['Sales'].sum().reset_index()

# Plot time series of sales
plt.figure(figsize=(10, 6))
plt.plot(monthly_sales['order_date'], monthly_sales['Sales'], marker='o',␣
 ↪linestyle='-')
plt.title('Monthly Sales Trend')
plt.xlabel('Date')
plt.ylabel('Total Sales')
plt.grid(True)
plt.show()
```



[146]:
```
# Analyzing sales by ship mode
ship_mode_sales = df.groupby('Ship Mode')['Sales'].sum().
 ↪sort_values(ascending=False)
plt.figure(figsize=(8, 5))
ship_mode_sales.plot(kind='bar')
plt.title('Sales by Ship Mode')
plt.xlabel('Ship Mode')
plt.ylabel('Sales')
plt.xticks(rotation=45)
plt.show()

# Analyzing sales by segment
segment_sales = df.groupby('Segment')['Sales'].sum().
 ↪sort_values(ascending=False)
plt.figure(figsize=(8, 5))
segment_sales.plot(kind='bar')
plt.title('Sales by Customer Segment')
plt.xlabel('Segment')
plt.ylabel('Sales')
plt.xticks(rotation=45)
plt.show()

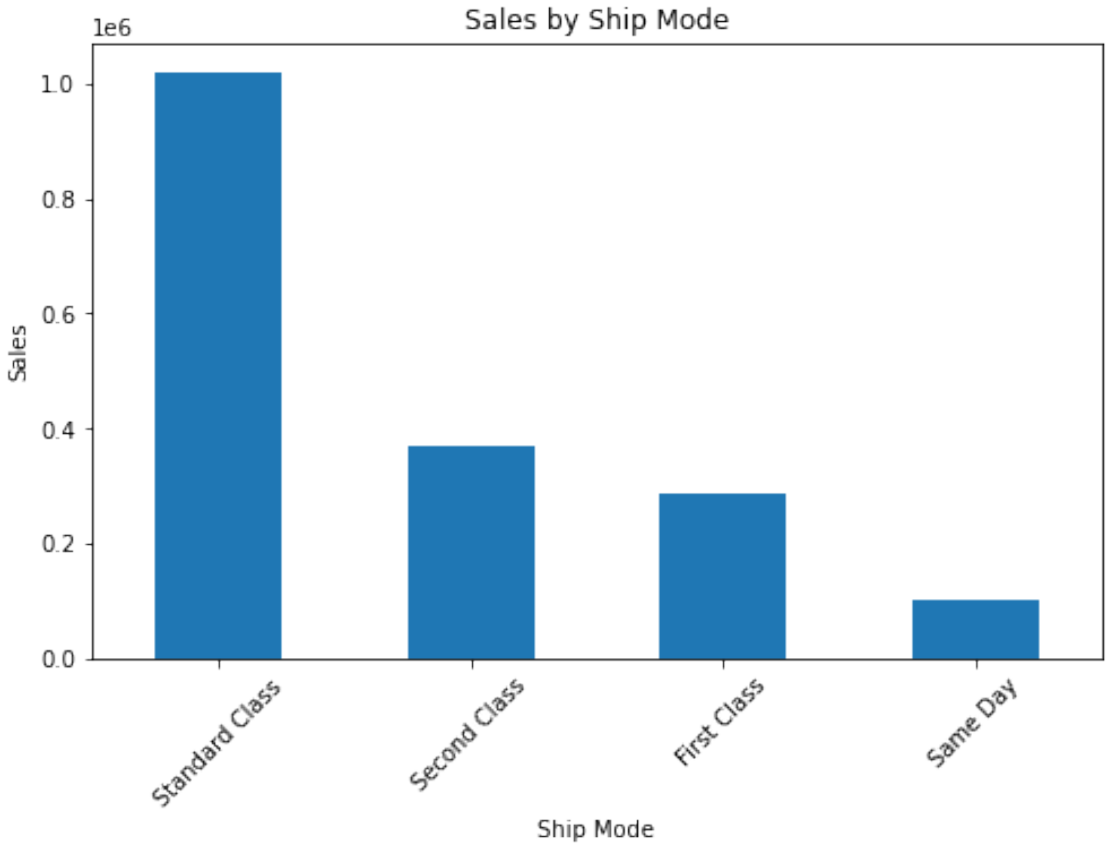
# Analyzing sales by region
region_sales = df.groupby('Region')['Sales'].sum().sort_values(ascending=False)
plt.figure(figsize=(8, 5))
```

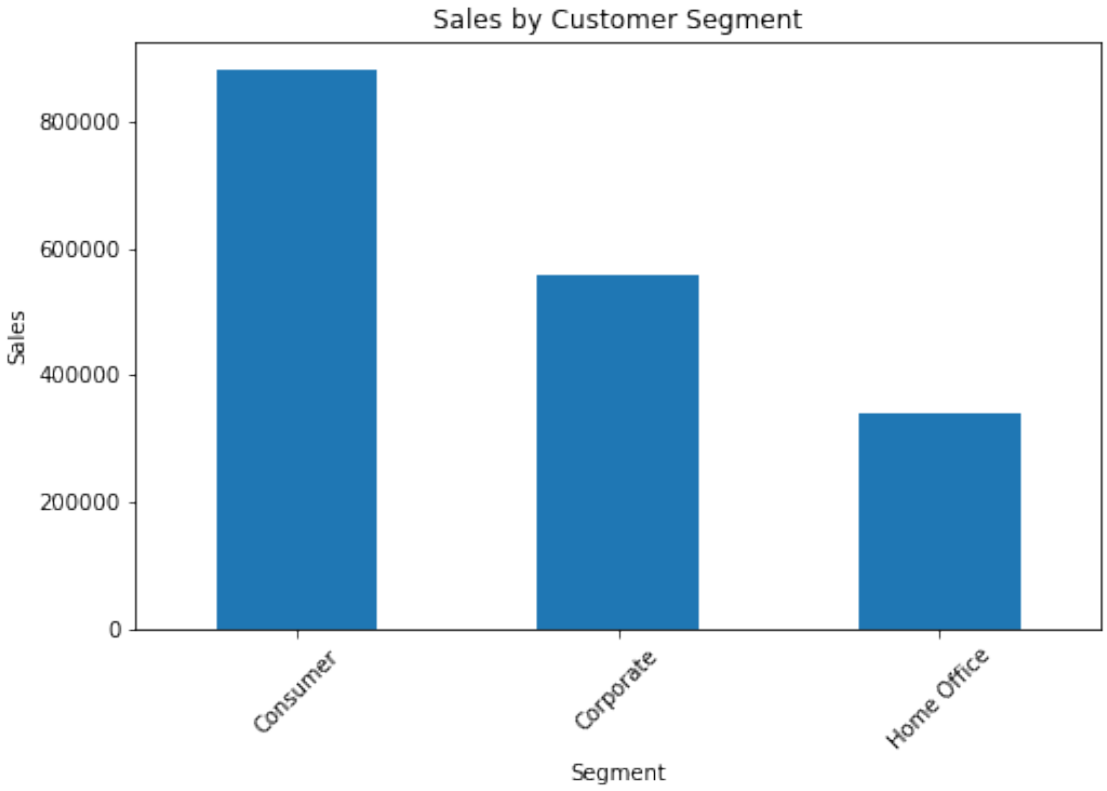
```
region_sales.plot(kind='bar')
plt.title('Sales by Region')
plt.xlabel('Region')
plt.ylabel('Sales')
plt.xticks(rotation=45)
plt.show()

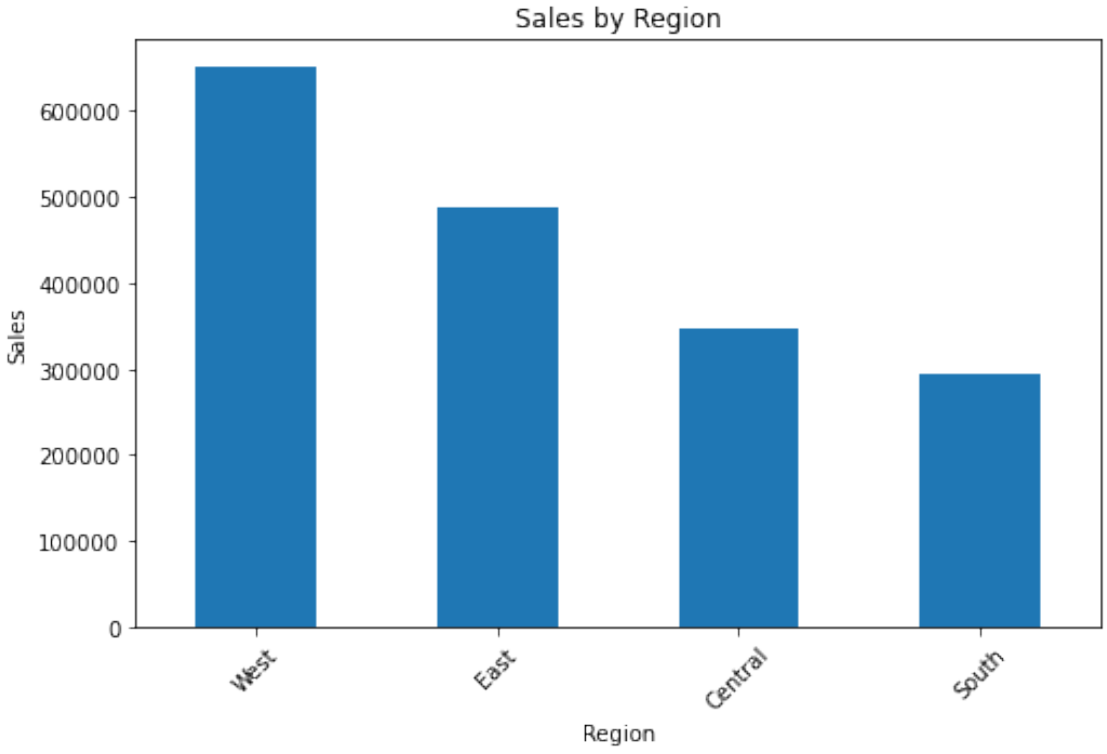
# Analyzing sales by category
category_sales = df.groupby('Category')['Sales'].sum().
 ↪sort_values(ascending=False)
plt.figure(figsize=(8, 5))
category_sales.plot(kind='bar')
plt.title('Sales by Category')
plt.xlabel('Category')
plt.ylabel('Sales')
plt.xticks(rotation=45)
plt.show()

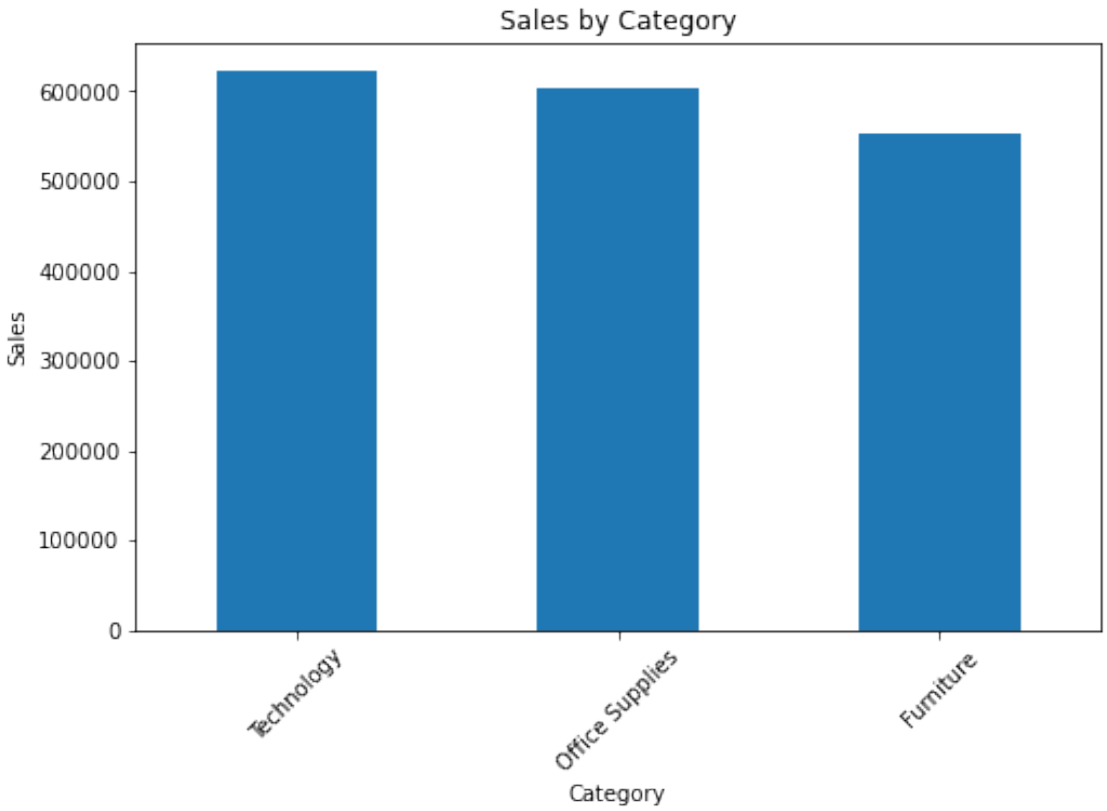
# Analyzing the impact of discount on sales
plt.figure(figsize=(8, 5))
sns.scatterplot(x='Discount', y='Sales', data=df)
plt.title('Impact of Discount on Sales')
plt.xlabel('Discount')
plt.ylabel('Sales')
plt.show()

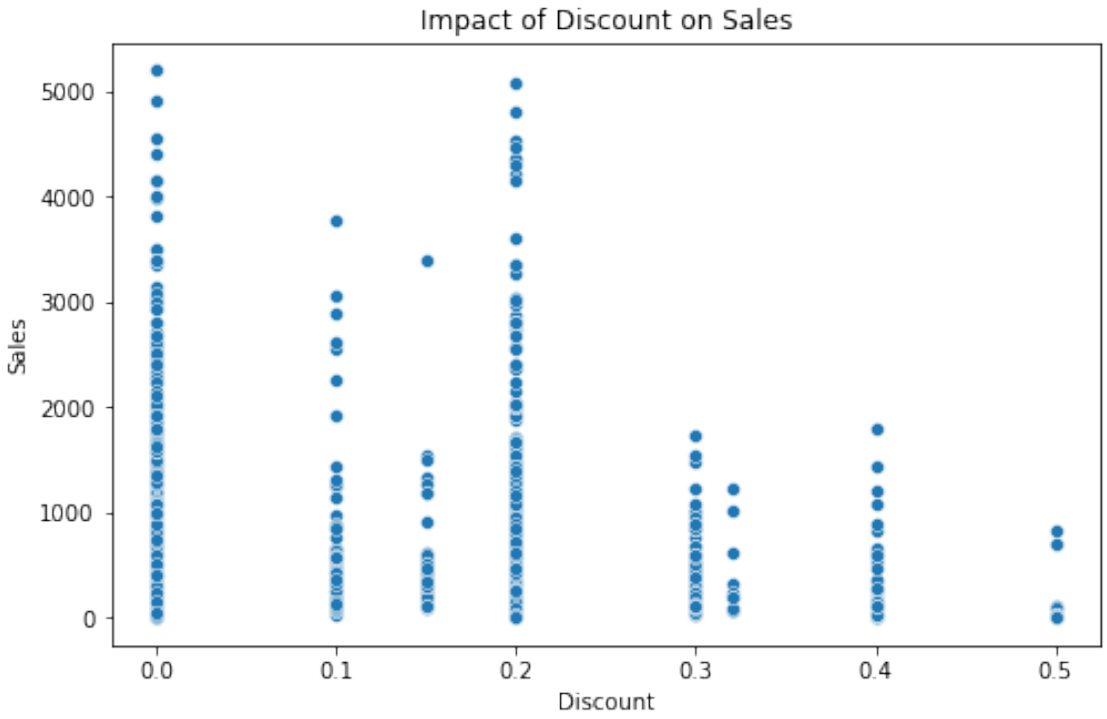
# Analyzing profit margins
plt.figure(figsize=(8, 5))
sns.boxplot(x='Category', y='Profit', data=df)
plt.title('Profit Margins by Category')
plt.xlabel('Category')
plt.ylabel('Profit')
plt.xticks(rotation=45)
plt.show()
```

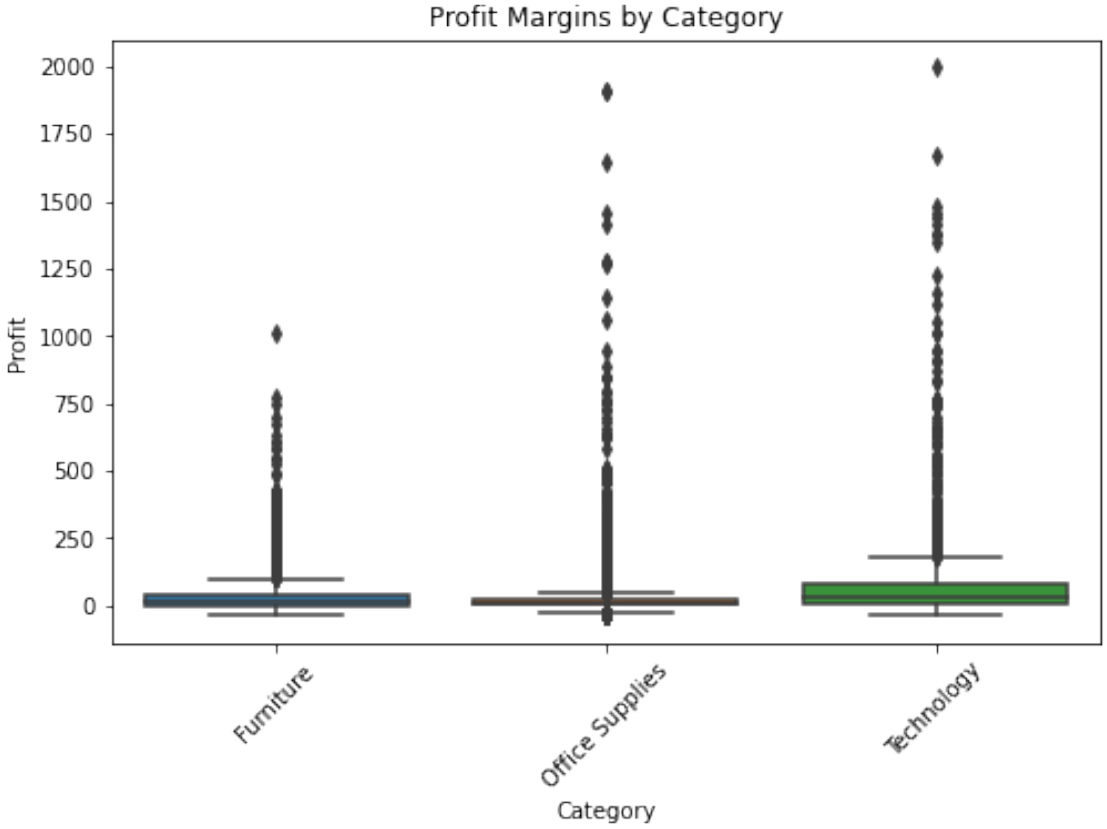

Sales by Ship Mode
1e6
1.0
0.8
0.6
0.4
0.2
0.0
Sales
Standard Class
Second Class
First Class
Same Day
Ship Mode


Sales by Customer Segment
800000
600000
400000
200000
0
Sales
Consumer
Corporate
Home Office
Segment


Sales by Region
600000
500000
400000
300000
200000
100000
0
Sales
West
East
Central
South
Region


Sales by Category
600000
500000
400000
300000
200000
100000
0
Sales
Technology
Office Supplies
Furniture
Category

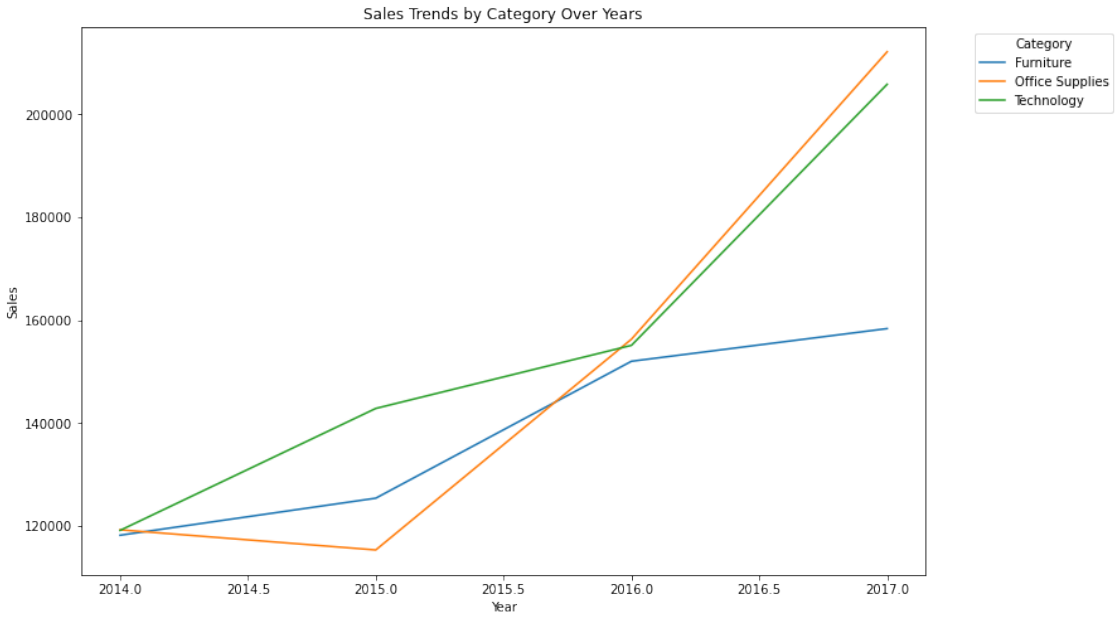

Impact of Discount on Sales
Sales
5000
4000
3000
2000
1000
0
0.0
0.1
0.2
0.3
0.4
0.5
Discount


Profit Margins by Category
Profit
2000
1750
1500
1250
1000
750
500
250
0
Furniture
Office Supplies
Technology
Category

10 Investigate sales patterns for different product categories (Increasing or decreasing over years).

[147]:
```
category_yearly_sales = df.groupby(['Category', 'order_year'])['Sales'].sum().
 ↪reset_index()
plt.figure(figsize=(12, 8))
sns.lineplot(x='order_year', y='Sales', hue='Category',␣
 ↪data=category_yearly_sales)
plt.title('Sales Trends by Category Over Years')
plt.xlabel('Year')
plt.ylabel('Sales')
plt.legend(title='Category', bbox_to_anchor=(1.05, 1), loc='upper left')
```

[147]:
```
<matplotlib.legend.Legend at 0x21b0d020550>
```



11 Analyze the correlation between sales and other variables within each category.

[148]:
```
category_correlations = {}
for category in df['Category'].unique():
    category_data = df[df['Category'] == category]
```

```
    category_correlation_matrix = category_data.corr()
    category_correlations[category] = category_correlation_matrix

for category, correlation_matrix in category_correlations.items():
    print(f"Correlation Matrix for {category} Category:")
    print(correlation_matrix)
    print()
```

```
Correlation Matrix for Furniture Category:
                      Sales  Quantity  Discount    Profit  order_year  \
Sales              1.000000  0.414408 -0.085544  0.765578   -0.045909
Quantity           0.414408  1.000000 -0.078189  0.362231   -0.070076
Discount          -0.085544 -0.078189  1.000000 -0.333928   -0.034070
Profit             0.765578  0.362231 -0.333928  1.000000   -0.030386
order_year        -0.045909 -0.070076 -0.034070 -0.030386    1.000000
order_month        0.034092 -0.001358  0.015186  0.026142   -0.012841
order_date         0.004778  0.012220  0.007750 -0.003917   -0.003544
Ship_year         -0.047723 -0.069455 -0.031428 -0.030472    0.993575
Ship_month         0.041604  0.001825  0.003635  0.026501   -0.009276
Ship_date          0.003479 -0.033666  0.010094 -0.000326   -0.036496
Transformed_Profit 0.374131  0.247231 -0.675976  0.625102   -0.016565
Transformed_Sales  0.741005  0.364254 -0.120222  0.534449   -0.030388

                   order_month  order_date  Ship_year  Ship_month  Ship_date  \
Sales                 0.034092    0.004778  -0.047723    0.041604   0.003479
Quantity             -0.001358    0.012220  -0.069455    0.001825  -0.033666
Discount              0.015186    0.007750  -0.031428    0.003635   0.010094
Profit                0.026142   -0.003917  -0.030472    0.026501  -0.000326
order_year           -0.012841   -0.003544   0.993575   -0.009276  -0.036496
order_month           1.000000   -0.054651   0.005182    0.906667  -0.028408
order_date           -0.054651    1.000000   0.017885   -0.086814   0.385182
Ship_year             0.005182    0.017885   1.000000   -0.039000  -0.058611
Ship_month            0.906667   -0.086814  -0.039000    1.000000   0.008354
Ship_date            -0.028408    0.385182  -0.058611    0.008354   1.000000
Transformed_Profit    0.032409   -0.008701  -0.016583    0.031189   0.014099
Transformed_Sales     0.012867    0.000152  -0.032783    0.023049  -0.003641

                   Transformed_Profit  Transformed_Sales
Sales                        0.374131           0.741005
Quantity                     0.247231           0.364254
Discount                    -0.675976          -0.120222
Profit                       0.625102           0.534449
order_year                  -0.016565          -0.030388
order_month                  0.032409           0.012867
order_date                  -0.008701           0.000152
Ship_year                   -0.016583          -0.032783
Ship_month                   0.031189           0.023049
```

```
Ship_date                    0.014099          -0.003641
Transformed_Profit           1.000000           0.351710
Transformed_Sales            0.351710           1.000000

Correlation Matrix for Office Supplies Category:
                      Sales  Quantity  Discount    Profit  order_year  \
Sales              1.000000  0.167235 -0.120066  0.857103    0.014741
Quantity           0.167235  1.000000 -0.016831  0.142620    0.022021
Discount          -0.120066 -0.016831  1.000000 -0.153288    0.000224
Profit             0.857103  0.142620 -0.153288  1.000000    0.017693
order_year         0.014741  0.022021  0.000224  0.017693    1.000000
order_month       -0.007454  0.024422  0.000188  0.004639   -0.011874
order_date         0.005073 -0.003157 -0.003023  0.000185   -0.021896
Ship_year          0.014565  0.020591 -0.000291  0.017404    0.993790
Ship_month        -0.007163  0.029372  0.000444  0.005948   -0.001428
Ship_date          0.012367  0.005077  0.020189 -0.001403   -0.013676
Transformed_Profit 0.435989  0.255263 -0.618825  0.502668    0.017911
Transformed_Sales  0.628206  0.373706 -0.340726  0.526248    0.015244

                   order_month  order_date  Ship_year  Ship_month  Ship_date  \
Sales                -0.007454    0.005073   0.014565   -0.007163   0.012367
Quantity              0.024422   -0.003157   0.020591    0.029372   0.005077
Discount              0.000188   -0.003023  -0.000291    0.000444   0.020189
Profit                0.004639    0.000185   0.017404    0.005948  -0.001403
order_year           -0.011874   -0.021896   0.993790   -0.001428  -0.013676
order_month           1.000000   -0.031090   0.006544    0.906240  -0.020464
order_date           -0.031090    1.000000  -0.000052   -0.066594   0.389597
Ship_year             0.006544   -0.000052   1.000000   -0.030102  -0.034899
Ship_month            0.906240   -0.066594  -0.030102    1.000000   0.013945
Ship_date            -0.020464    0.389597  -0.034899    0.013945   1.000000
Transformed_Profit    0.016034   -0.003491   0.016949    0.020760  -0.022837
Transformed_Sales     0.007906    0.000924   0.015433    0.007314  -0.006283

                   Transformed_Profit  Transformed_Sales
Sales                        0.435989           0.628206
Quantity                     0.255263           0.373706
Discount                    -0.618825          -0.340726
Profit                       0.502668           0.526248
order_year                   0.017911           0.015244
order_month                  0.016034           0.007906
order_date                  -0.003491           0.000924
Ship_year                    0.016949           0.015433
Ship_month                   0.020760           0.007314
Ship_date                   -0.022837          -0.006283
Transformed_Profit           1.000000           0.700100
Transformed_Sales            0.700100           1.000000

Correlation Matrix for Technology Category:
```

```
                      Sales  Quantity  Discount    Profit  order_year  \
Sales                 1.000000  0.319961 -0.032084  0.838539   -0.007476
Quantity              0.319961  1.000000 -0.028492  0.234063   -0.008968
Discount             -0.032084 -0.028492  1.000000 -0.204603    0.001747
Profit                0.838539  0.234063 -0.204603  1.000000   -0.013748
order_year           -0.007476 -0.008968  0.001747 -0.013748    1.000000
order_month          -0.012163  0.041371 -0.028493  0.013373   -0.043843
order_date            0.021743  0.054802 -0.001203  0.009719   -0.013018
Ship_year            -0.007600 -0.009185  0.002401 -0.013821    0.994769
Ship_month           -0.010463  0.042095 -0.031123  0.014313   -0.006737
Ship_date            -0.004449  0.050469  0.001069 -0.012495    0.023132
Transformed_Profit    0.539624  0.243737 -0.431459  0.558680   -0.036687
Transformed_Sales     0.742175  0.395415 -0.048060  0.599116   -0.035851

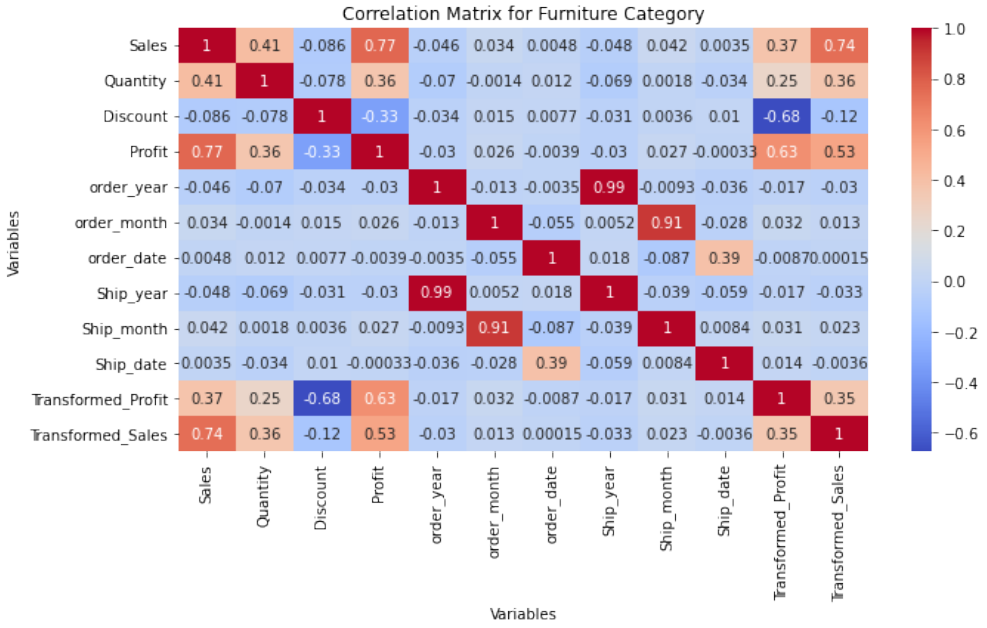
                    order_month  order_date  Ship_year  Ship_month  Ship_date  \
Sales                 -0.012163    0.021743  -0.007600   -0.010463  -0.004449
Quantity               0.041371    0.054802  -0.009185    0.042095   0.050469
Discount              -0.028493   -0.001203   0.002401   -0.031123   0.001069
Profit                 0.013373    0.009719  -0.013821    0.014313  -0.012495
order_year            -0.043843   -0.013018   0.994769   -0.006737   0.023132
order_month            1.000000   -0.037157  -0.028908    0.923858   0.001977
order_date            -0.037157    1.000000   0.005905   -0.062725   0.416332
Ship_year             -0.028908    0.005905   1.000000   -0.030615   0.005172
Ship_month             0.923858   -0.062725  -0.030615    1.000000   0.025193
Ship_date              0.001977    0.416332   0.005172    0.025193   1.000000
Transformed_Profit     0.014378    0.031783  -0.036676    0.017842  -0.023510
Transformed_Sales     -0.000178    0.037611  -0.036669    0.005336  -0.003888

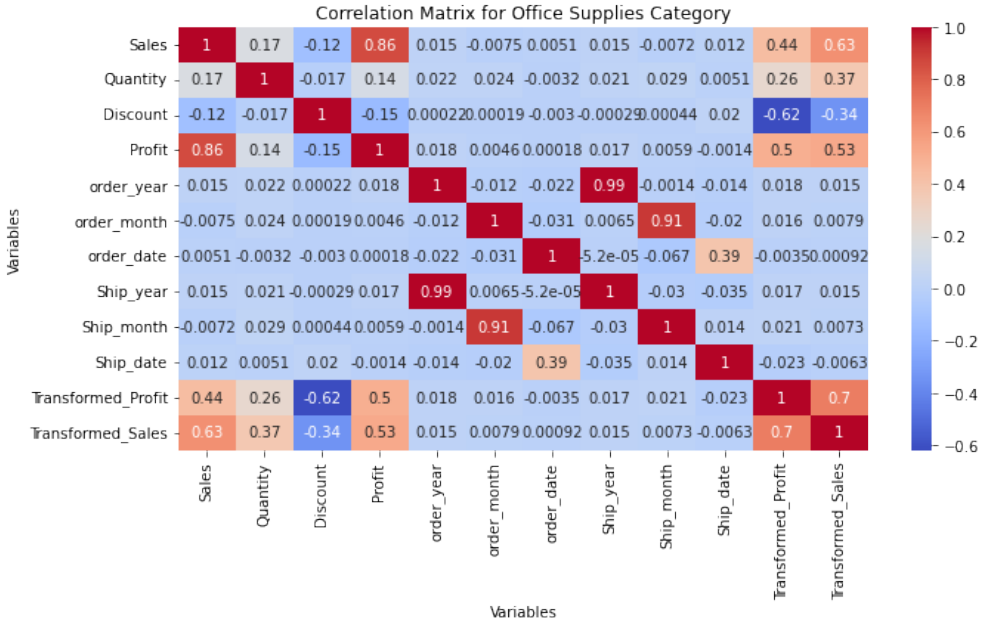
                    Transformed_Profit  Transformed_Sales
Sales                         0.539624           0.742175
Quantity                      0.243737           0.395415
Discount                     -0.431459          -0.048060
Profit                        0.558680           0.599116
order_year                   -0.036687          -0.035851
order_month                   0.014378          -0.000178
order_date                    0.031783           0.037611
Ship_year                    -0.036676          -0.036669
Ship_month                    0.017842           0.005336
Ship_date                    -0.023510          -0.003888
Transformed_Profit            1.000000           0.691990
Transformed_Sales             0.691990           1.000000
```

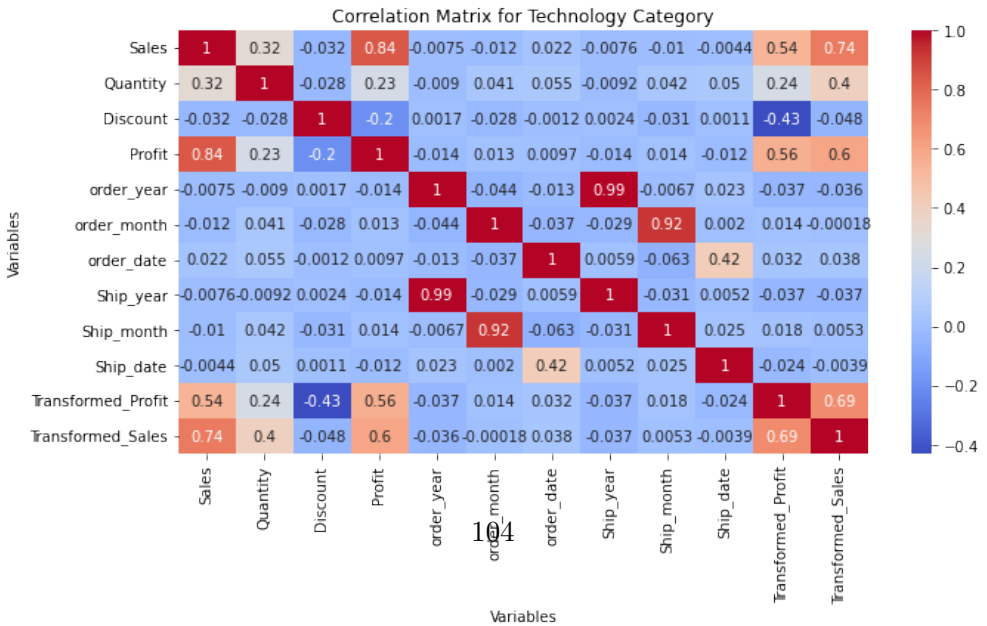
[149]:
```
fig, axes = plt.subplots(nrows=len(category_correlations), figsize=(10, 6 *␣
 ↪len(category_correlations)))
```

```
for i, (category, correlation_matrix) in enumerate(category_correlations.
  ↪items()):
    sns.heatmap(correlation_matrix, annot=True, cmap='coolwarm', ax=axes[i])
    axes[i].set_title(f'Correlation Matrix for {category} Category')
    axes[i].set_xlabel('Variables')
    axes[i].set_ylabel('Variables')

plt.tight_layout()
plt.show()
```


Correlation Matrix for Furniture Category
Variables
Sales 1 0.41 -0.086 0.77 -0.046 0.034 0.0048 -0.048 0.042 0.0035 0.37 0.74
Quantity 0.41 1 -0.078 0.36 -0.07 -0.0014 0.012 -0.069 0.0018 -0.034 0.25 0.36
Discount -0.086 -0.078 1 -0.33 -0.034 0.015 0.0077 -0.031 0.0036 0.01 -0.68 -0.12
Profit 0.77 0.36 -0.33 1 -0.03 0.026 -0.0039 -0.03 0.027 -0.00033 0.63 0.53
order_year -0.046 -0.07 -0.034 -0.03 1 -0.013 -0.0035 0.99 -0.0093 -0.036 -0.017 -0.03
order_month 0.034 -0.0014 0.015 0.026 -0.013 1 -0.055 0.0052 0.91 -0.028 0.032 0.013
order_date 0.0048 0.012 0.0077 -0.0039 -0.0035 -0.055 1 0.018 -0.087 0.39 -0.0087 0.00015
Ship_year -0.048 -0.069 -0.031 -0.03 0.99 0.0052 0.018 1 -0.039 -0.059 -0.017 -0.033
Ship_month 0.042 0.0018 0.0036 0.027 -0.0093 0.91 -0.087 -0.039 1 0.0084 0.031 0.023
Ship_date 0.0035 -0.034 0.01 -0.00033 -0.036 -0.028 0.39 -0.059 0.0084 1 0.014 -0.0036
Transformed_Profit 0.37 0.25 -0.68 0.63 -0.017 0.032 -0.0087 -0.017 0.031 0.014 1 0.35
Transformed_Sales 0.74 0.36 -0.12 0.53 -0.03 0.013 0.00015 -0.033 0.023 -0.0036 0.35 1
Sales Quantity Discount Profit order_year order_month order_date Ship_year Ship_month Ship_date Transformed_Profit Transformed_Sales
Variables
1.0 0.8 0.6 0.4 0.2 0.0 −0.2 −0.4 −0.6

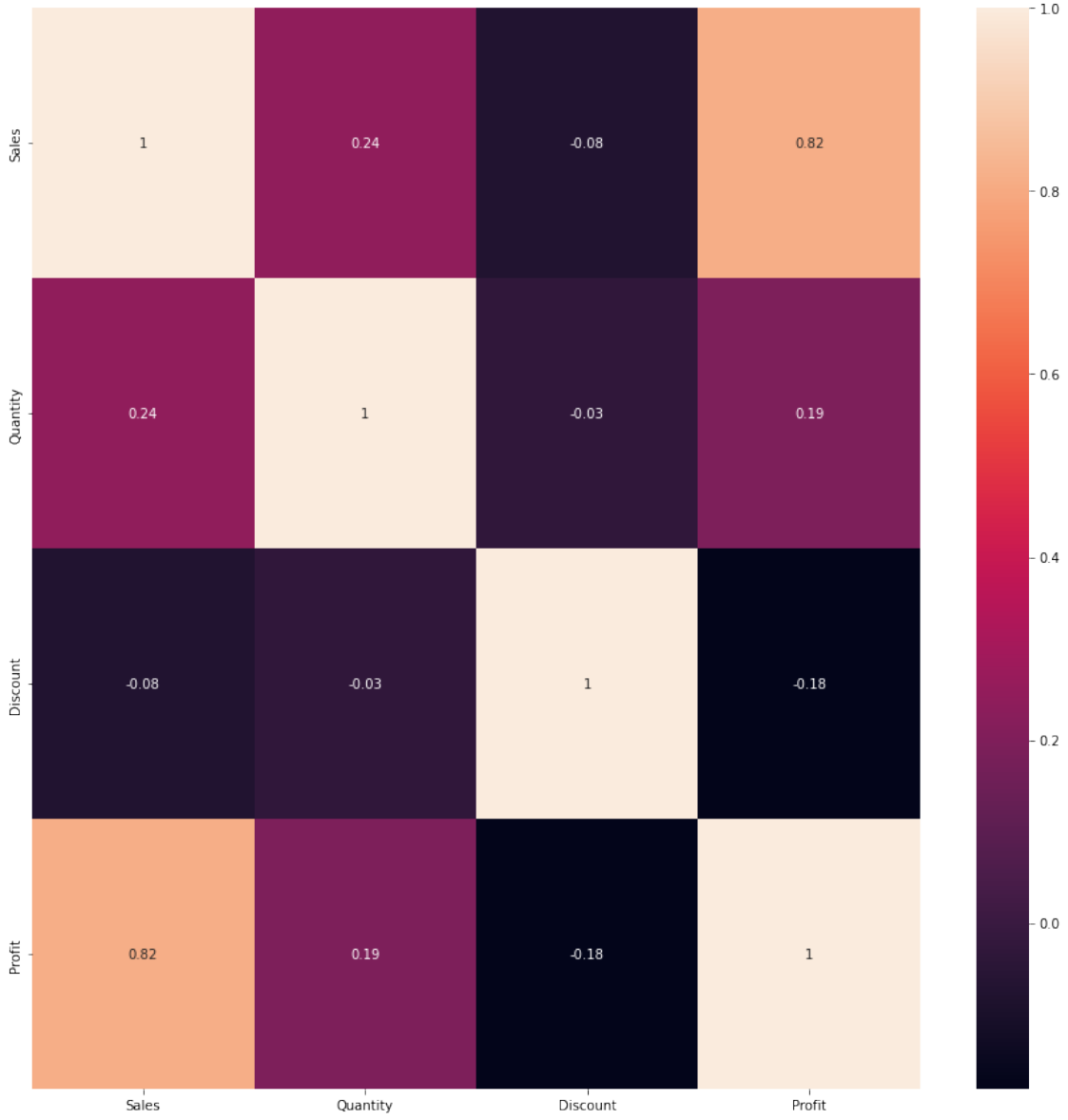

Correlation Matrix for Office Supplies Category
Variables
Sales 1 0.17 -0.12 0.86 0.015 -0.0075 0.0051 0.015 -0.0072 0.012 0.44 0.63
Quantity 0.17 1 -0.017 0.14 0.022 0.024 -0.0032 0.021 0.029 0.0051 0.26 0.37
Discount -0.12 -0.017 1 -0.15 0.00022 0.00019 -0.003 -0.00029 0.00044 0.02 -0.62 -0.34
Profit 0.86 0.14 -0.15 1 0.018 0.0046 0.00018 0.017 0.0059 -0.0014 0.5 0.53
order_year 0.015 0.022 0.00022 0.018 1 -0.012 -0.022 0.99 -0.0014 -0.014 0.018 0.015
order_month -0.0075 0.024 0.00019 0.0046 -0.012 1 -0.031 0.0065 0.91 -0.02 0.016 0.0079
order_date 0.0051 -0.0032 -0.003 0.00018 -0.022 -0.031 1 -5.2e-05 -0.067 0.39 -0.0035 0.00092
Ship_year 0.015 0.021 -0.00029 0.017 0.99 0.0065 -5.2e-05 1 -0.03 -0.035 0.017 0.015
Ship_month -0.0072 0.029 0.00044 0.0059 -0.0014 0.91 -0.067 -0.03 1 0.014 0.021 0.0073
Ship_date 0.012 0.0051 0.02 -0.0014 -0.014 -0.02 0.39 -0.035 0.014 1 -0.023 -0.0063
Transformed_Profit 0.44 0.26 -0.62 0.5 0.018 0.016 -0.0035 0.017 0.021 -0.023 1 0.7
Transformed_Sales 0.63 0.37 -0.34 0.53 0.015 0.0079 0.00092 0.015 0.0073 -0.0063 0.7 1
Sales Quantity Discount Profit order_year order_month order_date Ship_year Ship_month Ship_date Transformed_Profit Transformed_Sales
Variables
1.0 0.8 0.6 0.4 0.2 0.0 −0.2 −0.4 −0.6


Correlation Matrix for Technology Category
Variables
Sales 1 0.32 -0.032 0.84 -0.0075 -0.012 0.022 -0.0076 -0.01 -0.0044 0.54 0.74
Quantity 0.32 1 -0.028 0.23 -0.009 0.041 0.055 -0.0092 0.042 0.05 0.24 0.4
Discount -0.032 -0.028 1 -0.2 0.0017 -0.028 -0.0012 0.0024 -0.031 0.0011 -0.43 -0.048
Profit 0.84 0.23 -0.2 1 -0.014 0.013 0.0097 -0.014 0.014 -0.012 0.56 0.6
order_year -0.0075 -0.009 0.0017 -0.014 1 -0.044 -0.013 0.99 -0.0067 0.023 -0.037 -0.036
order_month -0.012 0.041 -0.028 0.013 -0.044 1 -0.037 -0.029 0.92 0.002 0.014 -0.00018
order_date 0.022 0.055 -0.0012 0.0097 -0.013 -0.037 1 0.0059 -0.063 0.42 0.032 0.038
Ship_year -0.0076 -0.0092 0.0024 -0.014 0.99 -0.029 0.0059 1 -0.031 0.0052 -0.037 -0.037
Ship_month -0.01 0.042 -0.031 0.014 -0.0067 0.92 -0.063 -0.031 1 0.025 0.018 0.0053
Ship_date -0.0044 0.05 0.0011 -0.012 0.023 0.002 0.42 0.0052 0.025 1 -0.024 -0.0039
Transformed_Profit 0.54 0.24 -0.43 0.56 -0.037 0.014 0.032 -0.037 0.018 -0.024 1 0.69
Transformed_Sales 0.74 0.4 -0.048 0.6 -0.036 -0.00018 0.038 -0.037 0.0053 -0.0039 0.69 1
Sales Quantity Discount Profit order_year order_month order_date Ship_year Ship_month Ship_date Transformed_Profit Transformed_Sales
Variables
1.0 0.8 0.6 0.4 0.2 0.0 −0.2 −0.4

12 Correlation Matrix

[150]:
```
#Correlation between columns
plt.figure(figsize=(15,15))
sns.heatmap(df[['Sales', 'Quantity', 'Discount', 'Profit']].corr(),annot=True)
```

[150]: <AxesSubplot:>



[151]:
```
df[['Sales', 'Quantity', 'Discount', 'Profit']].corr()
```

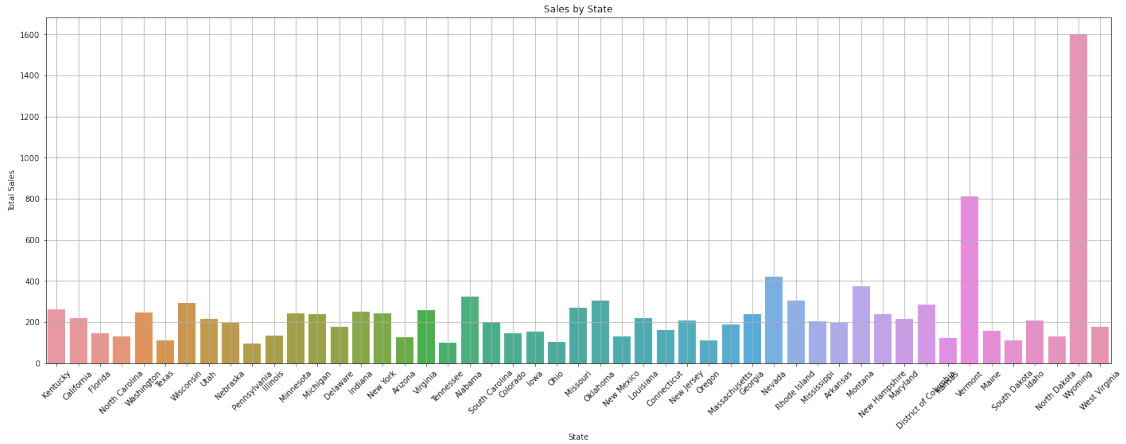
[151]:

	Sales	Quantity	Discount	Profit
Sales	1.000000	0.243554	-0.079578	0.815014
Quantity	0.243554	1.000000	-0.030481	0.192574
Discount	-0.079578	-0.030481	1.000000	-0.181416
Profit	0.815014	0.192574	-0.181416	1.000000

13 Regional Analysis:

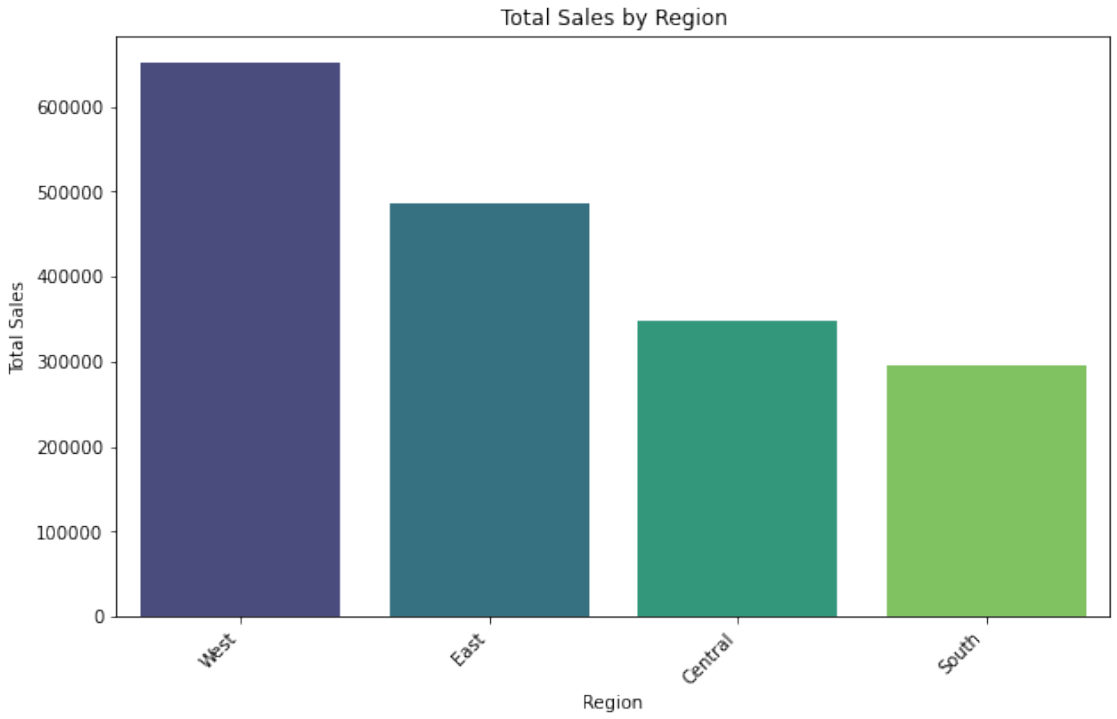
14 Explore regional variations in sales (e.g., by state or city).

[152]:
```
# Regional Analysis - Sales by State
plt.figure(figsize=(24, 8))
sns.barplot(x='State', y='Sales', data=df, ci=None)
plt.title('Sales by State')
plt.xlabel('State')
plt.ylabel('Total Sales')
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```



[153]:
```
region_sales = df.groupby('Region')['Sales'].sum().reset_index()
region_sales_sorted = region_sales.sort_values(by='Sales', ascending=False)
plt.figure(figsize=(10, 6))
sns.barplot(x='Region', y='Sales', data=region_sales_sorted, palette='viridis')
plt.title('Total Sales by Region')
plt.xlabel('Region')
plt.ylabel('Total Sales')
plt.xticks(rotation=45, ha='right')
```

```
plt.show()
```


Total Sales by Region
Total Sales
600000
500000
400000
300000
200000
100000
0
West
East
Central
South
Region

15 Identify factors contributing to sales differences across regions.

16 Exploring Sales Dynamics Across Regions

17 Total Sales by Region:

17.0.1 Analysis of total sales across different regions reveals that the West region boasts the highest cumulative sales figures, closely followed by the East, Central, and South regions.

18 Sales Breakdown by Region and Segment:

18.0.1 Delving deeper into sales segmentation across regions, it becomes evident that the Consumer segment consistently emerges as the primary contributor to sales figures across all regions. This is followed by the Corporate and Home Office segments, albeit with varying degrees of influence depending on the region.

19 Sales Analysis by Region and Category:

19.0.1 An insightful examination of sales performance by product category reveals that Furniture sales exhibit prominence across all regions, with particularly robust figures observed in the West and East regions.

19.0.2 Additionally, Office Supplies and Technology categories emerge as significant contributors to overall sales, displaying noteworthy traction across regions.

20 Monthly Sales Trends Across Regions:

20.0.1 A comprehensive review of monthly sales data uncovers nuanced variations in sales patterns across different regions, hinting at potential seasonal trends or divergent demand dynamics throughout the year.

20.0.2 For instance, the West region showcases a distinct surge in sales during December, suggesting heightened consumer activity aligned with the holiday season festivities.

21 Identifying Factors Driving Regional Sales Disparities:

21.0.1 Regional Economic Landscape and Consumer Preferences: Variances in regional economic conditions and consumer preferences play a pivotal role in shaping sales disparities. Factors such as income levels, employment rates, and cultural inclinations influence consumer spending patterns across regions.

21.0.2 Population Dynamics and Demographics: Population density, age distribution, and demographic composition contribute to regional sales disparities, with densely populated regions often exhibiting heightened consumer activity.

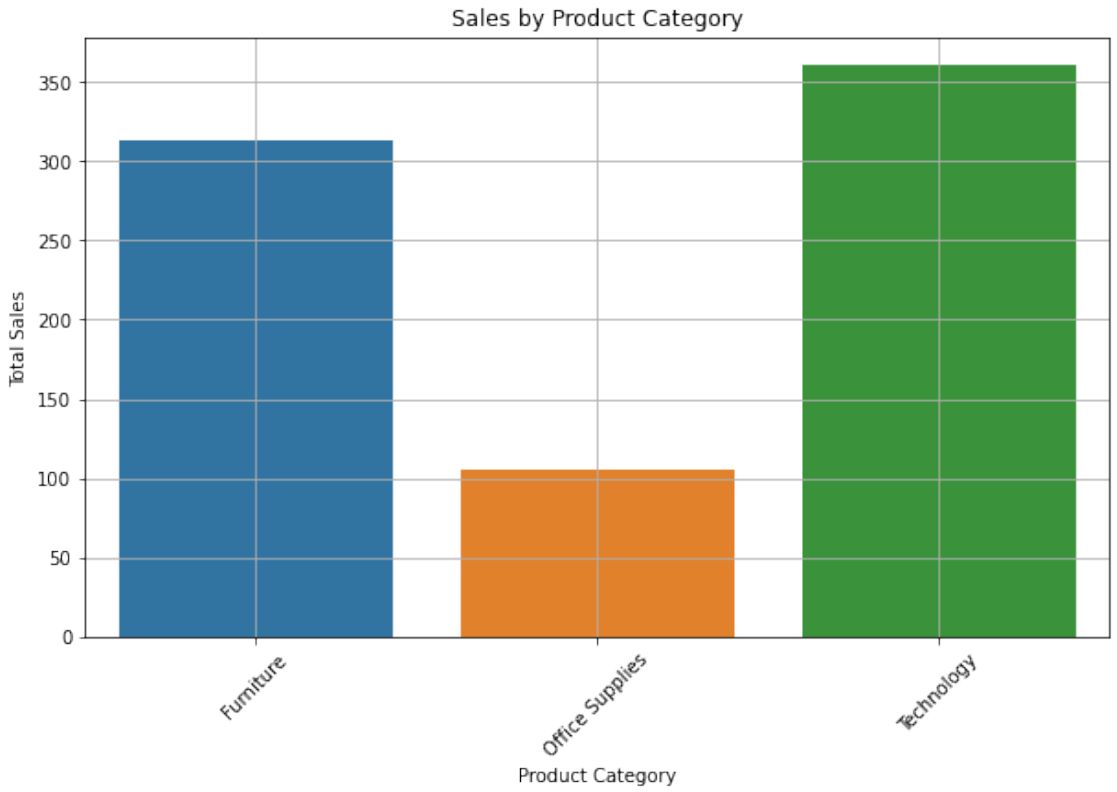
21.0.3 Tailored Marketing and Distribution Strategies: The efficacy of region-specific marketing campaigns and distribution strategies tailored to local preferences and needs significantly impacts sales performance across regions.

21.0.4 Seasonal Dynamics and Cultural Influences: Seasonal fluctuations and cultural events exert a profound influence on consumer behavior, leading to fluctuations in sales volumes across regions. Understanding and adapting to these seasonal dynamics are essential for optimizing regional sales strategies.

[154]:
```
monthly_sales = df.groupby(['order_year','order_month'])['Sales'].sum().
  ↪reset_index()
plt.figure(figsize=(12, 6))
sns.lineplot(x='order_month', y='Sales', hue='order_year', data=monthly_sales)
plt.title('Monthly Sales Over the Years')
plt.xlabel('Month')
plt.ylabel('Total Sales')
plt.legend(title='Year')
plt.grid(True)
plt.show()
```

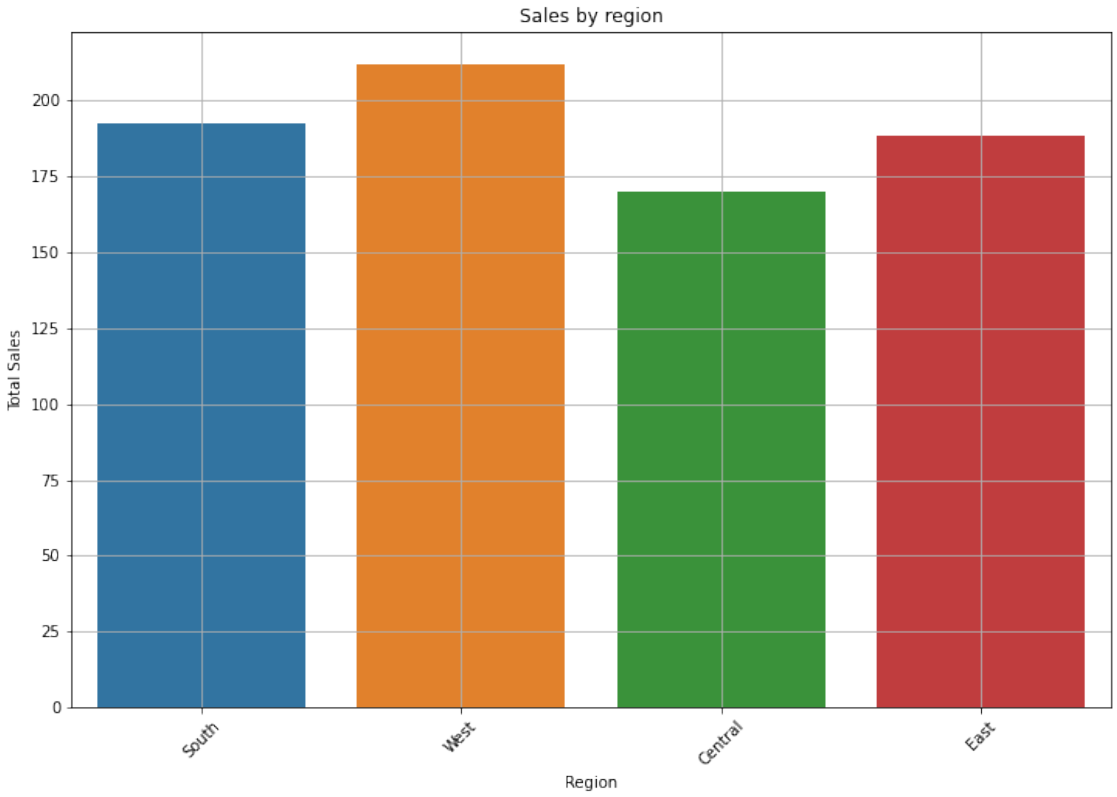
24 Create visualizations to represent product category insights

[155]:
```
plt.figure(figsize=(10, 6))
sns.barplot(x='Category', y='Sales', data=df, ci=None)
plt.title('Sales by Product Category')
plt.xlabel('Product Category')
plt.ylabel('Total Sales')
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```



25 Create visualizations to represent regional variations.

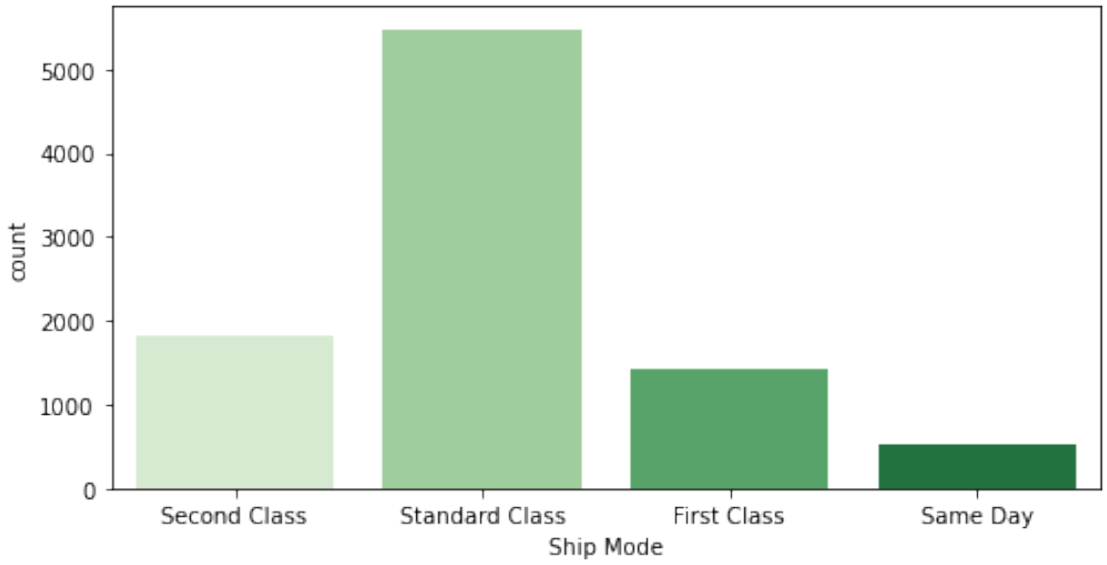
[156]:
```
plt.figure(figsize=(12, 8))
sns.barplot(x='Region', y='Sales', data=df, ci=None)
plt.title('Sales by region')
plt.xlabel('Region')
plt.ylabel('Total Sales')
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```

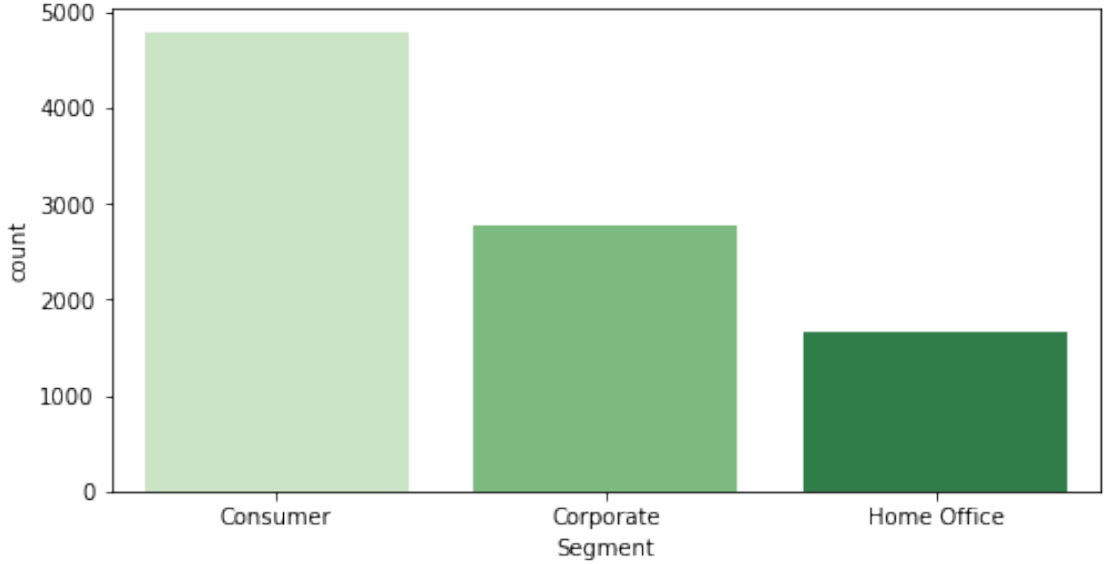


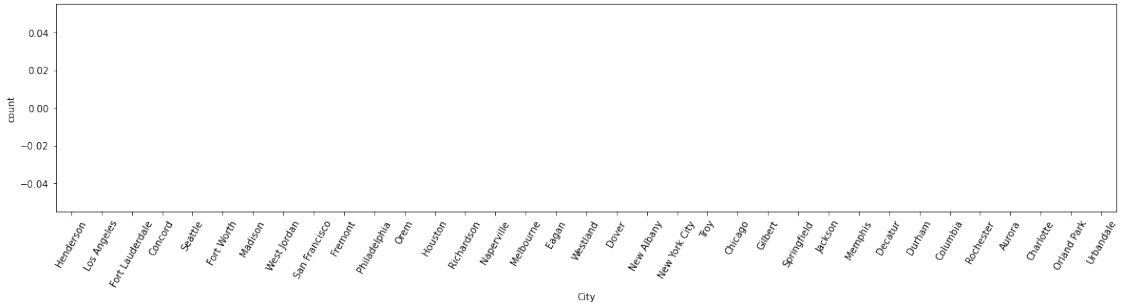
26 Use visualizations to communicate findings effectively.

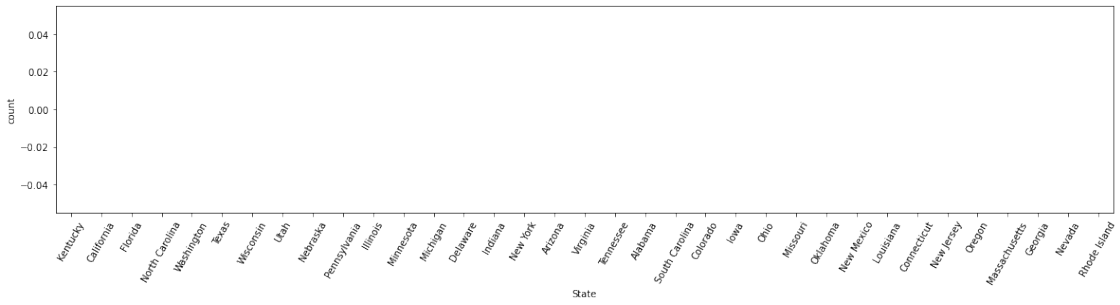
[157]:
```
imp_categotical_features=df[['Ship Mode','Segment','Region','Category']]

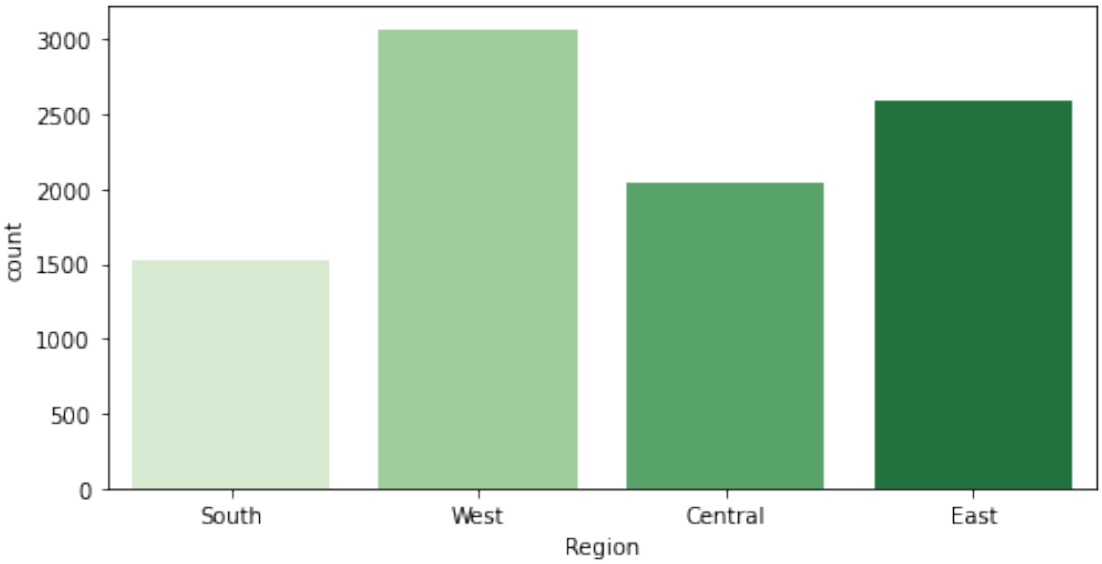
for col in imp_categotical_features:
    width=8
    n=len(df[col].unique())
    if n > 15:
        width=20
        plt.figure(figsize=(width,4))
        temp=pd.DataFrame(df[col].value_counts(), index=df[col].
 ↪unique(),columns=['count']).sort_values('count', ascending=False)[:35]
        sns.barplot(data=temp,x=temp.index,y='count',palette= 'Blues')
        plt.ylabel("count")
        plt.xlabel(col)
        plt.xticks(rotation=60)
    else:
        plt.figure(figsize=(width,4))
        sns.countplot(data=df,x=col,palette='Greens')
    plt.show()
```

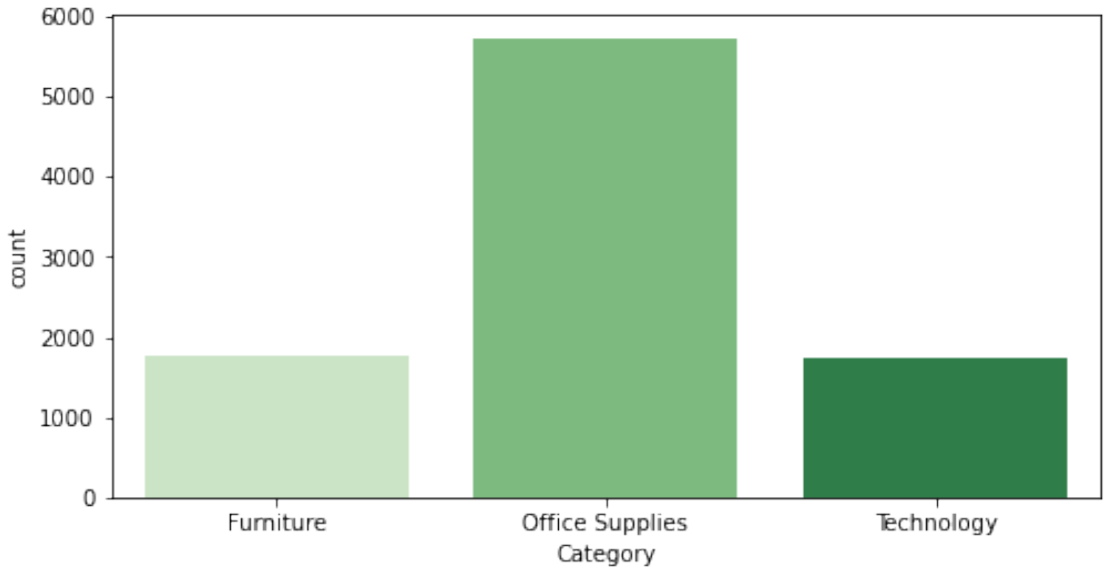

5000
4000
3000
2000
1000
0
count
Second Class
Standard Class
First Class
Same Day
Ship Mode

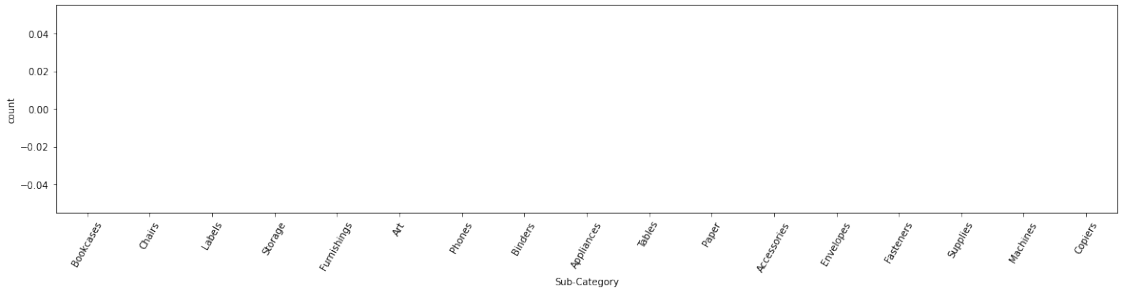

5000
4000
3000
2000
1000
0
count
Consumer
Corporate
Home Office
Segment


0.04
0.02
0.00
−0.02
−0.04
count
Henderson
Los Angeles
Fort Lauderdale
Concord
Seattle
Fort Worth
Madison
West Jordan
San Francisco
Fremont
Philadelphia
Orem
Houston
Richardson
Naperville
Melbourne
Eagan
Westland
Dover
New Albany
New York City
Troy
Chicago
Gilbert
Springfield
Jackson
Memphis
Decatur
Durham
Columbia
Rochester
Aurora
Charlotte
Orland Park
Urbandale
City


0.04
0.02
0.00
−0.02
−0.04
count
Kentucky
California
Florida
North Carolina
Washington
Texas
Wisconsin
Utah
Nebraska
Pennsylvania
Illinois
Minnesota
Michigan
Delaware
Indiana
New York
Arizona
Virginia
Tennessee
Alabama
South Carolina
Colorado
Iowa
Ohio
Missouri
Oklahoma
New Mexico
Louisiana
Connecticut
New Jersey
Oregon
Massachusetts
Georgia
Nevada
Rhode Island
State


3000
2500
2000
1500
1000
500
0
count
South
West
Central
East
Region





27 Scaling

[158]:
```
#Scaling all numeric columns for efficiency,performance,normalization etc
from sklearn.preprocessing import StandardScaler, MinMaxScaler,RobustScaler

numeric_features = ["Quantity","Discount","order_year", "order_month",␣
 ↪"order_date","Ship_year", "Ship_month", "Ship_date"]
RobustScaler = RobustScaler()
df[numeric_features] = RobustScaler.fit_transform(df[numeric_features])
```

28 One Hot Encoding(Nominal Data)

[159]:
```
#donce encoding to label data(machine can understand only numbers)
df=pd.get_dummies(data=df,columns=['Ship␣
 ↪Mode','Segment','City','State','Region','Category','Sub-Category','Country','Product␣
 ↪Name'])
df.columns
```

[159]:
```
Index(['Sales', 'Quantity', 'Discount', 'Profit', 'order_year', 'order_month',
       'order_date', 'Ship_year', 'Ship_month', 'Ship_date',
       …
       'Product Name_Zebra ZM400 Thermal Label Printer',
       'Product Name_Zebra Zazzle Fluorescent Highlighters',
       'Product Name_Zipper Ring Binder Pockets',
       'Product Name_i.Sound Portable Power - 8000 mAh',
       'Product Name_iHome FM Clock Radio with Lightning Dock',
       'Product Name_iKross Bluetooth Portable Keyboard + Cell Phone Stand
Holder + Brush for Apple iPhone 5S 5C 5, 4S 4',
       'Product Name_iOttie HLCRIO102 Car Mount',
       'Product Name_iOttie XL Car Mount',
       'Product Name_invisibleSHIELD by ZAGG Smudge-Free Screen Protector',
       'Product Name_netTALK DUO VoIP Telephone Service'],
      dtype='object', length=2440)
```

[160]:
```
# drop columns Preventing Multicollinearity
df.drop(columns=["Product Name_Bush Somerset Collection␣
 ↪Bookcase","City_Henderson","Ship Mode_First␣
 ↪Class","Segment_Consumer","State_Alabama","Region_Central","Category_Furniture","Sub-Catego
```

[161]:
```
df.sample(10) #random 5 samples
```

[161]:

	Sales	Quantity	Discount	Profit	order_year	order_month	\
8379	182.220	0.000000	0.0	45.5550	0.5	0.500000	
6929	227.460	1.000000	0.0	65.9634	0.5	-1.166667	
5207	49.120	0.333333	0.0	23.0864	0.0	0.500000	
2852	49.650	0.666667	0.0	20.8530	-1.0	-1.000000	
2039	23.680	-0.333333	1.0	8.8800	-1.0	0.333333	
37	113.328	1.666667	1.0	35.4150	-0.5	0.500000	
1005	99.990	-0.666667	0.0	37.9962	-1.0	-0.666667	
5227	27.920	0.333333	0.0	8.0968	0.5	-1.333333	
1780	31.320	1.666667	2.5	-25.0560	0.0	0.500000	
8283	40.480	-0.333333	0.0	17.4064	0.5	0.166667	

	order_date	Ship_year	Ship_month	Ship_date	Transformed_Profit	…	\
8379	-0.733333	0.5	0.500000	-0.3750	3.818920	…	
6929	-0.600000	0.5	-1.166667	-0.2500	4.189100	…	
5207	-0.200000	0.0	0.500000	0.1250	3.139244	…	

```
2852    1.000000       -1.0   -0.833333    -0.8125           3.037498  …
2039    0.533333       -1.0    0.333333     0.8125           2.183802  …
37      0.800000       -0.5    0.500000     0.9375           3.567135  …
1005    0.800000       -1.0   -0.500000    -0.9375           3.637486  …
5227    0.066667        0.5   -1.333333     0.0000           2.091469  …
1780    0.466667        0.0    0.500000     0.7500          -3.221113  …
8283   -0.200000        0.5    0.166667     0.0000           2.856838  …

      Product Name_Zebra GX420t Direct Thermal/Thermal Transfer Printer  \
8379                                                  0
6929                                                  0
5207                                                  0
2852                                                  0
2039                                                  0
37                                                    0
1005                                                  0
5227                                                  0
1780                                                  0
8283                                                  0

      Product Name_Zebra ZM400 Thermal Label Printer  \
8379                                               0
6929                                               0
5207                                               0
2852                                               0
2039                                               0
37                                                 0
1005                                               0
5227                                               0
1780                                               0
8283                                               0

      Product Name_Zebra Zazzle Fluorescent Highlighters  \
8379                                                  0
6929                                                  0
5207                                                  0
2852                                                  0
2039                                                  0
37                                                    0
1005                                                  0
5227                                                  0
1780                                                  0
8283                                                  0

      Product Name_Zipper Ring Binder Pockets  \
8379                                        0
6929                                        0
```

```
5207                                          0
2852                                          0
2039                                          0
37                                            0
1005                                          0
5227                                          0
1780                                          0
8283                                          0

      Product Name_i.Sound Portable Power - 8000 mAh  \
8379                                                0
6929                                                0
5207                                                0
2852                                                0
2039                                                0
37                                                  0
1005                                                0
5227                                                0
1780                                                0
8283                                                0

      Product Name_iHome FM Clock Radio with Lightning Dock  \
8379                                                    0
6929                                                    0
5207                                                    0
2852                                                    0
2039                                                    0
37                                                      0
1005                                                    0
5227                                                    0
1780                                                    0
8283                                                    0

      Product Name_iKross Bluetooth Portable Keyboard + Cell Phone Stand Holder
+ Brush for Apple iPhone 5S 5C 5, 4S 4  \
8379                                                    0
6929                                                    0
5207                                                    0
2852                                                    0
2039                                                    0
37                                                      0
1005                                                    0
5227                                                    0
1780                                                    0
8283                                                    0

      Product Name_iOttie HLCRIO102 Car Mount  \
```

```
8379                                        0
6929                                        0
5207                                        0
2852                                        0
2039                                        0
37                                          0
1005                                        0
5227                                        0
1780                                        0
8283                                        0

      Product Name_iOttie XL Car Mount  \
8379                                  0
6929                                  0
5207                                  0
2852                                  0
2039                                  0
37                                    0
1005                                  0
5227                                  0
1780                                  0
8283                                  0

      Product Name_invisibleSHIELD by ZAGG Smudge-Free Screen Protector  \
8379                                                                  0
6929                                                                  0
5207                                                                  0
2852                                                                  0
2039                                                                  0
37                                                                    0
1005                                                                  0
5227                                                                  0
1780                                                                  0
8283                                                                  0

      Product Name_netTALK DUO VoIP Telephone Service
8379                                                0
6929                                                0
5207                                                0
2852                                                0
2039                                                0
37                                                  0
1005                                                0
5227                                                0
1780                                                0
8283                                                0
```

```
[10 rows x 2432 columns]
```

[162]:
```
df.dtypes #datatypes of all columns
```

[162]:
```
Sales
float64
Quantity
float64
Discount
float64
Profit
float64
order_year
float64
                                                ...
Product Name_iKross Bluetooth Portable Keyboard + Cell Phone Stand Holder +
Brush for Apple iPhone 5S 5C 5, 4S 4      uint8
Product Name_iOttie HLCRIO102 Car Mount
uint8
Product Name_iOttie XL Car Mount
uint8
Product Name_invisibleSHIELD by ZAGG Smudge-Free Screen Protector
uint8
Product Name_netTALK DUO VoIP Telephone Service
uint8
Length: 2432, dtype: object
```

29 Spliting

[163]:
```
#Spliting the data into dependent variable(y) and independent variables(X)
X=df.drop(columns=["Profit","Sales","Transformed_Sales"],axis=1)
y=df["Transformed_Sales"]
```

[164]:
```
X
```

[164]:

	Quantity	Discount	order_year	order_month	order_date	Ship_year	\
0	-0.333333	0.0	0.0	0.333333	-0.466667	0.0	
1	0.000000	0.0	0.0	0.333333	-0.466667	0.0	
2	-0.333333	0.0	0.0	-0.500000	-0.200000	0.0	
4	-0.333333	1.0	-0.5	0.166667	-0.266667	-0.5	
5	1.333333	0.0	-1.0	-0.500000	-0.400000	-1.0	
…	…	…	…	…	…	…	
9867	0.333333	0.0	0.0	0.000000	-0.933333	0.0	
9868	-0.333333	0.0	0.0	0.000000	-0.933333	0.0	
9869	0.666667	0.0	0.0	0.000000	-0.933333	0.0	
9870	0.666667	1.0	0.5	0.333333	-0.266667	0.5	

```
9871  0.000000       0.0        -0.5     0.333333   -0.466667       -0.5

      Ship_month  Ship_date  Transformed_Profit  Ship Mode_Same Day  \
0       0.333333    -0.3125            3.735610                   0
1       0.333333    -0.3125            5.391726                   0
2      -0.500000     0.0000            1.927368                   0
4       0.166667     0.1250            0.922829                   0
5      -0.500000    -0.1250            2.651085                   0
…          …         …                  …                  …
9867    0.000000    -0.6875            2.671718                   0
9868    0.000000    -0.6875            1.095273                   0
9869    0.000000    -0.6875            2.539395                   0
9870    0.333333     0.0000            4.869751                   0
9871    0.333333    -0.1875            2.926414                   0

      Ship Mode_Second Class  …  \
0                          1  …
1                          1  …
2                          1  …
4                          0  …
5                          0  …
…                        …  …
9867                       0  …
9868                       0  …
9869                       0  …
9870                       1  …
9871                       1  …

      Product Name_Zebra GX420t Direct Thermal/Thermal Transfer Printer  \
0                                                     0
1                                                     0
2                                                     0
4                                                     0
5                                                     0
…                                                   …
9867                                                  0
9868                                                  0
9869                                                  0
9870                                                  0
9871                                                  0

      Product Name_Zebra ZM400 Thermal Label Printer  \
0                                                  0
1                                                  0
2                                                  0
4                                                  0
5                                                  0
```

```
…                                                    …
9867                                                     0
9868                                                     0
9869                                                     0
9870                                                     0
9871                                                     0

      Product Name_Zebra Zazzle Fluorescent Highlighters  \
0                                                        0
1                                                        0
2                                                        0
4                                                        0
5                                                        0
…                                                      …
9867                                                     0
9868                                                     0
9869                                                     0
9870                                                     0
9871                                                     0

      Product Name_Zipper Ring Binder Pockets  \
0                                           0
1                                           0
2                                           0
4                                           0
5                                           0
…                                         …
9867                                        0
9868                                        0
9869                                        0
9870                                        0
9871                                        0

      Product Name_i.Sound Portable Power - 8000 mAh  \
0                                                    0
1                                                    0
2                                                    0
4                                                    0
5                                                    0
…                                                  …
9867                                                 0
9868                                                 0
9869                                                 0
9870                                                 0
9871                                                 0

      Product Name_iHome FM Clock Radio with Lightning Dock  \
```

```
0                                                     0
1                                                     0
2                                                     0
4                                                     0
5                                                     0
…                                                   …
9867                                                  0
9868                                                  0
9869                                                  0
9870                                                  0
9871                                                  0

      Product Name_iKross Bluetooth Portable Keyboard + Cell Phone Stand Holder
+ Brush for Apple iPhone 5S 5C 5, 4S 4  \
0                                                     0
1                                                     0
2                                                     0
4                                                     0
5                                                     0
…                                                   …
9867                                                  0
9868                                                  0
9869                                                  0
9870                                                  0
9871                                                  0

      Product Name_iOttie HLCRIO102 Car Mount  \
0                                          0
1                                          0
2                                          0
4                                          0
5                                          0
…                                        …
9867                                       0
9868                                       0
9869                                       0
9870                                       0
9871                                       0

      Product Name_iOttie XL Car Mount  \
0                                    0
1                                    0
2                                    0
4                                    0
5                                    0
…                                  …
9867                                 0
```

```
9868                                    0
9869                                    0
9870                                    0
9871                                    0

      Product Name_invisibleSHIELD by ZAGG Smudge-Free Screen Protector  \
0                                                                     0
1                                                                     0
2                                                                     0
4                                                                     0
5                                                                     0
…                                                                   …
9867                                                                  0
9868                                                                  0
9869                                                                  0
9870                                                                  0
9871                                                                  0

      Product Name_netTALK DUO VoIP Telephone Service
0                                                   0
1                                                   0
2                                                   0
4                                                   0
5                                                   0
…                                                 …
9867                                                0
9868                                                0
9869                                                0
9870                                                0
9871                                                0

[9231 rows x 2429 columns]
```

30 Feature Selection

[165]:
```
best_features = SelectKBest(score_func=f_regression, k=10)
fit = best_features.fit(X, y)
```

```
C:\Users\ganesh\anaconda3\lib\site-
packages\sklearn\feature_selection\_univariate_selection.py:289: RuntimeWarning:
divide by zero encountered in true_divide
  correlation_coefficient /= X_norms
C:\Users\ganesh\anaconda3\lib\site-
packages\sklearn\feature_selection\_univariate_selection.py:358: RuntimeWarning:
invalid value encountered in true_divide
  f_statistic = corr_coef_squared / (1 - corr_coef_squared) * deg_of_freedom
```

[166]:
```
dfscores=pd.DataFrame(fit.scores_)
dfcolumns=pd.DataFrame(X.columns)
```

[167]:
```
featureScores=pd.concat([dfcolumns,dfscores],axis=1)
featureScores.columns=["Specs","Score"]
```

[168]:
```
featureScores
```

[168]:

	Specs	Score
0	Quantity	1108.203578
1	Discount	491.504260
2	order_year	0.029984
3	order_month	1.162049
4	order_date	0.044602
…	…	…
2424	Product Name_iKross Bluetooth Portable Keyboar…	0.207501
2425	Product Name_iOttie HLCRIO102 Car Mount	0.609101
2426	Product Name_iOttie XL Car Mount	0.354925
2427	Product Name_invisibleSHIELD by ZAGG Smudge-Fr…	0.017594
2428	Product Name_netTALK DUO VoIP Telephone Service	2.372775

[2429 rows x 2 columns]

[169]:
```
print(featureScores.nlargest(55,"Score"))
```

	Specs	Score
8	Transformed_Profit	5061.240835
589	Category_Office Supplies	2307.897944
0	Quantity	1108.203578
590	Category_Technology	1026.866451
595	Sub-Category_Chairs	784.610347
593	Sub-Category_Binders	669.970751
603	Sub-Category_Phones	526.775250
1	Discount	491.504260
592	Sub-Category_Art	449.609784
606	Sub-Category_Tables	263.951495
598	Sub-Category_Fasteners	248.071964
594	Sub-Category_Bookcases	221.948901
596	Sub-Category_Copiers	203.365874
600	Sub-Category_Labels	201.657948
604	Sub-Category_Storage	186.114097
602	Sub-Category_Paper	185.667940
601	Sub-Category_Machines	152.133133
578	State_Texas	105.131382
573	State_Pennsylvania	62.265101
381	City_Philadelphia	57.783160
548	State_Illinois	51.301009

```
591                              Sub-Category_Appliances    49.581887
588                                          Region_West    43.703354
540                                     State_California    42.470469
92                                          City_Chicago    39.925238
2210  Product Name_Wilson Jones Easy Flow II Sheet L…    39.046504
1243  Product Name_Fellowes PB500 Electric Punch Pla…    38.661972
218                                         City_Houston    37.970459
2081                              Product Name_Staples    35.995389
1945             Product Name_SAFCO Arco Folding Chair    35.892068
1279  Product Name_GBC DocuBind TL300 Electric Bindi…    35.437552
570                                          State_Ohio    35.106957
1395  Product Name_Hewlett Packard LaserJet 3310 Copier    32.785323
1360  Product Name_Global Troy Executive Leather Low…    32.779995
2130  Product Name_Tennsco 6- and 18-Compartment Loc…    32.463255
1427  Product Name_Hon Deluxe Fabric Upholstered Sta…    32.005188
1447  Product Name_Honeywell Enviracaire Portable HE…    30.940444
1852  Product Name_Plantronics CS510 - Over-the-Head…    30.419267
867               Product Name_Avery Non-Stick Binders    30.276044
2421           Product Name_Zipper Ring Binder Pockets    29.927885
1970              Product Name_Samsung Galaxy Mega 6.3    29.919507
1377  Product Name_HON 5400 Series Task Chairs for B…    29.040657
605                              Sub-Category_Supplies    27.857567
1611   Product Name_Logitech P710e Mobile Speakerphone    27.245337
1859  Product Name_Plantronics Savi W720 Multi-Devic…    26.991260
874   Product Name_Avery Reinforcements for Hole-Pun…    26.177325
1394  Product Name_Hewlett Packard 610 Color Digital…    25.964879
1376  Product Name_GuestStacker Chair with Chrome Fi…    25.746257
720     Product Name_Adjustable Depth Letter/Legal Cart    25.739577
1460       Product Name_Hot File 7-Pocket, Floor Stand    25.221180
689   Product Name_Acco Suede Grain Vinyl Round Ring…    24.974089
844                 Product Name_Avery Durable Binders    24.892038
1795  Product Name_Office Star - Professional Matrix…    24.598514
1335  Product Name_Global Deluxe High-Back Manager's…    24.473559
1867            Product Name_Poly String Tie Envelopes    24.317337
```

31 Data Spliting

[170]:
```
#spliting the data into train and test
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
 ↪random_state=42)
```

32 Training Model

[171]:
```
#Training model on RandomForestRegressor

model = RandomForestRegressor(random_state=42)
# Train the model
model.fit(X_train, y_train)

# Make predictions
y_pred = model.predict(X_test)

# Calculate evaluation metrics
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

# Print evaluation metrics
print("Mean Squared Error:", mse)
print("R-squared:", r2)
```

```
Mean Squared Error: 0.14796312980709456
R-squared: 0.9434364088363466
```

[172]:
```
#Training model on KNeighborsRegressor

modelk = KNeighborsRegressor()

#model fit and train
modelk.fit(X_train, y_train)

# Make predictions
y_pred = modelk.predict(X_test)

# Calculate evaluation metrics
msek = mean_squared_error(y_test, y_pred)
r2k = r2_score(y_test, y_pred)

# Print evaluation metrics
print("Mean Squared Error:", msek)
print("R-squared:", r2k)
```

```
Mean Squared Error: 0.4503792650396285
R-squared: 0.8278282660720876
```

[173]:
```
#Training model on MLPRegressor

model = MLPRegressor(random_state=42)
```

```
#model fit and train
model.fit(X_train, y_train)

# Make predictions
y_pred = model.predict(X_test)

# Calculate evaluation metrics
msem = mean_squared_error(y_test, y_pred)
r2m = r2_score(y_test, y_pred)
mae = mean_absolute_error(y_test, y_pred)
rms=np.sqrt(mse)

print("R-squared:", r2m)
```

```
R-squared: 0.9836333726161193
```

33 Evaluate the model's performance using appropriate metrics for MLPRegressor

[174]:
```
print("rmse :",rms)
print("Mean Squared Error:", msem)
print("R-squared:", r2m)
print("Mean Absolute Error:", mae)
```

```
rmse : 0.38465975849716144
Mean Squared Error: 0.042813006782030524
R-squared: 0.9836333726161193
Mean Absolute Error: 0.12647042964582925
```

34 Model Prediction

[175]:
```
#model Prediction
ll=model.predict(X_test)
ll[:20]
```

[175]:
```
array([2.91184998, 8.43196963, 5.01888031, 7.34349144, 4.04138845,
       4.10060321, 3.11776551, 2.93605332, 5.70730388, 5.83653792,
       2.48335608, 2.40176275, 3.56379378, 3.37635933, 4.44597523,
       3.35233614, 5.99622523, 4.62667132, 3.18045318, 4.78959973])
```

[176]:
```
#Actual Data
y_test[:20]
```

[176]:
```
1263    2.874242
1111    7.716229
9861    5.042780
```

```
977     7.144825
9090    4.065945
1998    4.051855
82      3.062924
4883    2.967333
678     5.691609
7696    5.727291
8996    2.329422
9020    2.474856
6219    3.540959
6609    3.395850
3717    4.472781
9780    3.108436
2274    5.966070
52      4.499699
6624    3.726946
3502    4.663250
Name: Transformed_Sales, dtype: float64
```

[177]:
```
dfpre = pd.DataFrame({'y_pred': ll, 'y_test': y_test})
dfpre.head(30)
```

[177]:

	y_pred	y_test
1263	2.911850	2.874242
1111	8.431970	7.716229
9861	5.018880	5.042780
977	7.343491	7.144825
9090	4.041388	4.065945
1998	4.100603	4.051855
82	3.117766	3.062924
4883	2.936053	2.967333
678	5.707304	5.691609
7696	5.836538	5.727291
8996	2.483356	2.329422
9020	2.401763	2.474856
6219	3.563794	3.540959
6609	3.376359	3.395850
3717	4.445975	4.472781
9780	3.352336	3.108436
2274	5.996225	5.966070
52	4.626671	4.499699
6624	3.180453	3.726946
3502	4.789600	4.663250
6010	2.537331	2.501518
7490	5.472728	5.529207
1741	3.655699	3.497719
7297	3.136132	3.061520

```
7446  2.259446  2.232163
4960  3.820677  3.866816
5118  5.644951  5.710295
1515  3.613258  3.565355
3928  2.841434  2.601207
4994  4.931324  5.297497
```

[178]:
```
#back transformation on predicted data
count=0
a=[]
for i in ll:
    if count == 1847:
        break
    else:
        print(round(np.exp(i),2))
        a.append(round(np.exp(i),2))
        count += 1
```

```
18.39
4591.53
151.24
1546.1
56.91
60.38
22.6
18.84
301.06
342.59
11.98
11.04
35.3
29.26
85.28
28.57
401.91
102.17
24.06
120.25
12.65
238.11
38.69
23.01
9.58
45.64
282.86
37.09
17.14
```

138.56
87.65
7.03
61.31
184.53
19.06
9.3
20.92
46.99
34.31
7.08
39.76
1699.09
552.45
71.66
18.72
52.74
19.22
12.22
1054.54
270.43
18.27
6.11
81.85
42.19
54.92
14.23
9.8
61.96
57.62
43.3
1213.88
189.15
345.21
217.26
35.85
15.18
1083.33
168.02
14.85
8.69
24.85
56.2
91.78
3.44
14.61
98.36
322.04

2.46
43.98
119.53
12.22
2.49
7.95
148.23
63.72
7.53
49.97
63.01
18.47
43.17
687.87
132.2
172.78
507.98
574.43
10.15
82.07
10.38
1612.02
12.49
19.15
60.59
20.8
146.34
16.05
5.01
12.89
64.08
9.51
27.45
12.07
42.51
12.08
72.93
20.06
6.02
10.37
20.58
13.52
10.42
352.81
10.7
41.56
21.75
5.41

21.33
14.6
818.78
227.48
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268.23

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204.95
505.91
81.35
13.12
723.7
19.97
2.56
664.02
317.27
48.24
73.12
76.62
```

[179]:
```
#back transformation on test data
count=0
b=[]
for i in y_test:
```

```
    if count == 1847:
        break
    else:
        print(round(np.exp(i),2))
        b.append(round(np.exp(i),2))
        count += 1
```

```
17.71
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154.9
1267.53
58.32
57.5
21.39
19.44
296.37
307.14
10.27
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10.37
586.4
57.4
6.48
323.98
26.16
436.0
906.68
27.89
15.96
108.96
38.52
35.56
74.35
87.92
354.9
43.58
4.62
12.96
21.86
408.74
2548.56
98.38
8.7
166.44
5.48
378.0
3.75
469.99

19.75
833.94
13.13
13.48
32.4
86.35
116.31
92.96
29.9
481.32
599.29
29.8
12.96
19.8
49.12
33.09
8.9
265.86
127.88
10.27
244.55
100.49
13.22
350.98
40.78
23.12
70.88
61.96
18.84
52.51
4.93
272.65
286.79
3.2
9.42
11.68
93.15
48.82
430.88
208.16
38.88
35.28
11.96
18.84
104.85
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150.41
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19.83
51.75
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508.7
102.13
10.86
148.7
11.96
42.38
60.89
387.14
46.8
47.82
563.81
185.38
614.27
8.28
122.94
12.96
22.75
361.76
42.76
10.37
264.18
85.52
21.98
6.63
106.5
270.72
13.27
7.5
261.96
45.98
36.88
599.97
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16.18
1059.12
44.38
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826.11
26.4
333.0
15.0
842.72
37.41
106.32

1454.9
21.44
7.99
4.26
104.9
13.98
686.32
176.8
122.97
205.33
9.35
754.45
84.78
103.92
1454.49
35.17
41.47
7.04
142.78
179.97
241.96
117.46
424.12
561.58
2.96
4.28
31.68
595.38
46.24
13.9
35.49
25.16
239.67
12.96
22.96
7.58
20.7
8.64
21.98
11.76
15.55
144.12
5.55
863.64
5.18
301.96
8.45
15.96

368.91
11.34
20.04
64.96
10.08
271.76
9.3
6.26
314.35
19.04
5.18
94.2
189.0
21.56
5.47
42.85
6.73
145.57
118.0
279.86
601.54
824.97
89.95
155.88
212.94
9.52
27.42
15.75
5.18
13.39
51.84
20.74
17.14
209.79
59.97
205.67
31.1
11.76
24.64
8.32
8.86
7.04
4.73
14.73
362.94
307.98
61.96
19.44

3991.98
206.1
1.87
372.14
844.12
15.88
38.88
50.94
37.31
15.55
300.93
76.12
201.58
88.8
89.97
44.67
12.42
57.59
52.4
48.66
17.04
5.23
11.76
155.37
101.99
41.94
81.42
143.96
5.46
9.96
119.83
9.14
526.45
572.76
42.6
26.49
38.88
959.98
221.06
87.84
206.0
4.96
60.64
58.05
26.35
160.0
491.55
32.45

64.4
11.07
383.96
895.92
23.74
21.56
160.72
801.96
53.57
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342.37
19.99
3.01
59.76
549.99
55.62
30.69
63.97
1415.76
167.84
13.9
45.36
4.98
31.44
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52.51
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6.56
64.96
18.09
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40.18
212.94
61.93
801.57
299.97
63.96
129.3
917.92
46.86
114.52
32.9
72.78
154.9
28.85
15.26
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31.92
4.3
166.5
755.96
3.48
10.37
556.66
24.45
89.58
10.76
11.16
41.4
38.43
3.65
703.97
1591.02
194.53
159.98
211.96
209.57
636.86
89.97
15.55
909.12
19.46
1.19
523.26
298.12
49.12
78.35
79.96
```

[180]:
```
mse=mean_squared_error(b,a)
rms=np.sqrt(mse)
print("mse :",mse)
print("rms :",rms)
```

```
mse : 16339.518886085545
rms : 127.82612755648019
```

[181]:
```
dfpred = pd.DataFrame({'y_preds': a, 'y_tests': b})
dfpred.sample(30)
```

[181]:

	y_preds	y_tests
795	176.69	218.35
1407	160.63	148.48
470	7.85	8.26

```
643   1639.14  1499.95
1260    94.66    98.16
1731    71.86    76.12
1381    52.09    55.98
1679     6.19     6.26
81       2.49     1.34
79     119.53   107.44
1215     9.08    11.52
586    212.51   207.00
1236   432.77   377.97
827    198.62   196.75
1458    10.64    10.69
1332   210.78   225.30
1492    44.33    45.98
428      2.74     1.68
1558     5.47     4.93
713      7.31     7.30
417    359.00   359.50
1499    10.25    10.37
1041     9.35     9.82
476     31.96    33.40
17     102.17    89.99
1438     2.36     2.51
125     21.33    18.84
336    264.10   271.90
899    159.43   220.98
133      2.36     1.64
```

[182]:
```
mae = mean_absolute_error(b,a)
mae
```

[182]:
```
29.550157011369787
```

[183]:
```
for i in y_pred:
    if round(np.exp(i),2)<0:
        print(round(np.exp(i),2))
```

35 Giving a summary over interpretation of data and Suggesting pros and cons of methods used.

36 Interpretation of Data:

36.1 Handling Missing Values and Errors:

36.1.1 The identification and handling of missing values and errors are crucial steps in ensuring the reliability and accuracy of the analysis. By applying appropriate imputation techniques and dropping remaining missing values, the integrity of the dataset is preserved.

36.1.2 Understanding the nature and distribution of missing values can provide insights into data collection processes and potential areas for improvement in data collection protocols.

36.2 Transformation for Outliers:

36.2.1 Outliers can significantly influence model performance and may distort the results of statistical analyses. By applying transformations to 'profit' and 'sales' columns, the impact of outliers is mitigated, leading to more robust and reliable results.

36.2.2 Exploring various outlier trimming techniques allows for a comprehensive understanding of the data distribution and the identification of potential anomalies that may require further investigation.

36.3 Modeling Approach:

36.3.1 Recognizing the limitations of linear models for complex data structures highlights the importance of selecting appropriate modeling techniques that can capture nonlinear relationships and interactions among variables.

36.3.2 The application of feature selection techniques enhances model interpretability by identifying the most influential predictors of sales. This allows for more focused analysis and facilitates actionable insights for decision-makers.

36.3.3 While achieving a high accuracy of 98% using MLPRegressor is commendable, it's essential to consider the trade-offs between model complexity, computational resources, and interpretability when selecting modeling approaches.

36.4 Data Quality Assessment:

36.4.1 Conducting a comprehensive assessment of data quality, including identifying and addressing missing values, errors, and outliers, demonstrates a commitment to ensuring the reliability and validity of the analysis results.

36.4.2 Documenting the data preprocessing steps undertaken provides transparency and reproducibility, enabling others to replicate the analysis and validate the findings.

36.5 Continuous Improvement:

36.5.1 The process of data analysis is iterative, and there is always room for improvement. Regularly reviewing and refining data preprocessing techniques, modeling approaches, and interpretation methods can lead to more accurate and actionable insights over time.

36.5.2 Soliciting feedback from stakeholders and incorporating domain knowledge can further enhance the quality and relevance of the analysis results.

[ ]: