Data Analysis with different case studies

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1 Case Study 1:

1.1 Sales Analysis with pandas

OBJECTIVE • What is the overall sales trend?

- Sales by Category?
- Sales by Sub-Category?
- Profit Analysis
- Profit analysis by customer segments:
- Which are the Top 10 products by sales?
- Which are the Most Selling Products?
- Which is the most preferred Ship Mode?
- Which are the Most Profitable Category and Sub-Category?

[144]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
```

[145]:
```
import plotly.express as px
import plotly.graph_objects as go
import plotly.io as pio
import plotly.colors as colors
```

[146]:
```
df=pd.read_excel('superstore_sales.xlsx')
```

[5]:
```
df.head()
```

[5]:
```
          order_id order_date  ship_date       ship_mode    customer_name  \
0     AG-2011-2040 2011-01-01 2011-01-06  Standard Class  Toby Braunhardt
1    IN-2011-47883 2011-01-01 2011-01-08  Standard Class      Joseph Holt
2     HU-2011-1220 2011-01-01 2011-01-05    Second Class    Annie Thurman
```

```
3  IT-2011-3647632 2011-01-01 2011-01-05    Second Class     Eugene Moren
4    IN-2011-47883 2011-01-01 2011-01-08  Standard Class      Joseph Holt

       segment            state    country  market   region  …  \
0     Consumer      Constantine    Algeria  Africa   Africa  …
1     Consumer  New South Wales  Australia    APAC  Oceania  …
2     Consumer         Budapest    Hungary    EMEA     EMEA  …
3  Home Office        Stockholm     Sweden      EU    North  …
4     Consumer  New South Wales  Australia    APAC  Oceania  …

         category sub_category                 product_name    sales  \
0  Office Supplies      Storage          Tenex Lockers, Blue  408.300
1  Office Supplies     Supplies     Acme Trimmer, High Speed  120.366
2  Office Supplies      Storage      Tenex Box, Single Width   66.120
3  Office Supplies        Paper  Enermax Note Cards, Premium   44.865
4        Furniture  Furnishings   Eldon Light Bulb, Duo Pack  113.670

   quantity  discount   profit  shipping_cost  order_priority  year
0         2       0.0  106.140          35.46          Medium  2011
1         3       0.1   36.036           9.72          Medium  2011
2         4       0.0   29.640           8.17            High  2011
3         3       0.5  -26.055           4.82            High  2011
4         5       0.1   37.770           4.70          Medium  2011

[5 rows x 21 columns]
```

[7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 51290 entries, 0 to 51289
Data columns (total 21 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   order_id        51290 non-null  object
 1   order_date      51290 non-null  datetime64[ns]
 2   ship_date       51290 non-null  datetime64[ns]
 3   ship_mode       51290 non-null  object
 4   customer_name   51290 non-null  object
 5   segment         51290 non-null  object
 6   state           51290 non-null  object
 7   country         51290 non-null  object
 8   market          51290 non-null  object
 9   region          51290 non-null  object
 10  product_id      51290 non-null  object
 11  category        51290 non-null  object
 12  sub_category    51290 non-null  object
 13  product_name    51290 non-null  object
 14  sales           51290 non-null  float64
 15  quantity        51290 non-null  int64
 16  discount        51290 non-null  float64
 17  profit          51290 non-null  float64
 18  shipping_cost   51290 non-null  float64
 19  order_priority  51290 non-null  object
 20  year            51290 non-null  int64
dtypes: datetime64[ns](2), float64(4), int64(2), object(13)
memory usage: 8.2+ MB
```

[9]:
```
df.shape
```

[9]:
```
(51290, 21)
```

[10]:
```
#checking that is there any missing values
df.isnull().sum()
```

[10]:
```
order_id          0
order_date        0
ship_date         0
ship_mode         0
customer_name     0
segment           0
state             0
country           0
market            0
region            0
product_id        0
category          0
sub_category      0
product_name      0
sales             0
quantity          0
discount          0
profit            0
shipping_cost     0
order_priority    0
year              0
dtype: int64
```

[12]:
```
df.describe().round()
```

[12]:
```
                          order_date                      ship_date    sales  \
count                          51290                          51290  51290.0
mean   2013-05-11 21:26:49.155780864  2013-05-15 20:42:42.745174528    246.0
min              2011-01-01 00:00:00            2011-01-03 00:00:00      0.0
25%              2012-06-19 00:00:00            2012-06-23 00:00:00     31.0
50%              2013-07-08 00:00:00            2013-07-12 00:00:00     85.0
75%              2014-05-22 00:00:00            2014-05-26 00:00:00    251.0
```

```
max               2014-12-31 00:00:00           2015-01-07 00:00:00  22638.0
std                                NaN                           NaN    488.0

       quantity  discount   profit  shipping_cost     year
count   51290.0   51290.0  51290.0        51290.0  51290.0
mean        3.0       0.0     29.0           26.0   2013.0
min         1.0       0.0  -6600.0            0.0   2011.0
25%         2.0       0.0      0.0            3.0   2012.0
50%         3.0       0.0      9.0            8.0   2013.0
75%         5.0       0.0     37.0           24.0   2014.0
max        14.0       1.0   8400.0          934.0   2014.0
std         2.0       0.0    174.0           57.0      1.0
```

[13]:
```
df['order_date']=pd.to_datetime(df['order_date'])
```

[17]:
```
df['month year']=df['order_date'].dt.strftime('%Y-%m')
```

[18]:
```
df['month year']
```

[18]:
```
0        2011-01
1        2011-01
2        2011-01
3        2011-01
4        2011-01
           …
51285    2014-12
51286    2014-12
51287    2014-12
51288    2014-12
51289    2014-12
Name: month year, Length: 51290, dtype: object
```

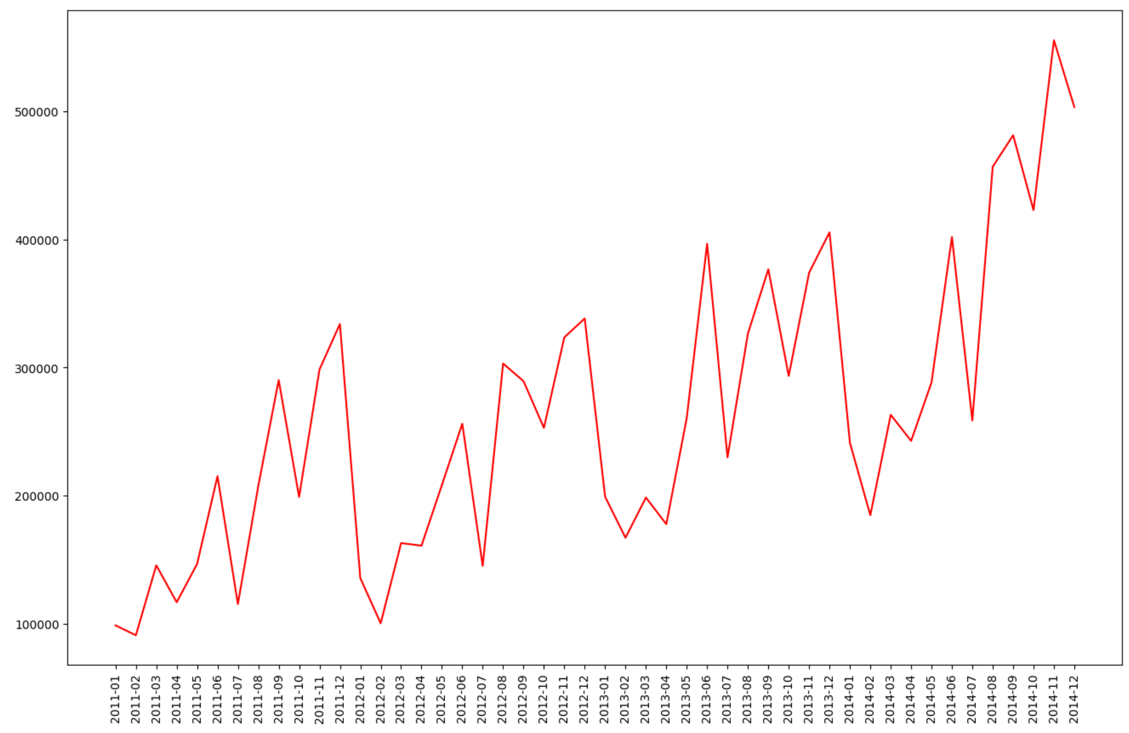
[20]:
```
df_temp=df.groupby('month year')['sales'].sum().reset_index()
```

[21]:
```
df_temp
```

[21]:
```
   month year          sales
0     2011-01    98898.48886
1     2011-02    91152.15698
2     2011-03   145729.36736
3     2011-04   116915.76418
4     2011-05   146747.83610
5     2011-06   215207.38022
6     2011-07   115510.41912
7     2011-08   207581.49122
8     2011-09   290214.45534
9     2011-10   199071.26404
```

```
10    2011-11  298496.53752
11    2011-12  333925.73460
12    2012-01  135780.72024
13    2012-02  100510.21698
14    2012-03  163076.77116
15    2012-04  161052.26952
16    2012-05  208364.89124
17    2012-06  256175.69842
18    2012-07  145236.78512
19    2012-08  303142.94238
20    2012-09  289389.16564
21    2012-10  252939.85020
22    2012-11  323512.41690
23    2012-12  338256.96660
24    2013-01  199185.90738
25    2013-02  167239.65040
26    2013-03  198594.03012
27    2013-04  177821.31684
28    2013-05  260498.56470
29    2013-06  396519.61190
30    2013-07  229928.95200
31    2013-08  326488.78936
32    2013-09  376619.24568
33    2013-10  293406.64288
34    2013-11  373989.36010
35    2013-12  405454.37802
36    2014-01  241268.55566
37    2014-02  184837.35556
38    2014-03  263100.77262
39    2014-04  242771.86130
40    2014-05  288401.04614
41    2014-06  401814.06310
42    2014-07  258705.68048
43    2014-08  456619.94236
44    2014-09  481157.24370
45    2014-10  422766.62916
46    2014-11  555279.02700
47    2014-12  503143.69348
```

[28]:
```
plt.figure(figsize=(16,10))
plt.plot(df_temp['month year'],df_temp['sales'],color='red')
plt.xticks(rotation='vertical',size=10)
plt.show()
```



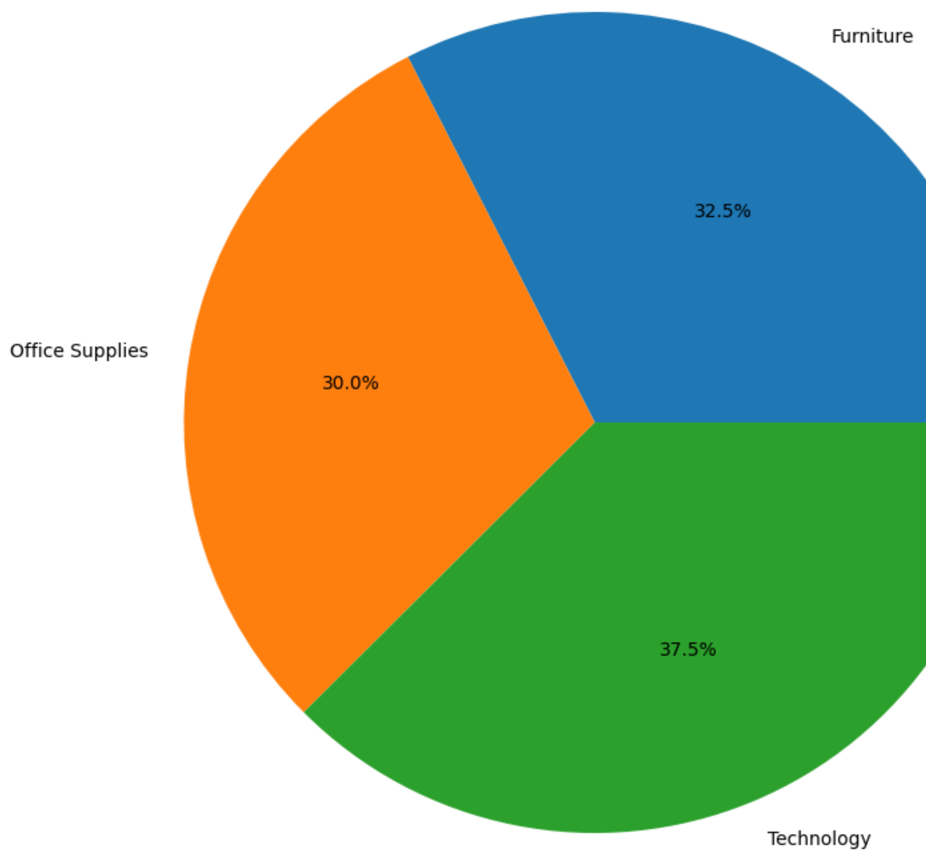
1.2 sales by category

[32]:
```
sales_by_category=df.groupby('category')['sales'].sum().reset_index()
```

[33]:
```
sales_by_category
```

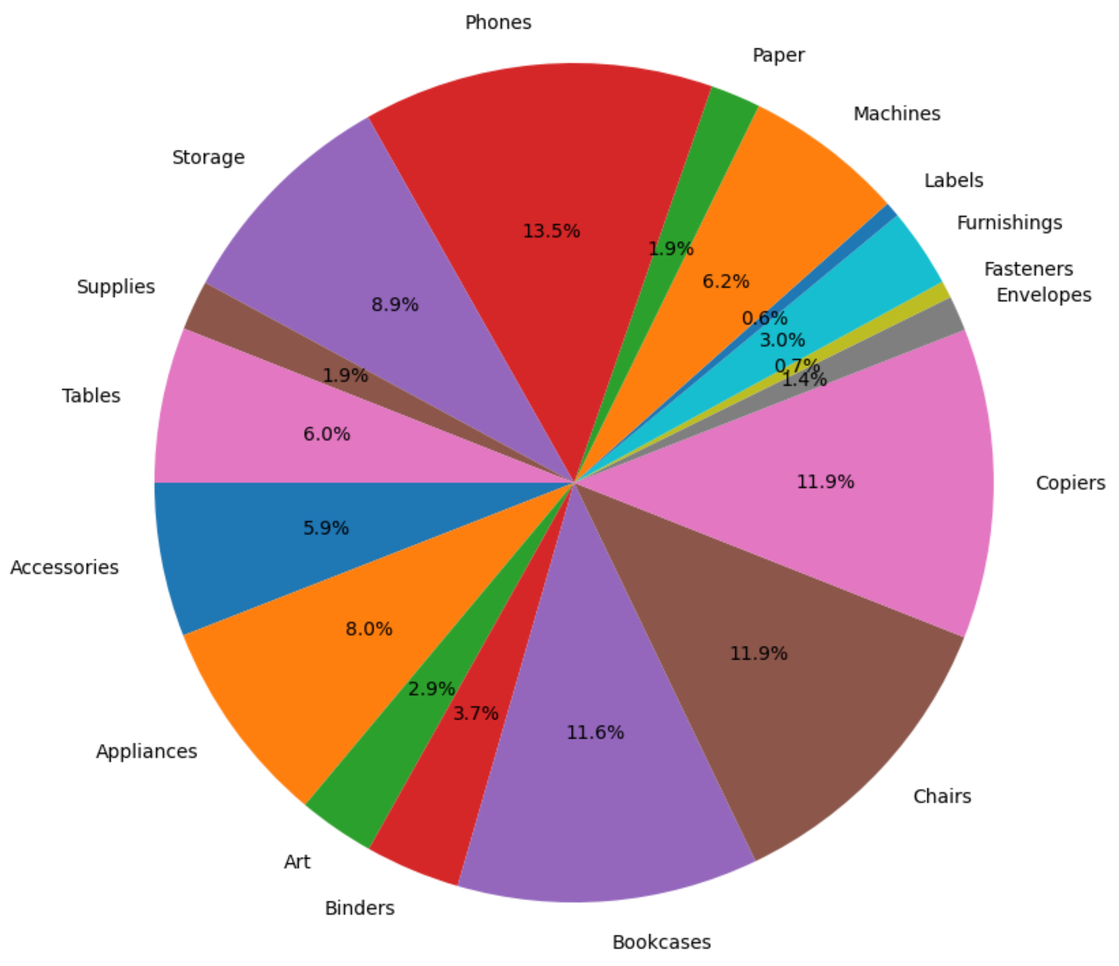
[33]:
```
          category         sales
0        Furniture  4.110874e+06
1  Office Supplies  3.787070e+06
2       Technology  4.744557e+06
```

[42]:
```
plt.figure(figsize=(20,10))
plt.
 ↪pie(sales_by_category['sales'],labels=sales_by_category['category'],autopct='%1.
 ↪1f%%')
plt.show()
```

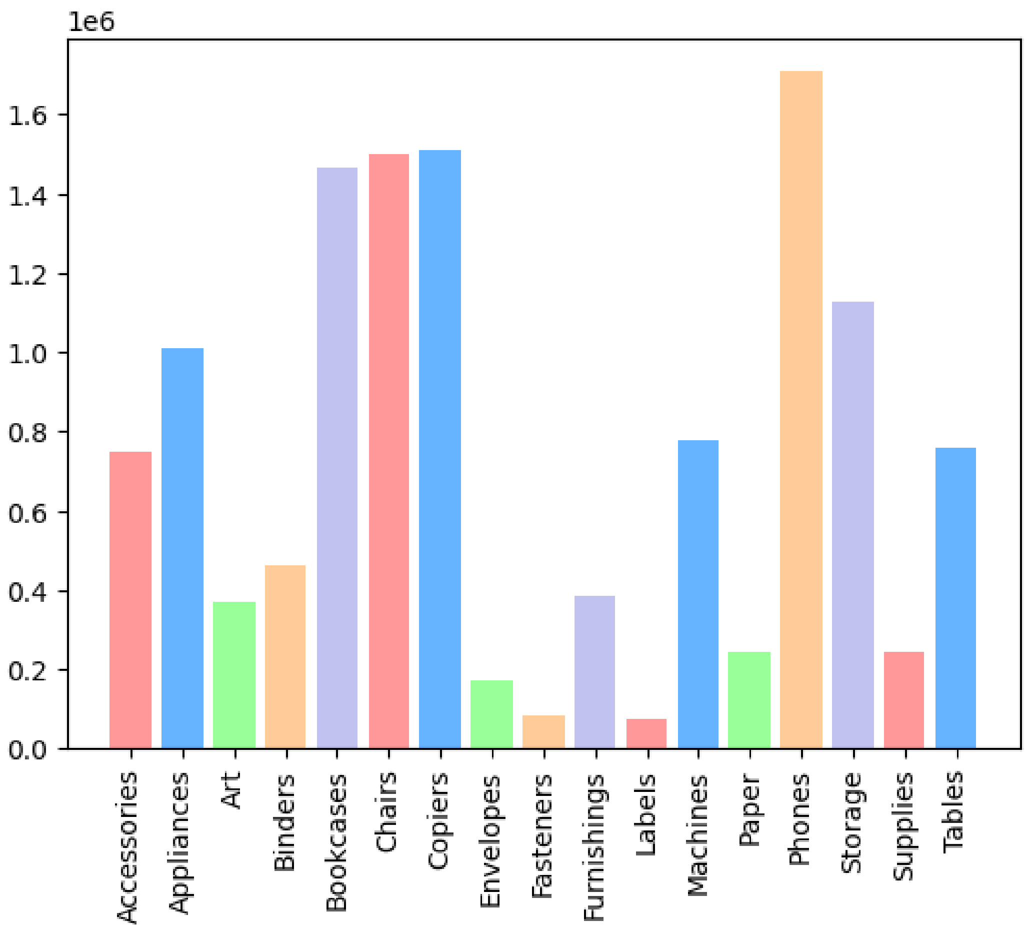


```
[45]: sales_by_subcategory=df.groupby('sub_category')['sales'].sum().reset_index()
```

```
[48]: plt.figure(figsize=(20,10))
      plt.pie(sales_by_subcategory['sales'],
              labels=sales_by_subcategory['sub_category'],
             autopct='%1.1f%%',startangle=180)
      plt.show()
```



[86]:
```
colors = ['#ff9999','#66b3ff','#99ff99','#ffcc99','#c2c2f0']
plt.
 ↪bar(sales_by_subcategory['sub_category'],sales_by_subcategory['sales'],color=colors)
plt.title=('Sales analysis on sub category')
plt.xticks(rotation='vertical')
plt.show()
```



1.3 Monthly Profits

[70]:
```
df.columns
```

[70]:
```
Index(['order_id', 'order_date', 'ship_date', 'ship_mode', 'customer_name',
       'segment', 'state', 'country', 'market', 'region', 'product_id',
       'category', 'sub_category', 'product_name', 'sales', 'quantity',
       'discount', 'profit', 'shipping_cost', 'order_priority', 'year',
       'month year'],
      dtype='object')
```

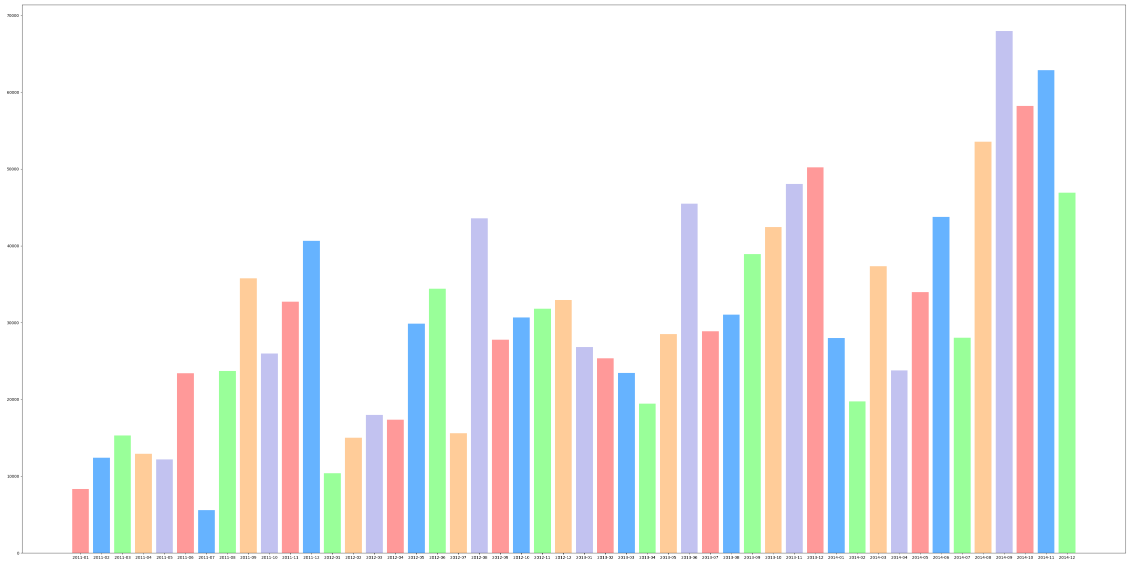
[72]:
```
monthly_profits=df.groupby('month year')['profit'].sum().reset_index()
```

[74]:
```
monthly_profits.head(3)
```

[74]:
```
  month year       profit
0    2011-01   8321.80096
1    2011-02  12417.90698
```

```
2    2011-03  15303.56826
```

[87]:
```
plt.figure(figsize=(40,20))
plt.bar(monthly_profits['month year'],monthly_profits['profit'],color=colors)
plt.tight_layout()
```



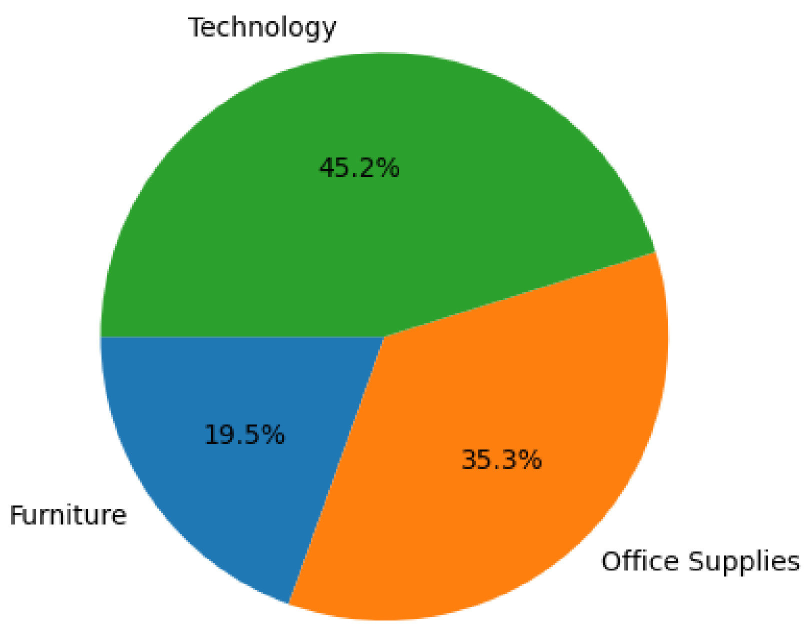
1.4 Profit by Category

[88]:
```
profitbycat=df.groupby('category')['profit'].sum().reset_index()
```

[89]:
```
profitbycat
```

[89]:
```
         category         profit
0       Furniture   286782.25380
1  Office Supplies   518473.83430
2      Technology   663778.73318
```

[111]:
```
plt.pie(profitbycat['profit'],
        labels=profitbycat['category'],
        autopct='%1.1f%%',shadow=False,startangle=180)
plt.show()
```



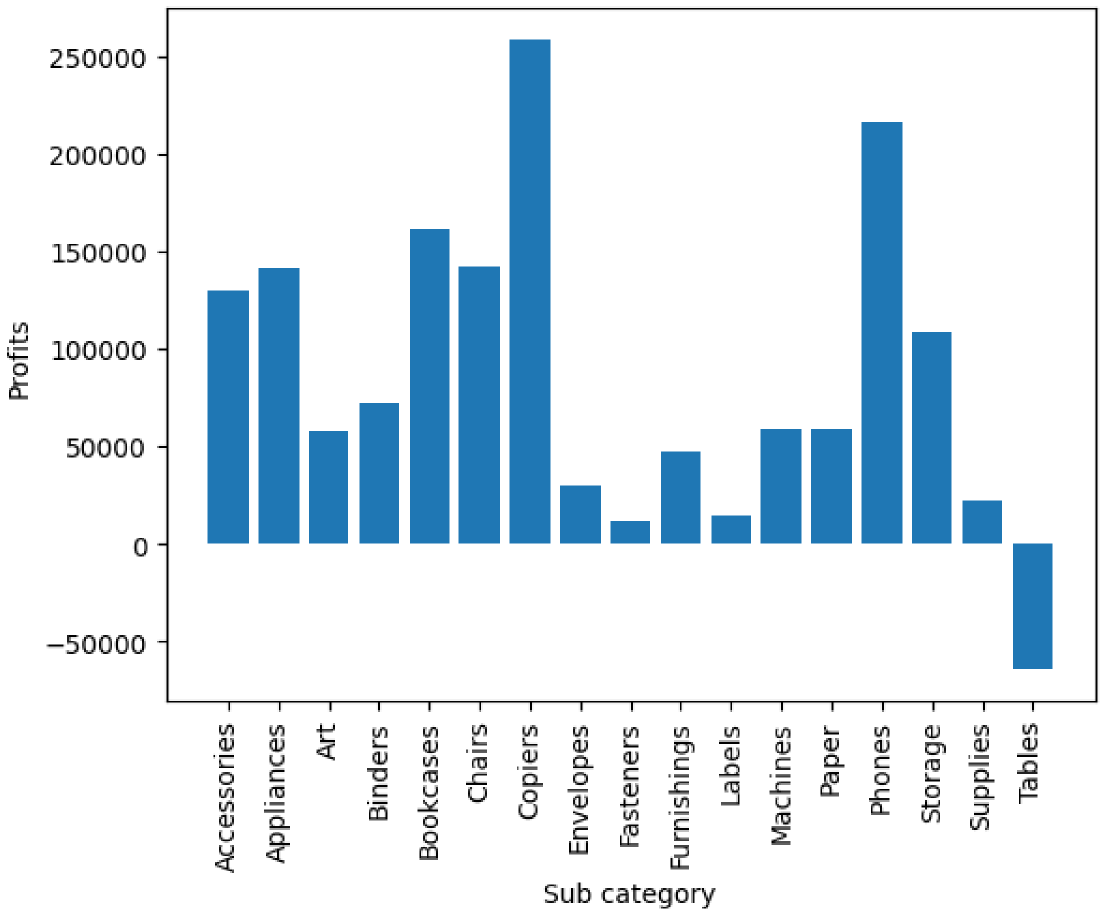
1.5 Profit by sub category

```
[96]: profitbysubcat=df.groupby('sub_category')['profit'].sum().reset_index()
```

```
[97]: profitbysubcat.head(3)
```

```
[97]:   sub_category       profit
      0  Accessories  129626.3062
      1   Appliances  141680.5894
      2          Art   57953.9109
```

```
[155]: plt.bar(profitbysubcat['sub_category'],
              profitbysubcat['profit'])
       plt.xlabel("Sub category")
       plt.ylabel("Profits")
       plt.xticks(rotation='vertical')
       plt.show()
```



1.6 Profit Analysis

[108]:
```
df['segment'].value_counts()
```

[108]:
```
segment
Consumer       26518
Corporate      15429
Home Office     9343
Name: count, dtype: int64
```

[103]:
```
df_profit_by_segment=df.groupby('segment').agg({'sales':'sum','profit':'sum'}).
  ↪reset_index()
```

[104]:
```
df_profit_by_segment
```

[104]:
```
     segment         sales        profit
0   Consumer  6.507949e+06  749239.78206
1  Corporate  3.824698e+06  442785.85866
```

```
2  Home Office  2.309855e+06  277009.18056
```

1.7 Top 10 product sales

```
[116]: product_sales=pd.DataFrame(df.groupby('product_name')['sales'].sum())
```

```
[117]: product_sales
```

```
[117]:                                                            sales
       product_name
       "While you Were Out" Message Book, One Form per…    25.228
       #10 Gummed Flap White Envelopes, 100/Box             41.300
       #10 Self-Seal White Envelopes                       108.682
       #10 White Business Envelopes,4 1/8 x 9 1/2          488.904
       #10- 4 1/8" x 9 1/2" Recycled Envelopes             286.672
       …                                                     …
       iKross Bluetooth Portable Keyboard + Cell Phone…   477.660
       iOttie HLCRIO102 Car Mount                          215.892
       iOttie XL Car Mount                                 223.888
       invisibleSHIELD by ZAGG Smudge-Free Screen Prot…   442.554
       netTALK DUO VoIP Telephone Service                 1112.788

       [3788 rows x 1 columns]
```

```
[120]: product_sales.sort_values(by=['sales'],ascending=False,inplace=True)
```

```
[122]: ##Most selled items
       product_sales[:10]
```

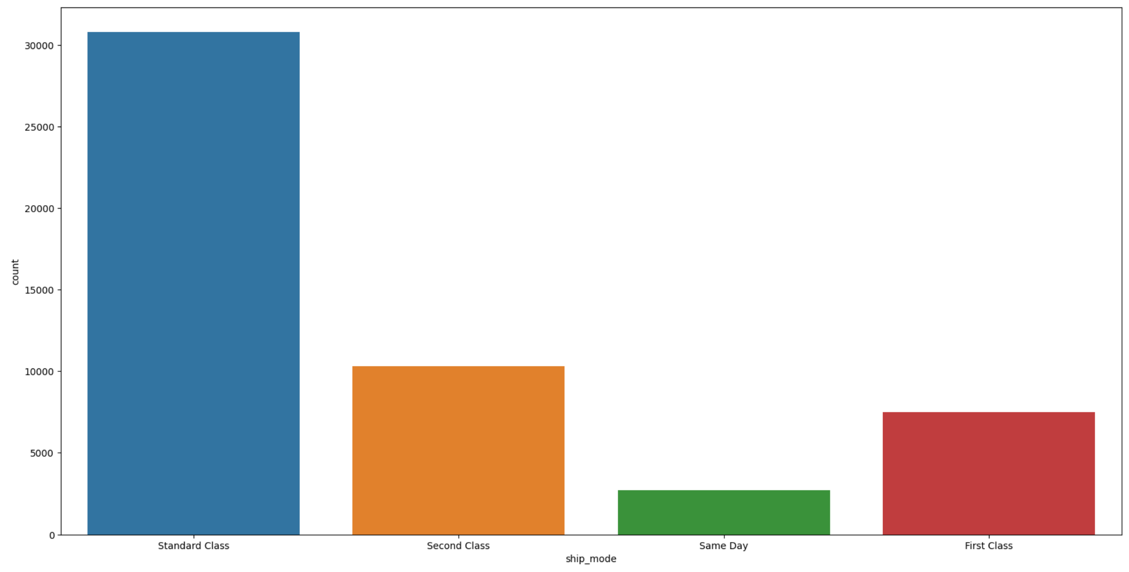
```
[122]:                                                              sales
       product_name
       Apple Smart Phone, Full Size                        86935.7786
       Cisco Smart Phone, Full Size                        76441.5306
       Motorola Smart Phone, Full Size                     73156.3030
       Nokia Smart Phone, Full Size                        71904.5555
       Canon imageCLASS 2200 Advanced Copier               61599.8240
       Hon Executive Leather Armchair, Adjustable          58193.4841
       Office Star Executive Leather Armchair, Adjustable  50661.6840
       Harbour Creations Executive Leather Armchair, A…  50121.5160
       Samsung Smart Phone, Cordless                       48653.4600
       Nokia Smart Phone, with Caller ID                   47877.7857
```

```
[128]: best_selling_prod=pd.DataFrame(df.groupby('product_name')['quantity'].sum())
       best_selling_prod.sort_values(by=['quantity'],ascending=False,inplace=True)
       best_selling_prod[:10]
```

```
[128]:                                              quantity
       product_name
       Staples                                           876
       Cardinal Index Tab, Clear                         337
       Eldon File Cart, Single Width                     321
       Rogers File Cart, Single Width                    262
       Sanford Pencil Sharpener, Water Color             259
       Stockwell Paper Clips, Assorted Sizes             253
       Avery Index Tab, Clear                            252
       Ibico Index Tab, Clear                            251
       Smead File Cart, Single Width                     250
       Stanley Pencil Sharpener, Water Color             242
```

1.8 Most prefered ship mode

```
[148]: plt.figure(figsize=(20,10))
       sns.countplot(x='ship_mode',data=df)
       plt.show()
```



1.9 Most Profitable category and sub category

```
[153]: cat_subcat=pd.DataFrame(df.groupby(['category','sub_category'])['profit'].sum())
       cat_subcat.sort_values(['category','sub_category'],ascending=False,inplace=True)
       cat_subcat
```

```
[153]:                                       profit
       category      sub_category
       Technology    Phones            216717.00580
```

```
                Machines       58867.87300
                Copiers       258567.54818
                Accessories   129626.30620
Office Supplies Supplies       22583.26310
                Storage       108461.48980
                Paper          59207.68270
                Labels         15010.51200
                Fasteners      11525.42410
                Envelopes      29601.11630
                Binders        72449.84600
                Art            57953.91090
                Appliances    141680.58940
Furniture       Tables        -64083.38870
                Furnishings    46967.42550
                Chairs        141973.79750
                Bookcases     161924.41950
```

1.10 Case Study 2: To analyze and answer business questions about 12 months worth of sales data

[166]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
all_data=pd.read_csv('all_data.csv')
all_data.head()
```

[166]:
```
  Order ID                     Product Quantity Ordered Price Each  \
0   176558        USB-C Charging Cable                2      11.95
1      NaN                         NaN              NaN        NaN
2   176559  Bose SoundSport Headphones                1      99.99
3   176560                Google Phone                1        600
4   176560            Wired Headphones                1      11.99

       Order Date                      Purchase Address
0  04/19/19 08:46          917 1st St, Dallas, TX 75001
1             NaN                                   NaN
2  04/07/19 22:30     682 Chestnut St, Boston, MA 02215
3  04/12/19 14:38  669 Spruce St, Los Angeles, CA 90001
4  04/12/19 14:38  669 Spruce St, Los Angeles, CA 90001
```

[167]:
```
all_data.isnull().sum()
all_data.shape
```

[167]:
```
(186850, 6)
```

[168]:
```
nan_df=all_data[all_data.isna().any(axis=1)]
```

```
[169]: nan_df.head()
```

```
[169]:      Order ID Product Quantity Ordered Price Each Order Date Purchase Address
       1          NaN     NaN              NaN        NaN        NaN              NaN
       356        NaN     NaN              NaN        NaN        NaN              NaN
       735        NaN     NaN              NaN        NaN        NaN              NaN
       1433       NaN     NaN              NaN        NaN        NaN              NaN
       1553       NaN     NaN              NaN        NaN        NaN              NaN
```

Droping null values

```
[170]: all_data=all_data.dropna()
       all_data.head()
       all_data.shape
```

```
[170]: (186305, 6)
```

```
[171]: ##Making the all columns in correct type
       all_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 186305 entries, 0 to 186849
Data columns (total 6 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   Order ID          186305 non-null  object
 1   Product           186305 non-null  object
 2   Quantity Ordered  186305 non-null  object
 3   Price Each        186305 non-null  object
 4   Order Date        186305 non-null  object
 5   Purchase Address  186305 non-null  object
dtypes: object(6)
memory usage: 9.9+ MB
```

```
[182]: all_data['Order Date']=pd.to_datetime(all_data['Order Date'],errors='coerce')
       all_data=all_data.dropna()
       all_data['Month']=all_data['Order Date'].dt.month
```

```
C:\Users\pabba\AppData\Local\Temp\ipykernel_21184\2018892805.py:1: UserWarning:

Could not infer format, so each element will be parsed individually, falling
back to `dateutil`. To ensure parsing is consistent and as-expected, please
specify a format.

C:\Users\pabba\AppData\Local\Temp\ipykernel_21184\2018892805.py:3:
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
```

[198]:
```
all_data['Purchase Address'].value_counts()
```

[198]:
```
Purchase Address
193 Forest St, San Francisco, CA 94016    9
279 Sunset St, San Francisco, CA 94016    8
223 Elm St, Los Angeles, CA 90001         8
197 Center St, San Francisco, CA 94016    7
727 9th St, San Francisco, CA 94016       7
                                         ..
414 Sunset St, Los Angeles, CA 90001      1
191 Wilson St, Atlanta, GA 30301          1
359 Meadow St, New York City, NY 10001    1
703 Highland St, Dallas, TX 75001         1
220 12th St, San Francisco, CA 94016      1
Name: count, Length: 140787, dtype: int64
```

[215]:
```
## Extyracting city and Address
def get_city(address):
    return address.split(",")[1].strip(" ")
def get_state(address):
    return address.split(",")[2].strip(" ")
all_data['City']=all_data['Purchase Address'].apply(lambda x: f"{get_city(x)}␣
 ↪({get_state(x)})")
all_data.head()
```

[215]:
```
  Order ID                     Product Quantity Ordered Price Each  \
0   176558        USB-C Charging Cable                2      11.95
2   176559  Bose SoundSport Headphones                1      99.99
3   176560                Google Phone                1        600
4   176560            Wired Headphones                1      11.99
5   176561            Wired Headphones                1      11.99

           Order Date                      Purchase Address  \
0 2019-04-19 08:46:00          917 1st St, Dallas, TX 75001
2 2019-04-07 22:30:00     682 Chestnut St, Boston, MA 02215
3 2019-04-12 14:38:00  669 Spruce St, Los Angeles, CA 90001
4 2019-04-12 14:38:00  669 Spruce St, Los Angeles, CA 90001
5 2019-04-30 09:27:00     333 8th St, Los Angeles, CA 90001

                    City Month
0       Dallas (TX 75001)    04
2       Boston (MA 02215)    04
```

```
3  Los Angeles (CA 90001)    04
4  Los Angeles (CA 90001)    04
5  Los Angeles (CA 90001)    04
```

Question 1: What was the best month for sales? How much was earned that month?

```
[231]: all_data['sales']=all_data['Quantity Ordered'].astype('int')*all_data['Price␣
         ↪Each'].astype('float')
```

```
[238]: monthly_sales=all_data.groupby('Month').agg({'Quantity Ordered':'sum','Price␣
         ↪Each':'sum','sales':'sum'})
```

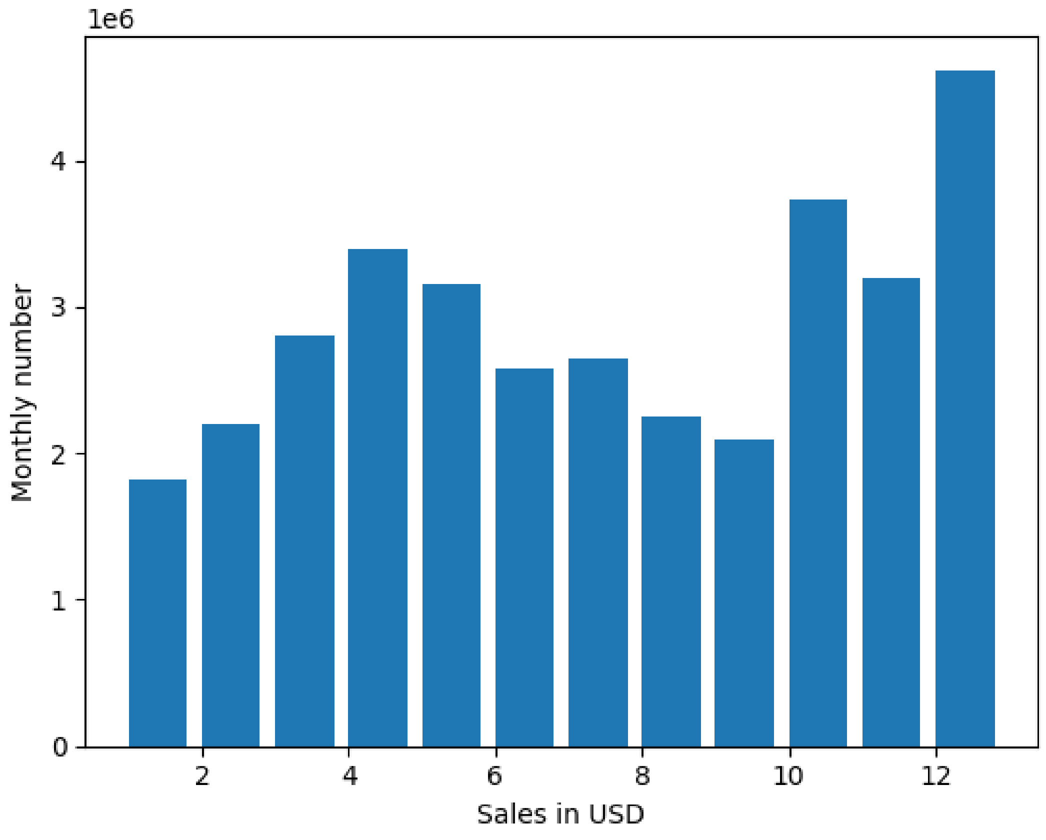
```
[239]: monthly_sales
```

```
[239]:                                         Quantity Ordered  \
Month
01       1121411111111111111111111111131111211211111111…
02       1111211111111111111211111112411121111211111111…
03       1111111111111111211211111151211111111131111111…
04       2111111111111111111111111111211121111111213112 1…
05       1111111112111111111111111111111211111111111111…
06       1111111111111111111111113111111211111211111111…
07       1111511111111111211111112112112111111111111121…
08       2112211111111111111111111111211111312111121111…
09       1111111111114211111111131111111111111121111111…
10       1121111111111111111111111111111111111111121131…
11       1211111111111111111131111121111111111111211111…
12       1111111214212211111111411111112111111211121111…

                                                Price Each       sales
Month
01       14.9570014.9560011.9915011.9511.9599.9914.9510…  1822256.73
02       7003.84389.9914.953.8414.953.8415011.9511.9599…  2202022.42
03       2.992.9911.9999.99999.9911.9999.99999.9911.953…  2807100.38
04       11.9599.9960011.9911.9911.9599.9911.95170011.9…  3390670.24
05       150149.9970015060011.9515099.9915099.993.84150…  3152606.75
06       11.951700.0999.99149.9999.99150.014.95150.011…  2577802.26
07       1503003.843.842.9999.99600600.011.9514.953.841…  2647775.76
08       11.9999.99700.03.843.8411.99379.99109.9911.991…  2244467.88
09       150379.9914.952.99999.99149.9911.9514.9599.991…  2097560.13
10       379.99389.992.99149.9911.992.9911.9914.95150.0…  3736726.88
11       11.9911.95150.0149.9999.9911.9514.9599.9914.95…  3199603.20
12       1700600.011.95149.9911.953.8411.9511.9599.992…  4613443.34
```

```
[246]: months=range(1,13)
       plt.bar(months,all_data.groupby(['Month'])['sales'].sum(),align='edge')
       plt.xlabel('Sales in USD')
       plt.ylabel('Monthly number')
```

```
# plt.title('Monthly Sales')
plt.show()
```



Question 2: What city sold the most product?

[250]:
```
city_sales=all_data.groupby('City').agg({'Quantity Ordered':'sum','Price Each':
↪'sum','sales':'sum'})
```

[251]:
```
city_sales
```

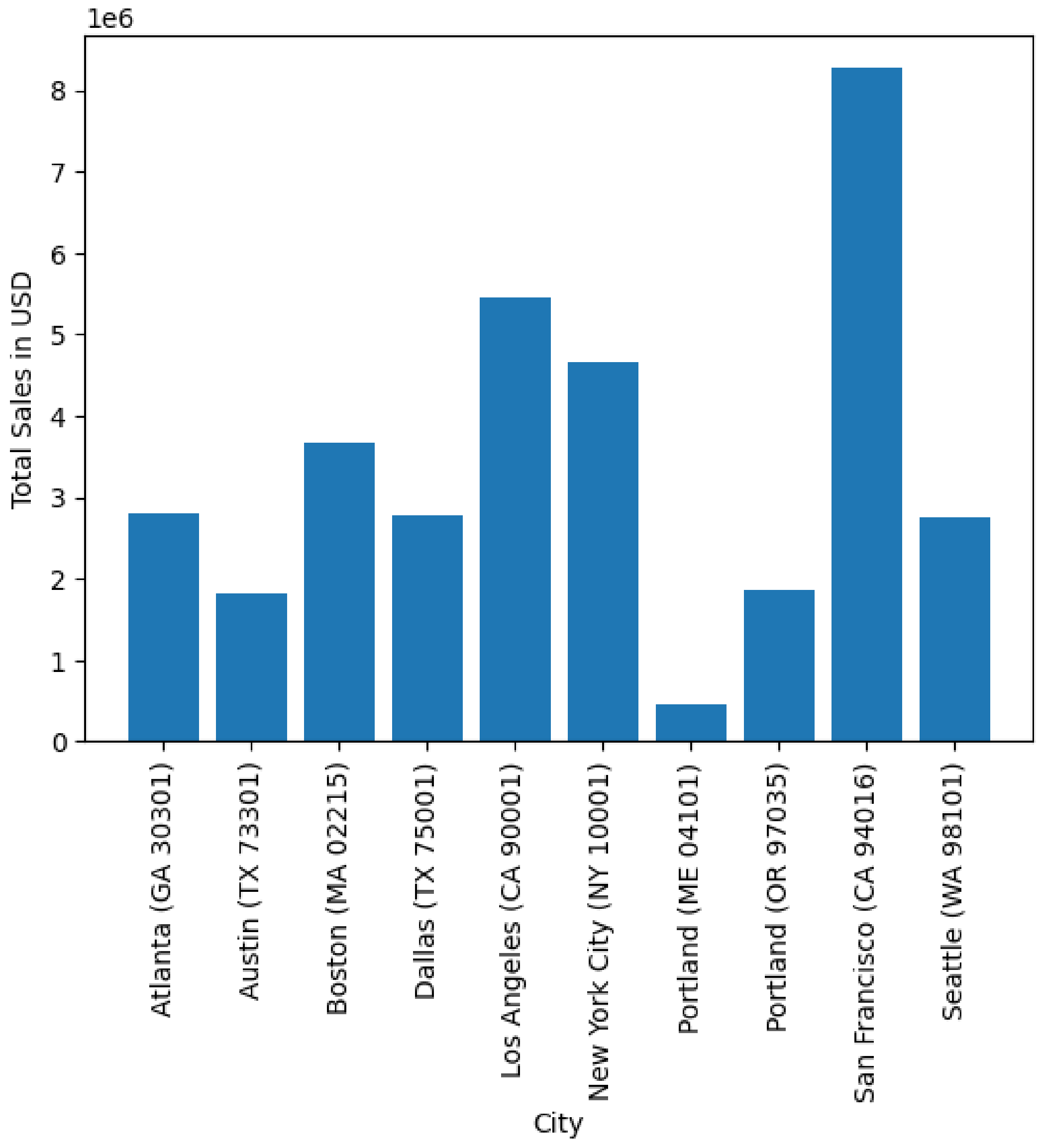
[251]:
```
                                                        Quantity Ordered  \
City
Atlanta (GA 30301)        1111111111111111111111111111111111111111111…
Austin (TX 73301)         1131112111111113111111111111111111111211111211…
Boston (MA 02215)         1111111211111111111111112111121111111111111111…
Dallas (TX 75001)         2111111123111111211111121211111111111121111171…
Los Angeles (CA 90001)    1111111111311111111111111111111111111111111111…
New York City (NY 10001)  1111121112111121111111111111111121111113112111…
Portland (ME 04101)       2111111121111111111111111121111111111112121111…
Portland (OR 97035)       2211111111111112111111111111111111111111111111…
San Francisco (CA 94016)  1111211121111111212111111211121211111111111221…
```

```
Seattle (WA 98101)        111111111112121111111111111111111111111111111…

                                                              Price Each  \
City
Atlanta (GA 30301)        11.9514.9599.9914.95149.9911.9914.9511.9911.95…
Austin (TX 73301)         1501502.99379.9911.9911.9514.95149.99379.99600…
Boston (MA 02215)         99.9911.9915070099.9999.99389.992.9914.9599.99…
Dallas (TX 75001)         11.95389.993.8415015014.952.9914.9514.952.9910…
Los Angeles (CA 90001)    60011.9911.9960060011.9515011.95149.9911.9511…
New York City (NY 10001)  1502.993.8460014.9511.952.99600.06002.9914.951…
Portland (ME 04101)       2.9930011.997007006002.99109.9911.95379.9911.9…
Portland (OR 97035)       2.9914.951503.841700149.99379.9915014.95389.99…
San Francisco (CA 94016)  11.95170011.953002.9960011.9911.952.9911.9511…
Seattle (WA 98101)        99.9914.95109.991503.8411.9599.9911.992.991509…

                               sales
City
Atlanta (GA 30301)        2795498.58
Austin (TX 73301)         1819581.75
Boston (MA 02215)         3661642.01
Dallas (TX 75001)         2767975.40
Los Angeles (CA 90001)    5452570.80
New York City (NY 10001)  4664317.43
Portland (ME 04101)        449758.27
Portland (OR 97035)       1870732.34
San Francisco (CA 94016)  8262203.91
Seattle (WA 98101)        2747755.48
```

[258]:
```
#Monthly sales
city_sales=all_data.groupby('City')['sales'].sum()
plt.bar(city_sales.index,city_sales.values)
plt.xlabel('City')
plt.ylabel('Total Sales in USD')
plt.xticks(rotation='vertical')
plt.show()
```

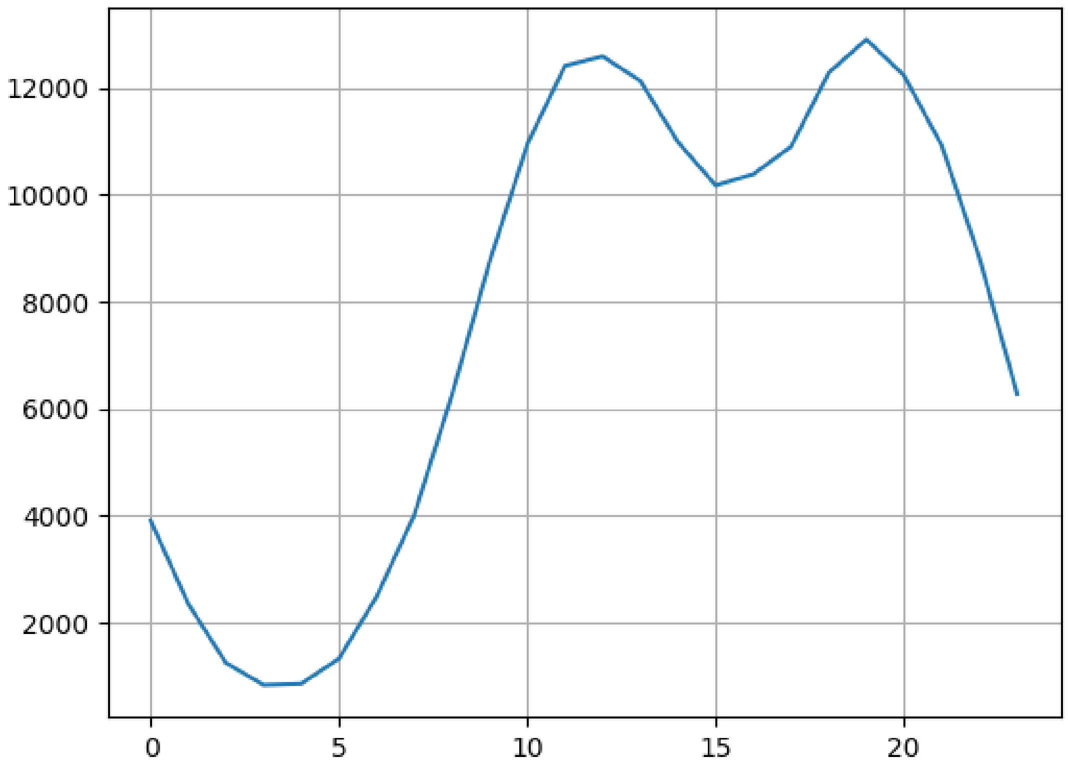


What time should we display advertisements to maximize likelihood of customer's buying product?

[261]:
```
# Adding hour column
all_data['hour']=pd.to_datetime(all_data['Order Date']).dt.hour
all_data['minute']=pd.to_datetime(all_data['Order Date']).dt.minute
```

[263]:
```
all_data['count']=1
```

[274]:
```
keys=[pair for pair,df in all_data.groupby(['hour'])]
plt.plot(keys,all_data.groupby(['hour']).count()['count'])
plt.grid()
```



There are approximately 2 peaks at the data. They are 12 (12 PM) and 19 (7 PM). It makes sense since most people shop during the day. From this data, It can suggest to advertise their product right before 12 PM and/or 7 PM. It could be 11.30 AM and/or 6.30 PM.

Question 4: What products are most often sold together?

[278]:
```
df=all_data[all_data['Order ID'].duplicated(keep=False)]
```

[285]:
```
df['Grouped']=df.groupby('Order ID')['Product'].transform(lambda x: ','.join(x))
df2=df[['Order ID','Grouped']].drop_duplicates()
```

```
C:\Users\pabba\AppData\Local\Temp\ipykernel_21184\3314610805.py:1:
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
```

[288]:
```
df2
```

[288]:
```
        Order ID                                            Grouped
3         176560                     Google Phone,Wired Headphones
18        176574                 Google Phone,USB-C Charging Cable
30        176585  Bose SoundSport Headphones,Bose SoundSport Hea…
32        176586               AAA Batteries (4-pack),Google Phone
119       176672        Lightning Charging Cable,USB-C Charging Cable
…          …                                                     …
186781    259296  Apple Airpods Headphones,Apple Airpods Headphones
186783    259297  iPhone,Lightning Charging Cable,Lightning Char…
186791    259303          34in Ultrawide Monitor,AA Batteries (4-pack)
186803    259314              Wired Headphones,AAA Batteries (4-pack)
186841    259350                 Google Phone,USB-C Charging Cable

[7136 rows x 2 columns]
```

[295]:
```python
from itertools import combinations
from collections import Counter

count=Counter()
for row in df2['Grouped']:
    row_list=row.split(',')
    count.update(Counter(combinations(row_list,2)))
for key,value in count.most_common(10):
    print(key,value)
```

```
('iPhone', 'Lightning Charging Cable') 1005
('Google Phone', 'USB-C Charging Cable') 987
('iPhone', 'Wired Headphones') 447
('Google Phone', 'Wired Headphones') 414
('Vareebadd Phone', 'USB-C Charging Cable') 361
('iPhone', 'Apple Airpods Headphones') 360
('Google Phone', 'Bose SoundSport Headphones') 220
('USB-C Charging Cable', 'Wired Headphones') 160
('Vareebadd Phone', 'Wired Headphones') 143
('Lightning Charging Cable', 'Wired Headphones') 92
```

1.11 Case Study 3 :

Create a report for an upcoming board meeting. Go through and analyze the sales data from 2015-2017 in order to generate the requested report. The report should capture the following;

- Revenue by region
- Revenue by sales Rep
- Revenue by products
- Sales trend
- Yearly changes in revenue

[2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

df=pd.read_csv('sales-data.csv')
df.head()
```

[2]:
```
         Date SalesRep Region   Product  Color  Units  Revenue
0  2015-11-06    Julie   East  Sunshine   Blue      4     78.8
1  2015-11-07     Adam   West    Bellen  Clear      4    123.0
2  2015-11-07    Julie   East     Aspen  Clear      1     26.0
3  2015-11-07    Nabil  South      Quad  Clear      2     69.0
4  2015-11-07    Julie  South     Aspen   Blue      2     51.0
```

[4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9971 entries, 0 to 9970
Data columns (total 7 columns):
 #   Column    Non-Null Count  Dtype
---  ------    --------------  -----
 0   Date      9971 non-null   object
 1   SalesRep  9971 non-null   object
 2   Region    9971 non-null   object
 3   Product   9971 non-null   object
 4   Color     9971 non-null   object
 5   Units     9971 non-null   int64
 6   Revenue   9971 non-null   float64
dtypes: float64(1), int64(1), object(5)
memory usage: 545.4+ KB
```

[5]:
```
df.describe()
```

[5]:
```
             Units      Revenue
count  9971.000000  9971.000000
mean      3.388828    91.181513
std       4.320759   120.894473
min       1.000000    21.000000
25%       2.000000    42.900000
50%       2.000000    60.000000
75%       3.000000    76.500000
max      25.000000  1901.750000
```

There was a total of 9,971 sales entries between 2015-2017 Units:

- The minimum number of units sold between 2015-2017 was 1
- The maximum number of units sold between 2015-2017 was 25

- The average number of units sold between 2015-2017 was aproximately 3

Revenue:

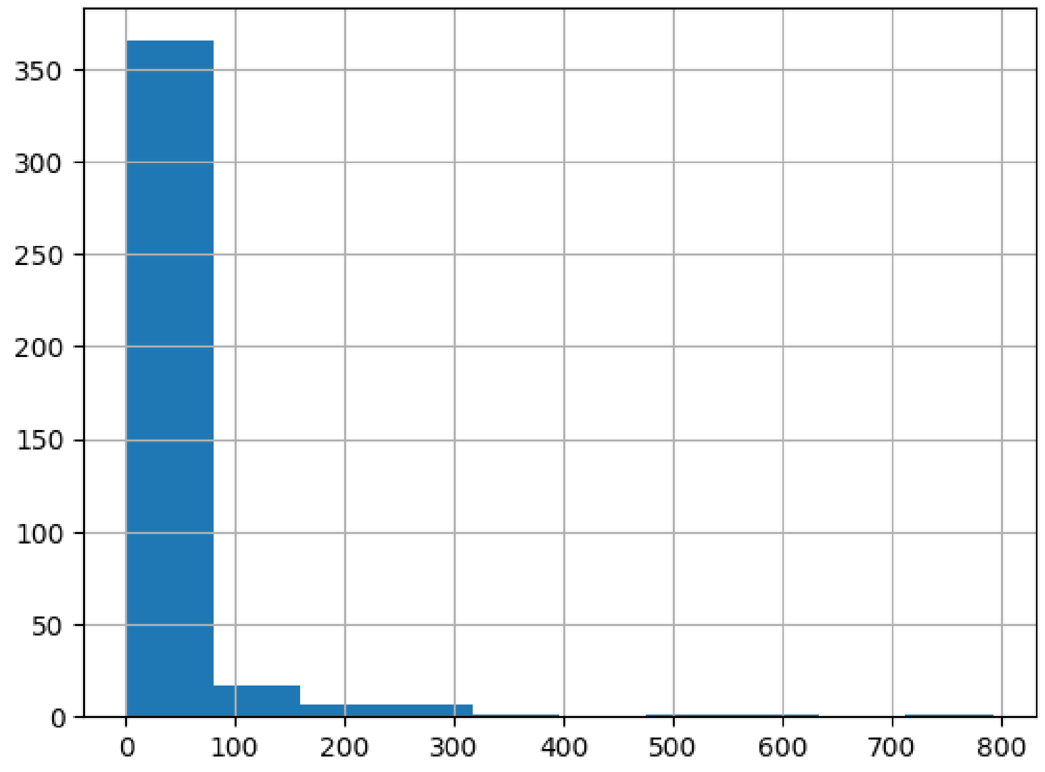
- The least revenue generated between 2015-2017 was 21
- The most revenue between 2015-2017 was approximately 1902

```
[7]: ##cheking null values
     df.isnull().any()
```

```
[7]: Date        False
     SalesRep    False
     Region      False
     Product     False
     Color       False
     Units       False
     Revenue     False
     dtype: bool
```

```
[11]: df['Revenue'].value_counts().hist(bins=10)
```

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



What's the total revenue generated between 2015-2017?

```
[12]: df['Revenue'].sum()
```

```
[12]: 909170.8700000001
```

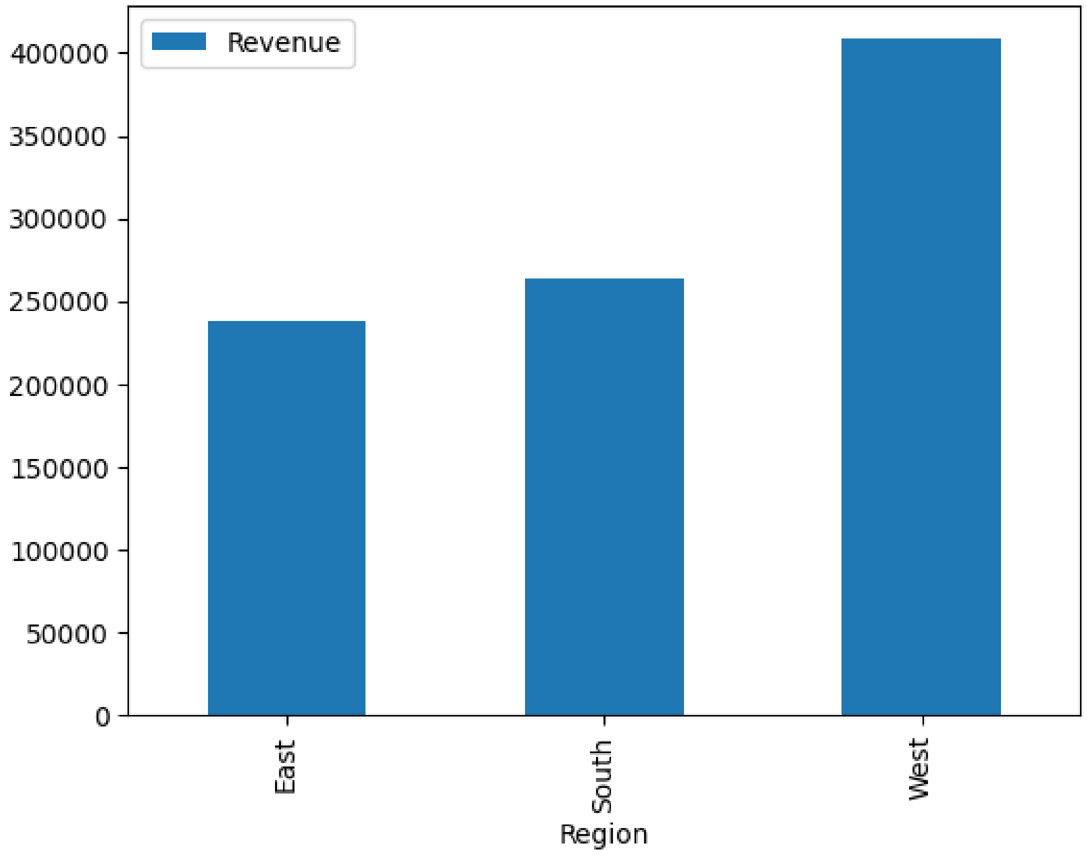
Revenue by region

```
[14]: region_revenue=pd.DataFrame(df.groupby(df['Region'])['Revenue'].sum())
      ##sorting the revenue data
      region_revenue.sort_values(ascending=False,by='Revenue')
```

```
[14]:          Revenue
      Region
      West    408037.58
      South   263256.50
      East    237876.79
```

```
[15]: region_revenue.plot(kind='bar')
```

```
[15]: <Axes: xlabel='Region'>
```



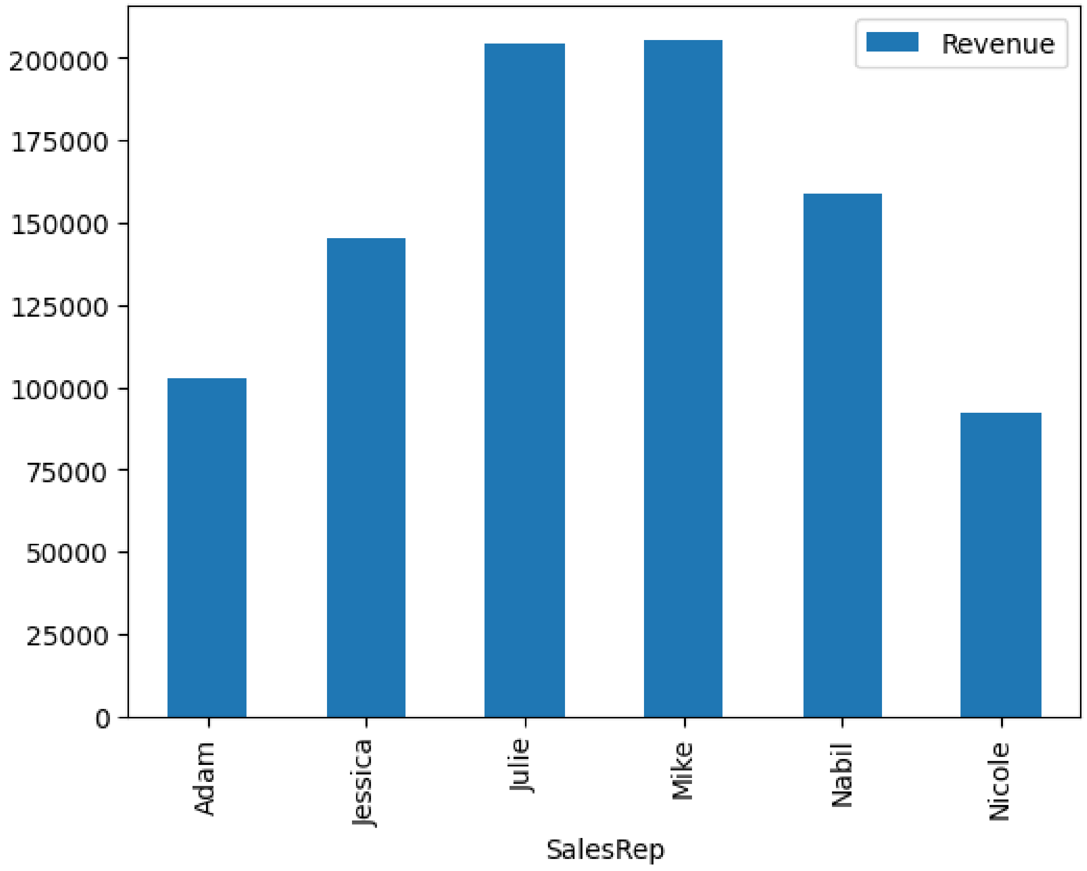
Revenue by sales Rep

```
[19]: rev_by_sales=pd.DataFrame(df.groupby('SalesRep')['Revenue'].sum())
      rev_by_sales.sort_values(by='Revenue',ascending=False)
```

```
[19]:             Revenue
      SalesRep
      Mike      205577.78
      Julie     204450.05
      Nabil     158904.48
      Jessica   145496.28
      Adam      102715.60
      Nicole     92026.68
```

```
[23]: rev_by_sales.plot(kind='bar')
```

```
[23]: <Axes: xlabel='SalesRep'>
```



Revenue by Products

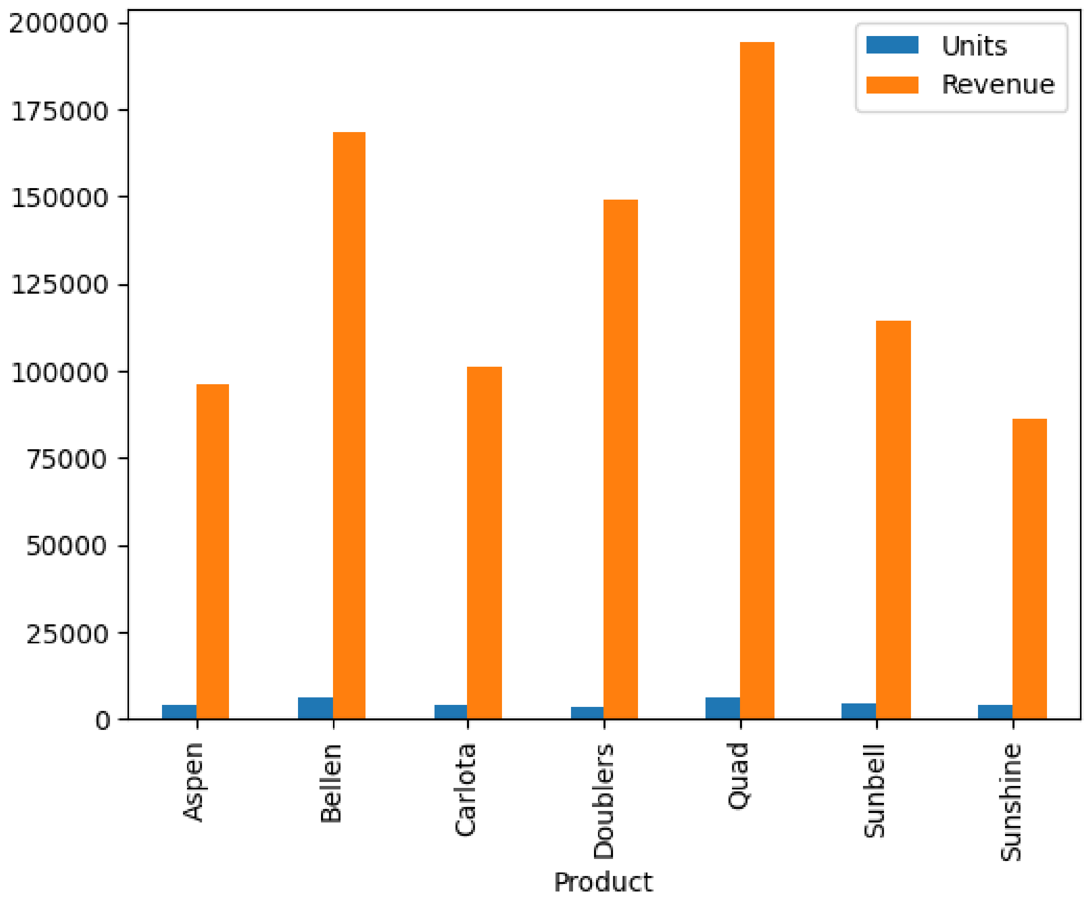
```
[28]: product_rev=df[['Units','Revenue','Product']].groupby('Product').sum()
```

```
[32]: product_rev.sort_values(by='Units',ascending=False)
```

```
[32]:           Units    Revenue
      Product
      Bellen     6579  168175.05
      Quad       6223  194032.15
      Sunbell    4500  114283.09
      Carlota    4371  101272.05
      Aspen      4242   96382.80
      Sunshine   4229   85983.80
      Doublers   3646  149041.93
```

```
[33]: product_rev.plot(kind='bar')
```

```
[33]: <Axes: xlabel='Product'>
```



Quad has highest revenue

Sales Trend

```
[34]: df['Date']=pd.to_datetime(df['Date'])
      df['year']=df['Date'].dt.year
      df['month']=df['Date'].dt.month
      df['day']=df['Date'].dt.day
```

```
[37]: df.year.unique()
```

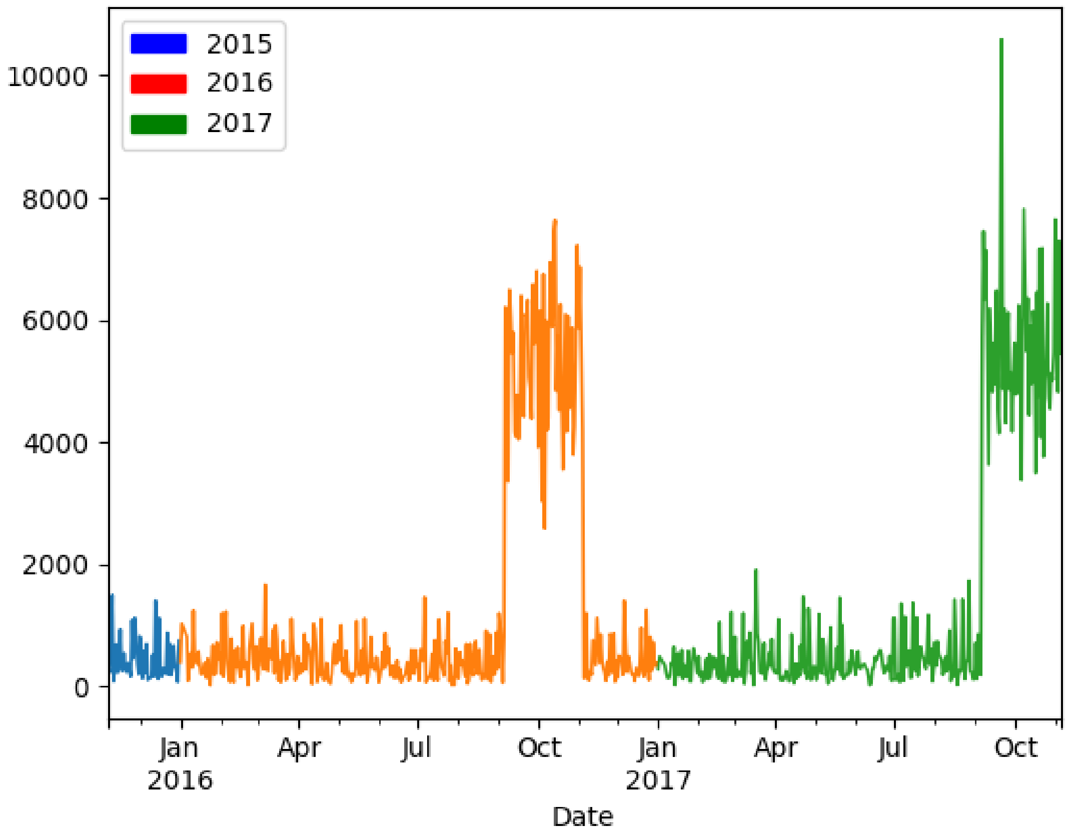
```
[37]: array([2015, 2016, 2017])
```

Ploting year trends

```
[46]: def plotingtrend(years:list,df):
          for year in years:
              new_df=df[df['year']==year]
              new_df.groupby('Date')['Revenue'].sum().plot(linewidth=1.2)
```

```
[48]: import matplotlib.patches as pt
      year1=pt.Patch(color='blue',label='2015')
      year2=pt.Patch(color='red',label='2016')
      year3=pt.Patch(color='Green',label='2017')
      plotingtrend(years,df)
      plt.legend(handles=[year1,year2,year3],loc=2)
```

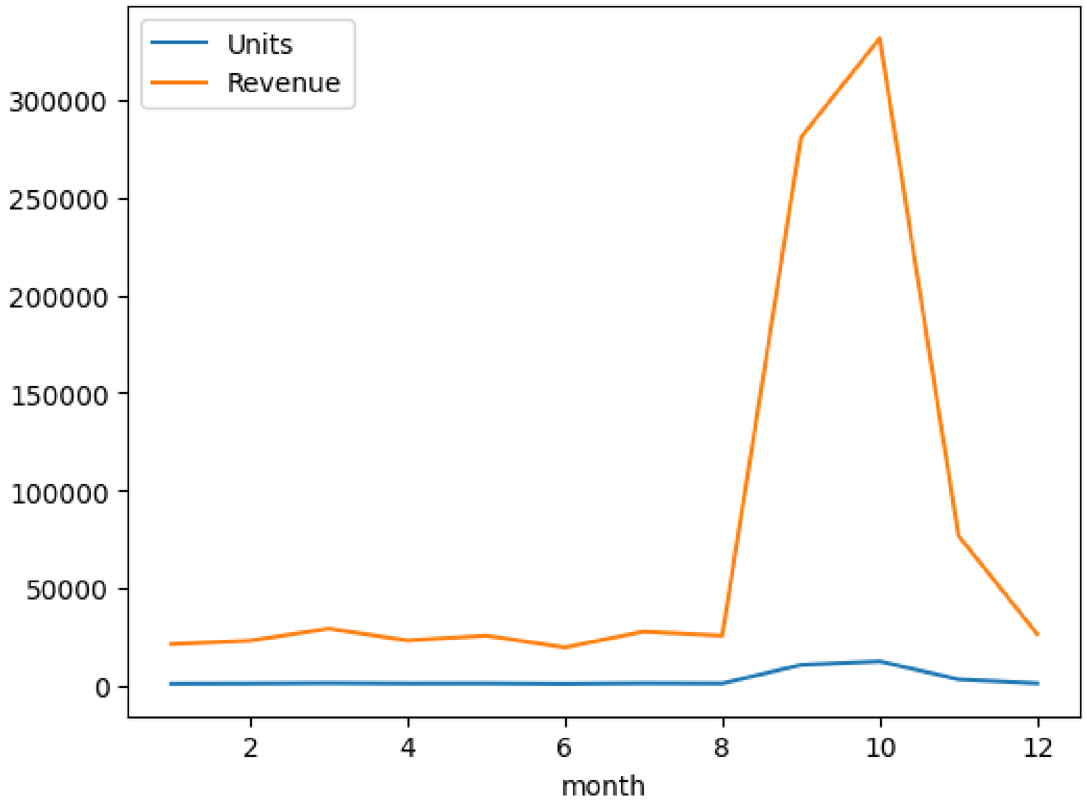
```
[48]: <matplotlib.legend.Legend at 0x1f04b6aa350>
```



Monthly Sales Trends

[54]:
```
ax=df[['month','Units','Revenue']].groupby('month').sum()
ax.plot()
```

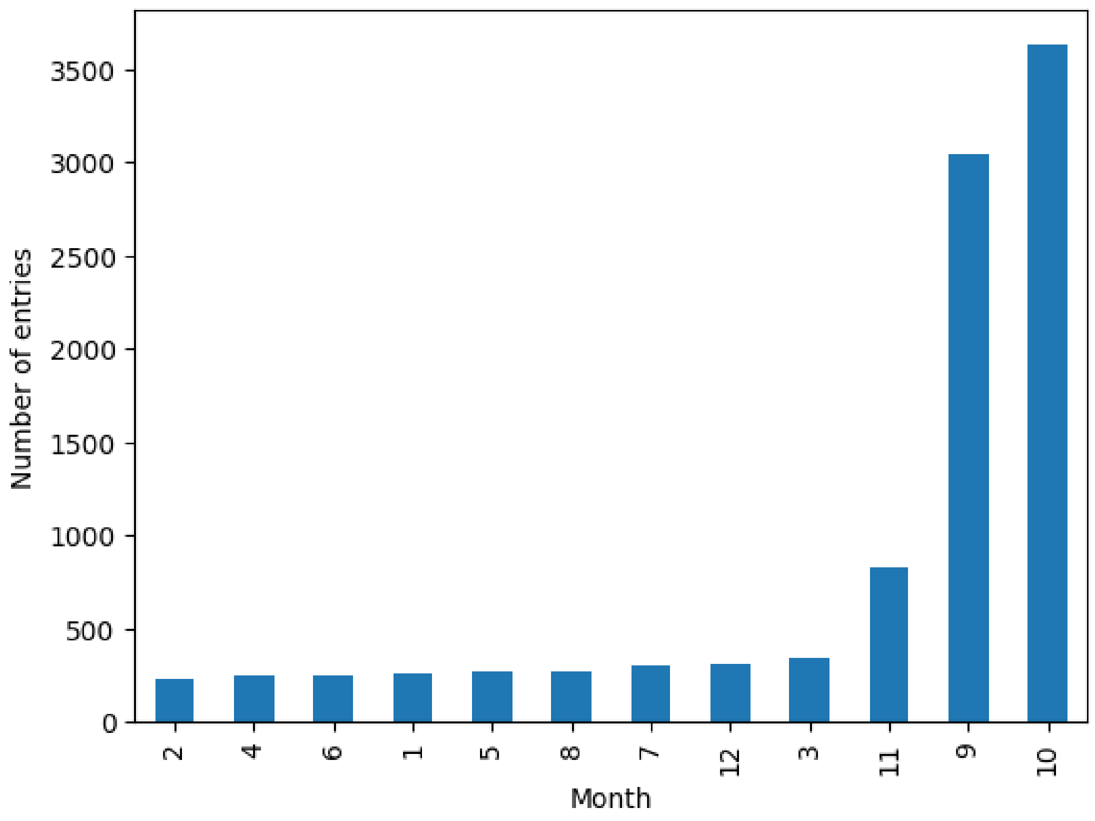
[54]:
```
<Axes: xlabel='month'>
```



How many times was entry made in each month?

[60]:
```
month_entry=df['month'].value_counts().sort_values()
month_entry.plot(kind='bar',xlabel='Month',ylabel='Number of entries')
```

[60]:
```
<Axes: xlabel='Month', ylabel='Number of entries'>
```



Monthly Sales

```
[94]: products=pd.DataFrame(df[['Units','Revenue','Product','month','Region']].
        ↪groupby('month')['Product'].value_counts())
```

```
[95]: products
```

```
[95]:                  count
      month Product
      1     Bellen        52
            Quad          46
            Sunbell       34
            Aspen         33
            Sunshine      33
      …                 …
      12    Sunbell       43
            Aspen         41
            Sunshine      36
            Carlota       35
            Doublers      32
```

```
[84 rows x 1 columns]
```

[96]:
```
products['number of products']=products['count']
products=products.reset_index()
```

[97]:
```
products.drop('count',inplace=True,axis=1)
products
```

[97]:
```
    month   Product  number of products
0       1    Bellen                  52
1       1      Quad                  46
2       1   Sunbell                  34
3       1     Aspen                  33
4       1  Sunshine                  33
..    …        …                  …
79     12   Sunbell                  43
80     12     Aspen                  41
81     12  Sunshine                  36
82     12   Carlota                  35
83     12  Doublers                  32

[84 rows x 3 columns]
```

[98]:
```
products=products.pivot_table(values=['number of␣
↪products'],index=['month'],columns=['Product'],aggfunc=np.sum)
```

```
C:\Users\pabba\AppData\Local\Temp\ipykernel_15088\2649347101.py:1:
FutureWarning: The provided callable <function sum at 0x000001F00C8E7420> is
currently using DataFrameGroupBy.sum. In a future version of pandas, the
provided callable will be used directly. To keep current behavior pass the
string "sum" instead.
  products=products.pivot_table(values=['number of
products'],index=['month'],columns=['Product'],aggfunc=np.sum)
```

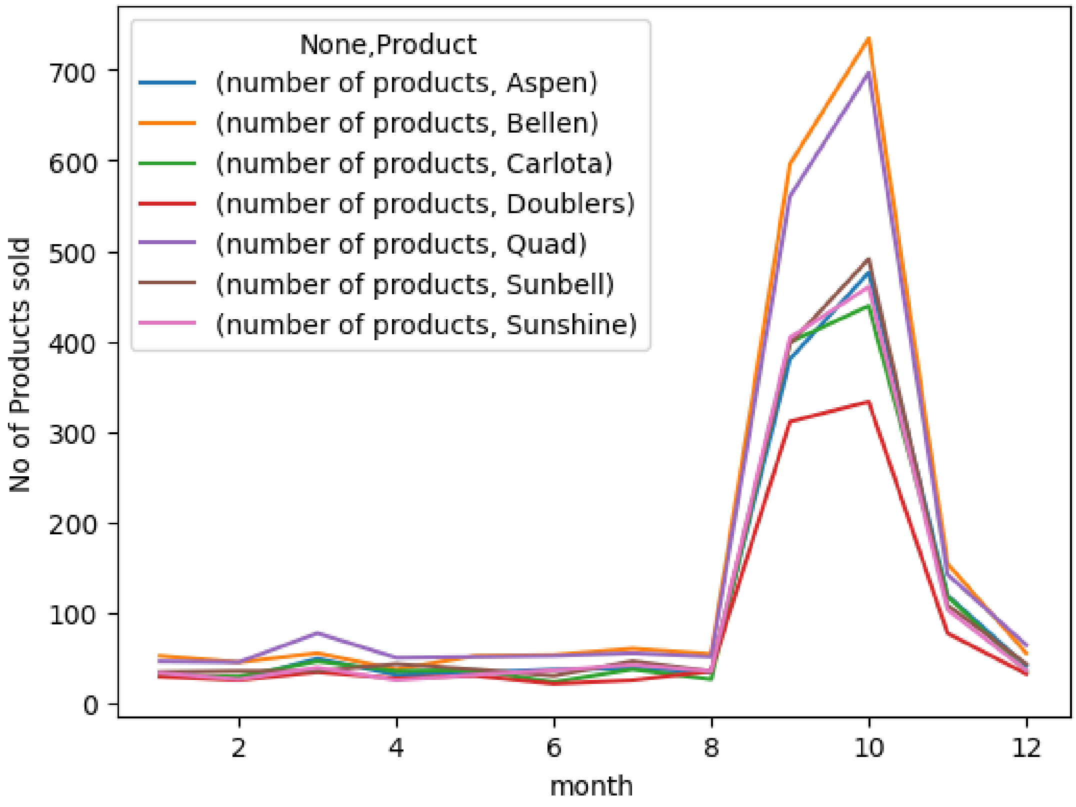
[99]:
```
products
```

[99]:
```
        number of products
Product                  Aspen Bellen Carlota Doublers Quad Sunbell Sunshine
month
1                           33     52      30       29   46      34       33
2                           26     45      29       25   45      35       26
3                           49     55      46       34   77      35       39
4                           31     37      35       27   50      43       25
5                           33     52      36       30   51      37       31
6                           37     53      23       21   52      30       36
7                           38     60      37       25   55      46       42
8                           34     54      26       35   51      35       35
9                          380    596     399      311  560     397      404
```

```
10                          476    735    439     333   697     491      460
11                          119    154    118      77   142     108      103
12                           41     55     35      32    64      43       36
```

[100]:
```
products.plot(ylabel='No of Products sold')
```

[100]:
```
<Axes: xlabel='month', ylabel='No of Products sold'>
```



Region Revenue

[114]:
```
region_sales=pd.DataFrame(df[['Units','Revenue','Product','Region','month']].
  ↪groupby(['month','Region'])['Revenue'].sum()
```

[115]:
```
region_sales=pd.DataFrame(region_sales)
region_sales
```

[115]:
```
                Revenue
month Region
1     East      5012.34
      South     7551.55
      West      8550.33
2     East      6428.75
```

```
        South     5540.10
        West     10864.87
3       East      6082.75
        South     8863.80
        West     14087.99
4       East      6420.63
        South     7647.28
        West      8865.57
5       East      8782.68
        South     5651.30
        West     10962.00
6       East      6442.85
        South     3954.90
        West      9020.65
7       East      7180.45
        South    10155.59
        West     10150.25
8       East      6031.55
        South     7767.60
        West     11567.37
9       East     70532.44
        South    83228.39
        West    127160.06
10      East     87858.60
        South    92034.70
        West    151780.43
11      East     19478.10
        South    24048.59
        West     33196.52
12      East      7625.65
        South     6812.70
        West     11831.54
```

[116]:
```
region_sales=region_sales.reset_index()
region_sales=region_sales.
  ↪pivot_table(values=['Revenue'],index=['month'],columns=['Region'],aggfunc=np.
  ↪sum)
```

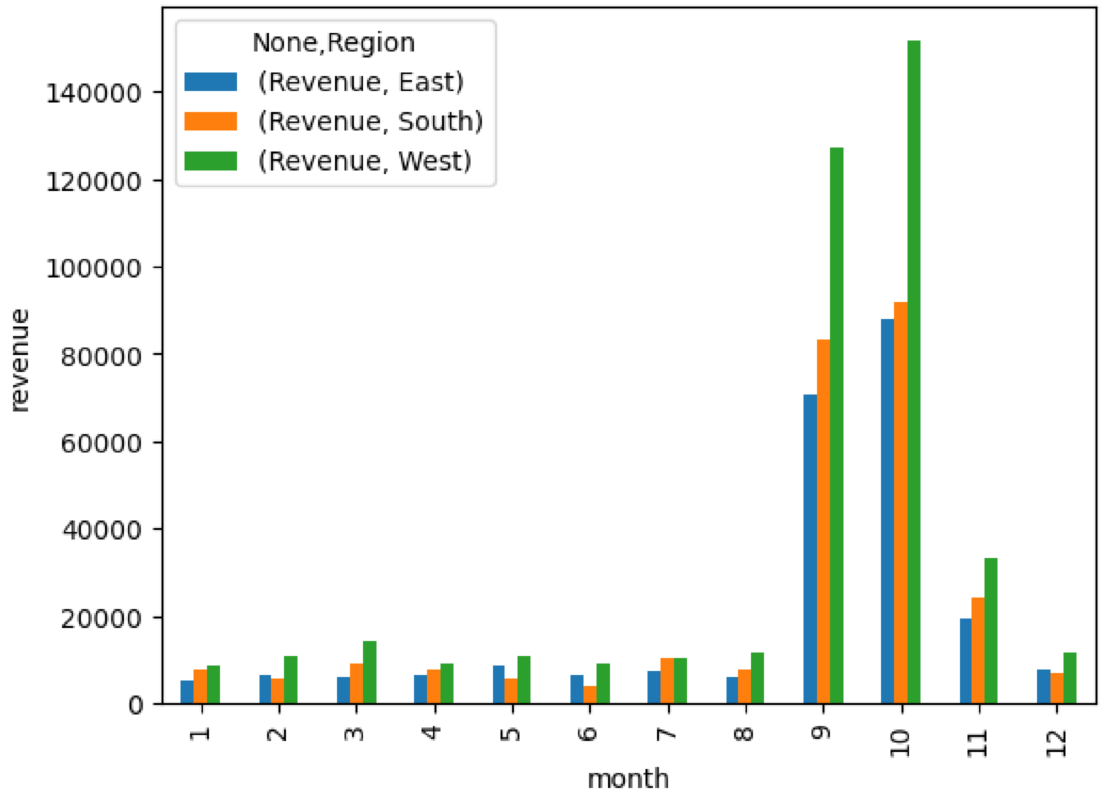
```
C:\Users\pabba\AppData\Local\Temp\ipykernel_15088\3398456180.py:2:
FutureWarning: The provided callable <function sum at 0x000001F00C8E7420> is
currently using DataFrameGroupBy.sum. In a future version of pandas, the
provided callable will be used directly. To keep current behavior pass the
string "sum" instead.
  region_sales=region_sales.pivot_table(values=['Revenue'],index=['month'],colum
ns=['Region'],aggfunc=np.sum)
```

[117]:
```
region_sales
```

```
[117]:          Revenue
       Region      East      South       West
       month
       1         5012.34    7551.55    8550.33
       2         6428.75    5540.10   10864.87
       3         6082.75    8863.80   14087.99
       4         6420.63    7647.28    8865.57
       5         8782.68    5651.30   10962.00
       6         6442.85    3954.90    9020.65
       7         7180.45   10155.59   10150.25
       8         6031.55    7767.60   11567.37
       9        70532.44   83228.39  127160.06
       10       87858.60   92034.70  151780.43
       11       19478.10   24048.59   33196.52
       12        7625.65    6812.70   11831.54
```

```
[118]: region_sales.plot(kind='bar',xlabel='month',ylabel='revenue')
```

```
[118]: <Axes: xlabel='month', ylabel='revenue'>
```



Top 3 products

[125]:
```
product_rev.sort_values(by='Revenue',ascending=False)
```

[125]:
```
          Units    Revenue
Product
Quad       6223  194032.15
Bellen     6579  168175.05
Doublers   3646  149041.93
Sunbell    4500  114283.09
Carlota    4371  101272.05
Aspen      4242   96382.80
Sunshine   4229   85983.80
```

The most productive sales Rep in the respective years.

[ ]:
```

```

[ ]:
```

```