In [16]:
```
import pandas as pd
import os
```

In [11]:
```
# merging 12 months of data into a single file
```

In [20]:
```
all_data = pd.read_csv("D:\Data Analytics/all_data.csv")
```

In [21]:
```
all_data.head()
```

Out[21]:

	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 [ ]:
```
# CLEANING UP OF THE DATA
# First step in this is figuring out what we need to clean. I have found in practice, that y
# ou find things you need to clean as you perform operations and get errors.
# Based on the error, you decide how you should go about cleaning the data
```

In [22]:
```
# Find NAN
nan_df = all_data[all_data.isna().any(axis=1)]
display(nan_df.head())

all_data = all_data.dropna(how='all')
all_data.head()
```

	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

Out[22]:

	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
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
5	176561	Wired Headphones	1	11.99	04/30/19 09:27	333 8th St, Los Angeles, CA 90001

In [ ]:
```
# Get rid of text in order date column
```

In [23]:
```
all_data = all_data[all_data['Order Date'].str[0:2]!='Or']
```

In [24]:
```
# Make columns correct type
```

In [25]:
```
all_data['Quantity Ordered'] = pd.to_numeric(all_data['Quantity Ordered'])
all_data['Price Each'] = pd.to_numeric(all_data['Price Each'])
```

In [26]:
```
#Add month column
```

In [27]:
```
all_data['Month'] = all_data['Order Date'].str[0:2]
all_data['Month'] = all_data['Month'].astype('int32')
all_data.head()
```

Out[27]:

	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	600.00	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

In [28]:
```
# Add city column
```

In [29]:
```
def get_city(address):
    return address.split(",")[1].strip(" ")

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

all_data['City'] = all_data['Purchase Address'].apply(lambda x: f"{get_city(x)}  ({get_state
(x)})")
all_data.head()
```

Out[29]:

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

In [30]:
```
## Data Exploration
```

In [31]:
```
# Question 1: What was the best month for sales? How much was earned that month?
```

In [32]:
```
all_data['Sales'] = all_data['Quantity Ordered'].astype('int') * all_data['Price Each'].asty
pe('float')
```

In [33]:
```
all_data.groupby(['Month']).sum()
```

Out[33]:

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

In [34]:
```
import matplotlib.pyplot as plt

months = range(1,13)
print(months)

plt.bar(months,all_data.groupby(['Month']).sum()['Sales'])
plt.xticks(months)
plt.ylabel('Sales in USD ($)')
plt.xlabel('Month number')
plt.show()
```

```
range(1, 13)
```

In [35]:
```
#Question 2: What city sold the most product?
```

In [36]:
```
all_data.groupby(['City']).sum()
```

Out[36]:

City	Quantity Ordered	Price Each	Month	Sales
Atlanta (GA)	16602	2.779908e+06	104734	2.795499e+06
Austin (TX)	11153	1.809874e+06	69829	1.819582e+06
Boston (MA)	22528	3.637409e+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	4.635370e+06	175741	4.664317e+06
Portland (ME)	2750	447189.0e+05	17144	4.497583e+05
Portland (OR)	11303	1.860558e+06	70621	1.870732e+06
San Francisco (CA)	50239	8.211461e+06	315520	8.262204e+06
Seattle (WA)	16553	2.733296e+06	104941	2.747755e+06

In [37]:
```
import matplotlib.pyplot as plt

keys = [city for city, df in all_data.groupby(['City'])]

plt.bar(keys,all_data.groupby(['City']).sum()['Sales'])
plt.ylabel('Sales in USD ($)')
plt.xlabel('Month number')
plt.xticks(keys, rotation='vertical', size=8)
plt.show()
```

In [38]:
```
#Question 3: What time should we display advertisements to maximize likelihood of customer's
buying product?
```

In [40]:
```
# Add 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
all_data['Count'] = 1
all_data.head()
```

Out[40]:

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

In [41]:
```
keys = [pair for pair, df in all_data.groupby(['Hour'])]

plt.plot(keys, all_data.groupby(['Hour']).count()['Count'])
plt.xticks(keys)
plt.grid()
plt.show()

# My recommendation is slightly before 11am or 7pm
```


In [42]:
```
# Question 4: What products are most often sold together?
```

In [45]:
```
# https://stackoverflow.com/questions/43348194/pandas-select-rows-if-id-appear-several-time
df = all_data[all_data['Order ID'].duplicated(keep=False)]

# Referenced: https://stackoverflow.com/questions/27298178/concatenate-strings-from-several-
rows-using-pandas-groupby
df['Grouped'] = df.groupby('Order ID')['Product'].transform(lambda x: ','.join(x))
df2 = df[['Order ID', 'Grouped']].drop_duplicates()
```

```
C:\Users\Lindian\anaconda3\lib\site-packages\ipykernel_launcher.py:5: 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_guid
e/indexing.html#returning-a-view-versus-a-copy
  """
```

In [46]:
```
# Referenced: https://stackoverflow.com/questions/52195887/counting-unique-pairs-of-numbers-
into-a-python-dictionary
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
```

In [47]:
```
# What product sold the most? Why do you think it sold the most?
```

In [48]:
```
product_group = all_data.groupby('Product')
quantity_ordered = product_group.sum()['Quantity Ordered']

keys = [pair for pair, df in product_group]
plt.bar(keys, quantity_ordered)
plt.xticks(keys, rotation='vertical', size=8)
plt.show()
```


In [49]:
```
# Referenced: https://stackoverflow.com/questions/14762181/adding-a-y-axis-label-to-secondar
y-y-axis-in-matplotlib

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

fig, ax1 = plt.subplots()

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

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

fig.show()
```

```
C:\Users\Lindian\anaconda3\lib\site-packages\ipykernel_launcher.py:16: UserWarning: Matplotlib
is currently using module://ipykernel.pylab.backend_inline, which is a non-GUI backend, so ca
nnot show the figure.
  app.launch_new_instance()
```