ProductSalesAnalysisUsingPython

TEAM MEMBER

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Phase_1:submissiondocument

ProjectTitle:ProductSalesAnalysisUsingPython

Phase1:ProblemDefinitionandDesignThinking

In this part you will need to understand the problem statement and create adocument on what have you understood and how will you proceed ahead withsolvingthe problem.

ProductSalesAnalysisUsing Python

OVERVIEW

In this post, I use Python Pandas & Python Matplotlib to analyzeandanswerbusinessquestionsabout12monthsworthofsales data.The data contains hundreds of thousands of electronics storepurchases broken down by month, product type, cost, purchaseaddress, etc. The dataset can be downloaded here. In this analysis,I'musingjupyternotebook.

Source:https://www.freepik.com/photos/businessBusinessphotocreatedbycookie_studio —

PROBLEMS

1. Whatwasthebestmonthforsales?Howmuchwasearnedthatmonth?
2. Whatcitysoldthemostproduct?
3. Whattimeshouldwedisplayadvertisementstomaximizelikelihoodofcustomer'sbuyingproducts?
4. WhatProductsaremostoftensoldtogether?
5. Whatproductsoldthemost?Whydoyouthinkitdid?

SOLUTION

1. **Whatwasthebestmonthforsales?Howmuchwasearnedtha tmonth?**

Firstofall,weneedtoseewhatkindofdatawearetryingtoanalyze.wecan simplydothis

Import Necessary Libraries

```
In [3]: 1 import pandas as pd
```

Look at the first 5 datas

```
In [5]: 1 df = pd.read_csv("D:\Self\Online Course\Solve real world Data science task\Pandas-Data-Science-Tasks-master\Pandas-Data
        2
        3 df.head()
```

Out[5]:

	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

Figure1. Codeto show thetop 5 datain Sales_April_2019.csv

Weusepandatoreadthecsvfileandcreateadataframefromit.Thefile’sdi rectorycanbeputanywhere.IpersonallyputitinD.Youcancopy the directory and paste it in the syntax. At Figure 1, we can seethat we have 6 columns. Now the first task is to merge all 12 monthsworth of sales data (12 csv files) into a single csv file. To do that, weneedtoimportnewlibrarycalledos.

```
In [3]:
import pandas as pd
import os
```

Task 1: Merging 12 months of sales data into a single csv file.

```
In [7]:
df = pd.read_csv("D:\Self\Online Course\Solve real world Data science task\Pandas-Data-Science-Tasks-master\Pandas-Data

files = [file for file in os.listdir("D:\Self\Online Course\Solve real world Data science task\Pandas-Data-Science-Task
for file in files:
    print(file)
```

```
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
```

Figure2.Importnew libraryos.

Weneedoslibrarytoreadallcsvfiles'titleandcallitusing*forloop*.As you can see from Figure 2, we successfully read all the csv files'titleandwe'rereadytomergeit.Todothat,wecansimplydo

Import Necessary Libraries

```
In [3]:
import pandas as pd
import os
```

Task 1: Merging 12 months of sales data into a single csv file.

```
In [13]:
df = pd.read_csv("D:\Self\Online Course\Solve real world Data science task\Pandas-Data-Science-Tasks-master\Pandas-Data

files = [file for file in os.listdir("D:\Self\Online Course\Solve real world Data science task\Pandas-Data-Science-Task

all_months_data = pd.DataFrame() #Creating empty dataframe called 'all_month_data'

for file in files:
    df = pd.read_csv("D:\Self\Online Course\Solve real world Data science task\Pandas-Data-Science-Tasks-master\Pandas-
    all_months_data = pd.concat([all_months_data, df]) #Merging to the previous empty dataframe

#Checking the result
all_months_data.to_csv("all_data.csv", index=False) #single csv file contain 12 months data.
```

```
In [ ]:
```

Figure3.Creatinganew file containsall12 monthsdata.

——————————DETAILCODE————————

———

```
importpandasaspdimporto
s

df=pd.read_csv("D:\Self\OnlineCourse\SolverealworldDatascie
nce task\Pandas-Data-Science-Tasks-master\Pandas-Data-
Science-Tasks-
master\SalesAnalysis\Sales_Data\Sales_April_2019.csv")

files=[fileforfileinos.listdir("D:\Self\OnlineCourse\Solverealworld
Data science task\Pandas-Data-Science-Tasks-master\Pandas-
Data-Science-Tasks-master\SalesAnalysis\Sales_Data")]

all_months_data=pd.DataFrame()#Creatingemptydataframecalle
d'all_month_data'

forfileinfiles:
df = pd.read_csv("D:\Self\Online Course\Solve real world
Datascience task\Pandas-Data-Science-Tasks-master\Pandas-
Data-Science-Tasks-
master\SalesAnalysis\Sales_Data/"+file)all_months_data=pd.con
cat([all_months_data,df])#Mergingtothepreviousemptydataframe

#Checkingtheresult
all_months_data.to_csv("all_data.csv",index=False)#singlecsvfile
contain12monthsdata.

————————————————————————
————
```

It will take a little longer time because of heavy computation. Butonceit'sdone,youcanopenthesamedirectoryfolderandcheckthefolder called "Output". You will see a new csv file contains all 12monthsdata.

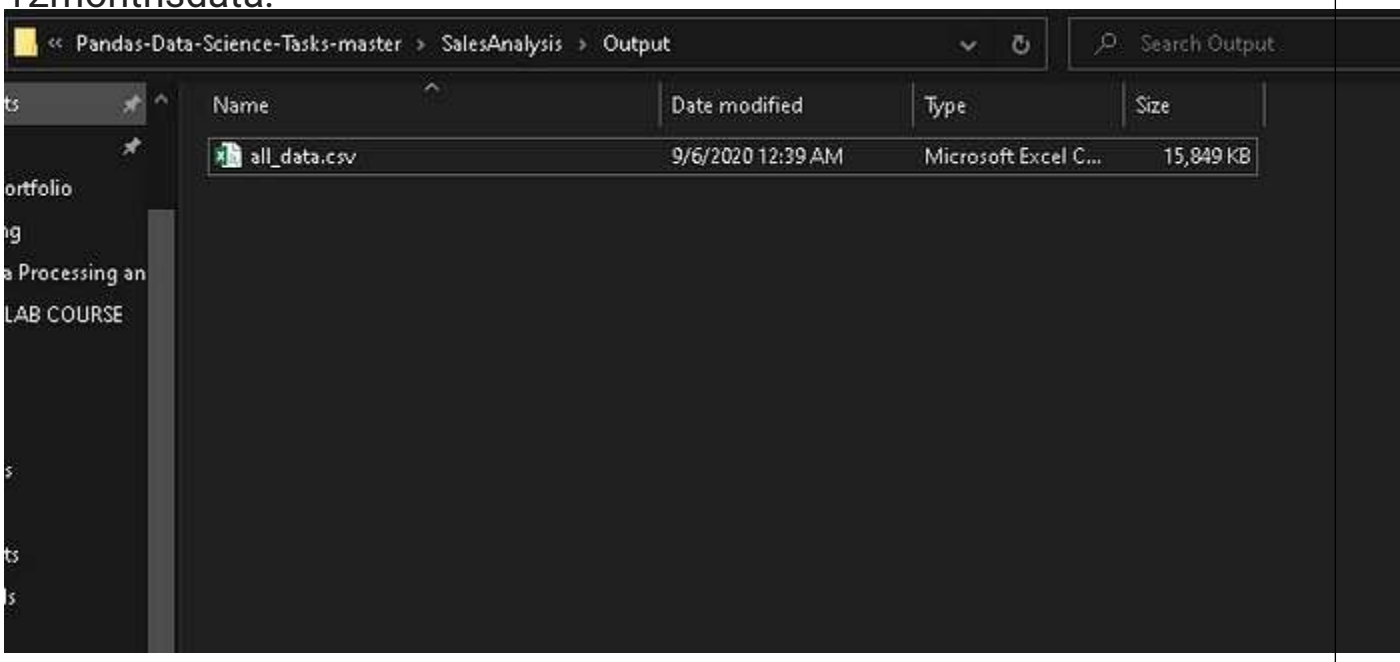


Figure4.A newcsvfilecontainsall12 monthsdata.

Afterwecreatethisnewcsvfile,youcandeletethepreviouscode(ifyouwant)andwewillusethisfiletoanswerallofttheproblems.

Nowweonlyusethiscodetoreadallof12monthsdata.

Reading an updated dataframe

```
In [14]:  1 all_data=pd.read_csv("all_data.csv")
          2 all_data.head()
```

Out[14]:

	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

Figure5.Readinganupdateddataframe

Nowwe’rereadytoanswertheproblemnumber1.Toremindyou,the question is: **What was the best month for sales? Howmuchwasearnedthatmonth?**

To answer this problem, obviously we need an additional columncalled“Month”.IfyoulookcarefullyatFigure5,youwillseethefirst 2 characters in “Order Date” values represent months. So the nexttaskwewilldoistoadd“Month”Column.

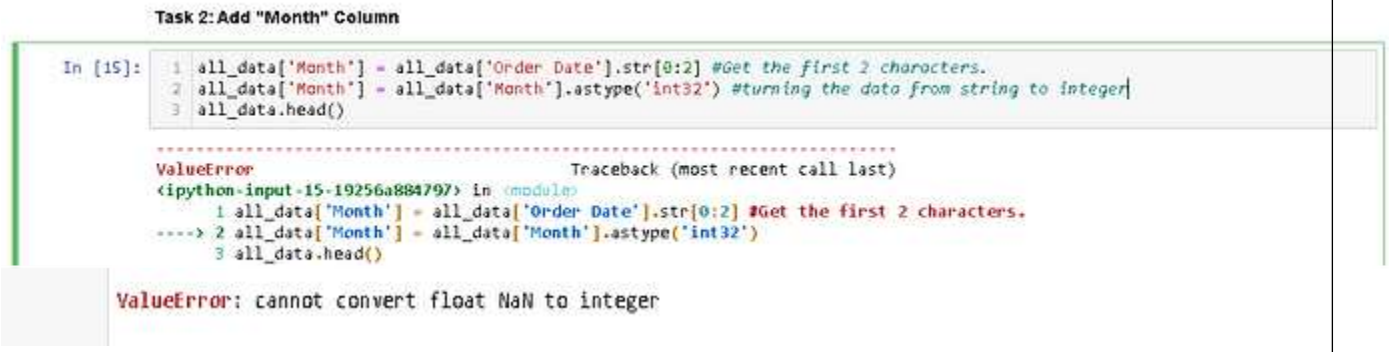
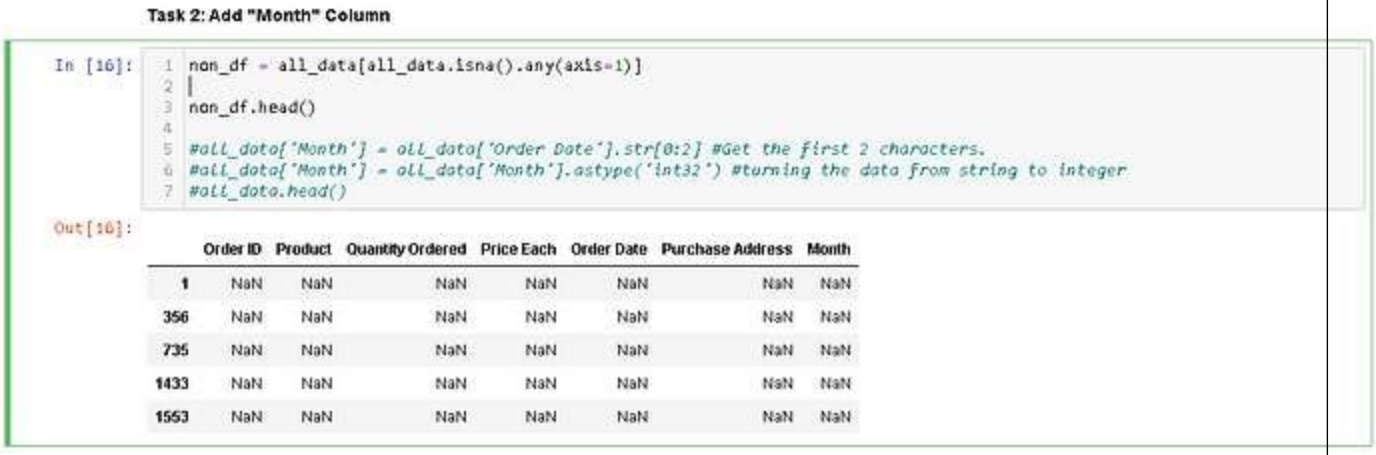


Figure6.Adding“Month”Column

Now, we get an issue here. There are NaN values in our data. YoucouldspotonofNaNvalueatFigure1orFigure5inindex1.Nowwe need to clean up the data by dropping rows of NaN. Let’s spotmoreNaNvaluehere.Youdon’thavetodothis,Iamjustcurious.



	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month
1	NaN	NaN	NaN	NaN	NaN	NaN	NaN
356	NaN	NaN	NaN	NaN	NaN	NaN	NaN
735	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1433	NaN	NaN	NaN	NaN	NaN	NaN	NaN
1553	NaN	NaN	NaN	NaN	NaN	NaN	NaN

Figure7.Spottingthe NaN Valuesin ourdata.

We use *.isna().any(axis=1)* to spot rows containing the NaN values(axis=0tospotcolumncontainingNaNvalues).Now,we'regonn aremoveitfromourdataframeusing.*dropna()*method.

Task 2: Add "Month" Column

```
In [17]:
all_data=all_data.dropna(how='all')

all_data['Month'] = all_data['Order Date'].str[0:2] #Get the first 2 characters.
all_data['Month'] = all_data['Month'].astype('int32') #turning the data from string to integer
all_data.head()
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-17-dcd59b77aa46> in <module>
      2
      3 all_data['Month'] = all_data['Order Date'].str[0:2] #Get the first 2 characters.
----> 4 all_data['Month'] = all_data['Month'].astype('int32') #turning the data from string to integer
      5 all_data.head()

ValueError: invalid literal for int() with base 10: 'Or'
```

Figure8. DroppingtheNaN values from ourdataframe.

*.dropna()*methodissuccessful,butwegetanewissuehere.Therearev alues"Or"inourdata.Let'sfinditfirst.

Task 2: Add "Month" Column

```
In [19]:
#Removing Nan Values in our data
all_data=all_data.dropna(how='all')

#Removing rows based on condition, finding 'Or' and delete it
df_dummy = all_data[all_data['Order Date'].str[0:2]=='Or']
df_dummy.head()

#all_data['Month'] = all_data['Order Date'].str[0:2] #Get the first 2 characters.
#all_data['Month'] = all_data['Month'].astype('int32') #turning the data from string to integer
#all_data.head()
```

Out[19]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month
519	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Or
1149	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Or
1155	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Or
2878	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Or
2893	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Or

Figure9.Finding"Or"valuesinour dataframe.

We can see clearly from Figure 9 that the issue is the rows containthe same words as the title rows. So clearly 'Or' is coming from'OrderDate'.Weneedtodropthis"Or"rowsjustsimplychangetheeq ualsign("==")tonotequalsign("!=").

Task 2: Add "Month" Column

In [20]:
```
#Removing Nan Values in our data
all_data=all_data.dropna(how='all')

#Removing rows based on condition, finding 'Or' and delete it
all_data = all_data[all_data['Order Date'].str[0:2]!='Or']

all_data['Month'] = all_data['Order Date'].str[0:2] #Get the first 2 characters.
all_data['Month'] = all_data['Month'].astype('int32') #turning the data from string to integer
all_data.head()
```

Out[20]:

	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	4
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4
3	176560	Google Phone	1	600	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001	4

Figure10. Droppingall unnecesaryvalues inour dataframe.

WecanseeclearlyfromFigure10thatwesuccessfullycreated“Month” columnandmakeitsdatatypetointeger.

Now, are we ready to answer the question? Not yet, we needobviouslyonemorecolumncalled“Sales”Column.Howcanwegett hat? We get “Sales” by multiplying “Quantity Ordered” and “PriceEach”values. Let’screateit.

Task 2: Add "Month" Column

In [21]:
```
#Removing Nan Values in our data
all_data=all_data.dropna(how='all')

#Removing rows based on condition, finding 'Or' and delete it
all_data = all_data[all_data['Order Date'].str[0:2]!='Or']

#Add "Month" Column
all_data['Month'] = all_data['Order Date'].str[0:2] #Get the first 2 characters.
all_data['Month'] = all_data['Month'].astype('int32') #turning the data from string to integer

#Add "Sales" Column
all_data['Sales'] = all_data['Quantity Ordered']*all_data['Price Each']

all_data.head()
```

```
---------------------------------------------------------------------------
TypeError                                 Traceback (most recent call last)
~\anaconda3\lib\site-packages\pandas\core\ops\array_ops.py in na_arithmetic_op(left, right, op, str_rep)
    148     try:
--> 149         result = expressions.evaluate(op, str_rep, left, right)
    150     except TypeError:

TypeError: can't multiply sequence by non-int of type 'str'
```

Figure11.Adding“Sales”Columninourdataframe.

Now we encounter a new issue. The values of the column “QuantityOrdered” and “Price Each” are strings. So the next task is to convertthesecolumnstothecorrecttype(“QuantityOrdered”isintegera nd“Price Each” is float). We’re gonna use *pd.to_numeric()* method toconvertthem tonumeric.

Task 2: Add "Month" Column

In [22]:
```
#Removing Nan Values in our data
all_data=all_data.dropna(how='all')

#Removing rows based on condition, finding 'Or' and delete it
all_data = all_data[all_data['Order Date'].str[0:2]!='Or']

#Add "Month" Column
all_data['Month'] = all_data['Order Date'].str[0:2] #Get the first 2 characters.
all_data['Month'] = all_data['Month'].astype('int32') #turning the data from string to integer

#Convert 'Quantity Ordered' and 'Price Each' to numeric
all_data['Quantity Ordered'] = pd.to_numeric(all_data['Quantity Ordered']) #Becoming integer
all_data['Price Each'] = pd.to_numeric(all_data['Price Each']) #Becoming float

#Add "Sales" Column
all_data['Sales'] = all_data['Quantity Ordered']*all_data['Price Each']
all_data.head()
```

Out[22]:

	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

Figure12.Converting“QuantityOrdered”and“PriceEach”Columns toNumeric

Nowthe“Sales”Columnissuccessfullycreated,wecananswerthefirst question. What was the best month for sales? How much wasearnedthatmonth?Wecaneasilyansweritby using*groupby(‘Month’).sum()*method.

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

```
In [23]: 1 all_data.groupby('Month').sum()
```

Out[23]:

Month	Quantity Ordered	Price Each	Sales
1	10903	1.811768e+06	1.822257e+06
2	13449	2.188885e+06	2.202022e+06
3	17005	2.791208e+06	2.807100e+06
4	20558	3.367671e+06	3.390670e+06
5	18667	3.135125e+06	3.152607e+06
6	15253	2.562026e+06	2.577802e+06
7	16072	2.632540e+06	2.647776e+06
8	13448	2.230345e+06	2.244468e+06
9	13109	2.084992e+06	2.097560e+06
10	22703	3.715555e+06	3.736727e+06
11	19798	3.180601e+06	3.199603e+06
12	28114	4.588415e+06	4.613443e+06

Figure13. Groupingbymonth and summingthe Sales.

LookcarefullyatFigure13.Wecanclearlyseethatmonth12(Decembe r)isthehighestsalesin2019withapproximately $4,810,000. But we need to visualize it to make our bussinesspartnereasiertounderstand.Sowe’regonnaimportmatplotli bandvisualizingourresultswithbarchart.

Importing Matplotlib

```
In [27]: 1 import matplotlib.pyplot as plt
```

Visualizing our results

```
In [28]: 1 months = range(1,13) #For x axes
         2 results = all_data.groupby('Month').sum()
         3
         4 plt.bar(months, results['Sales'])
         5 plt.show()
```

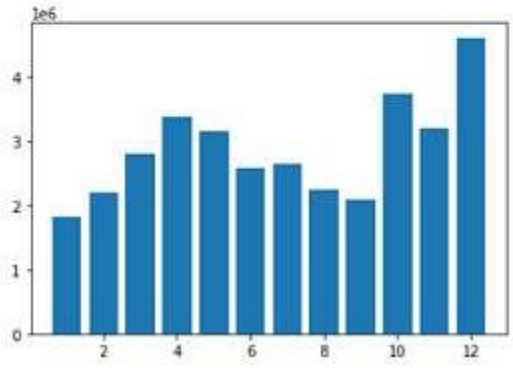


Figure14.Visualizingourresultsusingmatplotliblibrary.

It’sgood.Butweneedtomakeitlooksneater.Sowe’rejustgonnaaddali ttlecode.

Importing Matplotlib

```
In [27]: 1 import matplotlib.pyplot as plt
```

Visualizing our results

```
In [35]: 1  months = range(1,13) #For x axes
         2  results = all_data.groupby('Month').sum()
         3
         4  plt.bar(months, results['Sales'])
         5  plt.xticks(months)
         6  labels, location = plt.yticks()
         7  plt.yticks(labels, (labels/1000000).astype(int)) #Scaling in million USD
         8  plt.ylabel('Sales in million USD')
         9  plt.xlabel('Month Number')
        10  plt.show()
```

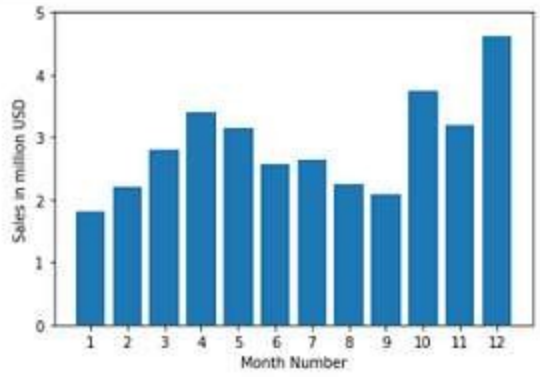


Figure15.Improvingthe visualization.

Now, not only we can get the highest sales, but we can also get thelowestsalesjustbylookingitforafewseconds.Asadatascientist,we havetofigureoutwhyacertainmonthisbetterthanothers.
Maybe the company spend more money on April so the productsales are increasing. Maybe the best product sales are on Decemberbecause it’s holiday and Christmas. Those are just my hyphothesis,right now we don’t have enough data to prove that hypothesis.
Butwecantaketheseasaconsiderationifyouwanttodecidesomethingt hatrelatestoproductsales.

2. Whatcitysoldthemostproduct?

To answer this question, obviously we need to create a new columncalled “City” column. How do we get that? As usual, we’re gonnacheckthetop5datainourdataframetofigureoutwherecanweget our“City”columnusing.*head()*method.

Question 2: What city sold the most product?

Task 3: Add a "City" Column

```
In [11]: 1 all_data.head()
```

Out[11]:

	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

Figure16.ShowingOurTop5 UpdatedDataframe

AsyoucanseeatFigure16,the“PurchaseAddress”Columncontainthe city. We can’t get it directly, we need to extract the data. We canuseoneofmostusefulfunctioninpandas,*.apply()*method.

Question 2: What city sold the most product?

Task 3: Add a "City" Column

```
In [15]: 1 all_data['City'] = all_data['Purchase Address'].apply(lambda x: x.split(',')[1])
         2
         3 all_data.head()
```

Out[15]:

	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

Figure17. Using.apply() Method toExtract TheData

Tomakeitneater,wecanusethis

Question 2: What city sold the most product?

Task 3: Add a "City" Column

In [17]:

```
#Function
def get_city(address):
    return address.split(',')[1]

#Extract the city and the state
all_data['City'] = all_data['Purchase Address'].apply(lambda x: get_city(x))

all_data.head()
```

Out[17]:

	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

Figure18. Usingdef functionto MakeTheCodeNeater

applyandlambdausuallyusedtocreatenewcolumnbasedonothercolumn (example .apply(lambda x: x*2. It means every input x inother column will be changed to x*2 in a new column). In this casewe create “City” column based on “Purchase Address” column andwe split the data into 3 part. The first one is before the first comma(index = 0), the second one is between the commas (index = 1), andthe third on is after the last comma (index = 2). As we need toextractthecitydata,weuse[1]tostateittoindex1.

AsyoucanseeatFigure17,wesuccessfullycreateda“City”column.So are we ready to answer the second question? Not yet. We get anissue here. It’s not error, it’s the value of the “City” Column. This isjust a rare case when there are 2 cities are named exactly the same.Example someone in New England and someone in West Coastwould think Portland in different way. Someone in New Englandthinks Portland as Portland Maine and someone in West CoastthinksPortlandasPortlandOregon.Soinourdatasetweactually

hadtheoverlappingcitiesbetweenthesetwo.So,weshouldalsograbthestate.

Question 2: What city sold the most product?

Task 3: Add a "City" Column

In [18]:
```
#Function
def get_city(address):
    return address.split(',')[1]

def get_state(address):
    return address.split(',')[2].split(' ')[1]

#Extract the city and the state
all_data['City'] = all_data['Purchase Address'].apply(lambda x: get_city(x) + ' ' + get_state(x))

all_data.head()
```

Out[18]:

	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 TX
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99	Boston MA
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles CA
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	11.99	Los Angeles CA
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001	4	11.99	Los Angeles CA

Figure19.Extractingthe stateto“City”Column

Thefunctionget_state()basicallyworksasexplainedbefore.Butinthis function, we seperate the data again become three parts. Thefirst one is before the whitespace (index = 0), the second one isbetween the whitespaces (index = 1), and the third one is after thelast whitespace (index = 2). So that’s why we use *.split(‘ ’)[1*] in thesecondsplit.

Now we’re ready to answer the second question, **what city soldthemostproduct**?Aswedidbefore,we’regonnagroupitbythecityan dsummingallthevaluesbasedonthegroup.

```
In [19]:
1 results2 = all_data.groupby('City').sum()
2 results2
```

Out[19]:

City	Quantity Ordered	Price Each	Month	Sales
Atlanta GA	16602	2.779908e+06	104794	2.795499e+06
Austin TX	11153	1.809874e+06	69829	1.819582e+06
Boston MA	22528	3.637410e+06	141112	3.661642e+06
Dallas TX	16730	2.752628e+06	104620	2.767975e+06
Los Angeles CA	33289	5.421435e+06	208325	5.452571e+06
New York City NY	27932	4.635371e+06	175741	4.664317e+06
Portland ME	2750	4.471893e+05	17144	4.497583e+05
Portland OR	11303	1.860558e+06	70621	1.870732e+06
San Francisco CA	50239	8.211462e+06	315520	8.262204e+06
Seattle WA	16553	2.733296e+06	104941	2.747755e+06

Figure20. Grouping The DataframebyTheCity

It’s too messy, but if you look carefully you can see that SanFransiscoisthehighestsoldproductofallcitieswithapproximately $8,200,000. We clearly need to visualize it because it’s so hard toconcludeanythingjustbasedonthatnumbersandalsoitwillmakeourbussinesspartnereasiertounderstand.

```
In [22]:
1  #We've already import the matplotlib
2
3  cities = all_data['City'].unique()
4
5  plt.bar(cities, results2['Sales'])
6  plt.xticks(cities, rotation='vertical', size = 8)
7  labels, location = plt.yticks()
8  plt.yticks(labels, (labels/1000000).astype(int)) #Scaling in million USD
9  plt.ylabel('Sales in million USD')
10 plt.xlabel('City Name')
11 plt.show()
```

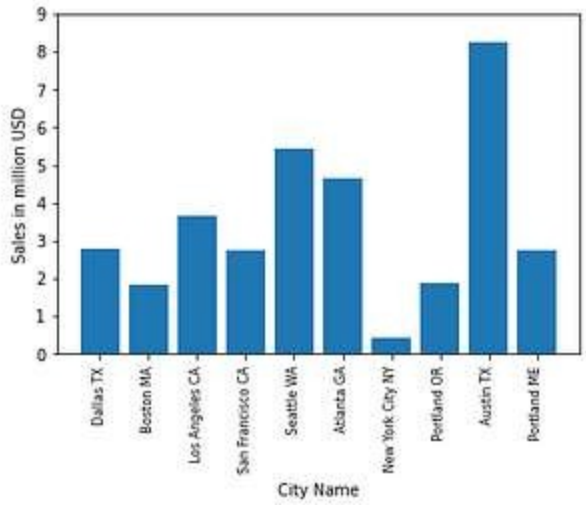


Figure21. Plottingthe Sales Grouped byCities.

Now we successfully plot it. But there is a big issue here. If younoticethatthevalues(Figure20)andtheplot(Figure21)arenotsynchronized. The highest sales should be San Fransisco. What'swrongwithourcode?

There'sanissuebetween.*unique()*methodand*plt.bar()*.Theircitiesorderaredifferent.we'regonnasyncronizedtheorderbysimplyfixingthevariable'cities'.

```
In [23]:
#We've already import the matplotlib

#Fixing the cities order
#cities = all_data['City'].unique()
cities = [city for city, df in all_data.groupby('City')]

plt.bar(cities, results2['Sales'])
plt.xticks(cities, rotation='vertical', size = 8)
labels, location = plt.yticks()
plt.yticks(labels, (labels/1000000).astype(int)) #Scaling in million USD
plt.ylabel('Sales in million USD')
plt.xlabel('City Name')
plt.show()
```

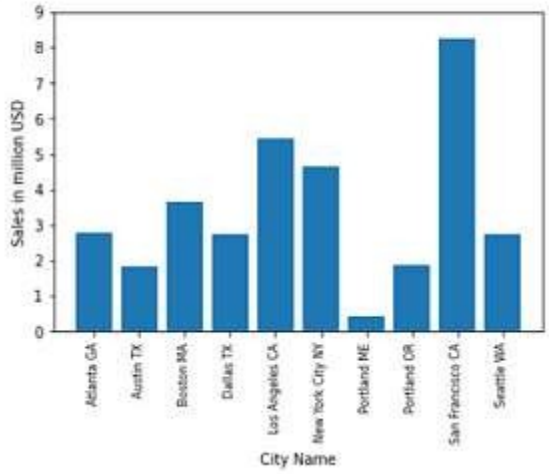


Figure22.FixingTheCode

Now,wefixtheissueandsuccessfullyplotit.Asadatascientist,weneedtofigureoutwhySanFransiscoisthehighestsalecomparetoothercities.MaybeSilliconValleyneedmoreelectronicproducts. MaybetheadvertisementisbetterinSanFransisco.Wecanusethisdatatoimprovethesalesofbussiness.

3. What Time Should We Display Advertisements toMaximizeLikelihoodofCustomer'sBuyingProduct?

Asusual,toremindwhatourdatalooklike,weusethe.head()methodto showthetop5ofourupdateddataframe.

Question 3: What time should we display advertisements to maximize likelihood of customer's buying product?

```
In [24]: 1 all_data.head()
```

Out[24]:

	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 TX
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99	Boston MA
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles CA
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	11.99	Los Angeles CA
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001	4	11.99	Los Angeles CA

Figure23.ShowingourTop5updateddataframe

If we're gonna use our data to answer this question, we need toaggregate the period in 24 hours distribution. Look carefully atFigure 23. In "Order Date" column, there are times data. We couldextractitlikewedidbefore.Buttomakeitmoreconsistent,weneedt o convert the "Order Date" Column into date time object. We'regonnause*pd.to_datetime()* method.

Question 3: What time should we display advertisements to maximize likelihood of customer's buying product?

Task 4: Aggregate the period in 24-hours distribution

```
In [29]: 1 #Create new column in date-time Object (DTO)
         2 all_data['Order_Date_DTO'] = pd.to_datetime(all_data['Order Date'])
         3 all_data.head()
```

Out[29]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month	Sales	City	Order_Date_DTO
0	176558	USB-C Charging Cable	2	11.95	04/19/19 08:46	917 1st St, Dallas, TX 75001	4	23.90	Dallas TX	2019-04-19 08:46:00
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99	Boston MA	2019-04-07 22:30:00
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles CA	2019-04-12 14:38:00
4	176560	Wired Headphones	1	11.99	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	11.99	Los Angeles CA	2019-04-12 14:38:00
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001	4	11.99	Los Angeles CA	2019-04-30 09:27:00

Figure24.Convertingthe"Order Date"Columninto Date-TimeObject

It will take a little bit longer because of the heavy calculation. Nowwecancreateanewcolumncalled“Hour”containtheextractionof“ Order_Date_DTO” data. We only need the hours data, so we canextractthem bydoingthis.

Task 4: Aggregate the period in 24-hours distribution

In [30]:
```
#Create new column in date-time Object (DTO)
all_data['Order_Date_DTO'] = pd.to_datetime(all_data['Order Date'])

#Extraction the hours data
all_data['Hour'] = all_data['Order_Date_DTO'].dt.hour

all_data.head()
```

Out[30]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month	Sales	City	Order_Date_DTO	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 TX	2019-04-19 08:46:00	8
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99	Boston MA	2019-04-07 22:30:00	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 CA	2019-04-12 14:38:00	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 CA	2019-04-12 14:38:00	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 CA	2019-04-30 09:27:00	9

Figure25.ExtractingTheHours Data IntoTheNewColumn

Now we can answer the third question, **what time should wedisplay advertisements to maximize likelihood ofcustomer’sbuyingproduct?**Toanswerthis,we’regonnagroupitbyth ehoursandcountingalloftheorders.

In [40]:
```
results3 = all_data.groupby(['Hour']).count()
results3
```

Out[40]:

Hour	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month	Sales	City	Order_Date_DTO
0	3910	3910	3910	3910	3910	3910	3910	3910	3910	3910
1	2350	2350	2350	2350	2350	2350	2350	2350	2350	2350
2	1243	1243	1243	1243	1243	1243	1243	1243	1243	1243
3	831	831	831	831	831	831	831	831	831	831
4	854	854	854	854	854	854	854	854	854	854
5	1321	1321	1321	1321	1321	1321	1321	1321	1321	1321
6	2482	2482	2482	2482	2482	2482	2482	2482	2482	2482
7	4011	4011	4011	4011	4011	4011	4011	4011	4011	4011
8	6256	6256	6256	6256	6256	6256	6256	6256	6256	6256
9	8748	8748	8748	8748	8748	8748	8748	8748	8748	8748
10	10944	10944	10944	10944	10944	10944	10944	10944	10944	10944
11	12411	12411	12411	12411	12411	12411	12411	12411	12411	12411
12	12587	12587	12587	12587	12587	12587	12587	12587	12587	12587

13	12129	12129	12129	12129	12129	12129	12129	12129	12129	12129
14	10984	10984	10984	10984	10984	10984	10984	10984	10984	10984
15	10175	10175	10175	10175	10175	10175	10175	10175	10175	10175
16	10384	10384	10384	10384	10384	10384	10384	10384	10384	10384
17	10899	10899	10899	10899	10899	10899	10899	10899	10899	10899
18	12280	12280	12280	12280	12280	12280	12280	12280	12280	12280
19	12905	12905	12905	12905	12905	12905	12905	12905	12905	12905
20	12228	12228	12228	12228	12228	12228	12228	12228	12228	12228
21	10921	10921	10921	10921	10921	10921	10921	10921	10921	10921
22	8822	8822	8822	8822	8822	8822	8822	8822	8822	8822
23	6275	6275	6275	6275	6275	6275	6275	6275	6275	6275

Figure26. Groupingthedatabythe hours

Ifwewanttoanswerthethirdquestion,weonlyneedthe“QuantityOrdered” column. Now let’s visualize it. We want it to be the linechart because this spesific data (hours) are more logical to showusinglinechartthanbarchartbecausethedatahastobecontinue.

```
In [41]:
#Plotting
results3 = all_data.groupby(['Hour'])['Quantity Ordered'].count()
hours = [hour for hour, df in all_data.groupby('Hour')]

plt.plot(hours, results3)
plt.xticks(hours)
plt.xlabel('Hour')
plt.ylabel('Number of Orders')
plt.grid()
plt.show()
```

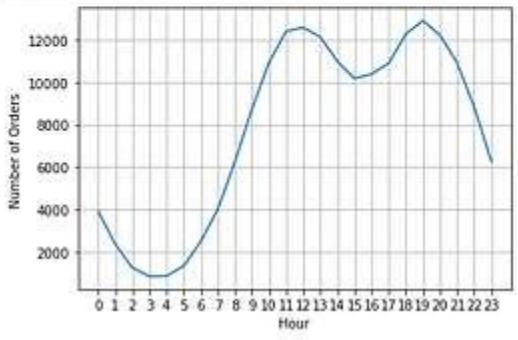


Figure27. VisualizingtheNumber of Orders in24 hours format

AsyoucanseefromFigure27,thereareapproximately2peaksattheda ta.Theyare12(12PM)and19(7PM).Itmakessensesincemost people shopping during the day. From this data, we cansuggest to our bussiness partner to advertise their product rightbefore12PMand/or7PM.Itcouldbe11.30AMand/or6.30PM.

Remember,thischartisthetotalordersof**allcities**.Maybeyoucould make a spesific chart for a spesific city and planning theadvertisementbetterforthatcity.

4. WhatProductsAreMostOftenSoldTogether?

We’regonnatakealooktoourtop5dataasusual.

Question 4: What products are most often sold together?

```
In [42]: all_data.head()
```

Out[42]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month	Sales	City	Order_Date_DTO	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 TX	2019-04-19 08:46:00	8
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99	Boston MA	2019-04-07 22:30:00	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 CA	2019-04-12 14:38:00	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 CA	2019-04-12 14:38:00	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 CA	2019-04-30 09:27:00	9

Figure28.ShowingOurTop 5Updated Dataframe

Look carefully at Figure 28. We can see that “Order ID” indicate thetransaction.Sobygroupingtheproductbytheorderid,weareabletok nowwhatproductsareoftensoldtogether.We’regonnause .duplicated()methodtofindaduplicatevaluesof“OrderID”.

Task 5: Make a new column called "Product Bundle"

```
In [43]: #Make a new dataframe to seperate the duplicated values of Order ID
         new_all = all_data[all_data['Order ID'].duplicated(keep=False)]
         new_all.head(20)
```

Out[43]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month	Sales	City	Order_Date_DTO	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 CA	2019-04-12 14:38:00	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 CA	2019-04-12 14:38:00	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 CA	2019-04-03 19:42:00	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 CA	2019-04-03 19:42:00	19
30	176585	Bose SoundSport Headphones	1	99.99	04/07/19 11:31	823 Highland St, Boston, MA 02215	4	99.99	Boston MA	2019-04-07 11:31:00	11
31	176585	Bose SoundSport Headphones	1	99.99	04/07/19 11:31	823 Highland St, Boston, MA 02215	4	99.99	Boston MA	2019-04-07 11:31:00	11
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 CA	2019-04-10 17:00:00	17

33	176586	Google Phone	1	600.00	04/10/19 17:00	365 Center St, San Francisco, CA 94016	4	600.00	San Francisco CA	2019-04-10 17:00:00	17
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 NY	2019-04-12 11:07:00	11
120	176672	USB-C Charging Cable	1	11.95	04/12/19 11:07	778 Maple St, New York City, NY 10001	4	11.95	New York City NY	2019-04-12 11:07:00	11
129	176681	Apple Airpods Headphones	1	150.00	04/20/19 10:39	331 Cherry St, Seattle, WA 98101	4	150.00	Seattle WA	2019-04-20 10:39:00	10
130	176681	ThinkPad Laptop	1	999.99	04/20/19 10:39	331 Cherry St, Seattle, WA 98101	4	999.99	Seattle WA	2019-04-20 10:39:00	10
138	176689	Bose SoundSport Headphones	1	99.99	04/24/19 17:15	659 Lincoln St, New York City, NY 10001	4	99.99	New York City NY	2019-04-24 17:15:00	17
139	176689	AAA Batteries (4-pack)	2	2.99	04/24/19 17:15	659 Lincoln St, New York City, NY 10001	4	5.98	New York City NY	2019-04-24 17:15:00	17
189	176739	34in Ultrawide Monitor	1	379.99	04/05/19 17:38	730 6th St, Austin, TX 73301	4	379.99	Austin TX	2019-04-05 17:38:00	17
190	176739	Google Phone	1	600.00	04/05/19 17:38	730 6th St, Austin, TX 73301	4	600.00	Austin TX	2019-04-05 17:38:00	17
225	176774	Lightning Charging Cable	1	14.95	04/25/19 15:06	372 Church St, Los Angeles, CA 90001	4	14.95	Los Angeles CA	2019-04-25 15:06:00	15
226	176774	USB-C Charging Cable	1	11.95	04/25/19 15:06	372 Church St, Los Angeles, CA 90001	4	11.95	Los Angeles CA	2019-04-25 15:06:00	15

Figure29.ShowingOurTop20 DuplicatedDataframe

Now we want to create a column called “Product Bundle” thatcontain example *Google Phone* and *Wired Headphone* (transaction17650)atthesameline.We’regonnausethe.*transform()*me thodtojoinvaluesfromtworowsintoasinglerow.

Question 4: What products are most often sold together?

Task 5: Make a new column called "Product Bundle"

In [44]:
```
#Make a new dataframe to seperate the duplicated values of Order ID
new_all = all_data[all_data['Order ID'].duplicated(keep=False)]

#Joining few products with the same Order ID into the same line.
new_all['Product_Bundle'] = new_all.groupby('Order ID')['Product'].transform(lambda x: ','.join(x))

new_all.head()
```

Out[44]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month	Sales	City	Order_Date_DTO	Hour	Product_Bundle
3	176560	Google Phone	1	600.00	04/12/19 14:38	669 Spruce St, Los Angeles, CA 90001	4	600.00	Los Angeles CA	2019-04-12 14:38:00	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 CA	2019-04-12 14:38:00	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 CA	2019-04-03 19:42:00	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 CA	2019-04-03 19:42:00	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 MA	2019-04-07 11:31:00	11	Bose SoundSport Headphones,Bose SoundSport Hea...

Figure30.JoiningFewProductsWithTheSameOrderID IntoTheSame Line

It’sgood,butwehaveanissuehere.Wehavethesameorderatleasttwice because we did merge them in every situation in groupbywithout dropping the duplicate values. Now let’s drop the rows withduplicatevalues.

Question 4: What products are most often sold together? ¶

Task 5: Make a new column called "Product Bundle"

In [18]:
```
#Make a new dataframe to seperate the duplicated values of Order ID
new_all = all_data[all_data['Order ID'].duplicated(keep=False)]

#Joining few products with the same Order ID into the same line.
new_all['Product_Bundle'] = new_all.groupby('Order ID')['Product'].transform(lambda x: ','.join(x))

#Dropping the duplicate values
new_all = new_all[['Order ID','Product_Bundle']].drop_duplicates()

new_all.head()
```

Out[18]:

	Order ID	Product_Bundle
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

Figure31.Droppingrows withduplicatevalues

Now, we need to count the pair of products. We need new librariesbecause they have all we need to count all the combination ofproductsbundle.We’regonnause*itertools*and*collections*libraries.

Task 6: Counting the Product bundles

In [21]:
```
#Importing libraries
from itertools import combinations
from collections import Counter

count = Counter()

for row in new_all['Product_Bundle']:
    row_list = row.split(',')
    count.update(Counter(combinations(row_list,2))) #Counting all the 2 products bundle
print(count)
```

```
Counter({('iPhone', 'Lightning Charging Cable'): 1005, ('Google Phone', 'USB-C Charging Cable'): 987, ('iPhone', 'Wired Hea
dphones'): 447, ('Google Phone', 'Wired Headphones'): 414, ('Vareebadd Phone', 'USB-C Charging Cable'): 361, ('iPhone', 'Ap
ple Airpods Headphones'): 360, ('Google Phone', 'Bose SoundSport Headphones'): 220, ('USB-C Charging Cable', 'Wired Headpho
nes'): 160, ('Vareebadd Phone', 'Wired Headphones'): 143, ('Lightning Charging Cable', 'Wired Headphones'): 92, ('Lightning
Charging Cable', 'Apple Airpods Headphones'): 81, ('Vareebadd Phone', 'Bose SoundSport Headphones'): 80, ('USB-C Charging C
able', 'Bose SoundSport Headphones'): 77, ('Apple Airpods Headphones', 'Wired Headphones'): 69, ('Lightning Charging Cabl
e', 'USB-C Charging Cable'): 58, ('Lightning Charging Cable', 'AA Batteries (4-pack)'): 55, ('Lightning Charging Cable', 'L
ightning Charging Cable'): 54, ('Bose SoundSport Headphones', 'Wired Headphones'): 53, ('AA Batteries (4-pack)', 'Lightning
Charging Cable'): 51, ('AAA Batteries (4-pack)', 'USB-C Charging Cable'): 50, ('Apple Airpods Headphones', 'AAA Batteries
(4-pack)'): 48, ('AA Batteries (4-pack)', 'AAA Batteries (4-pack)'): 48, ('USB-C Charging Cable', 'USB-C Charging Cable'):
48, ('AAA Batteries (4-pack)', 'AAA Batteries (4-pack)'): 48, ('USB-C Charging Cable', 'AAA Batteries (4-pack)'): 45, ('Wir
ed Headphones', 'USB-C Charging Cable'): 45, ('AA Batteries (4-pack)', 'Wired Headphones'): 44, ('AAA Batteries (4-pack)',
'Lightning Charging Cable'): 44, ('AAA Batteries (4-pack)', 'Wired Headphones'): 43, ('Wired Headphones', 'AAA Batteries (4
-pack)'): 43, ('USB-C Charging Cable', 'Lightning Charging Cable'): 42, ('AA Batteries (4-pack)', 'Apple Airpods Headphone
s'): 41, ('AAA Batteries (4-pack)', 'AA Batteries (4-pack)'): 39, ('Wired Headphones', 'AA Batteries (4-pack)'): 39, ('Ligh
tning Charging Cable', 'Bose SoundSport Headphones'): 39, ('USB-C Charging Cable', 'AA Batteries (4-pack)'): 38, ('Bose Sou
ndSport Headphones', 'AAA Batteries (4-pack)'): 37, ('AA Batteries (4-pack)', 'USB-C Charging Cable'): 37, ('Wired Headphon
es', 'Lightning Charging Cable'): 37, ('Lightning Charging Cable', 'AAA Batteries (4-pack)'): 36, ('Apple Airpods Headphone
s', 'Lightning Charging Cable'): 35, ('Wired Headphones', 'Wired Headphones'): 35, ('AA Batteries (4-pack)', 'AA Batteries
```

Figure32.Countingthe ProductBundle

It’stoomessy,let’sjustshowingthetop10data

Task 6: Counting the Product bundles

```
In [23]:
#Importing Libraries
from itertools import combinations
from collections import Counter

count = Counter()

for row in new_all['Product_Bundle']:
    row_list = row.split(',')
    count.update(Counter(combinations(row_list,2))) #Counting all the 2 products bundle

count.most_common(10)
```

```
Out[23]: [(('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)]
```

Figure33. ShowingThe Top 102-Product Bundles

Nowwecanclearlyseethatthemostoftenproductssoldtogetherarei PhoneandLightningChargingCablewith1005transactions. Wecouldcountthe3productbundlesbyjustchangingthe*cou nt.update*indexinto3.

Task 6: Counting the Product bundles

```
In [24]:
#Importing Libraries
from itertools import combinations
from collections import Counter

count = Counter()

for row in new_all['Product_Bundle']:
    row_list = row.split(',')
    #count.update(Counter(combinations(row_list,2))) #Counting all the 2 products bundle
    count.update(Counter(combinations(row_list,3))) #Counting all the 3 products bundle

count.most_common(10)
```

```
Out[24]: [(('Google Phone', 'USB-C Charging Cable', 'Wired Headphones'), 87),
 (('iPhone', 'Lightning Charging Cable', 'Wired Headphones'), 62),
 (('iPhone', 'Lightning Charging Cable', 'Apple Airpods Headphones'), 47),
 (('Google Phone', 'USB-C Charging Cable', 'Bose SoundSport Headphones'), 35),
 (('Vareebadd Phone', 'USB-C Charging Cable', 'Wired Headphones'), 33),
 (('iPhone', 'Apple Airpods Headphones', 'Wired Headphones'), 27),
 (('Google Phone', 'Bose SoundSport Headphones', 'Wired Headphones'), 24),
 (('Vareebadd Phone', 'USB-C Charging Cable', 'Bose SoundSport Headphones'),
  16),
 (('USB-C Charging Cable', 'Bose SoundSport Headphones', 'Wired Headphones'),
  5),
 (('Vareebadd Phone', 'Bose SoundSport Headphones', 'Wired Headphones'), 5)]
```

Figure34. ShowingThe Top 103-Product Bundles

We can see the most often sold products (3 products) together areGooglePhone,USB-CChargingCable,andWiredHeadphoneswith87 transactions. It’s not really significant compare to the 2-ProductBundle.Sowe’regonnaignorethe3-Productbundle.

What would we do with this data? Well, we could offer a smart dealtothecustomerthatbuyiPhone,youcouldrecommendthecharging cablewithdiscount.That’soneofthepossibilityandyoucanbundlethere mainingproductsifyouneedto.

5. Whatproductsoldthemost?Whydoyouthinkitdid?

Asusual,let’sseeourdatalookslikeagain.

Question 5: What Product sold the most? Why do you think it did?

```
In [25]: 1 all_data.head()
```

Out[25]:

	Order ID	Product	Quantity Ordered	Price Each	Order Date	Purchase Address	Month	Sales	City	Order_Date_DTO	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 TX	2019-04-19 08:46:00	8
2	176559	Bose SoundSport Headphones	1	99.99	04/07/19 22:30	682 Chestnut St, Boston, MA 02215	4	99.99	Boston MA	2019-04-07 22:30:00	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 CA	2019-04-12 14:38:00	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 CA	2019-04-12 14:38:00	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 CA	2019-04-30 09:27:00	9

Figure35.ShowingOutTop 5Updated Dataframe

Weneedtosumupthe“QuantityOrdered”basedongroupingtheProduct.Solet’sdoit.

Question 5: What Product sold the most? Why do you think it did?

Task 7: Grouping by the product

In [27]:
```
product_group = all_data.groupby('Product')
product_group.sum()
```

Out[27]:

Product	Quantity Ordered	Price Each	Month	Sales	Hour
20in Monitor	4129	451068.99	29336	454148.71	58764
27in 4K Gaming Monitor	6244	2429637.70	44440	2435097.56	90916
27in FHD Monitor	7550	1125974.93	52658	1132424.50	107540
34in Ultrawide Monitor	6199	2348718.19	43304	2355558.01	89076
AA Batteries (4-pack)	27635	79015.68	145558	106118.40	298342
AAA Batteries (4-pack)	31017	61716.59	140370	92740.83	297332
Apple Airpods Headphones	15661	2332350.00	109477	2349150.00	223304
Bose SoundSport Headphones	13457	1332366.75	94113	1345565.43	192445
Flatscreen TV	4819	1440000.00	34224	1445700.00	68815
Google Phone	5532	3315000.00	38305	3319200.00	79479
LG Dryer	646	387600.00	4383	387600.00	9326
LG Washing Machine	666	399600.00	4523	399600.00	9785
Lightning Charging Cable	23217	323787.10	153092	347094.15	312529
Macbook Pro Laptop	4728	8030800.00	33548	8037600.00	68261
ThinkPad Laptop	4130	4127958.72	28950	4129958.70	59746
USB-C Charging Cable	23975	261740.85	154819	286501.25	314645
Vareebadd Phone	2068	826000.00	14309	827200.00	29472
Wired Headphones	20557	226395.18	133397	246478.43	271720
iPhone	6849	4789400.00	47941	4794300.00	98657

Figure36. Groupingbythe Product

Tomakeiteasiertounderstand,let’svisualizeit.

Question 5: What Product sold the most? Why do you think it did?

Task 7: Grouping by the product

In [28]:
```
product_group = all_data.groupby('Product')

#Visualizing
quantity_ordered = product_group.sum()['Quantity Ordered']

products = [product for product, df in product_group]

plt.bar(products, quantity_ordered)
plt.ylabel('Quantity Ordered')
plt.xlabel('Product')
plt.xticks(products, rotation='vertical', size=8)
plt.show()
```

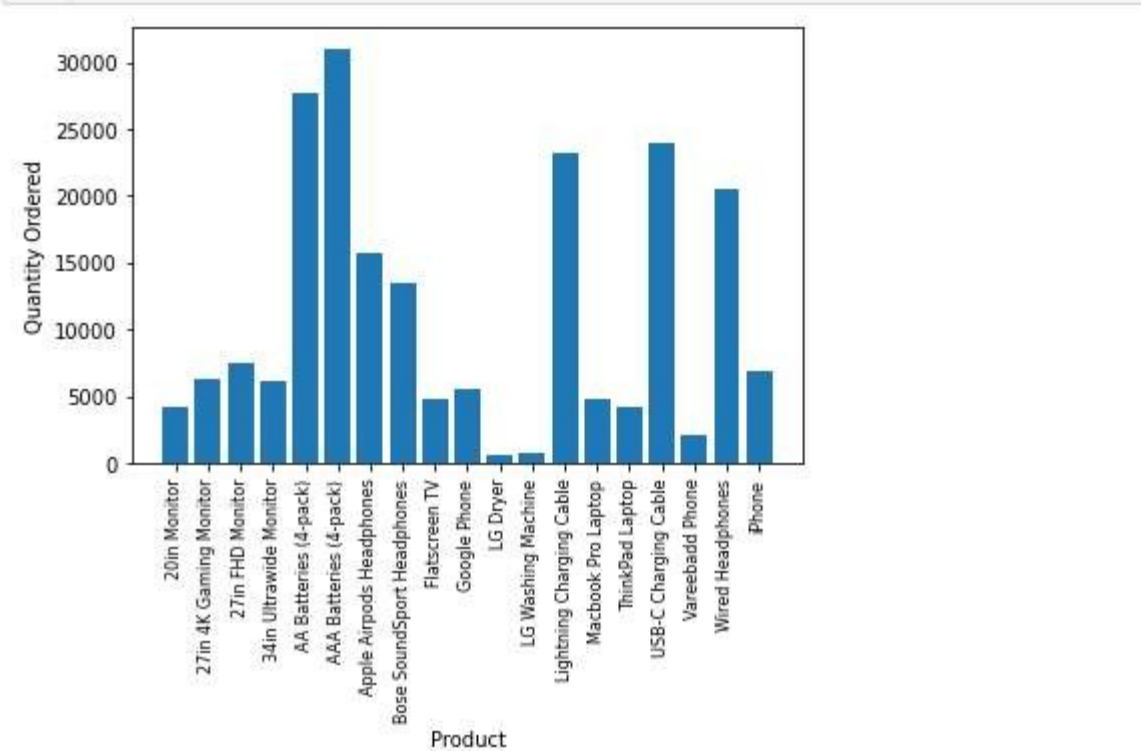


Figure37.VisualizingTheGroupedProduct.

Now we can see what product sold the most, it's AAA Batteries(4pack). We can also see that AA Batteries (4 pack), LightningChargingCable,USB-CChargingCable,andWiredHeadphonesaresold more than other products. Why are they sold the most? Thefirst impression is that they are cheaper than other products. As adata scientist, let's prove this hypothesis. We could do it byoverlayingthegraphbytheiractualpriceandseeiftheyhavedirectcorrelation.

Task 8: Overlaying a second y-axis on existing chart ¶

In [33]:

```
prices = all_data.groupby('Product').mean()['Price Each']

fig, ax1 = plt.subplots()

ax2 = ax1.twinx()
ax1.bar(products, quantity_ordered, color='g')
ax2.plot(products, prices, 'b-')

ax1.set_xlabel('Product Name')
ax1.set_ylabel('Quantity Ordered', color='g')
ax2.set_ylabel('Price ($)', color = 'b')
ax1.set_xticklabels(products, rotation='vertical', size=8)

plt.show()
```

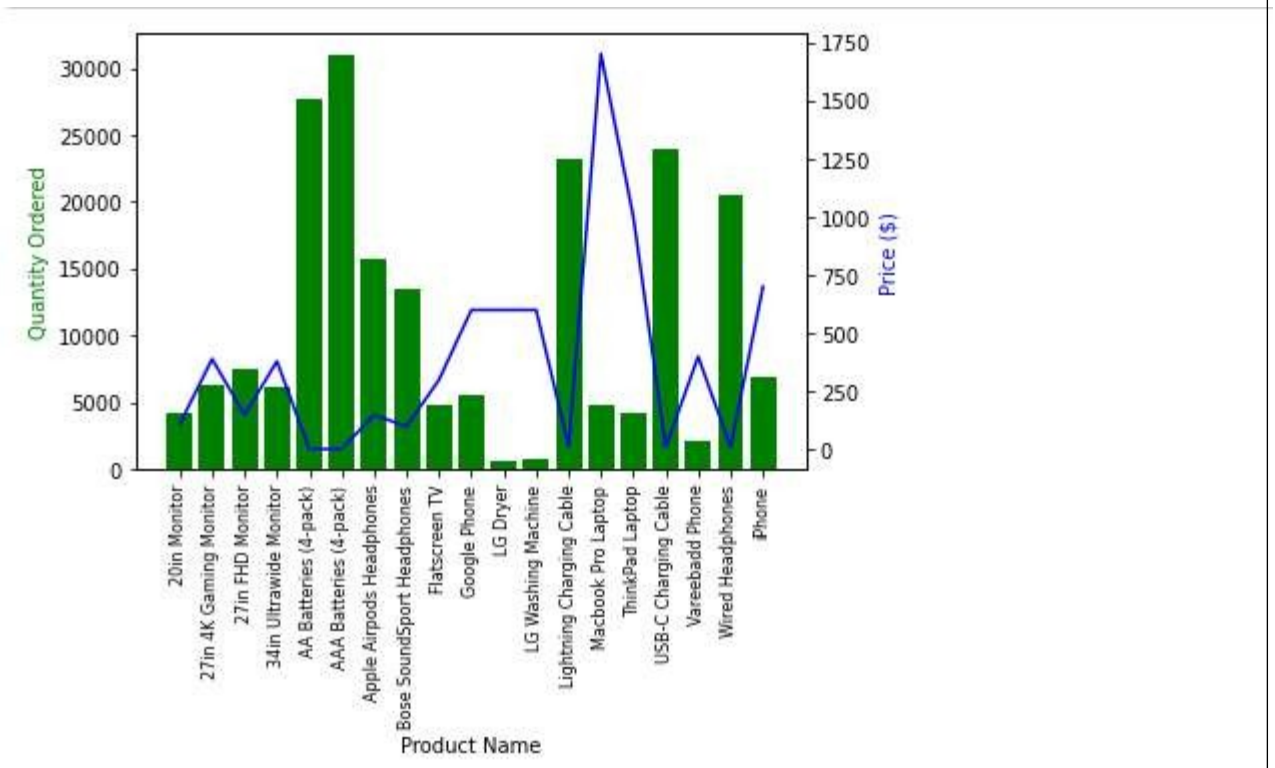


Figure38.OverlayingTheSecondy-axis

Nowwewillinterprateourresults.Ourhypothesisistrueifthehighsold products have low price. From the graph we can see it is thecase for AAA Batteries and all products except the Macbook ProLaptop and ThinkPad Laptop. They have decent orders eventhoughthey are expensive. We can say that there are many people in theworld need laptops. So the laptops are the exception because thelaptopshavehighdemand.

CONCLUSION

1. **Whatwasthebestmonthforsales?Howmuchwasearnedthatmonth?**

ThebestmonthforsalesisDecember.Thecompanyearnedapproximately$4,810,000.

2. **Whatcitysoldthemostproduct?**

SanFransiscoisthecitywiththehighestsales.

3. **Whattimeshouldwedisplayadvertisementsto maximizelikelihoodofcustomer'sbuyingproducts?**

Wecansuggesttoadvertisetheproductsrightbefore12PMand/or7PM. Itcouldbe**11.30AMand/or6.30PM**.

4. **WhatProductsaremostoftensoldtogether?**

Themostoftenproductssoldtogetherare**iPhoneandLightningChargingCable**with1005transactions.

5. **Whatproductsoldthemost?Whydoyouthinkitdid?**

AAABatteries(4pack)isthemostsoldproduct.Becauseit'scheaperthanotherproductsandhashighdemand.