In [34]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import os
```

Performing Data Analysis on the Sales Data

PREPARING THE DATA

In [35]:
```
path = r'D:\*******\Sales\Sales_Data'
```

In [36]:
```
files = [file for file in os.listdir(path)]
files
```

Out[36]:
```
['all_data.csv',
 'Sales_April_2019.csv',
 'Sales_August_2019.csv',
 'Sales_December_2019.csv',
 'Sales_February_2019.csv',
 'Sales_January_2019.csv',
 'Sales_July_2019.csv',
 'Sales_June_2019.csv',
 'Sales_March_2019.csv',
 'Sales_May_2019.csv',
 'Sales_November_2019.csv',
 'Sales_October_2019.csv',
 'Sales_September_2019.csv']
```

In [37]:
```
#Concatinating all datasets to one dataframe

all_data = pd.DataFrame()

for file in files[1:]:
    current_data = pd.read_csv(path + '/' + file)
    all_data = pd.concat([all_data,current_data])

all_data.shape
```

Out[37]:
```
(186850, 6)
```

ANALYSING MONTHLY SALES

In [38]:
```
#check the dataframe
all_data.head()
```

Out[38]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address
0	176558	USB-C Charging Cable	2	11.95	04/19/19 08:46	917 1st St, Dallas, TX 75001
1	NaN	NaN	NaN	NaN	NaN	NaN
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215
3	176560	Google Phone	1	600	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001

In [39]:
```
#check for null values
all_data.isnull().sum()
```

Out[39]:
```
Order ID            545
Product             545
Quantity Ordered    545
Price Each          545
Order Date          545
Purchase Address    545
dtype: int64
```

In [40]:
```
all_data.dropna(how='all',inplace=True)
all_data.shape
```

Out[40]:
```
(186305, 6)
```

In [ ]:
```

```

Finding the best month for sales

In [41]:
```
#Extract month from Order Date
all_data['month'] = all_data['Order Date'].apply(lambda date : date.split('/')[0])
#Check the updatated dataframe
all_data
```

Out[41]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	month
0	176558	USB-C Charging Cable	2	11.95	04/19/19 08:46	917 1st St, Dallas, TX 75001	04
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	04
3	176560	Google Phone	1	600	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	04
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	04
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001	04
...	...	...	...	...	...	...	...
11681	259353	AAA Batteries (4-pack)	3	2.99	09/17/19 20:56	840 Highland St, Los Angeles, CA 90001	09
11682	259354	iPhone	1	700	09/01/19 16:00	216 Dogwood St, San Francisco, CA 94016	09
11683	259355	iPhone	1	700	09/23/19 07:39	220 12th St, San Francisco, CA 94016	09
11684	259356	34in Ultrawide Monitor	1	379.99	09/19/19 17:30	511 Forest St, San Francisco, CA 94016	09
11685	259357	USB-C Charging Cable	1	11.95	09/30/19 00:18	250 Meadow St, San Francisco, CA 94016	09

186305 rows × 7 columns

In [42]:
```
#Check the datatype of feature
all_data.dtypes
```

Out[42]:
```
Order ID            object
Product             object
Quantity Ordered    object
Price Each          object
Order Date          object
Purchase Address    object
month               object
dtype: object
```

In [43]:
```
#check unique values of month feature
all_data['month'].unique()
```

Out[43]:
```
array(['04', '05', 'Order Date', '08', '09', '12', '01', '02', '03', '07',
       '06', '11', '10'], dtype=object)
```

In [44]:
```
#Applying filter to remove invalid entry
filter=all_data['month']=='Order Date'
all_data = all_data[~filter]
```

In [45]:
```
#Convert to month feature to integer
all_data['month'] = all_data['month'].astype('int')
```

```
C:\Users\DELL PC\AppData\Local\Temp\ipykernel_13320\2262781322.py:2: 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 (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  all_data['month'] = all_data['month'].astype('int')
```

In [46]:
```
#Check the datatype of feature
all_data.dtypes
```

Out[46]:
```
Order ID            object
Product             object
Quantity Ordered    object
Price Each          object
Order Date          object
Purchase Address    object
month                int32
dtype: object
```

In [47]:
```
#converting 'Quantity Ordered' feature to int
all_data['Quantity Ordered']=all_data['Quantity Ordered'].astype('int')
all_data['Quantity Ordered'].dtype
```

```
C:\Users\DELL PC\AppData\Local\Temp\ipykernel_13320\1384291444.py:2: 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 (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  all_data['Quantity Ordered']=all_data['Quantity Ordered'].astype('int')
```

Out[47]:
```
dtype('int32')
```

In [48]:
```
#converting 'Price Each' feature to float
all_data['Price Each']=all_data['Price Each'].astype('float')
```

```
C:\Users\DELL PC\AppData\Local\Temp\ipykernel_13320\3981700378.py:2: 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 (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  all_data['Price Each']=all_data['Price Each'].astype('float')
```

In [49]:
```
all_data.dtypes
```

Out[49]:
```
Order ID            object
Product             object
Quantity Ordered     int32
Price Each         float64
Order Date          object
Purchase Address    object
month                int32
dtype: object
```

In [50]:
```
#Add sales feature to dataframe
all_data['sales'] = all_data['Quantity Ordered'] * all_data['Price Each']
all_data.head()
```

```
C:\Users\DELL PC\AppData\Local\Temp\ipykernel_13320\357589813.py:2: 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 (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  all_data['sales'] = all_data['Quantity Ordered'] * all_data['Price Each']
```

Out[50]:

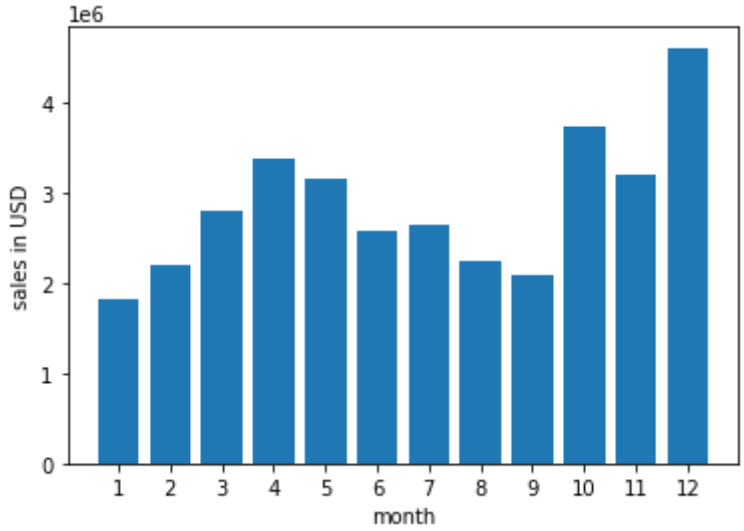
	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	month	sales
0	176558	USB-C Charging Cable	2	11.95	04/19/19 08:46	917 1st St, Dallas, TX 75001	4	23.90
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	11.99
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001	4	11.99

In [51]:
```
#Group by data on month feature
data=all_data.groupby('month')['sales'].sum()
data
```

Out[51]:
```
month
1     1822256.73
2     2202022.42
3     2807100.38
4     3390670.24
5     3152606.75
6     2577802.26
7     2647775.76
8     2244467.88
9     2097560.13
10    3736726.88
11    3199603.20
12    4613443.34
Name: sales, dtype: float64
```

In [52]:
```
#Creating a bar chart
plt.bar(data.index, data)
plt.xticks(data.index)
plt.xlabel('month')
plt.ylabel('sales in USD')
#Conclusion:- December month has the best sales
```

Out[52]: Text(0, 0.5, 'sales in USD')



In [ ]:

Analysing Maximum Order & Hour Analysis

Which city has maximum sales

In [53]:
```
# Extract city form the purchase address
all_data['city'] = all_data['Purchase Address'].apply(lambda city : city.split(',')[-2])
all_data.head()
```

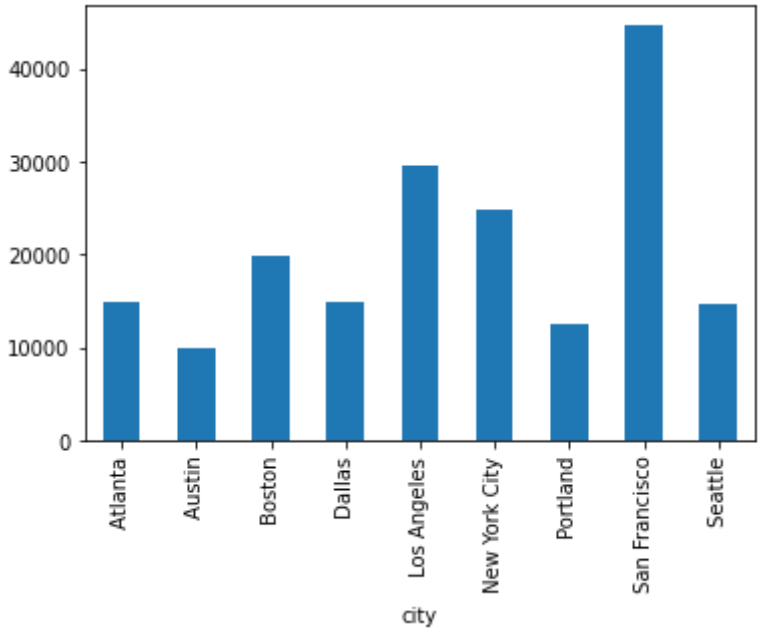
```
C:\Users\DELL PC\AppData\Local\Temp\ipykernel_13320\959901239.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  all_data['city'] = all_data['Purchase Address'].apply(lambda city : city.split(',')[-2])
```

Out[53]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	month	sales	city
0	176558	USB-C Charging Cable	2	11.95	04/19/19 08:46	917 1st St, Dallas, TX 75001	4	23.90	Dallas
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99	Boston
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	11.99	Los Angeles
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001	4	11.99	Los Angeles

In [54]:
```
#Count and plot by city
all_data.groupby('city')['city'].count().plot.bar()
all_data.groupby('city')['city'].count()
#Conclusion:- San Francisco has maximum orders
```

Out[54]:
```
city
 Atlanta          14881
 Austin            9905
 Boston           19934
 Dallas           14820
 Los Angeles      29605
 New York City    24876
 Portland         12465
 San Francisco    44732
 Seattle          14732
Name: city, dtype: int64
```



In [ ]:

At what times sales of a product is maximum

In [55]:
```
#check the datatyope of Order Date feature
all_data['Order Date'].dtypes
#string datatype
```

Out[55]:
```
dtype('O')
```

In [56]:
```
#Convert to datetime and extract hour
all_data['Hour']=pd.to_datetime(all_data['Order Date']).dt.hour
all_data.head()
```

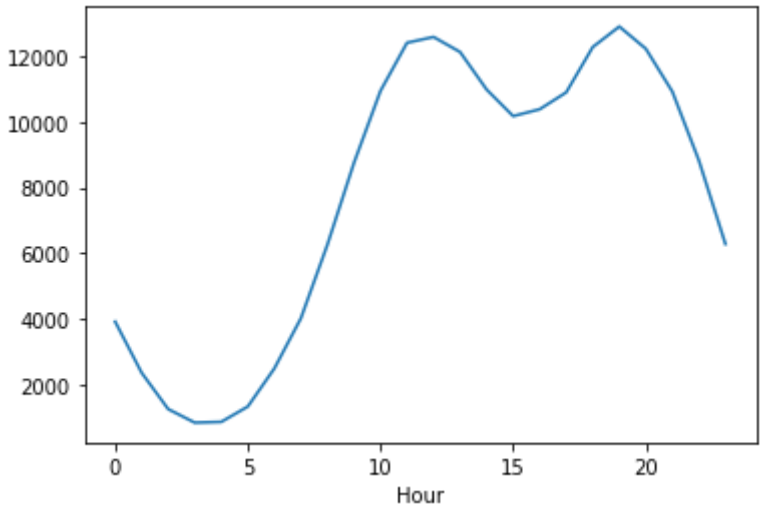
```
C:\Users\DELL PC\AppData\Local\Temp\ipykernel_13320\205359938.py:2: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  all_data['Hour']=pd.to_datetime(all_data['Order Date']).dt.hour
```

Out[56]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	month	sales	city	Hour
0	176558	USB-C Charging Cable	2	11.95	04/19/19 08:46	917 1st St, Dallas, TX 75001	4	23.90	Dallas	8
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99	Boston	22
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles	14
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	11.99	Los Angeles	14
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001	4	11.99	Los Angeles	9

In [57]:
```
# Plot the orders by hours
hour=all_data.groupby('Hour')['Quantity Ordered'].count()
hour.plot.line()
hour.sort_values(ascending=False)
#Conclusion:- 19th hour has maximum orders
```

Out[57]:
```
Hour
19    12905
12    12587
11    12411
18    12280
20    12228
13    12129
14    10984
10    10944
21    10921
17    10899
16    10384
15    10175
22     8822
9      8748
23     6275
8      6256
7      4011
0      3910
6      2482
1      2350
5      1321
2      1243
4       854
3       831
Name: Quantity Ordered, dtype: int64
```



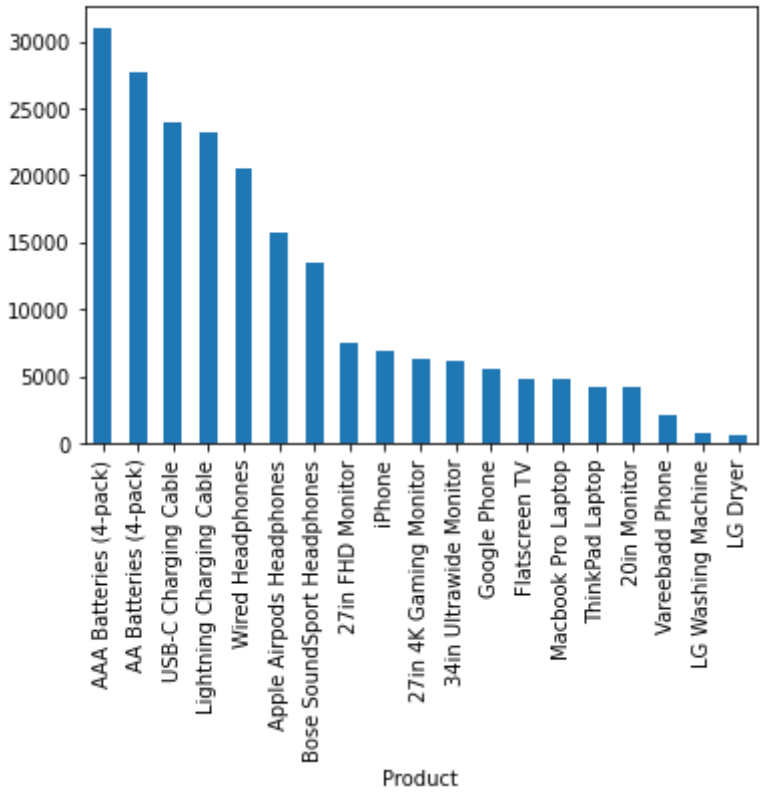
In [ ]:

Analysing Most Sold Products

Which product is most sold and why?

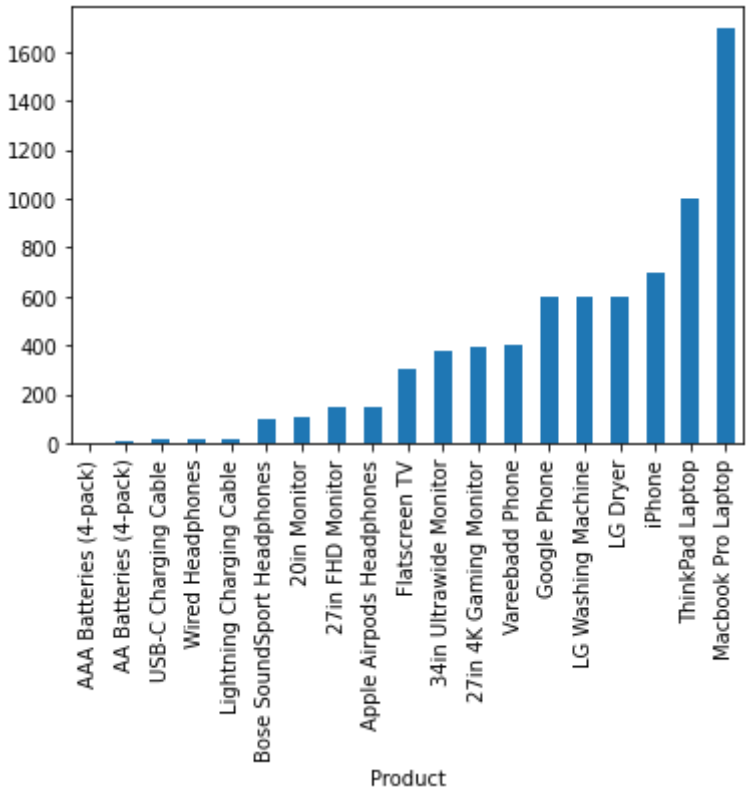
In [58]:
```
#Group by on Product
all_data.groupby('Product')['Quantity Ordered'].sum().sort_values(ascending=False).plot.bar()
all_data.groupby('Product')['Quantity Ordered'].sum().sort_values(ascending=False)
#conclusion:- AAA Batteries (4-pack) is most sold
```

Out[58]:
```
Product
AAA Batteries (4-pack)        31017
AA Batteries (4-pack)         27635
USB-C Charging Cable          23975
Lightning Charging Cable      23217
Wired Headphones              20557
Apple Airpods Headphones      15661
Bose SoundSport Headphones    13457
27in FHD Monitor               7550
iPhone                         6849
27in 4K Gaming Monitor         6244
34in Ultrawide Monitor         6199
Google Phone                   5532
Flatscreen TV                  4819
Macbook Pro Laptop             4728
ThinkPad Laptop                4130
20in Monitor                   4129
Vareebadd Phone                2068
LG Washing Machine              666
LG Dryer                        646
Name: Quantity Ordered, dtype: int32
```


30000
25000
20000
15000
10000
5000
0
AAA Batteries (4-pack)
AA Batteries (4-pack)
USB-C Charging Cable
Lightning Charging Cable
Wired Headphones
Apple Airpods Headphones
Bose SoundSport Headphones
27in FHD Monitor
iPhone
27in 4K Gaming Monitor
34in Ultrawide Monitor
Google Phone
Flatscreen TV
Macbook Pro Laptop
ThinkPad Laptop
20in Monitor
Vareebadd Phone
LG Washing Machine
LG Dryer
Product

In [59]:
```
#check mean price of every product
all_data.groupby('Product')['Price Each'].mean().sort_values().plot(kind='bar')
all_data.groupby('Product')['Price Each'].mean().sort_values()
#conclusion:- AAA Batteries (4-pack) has lowest mean price, so it is the most sold
```

Out[59]:
```
Product
AAA Batteries (4-pack)           2.99
AA Batteries (4-pack)            3.84
USB-C Charging Cable            11.95
Wired Headphones                11.99
Lightning Charging Cable        14.95
Bose SoundSport Headphones      99.99
20in Monitor                   109.99
27in FHD Monitor               149.99
Apple Airpods Headphones       150.00
Flatscreen TV                  300.00
34in Ultrawide Monitor         379.99
27in 4K Gaming Monitor         389.99
Vareebadd Phone                400.00
Google Phone                   600.00
LG Washing Machine             600.00
LG Dryer                       600.00
iPhone                         700.00
ThinkPad Laptop                999.99
Macbook Pro Laptop            1700.00
Name: Price Each, dtype: float64
```


1600
1400
1200
1000
800
600
400
200
0
AAA Batteries (4-pack)
AA Batteries (4-pack)
USB-C Charging Cable
Wired Headphones
Lightning Charging Cable
Bose SoundSport Headphones
20in Monitor
27in FHD Monitor
Apple Airpods Headphones
Flatscreen TV
34in Ultrawide Monitor
27in 4K Gaming Monitor
Vareebadd Phone
Google Phone
LG Washing Machine
LG Dryer
iPhone
ThinkPad Laptop
Macbook Pro Laptop
Product

In [60]:
```
#Creating Twin plots
products = all_data.groupby('Product')['Quantity Ordered'].sum().index
quantity = all_data.groupby('Product')['Quantity Ordered'].sum()
prices = all_data.groupby('Product')['Price Each'].mean()

fig,ax1 = plt.subplots()
ax2=ax1.twinx()
ax1.bar(products,quantity,color='r')
ax2.plot(products,prices, color='g')
ax1.set_xticklabels(products,rotation='vertical')

#conclusion:- cheaper the product, more it will be sold
```

Out[60]:
```
[Text(0, 0, '20in Monitor'),
 Text(1, 0, '27in 4K Gaming Monitor'),
 Text(2, 0, '27in FHD Monitor'),
 Text(3, 0, '34in Ultrawide Monitor'),
 Text(4, 0, 'AA Batteries (4-pack)'),
 Text(5, 0, 'AAA Batteries (4-pack)'),
 Text(6, 0, 'Apple Airpods Headphones'),
 Text(7, 0, 'Bose SoundSport Headphones'),
 Text(8, 0, 'Flatscreen TV'),
 Text(9, 0, 'Google Phone'),
 Text(10, 0, 'LG Dryer'),
 Text(11, 0, 'LG Washing Machine'),
 Text(12, 0, 'Lightning Charging Cable'),
 Text(13, 0, 'Macbook Pro Laptop'),
 Text(14, 0, 'ThinkPad Laptop'),
 Text(15, 0, 'USB-C Charging Cable'),
 Text(16, 0, 'Vareebadd Phone'),
 Text(17, 0, 'Wired Headphones'),
 Text(18, 0, 'iPhone')]
```

In [ ]:

Which Products are most often sold together

In [61]:
```
df=all_data['Order ID'].duplicated(keep=False)
df2=all_data[df]
df2.head()
```

Out[61]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	month	sales	city	Hour
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles	14
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	11.99	Los Angeles	14
18	176574	Google Phone	1	600.00	04/03/19 19:42	20 Hill St, Los Angeles, CA 90001	4	600.00	Los Angeles	19
19	176574	USB-C Charging Cable	1	11.95	04/03/19 19:42	20 Hill St, Los Angeles, CA 90001	4	11.95	Los Angeles	19
30	176585	Bose SoundSport Headphones	1	99.99	04/07/19 11:31	823 Highland St, Boston, MA 02215	4	99.99	Boston	11

In [62]:
```
# creating a new feature in df2 dataframe
df2['Grouped'] = df2.groupby('Order ID')['Product'].transform(lambda x: ','.join(x))
df2.head()
```

```
C:\Users\DELL PC\AppData\Local\Temp\ipykernel_13320\2828232519.py:2: 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 (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy)
  df2['Grouped'] = df2.groupby('Order ID')['Product'].transform(lambda x: ','.join(x))
```

Out[62]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	month	sales	city	Hour	Grouped
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles	14	Google Phone,Wired Headphones
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	11.99	Los Angeles	14	Google Phone,Wired Headphones
18	176574	Google Phone	1	600.00	04/03/19 19:42	20 Hill St, Los Angeles, CA 90001	4	600.00	Los Angeles	19	Google Phone,USB-C Charging Cable
19	176574	USB-C Charging Cable	1	11.95	04/03/19 19:42	20 Hill St, Los Angeles, CA 90001	4	11.95	Los Angeles	19	Google Phone,USB-C Charging Cable
30	176585	Bose SoundSport Headphones	1	99.99	04/07/19 11:31	823 Highland St, Boston, MA 02215	4	99.99	Boston	11	Bose SoundSport Headphones,Bose SoundSport Hea...

In [63]:
```
#Drop duplicate order ID rows
df2 = df2.drop_duplicates(subset=['Order ID'])
df2.head()
```

Out[63]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	month	sales	city	Hour	Grouped
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles	14	Google Phone,Wired Headphones
18	176574	Google Phone	1	600.00	04/03/19 19:42	20 Hill St, Los Angeles, CA 90001	4	600.00	Los Angeles	19	Google Phone,USB-C Charging Cable
30	176585	Bose SoundSport Headphones	1	99.99	04/07/19 11:31	823 Highland St, Boston, MA 02215	4	99.99	Boston	11	Bose SoundSport Headphones,Bose SoundSport Hea...
32	176586	AAA Batteries (4-pack)	2	2.99	04/10/19 17:00	365 Center St, San Francisco, CA 94016	4	5.98	San Francisco	17	AAA Batteries (4-pack),Google Phone
119	176672	Lightning Charging Cable	1	14.95	04/12/19 11:07	778 Maple St, New York City, NY 10001	4	14.95	New York City	11	Lightning Charging Cable,USB-C Charging Cable

In [64]:
```
#Top 5 Products which are most often sold together
df2['Grouped'].value_counts()[0:5].plot.pie()
df2['Grouped'].value_counts()[0:5]
```

Out[64]:
```
iPhone,Lightning Charging Cable          882
Google Phone,USB-C Charging Cable        856
iPhone,Wired Headphones                  361
Vareebadd Phone,USB-C Charging Cable     312
Google Phone,Wired Headphones            303
Name: Grouped, dtype: int64
```