first_time_test

July 31, 2023

0.1 Sales Products Analysis

The sales product data between 2019-2020. Dataset source: Kaggle, username: KNIGHTBEARR, dataset name: Sales Product Data

Questions:

- What was the best month for sales? How much was earned that month?
- What City had the highest number of sales?
- What time should we display adverstisement to maximize likelihood of customer's buying product?
- What products are most often sold together?
- What product sold the most? Why do you think it sold the most?

Key finding:

- Total number of sales by month, hour
- Total number of ordered quantity by city
- Total number of ordered quantity by products

[70]:
```python
import pandas as pd
```

Merge the 12 months of sales data into a single CSV file

[71]:
```python
# read single .csv file
df = pd.read_csv("D:/jupyter_directory/Sales_Data/Sales_January_2019.csv")
df.head()
```

[71]:
```
  Order ID                     Product Quantity Ordered Price Each  \
0   141234                      iPhone                1        700
1   141235    Lightning Charging Cable                1      14.95
2   141236            Wired Headphones                2      11.99
3   141237            27in FHD Monitor                1     149.99
4   141238            Wired Headphones                1      11.99

       Order Date                      Purchase Address
0  01/22/19 21:25         944 Walnut St, Boston, MA 02215
1  01/28/19 14:15        185 Maple St, Portland, OR 97035
2  01/17/19 13:33   538 Adams St, San Francisco, CA 94016
3  01/05/19 20:33      738 10th St, Los Angeles, CA 90001
```

```
4  01/25/19 11:59          387 10th St, Austin, TX 73301
```

[72]:

```
# create file list
import glob
file_list = glob.glob('D:/jupyter_directory/Sales_Data/*.csv')

# Read all CSV files and store them in a list comprehension
dataframes = [pd.read_csv(file) for file in file_list]

# Concatenate the list of DataFrames into a single DataFrame
df = pd.concat(dataframes, ignore_index=True)
df
```

[72]:

```
       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
…         …                         …              …        …
186845   259353      AAA Batteries (4-pack)                3       2.99
186846   259354                      iPhone                1        700
186847   259355                      iPhone                1        700
186848   259356      34in Ultrawide Monitor                1     379.99
186849   259357        USB-C Charging Cable                1      11.95

            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
…                …                                       …
186845  09/17/19 20:56   840 Highland St, Los Angeles, CA 90001
186846  09/01/19 16:00  216 Dogwood St, San Francisco, CA 94016
186847  09/23/19 07:39     220 12th St, San Francisco, CA 94016
186848  09/19/19 17:30   511 Forest St, San Francisco, CA 94016
186849  09/30/19 00:18   250 Meadow St, San Francisco, CA 94016

[186850 rows x 6 columns]
```

[73]:

```
df.to_csv("all_sales_data.csv", index=False)
```

[74]:

```
# Read in updated dataframe
df = pd.read_csv("all_sales_data.csv")
df.tail()
```

```
[74]:        Order ID                   Product Quantity Ordered Price Each  \
      186845   259353  AAA Batteries (4-pack)                3       2.99
      186846   259354                    iPhone                1        700
      186847   259355                    iPhone                1        700
      186848   259356  34in Ultrawide Monitor                1     379.99
      186849   259357    USB-C Charging Cable                1      11.95

                  Order Date                       Purchase Address
      186845  09/17/19 20:56   840 Highland St, Los Angeles, CA 90001
      186846  09/01/19 16:00  216 Dogwood St, San Francisco, CA 94016
      186847  09/23/19 07:39     220 12th St, San Francisco, CA 94016
      186848  09/19/19 17:30   511 Forest St, San Francisco, CA 94016
      186849  09/30/19 00:18   250 Meadow St, San Francisco, CA 94016
```

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

Clean data

```
[75]: # cheack missing values
      df.isna().sum()
```

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

```
[76]: # remove rows of missing values
      df = df.dropna(how = 'all')
```

```
[77]: # filter out text data that not related
      print(df['Quantity Ordered'].unique())
      print(df['Price Each'].unique())
```

```
['2' '1' '3' '5' 'Quantity Ordered' '4' '7' '6' '8' '9']
['11.95' '99.99' '600' '11.99' '1700' '14.95' '389.99' '3.84' '150' '2.99'
 '700' '300' '149.99' '109.99' '600.0' '999.99' '400' '379.99'
 'Price Each' '700.0' '1700.0' '150.0' '300.0' '400.0']
```

```
[78]: #Filter out text data that not related

      df[df['Quantity Ordered'] == 'Quantity Ordered']
```

```
[78]:         Order ID  Product  Quantity Ordered  Price Each  Order Date  \
      519     Order ID  Product  Quantity Ordered  Price Each  Order Date
```

```
1149    Order ID  Product  Quantity Ordered  Price Each  Order Date
1155    Order ID  Product  Quantity Ordered  Price Each  Order Date
2878    Order ID  Product  Quantity Ordered  Price Each  Order Date
2893    Order ID  Product  Quantity Ordered  Price Each  Order Date
…            …        …                 …           …           …
185164  Order ID  Product  Quantity Ordered  Price Each  Order Date
185551  Order ID  Product  Quantity Ordered  Price Each  Order Date
186563  Order ID  Product  Quantity Ordered  Price Each  Order Date
186632  Order ID  Product  Quantity Ordered  Price Each  Order Date
186738  Order ID  Product  Quantity Ordered  Price Each  Order Date

        Purchase Address
519     Purchase Address
1149    Purchase Address
1155    Purchase Address
2878    Purchase Address
2893    Purchase Address
…                    …
185164  Purchase Address
185551  Purchase Address
186563  Purchase Address
186632  Purchase Address
186738  Purchase Address

[355 rows x 6 columns]
```

[80]:
```python
# remove rows
df = df[df['Quantity Ordered'] != 'Quantity Ordered']
df['Quantity Ordered'].unique()
```

[80]:
```
array(['2', '1', '3', '5', '4', '7', '6', '8', '9'], dtype=object)
```

Change data type

[85]:
```python
# check data type
df.dtypes
```

[85]:
```
Order ID                    object
Product                     object
Quantity Ordered             int32
Price Each                 float64
Order Date          datetime64[ns]
Purchase Address            object
dtype: object
```

[83]:
```python
# Change data type
df['Quantity Ordered'] = df['Quantity Ordered'].astype(int)
df['Price Each'] = df['Price Each'].astype(float)
```

```
df['Order Date'] = pd.to_datetime(df['Order Date'])

# check data type
df.dtypes
```

```
[83]: Order ID                      object
      Product                       object
      Quantity Ordered               int32
      Price Each                   float64
      Order Date            datetime64[ns]
      Purchase Address              object
      dtype: object
```

Add month column

```
[86]: df['month'] = df['Order Date'].dt.month
      df.head()
```

```
[86]:   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      600.00
      4   176560            Wired Headphones                 1       11.99
      5   176561            Wired Headphones                 1       11.99

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

Create total sales column

```
[87]: df['total_sales'] = df['Quantity Ordered'] * df['Price Each']
      df.head()
```

```
[87]:   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      600.00
      4   176560            Wired Headphones                 1       11.99
      5   176561            Wired Headphones                 1       11.99

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

```
5 2019-04-30 09:27:00     333 8th St, Los Angeles, CA 90001      4

   total_sales
0        23.90
2        99.99
3       600.00
4        11.99
5        11.99
```

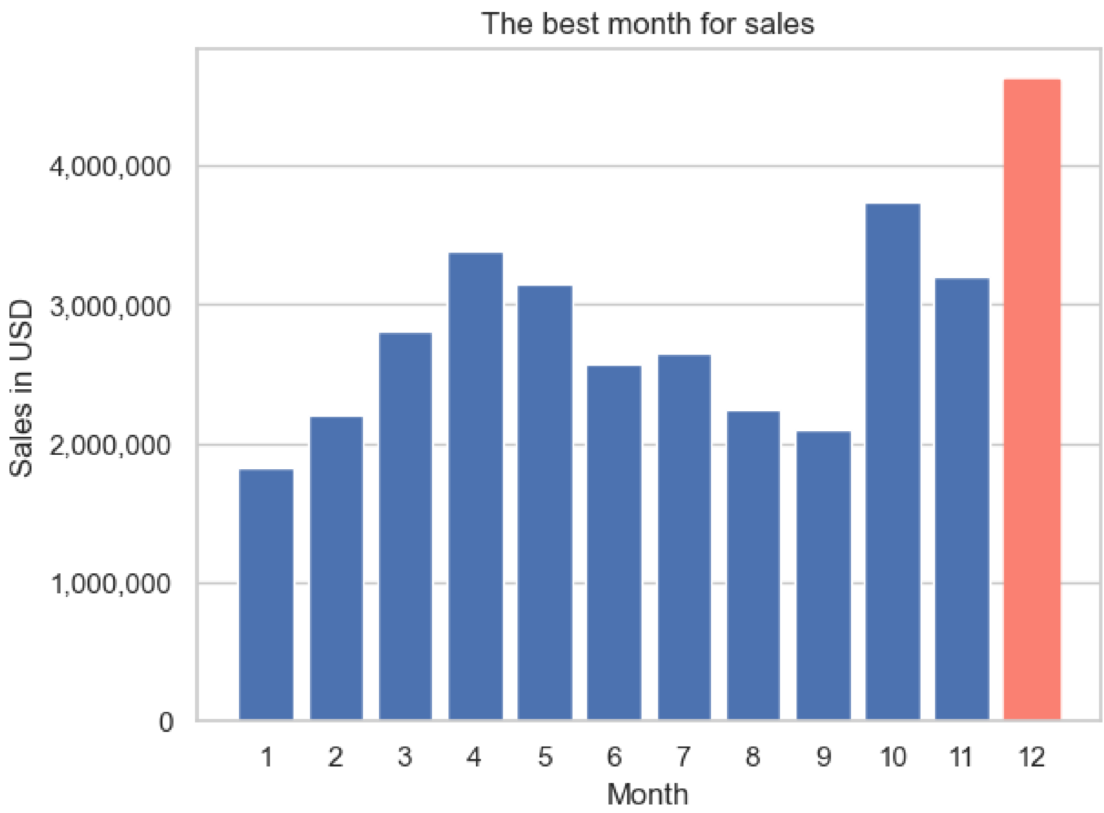
[183]:
```
best_month_sales = df.groupby('month')['total_sales'].sum().
 ↪sort_values(ascending = False).reset_index()
best_month_sales
```

[183]:
```
    month  total_sales
0      12   4613443.34
1      10   3736726.88
2       4   3390670.24
3      11   3199603.20
4       5   3152606.75
5       3   2807100.38
6       7   2647775.76
7       6   2577802.26
8       8   2244467.88
9       2   2202022.42
10      9   2097560.13
11      1   1822256.73
```

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

Answer: December, 4613443.34

[184]:
```
# create bar chart
import matplotlib.pyplot as plt

bars = plt.bar(best_month_sales['month'], best_month_sales['total_sales'])
plt.xticks(best_month_sales['month'])  # show a name of each bar
plt.ylabel("Sales in USD")
plt.xlabel("Month")
plt.title('The best month for sales')
bars[0].set_color('salmon')

plt.grid(axis='x')

plt.gca().yaxis.set_major_formatter('{:,.0f}'.format) # y axis number format

plt.show()
```



Question 2: What city had the higest number of sales?

```
[185]: # preview
       df.head()
```

```
[185]:   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      600.00
       4   176560            Wired Headphones                 1       11.99
       5   176561            Wired Headphones                 1       11.99

             Order Date                      Purchase Address  month  total_sales
       0  04/19/19 08:46          917 1st St, Dallas, TX 75001      4        23.90
       2  04/07/19 22:30     682 Chestnut St, Boston, MA 02215      4        99.99
       3  04/12/19 14:38  669 Spruce St, Los Angeles, CA 90001      4       600.00
       4  04/12/19 14:38  669 Spruce St, Los Angeles, CA 90001      4        11.99
       5  04/30/19 09:27     333 8th St, Los Angeles, CA 90001      4        11.99
```

Create city column

```
[186]: # find city(Regular expression)
       import re
       pattern = r',\s*([^,]+),'      #  \s*  ->  Matches zero or more white space
                                      #  [^,]+ -> match one or more characters except a␣
         ↪comma
                                      #   ()  ->  capture

       df['city'] = df['Purchase Address'].str.extract(pattern)
       df.head()
```

```
[186]:   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      600.00
       4   176560            Wired Headphones                 1       11.99
       5   176561            Wired Headphones                 1       11.99

             Order Date                      Purchase Address  month  total_sales  \
       0  04/19/19 08:46          917 1st St, Dallas, TX 75001      4        23.90
       2  04/07/19 22:30     682 Chestnut St, Boston, MA 02215      4        99.99
       3  04/12/19 14:38  669 Spruce St, Los Angeles, CA 90001      4       600.00
       4  04/12/19 14:38  669 Spruce St, Los Angeles, CA 90001      4        11.99
       5  04/30/19 09:27     333 8th St, Los Angeles, CA 90001      4        11.99

                 city
       0       Dallas
       2       Boston
       3  Los Angeles
       4  Los Angeles
       5  Los Angeles
```

```
[187]: # Sum 'total_sales' group by 'city'
       best_city_sales = df.groupby('city')['total_sales'].sum().
        ↪sort_values(ascending=False).reset_index()
       best_city_sales
```

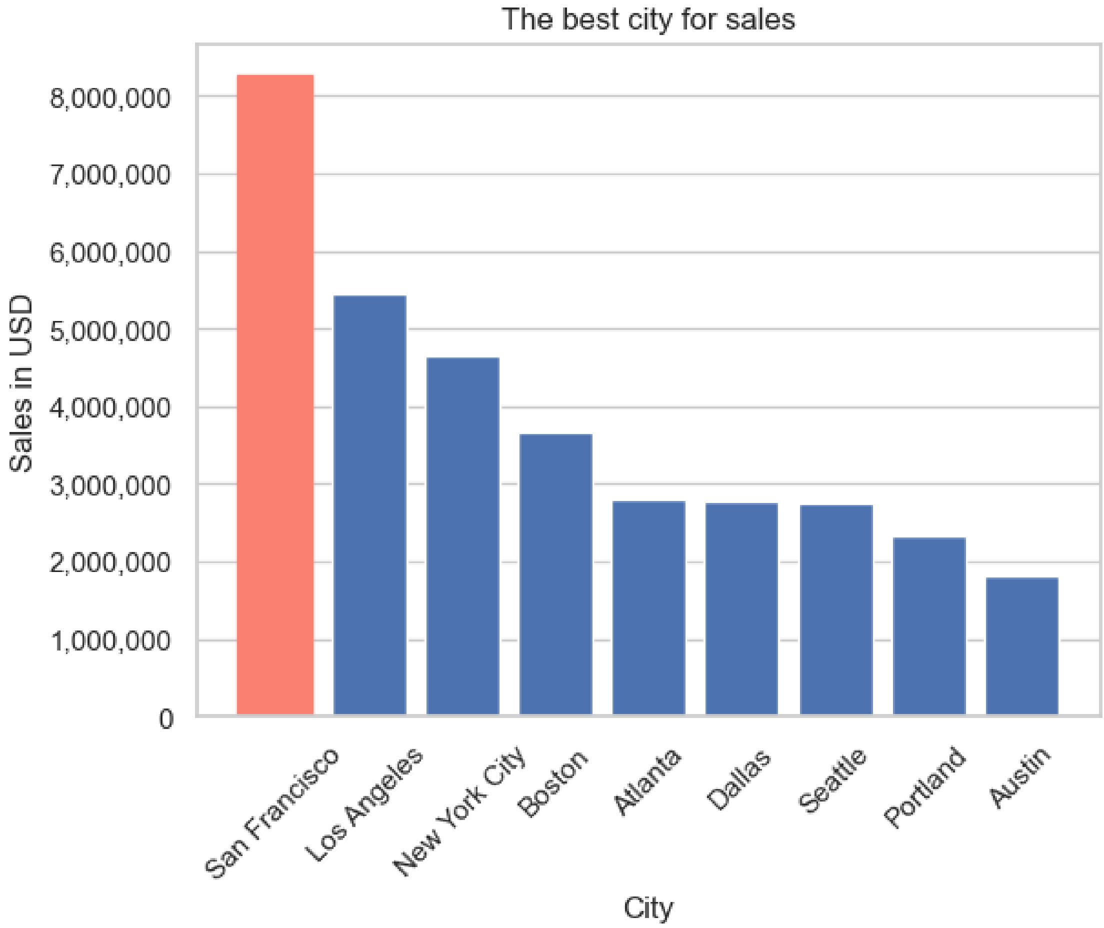
```
[187]:             city  total_sales
       0  San Francisco   8262203.91
       1    Los Angeles   5452570.80
       2  New York City   4664317.43
       3         Boston   3661642.01
       4        Atlanta   2795498.58
       5         Dallas   2767975.40
       6        Seattle   2747755.48
       7       Portland   2320490.61
       8         Austin   1819581.75
```

Question 2: What city had the higest number of sales?

Answer: San Francisco 8262203.91

[188]:

```
# create bar chart
bars = plt.bar(best_city_sales['city'], best_city_sales['total_sales'])

plt.xticks(rotation = 45)
plt.ylabel("Sales in USD")
plt.xlabel("City")
plt.title('The best city for sales')
bars[0].set_color('salmon')
#plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.grid(axis='x')
plt.gca().yaxis.set_major_formatter('{:,.0f}'.format)  # y axis number format

plt.show()
```



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

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

```
[189]:   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      600.00
       4   176560            Wired Headphones                 1       11.99
       5   176561            Wired Headphones                 1       11.99

              Order Date                      Purchase Address  month  total_sales  \
       0  04/19/19 08:46          917 1st St, Dallas, TX 75001      4        23.90
       2  04/07/19 22:30     682 Chestnut St, Boston, MA 02215      4        99.99
       3  04/12/19 14:38  669 Spruce St, Los Angeles, CA 90001      4       600.00
       4  04/12/19 14:38  669 Spruce St, Los Angeles, CA 90001      4        11.99
       5  04/30/19 09:27     333 8th St, Los Angeles, CA 90001      4        11.99

                 city
       0       Dallas
       2       Boston
       3  Los Angeles
       4  Los Angeles
       5  Los Angeles
```

Add 'time' column

```
[190]: # change data type to dateime
       df['Order Date'] = pd.to_datetime(df['Order Date'])
       df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 185950 entries, 0 to 186849
Data columns (total 9 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   Order ID          185950 non-null  object
 1   Product           185950 non-null  object
 2   Quantity Ordered  185950 non-null  int32
 3   Price Each        185950 non-null  float64
 4   Order Date        185950 non-null  datetime64[ns]
 5   Purchase Address  185950 non-null  object
 6   month             185950 non-null  int64
 7   total_sales       185950 non-null  float64
 8   city              185950 non-null  object
dtypes: datetime64[ns](1), float64(2), int32(1), int64(1), object(4)
memory usage: 13.5+ MB
```

[191]:

```
# Add hour and minute column
df['Hour'] = df['Order Date'].dt.hour
df['Minute'] = df['Order Date'].dt.minute
df.head()
```

[191]:

```
  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      600.00
4   176560          Wired Headphones                  1       11.99
5   176561          Wired Headphones                  1       11.99

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

   total_sales         city  Hour  Minute
0        23.90       Dallas     8      46
2        99.99       Boston    22      30
3       600.00  Los Angeles    14      38
4        11.99  Los Angeles    14      38
5        11.99  Los Angeles     9      27
```

[192]:

```
# Sum 'total_sales' group by 'Hour'
hour_sales = df.groupby('Hour')['total_sales'].sum().reset_index().
 ↪sort_values(by = 'Hour')
hour_sales
```

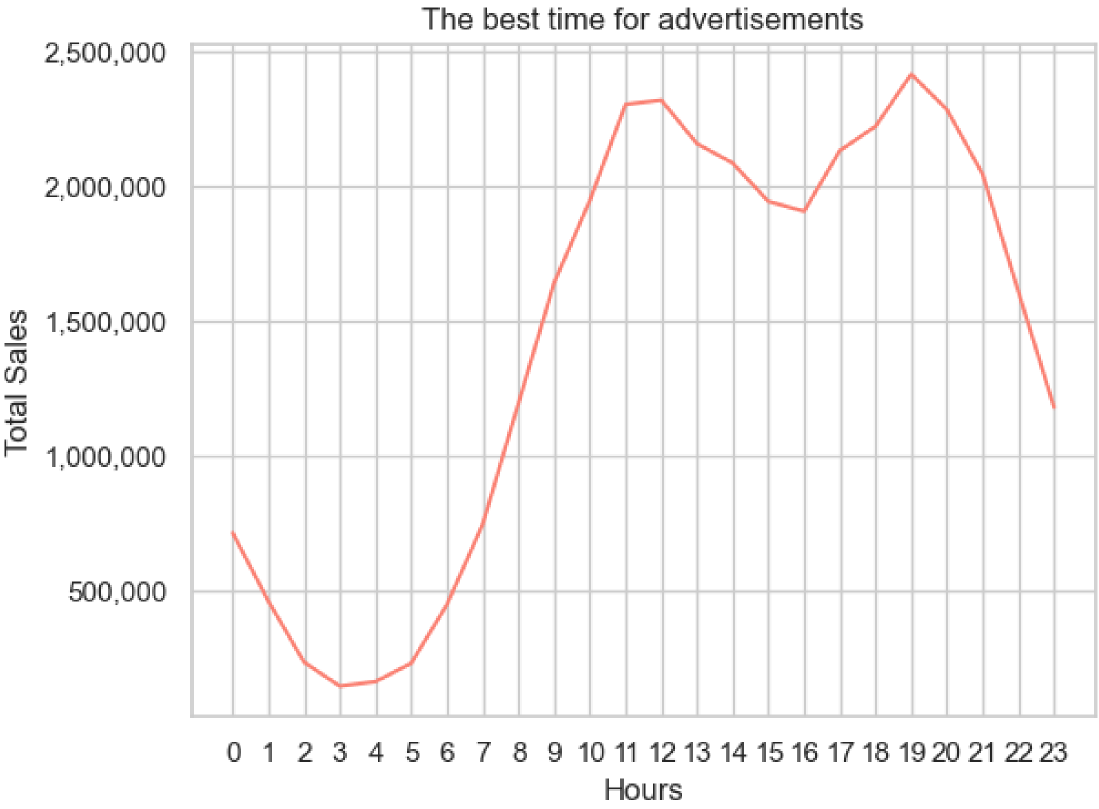
[192]:

```
    Hour  total_sales
0      0    713721.27
1      1    460866.88
2      2    234851.44
3      3    145757.89
4      4    162661.01
5      5    230679.82
6      6    448113.00
7      7    744854.12
8      8   1192348.97
9      9   1639030.58
10    10   1944286.77
11    11   2300610.24
12    12   2316821.34
13    13   2155389.80
14    14   2083672.73
```

```
15    15   1941549.60
16    16   1904601.31
17    17   2129361.61
18    18   2219348.30
19    19   2412938.54
20    20   2281716.24
21    21   2042000.86
22    22   1607549.21
23    23   1179304.44
```

[193]:

```
# create chart
plot = plt.plot(hour_sales['Hour'],hour_sales['total_sales'], color = 'salmon')
plt.xticks(hour_sales['Hour'])
plt.ylabel("Total Sales")
plt.xlabel("Hours")
plt.title('The best time for advertisements')

plt.gca().yaxis.set_major_formatter('{:,.0f}'.format)  # y axis number format
plt.grid(True)


plt.show()
```



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

Answer: 11.00-12.00 and 18.00-20.00

Question 4: What products are most often sold together?

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

```
[194]:   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      600.00
       4   176560            Wired Headphones                 1       11.99
       5   176561            Wired Headphones                 1       11.99

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

          total_sales         city  Hour  Minute
       0        23.90       Dallas     8      46
       2        99.99       Boston    22      30
       3       600.00  Los Angeles    14      38
       4        11.99  Los Angeles    14      38
       5        11.99  Los Angeles     9      27
```

```
[195]: # find duplicate id
       df_dup = df[df['Order ID'].duplicated(keep=False)] # False -> keep all␣
        ↪duplicate rows
       df_dup.head()
```

```
[195]:    Order ID                     Product  Quantity Ordered  Price Each  \
       3    176560                Google Phone                 1      600.00
       4    176560            Wired Headphones                 1       11.99
       18   176574                Google Phone                 1      600.00
       19   176574        USB-C Charging Cable                 1       11.95
       30   176585  Bose SoundSport Headphones                 1       99.99

                   Order Date                      Purchase Address  month  \
       3  2019-04-12 14:38:00  669 Spruce St, Los Angeles, CA 90001      4
```

```
4  2019-04-12 14:38:00  669 Spruce St, Los Angeles, CA 90001      4
18 2019-04-03 19:42:00     20 Hill St, Los Angeles, CA 90001      4
19 2019-04-03 19:42:00     20 Hill St, Los Angeles, CA 90001      4
30 2019-04-07 11:31:00     823 Highland St, Boston, MA 02215      4

    total_sales         city  Hour  Minute
3        600.00  Los Angeles    14      38
4         11.99  Los Angeles    14      38
18       600.00  Los Angeles    19      42
19        11.95  Los Angeles    19      42
30        99.99       Boston    11      31
```

[196]:

```
# add group_product column
df_dup['group'] = df.groupby('Order ID')['Product'].transform(lambda x: ','.
  ↪join(x))
# .transform() method applies this lambda function to each group of 'Product'

df_dup.head(10)
```

```
C:\Users\AVS_KTB\AppData\Local\Temp\ipykernel_10652\1989000491.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
  df_dup['group'] = df.groupby('Order ID')['Product'].transform(lambda x:
','.join(x))
```

[196]:

```
    Order ID                     Product  Quantity Ordered  Price Each  \
3     176560                Google Phone                 1      600.00
4     176560            Wired Headphones                 1       11.99
18    176574                Google Phone                 1      600.00
19    176574        USB-C Charging Cable                 1       11.95
30    176585  Bose SoundSport Headphones                 1       99.99
31    176585  Bose SoundSport Headphones                 1       99.99
32    176586      AAA Batteries (4-pack)                 2        2.99
33    176586                Google Phone                 1      600.00
119   176672    Lightning Charging Cable                 1       14.95
120   176672        USB-C Charging Cable                 1       11.95

             Order Date                        Purchase Address  month  \
3   2019-04-12 14:38:00    669 Spruce St, Los Angeles, CA 90001      4
4   2019-04-12 14:38:00    669 Spruce St, Los Angeles, CA 90001      4
18  2019-04-03 19:42:00       20 Hill St, Los Angeles, CA 90001      4
19  2019-04-03 19:42:00       20 Hill St, Los Angeles, CA 90001      4
30  2019-04-07 11:31:00       823 Highland St, Boston, MA 02215      4
31  2019-04-07 11:31:00       823 Highland St, Boston, MA 02215      4
```

```
32  2019-04-10 17:00:00  365 Center St, San Francisco, CA 94016      4
33  2019-04-10 17:00:00  365 Center St, San Francisco, CA 94016      4
119 2019-04-12 11:07:00   778 Maple St, New York City, NY 10001      4
120 2019-04-12 11:07:00   778 Maple St, New York City, NY 10001      4

     total_sales           city  Hour  Minute  \
3         600.00    Los Angeles    14      38
4          11.99    Los Angeles    14      38
18        600.00    Los Angeles    19      42
19         11.95    Los Angeles    19      42
30         99.99         Boston    11      31
31         99.99         Boston    11      31
32          5.98  San Francisco    17       0
33        600.00  San Francisco    17       0
119        14.95  New York City    11       7
120        11.95  New York City    11       7

                                                 group
3                        Google Phone,Wired Headphones
4                        Google Phone,Wired Headphones
18                   Google Phone,USB-C Charging Cable
19                   Google Phone,USB-C Charging Cable
30   Bose SoundSport Headphones,Bose SoundSport Hea…
31   Bose SoundSport Headphones,Bose SoundSport Hea…
32                 AAA Batteries (4-pack),Google Phone
33                 AAA Batteries (4-pack),Google Phone
119      Lightning Charging Cable,USB-C Charging Cable
120      Lightning Charging Cable,USB-C Charging Cable
```

[197]:

```
# select 2 columns & remove duplicate
df_dup = df_dup[['Order ID','group']].drop_duplicates()
df_dup.head(10)
```

[197]:

```
    Order ID                                              group
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
129   176681           Apple Airpods Headphones,ThinkPad Laptop
138   176689  Bose SoundSport Headphones,AAA Batteries (4-pack)
189   176739                34in Ultrawide Monitor,Google Phone
225   176774      Lightning Charging Cable,USB-C Charging Cable
233   176781                    iPhone,Lightning Charging Cable
```

[198]:

```
from itertools import combinations   # generates all possible combinations of a␣
  ↪list of items
```

```
from collections import Counter      # count a combinations

count = Counter()                 # store the counts of combinations.

for row in df_dup['group']:
    row_list = row.split(',')     # separated string (row) into a list of␣
 ↪individual products (row_list).
                                  # ex. 'AAA Batteries (4-pack),Google Phone'␣
 ↪-> ['AAA Batteries (4-pack)', 'Google Phone']
    count.update(Counter(combinations(row_list, 2)))
    # combinations(row_list, 3) -> generates all combinations of 3 products␣
 ↪without repetition.(creates tuples)
    # Counter(combinations(row_list, 3)) -> count the occurrences & converts␣
 ↪the combinations into a dictionary (key, values)
    # count.update(...) -> The update method of the Counter class is used to␣
 ↪update the count object

count.most_common(10)  # method of the Counter class sorts the combinations(10␣
 ↪combinations)
```

[198]:

```
[(('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)]
```

[199]:

```
# print only key & values
for key, values in count.most_common(10):
    print(key, values)
```

```
('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
```

Question 4: What products are most often sold together?

Answer: iPhone & Lightning Charging Cable

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

[200]:
```
df.head()
```

[200]:
```
   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      600.00
4    176560            Wired Headphones                 1       11.99
5    176561            Wired Headphones                 1       11.99

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

   total_sales         city  Hour  Minute
0        23.90       Dallas     8      46
2        99.99       Boston    22      30
3       600.00  Los Angeles    14      38
4        11.99  Los Angeles    14      38
5        11.99  Los Angeles     9      27
```

[201]:
```
quantity_ordered = df.groupby('Product')['Quantity Ordered'].sum().reset_index()
quantity_ordered
```

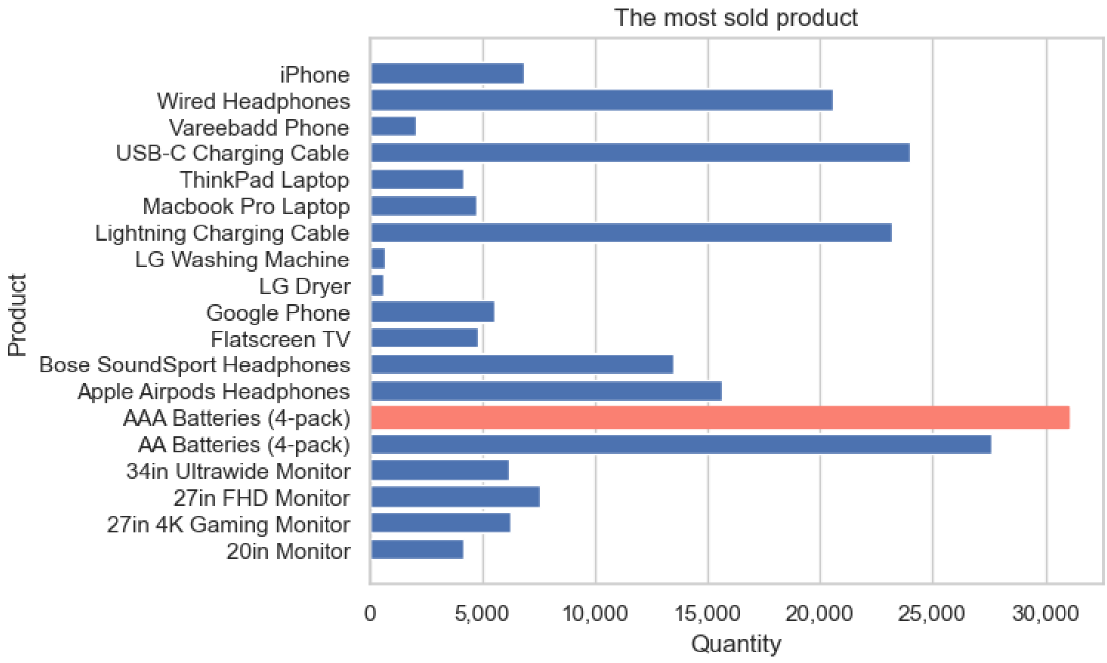
[201]:
```
                       Product  Quantity Ordered
0                 20in Monitor              4129
1        27in 4K Gaming Monitor              6244
2             27in FHD Monitor              7550
3        34in Ultrawide Monitor              6199
4         AA Batteries (4-pack)             27635
5        AAA Batteries (4-pack)             31017
6        Apple Airpods Headphones             15661
7     Bose SoundSport Headphones             13457
8                 Flatscreen TV              4819
9                  Google Phone              5532
10                    LG Dryer               646
11            LG Washing Machine               666
12       Lightning Charging Cable             23217
13            Macbook Pro Laptop              4728
14               ThinkPad Laptop              4130
```

```
15        USB-C Charging Cable              23975
16             Vareebadd Phone               2068
17            Wired Headphones              20557
18                      iPhone               6849
```

[90]:
```
# overview
df.groupby('Product')['Quantity Ordered'].sum().sort_values(ascending = False).
 ↪reset_index().head()
```

[90]:
```
                    Product  Quantity Ordered
0    AAA Batteries (4-pack)             31017
1     AA Batteries (4-pack)             27635
2      USB-C Charging Cable             23975
3  Lightning Charging Cable             23217
4          Wired Headphones             20557
```

[202]:
```
# create chart
products = plt.barh(quantity_ordered['Product'],quantity_ordered['Quantity␣
 ↪Ordered'])

plt.xlabel("Quantity")
plt.ylabel("Product")
plt.title('The most sold product')
products[5].set_color('salmon')

plt.gca().xaxis.set_major_formatter('{:,.0f}'.format)  # y axis number format

plt.grid(axis='y')

plt.show()
```



[203]:

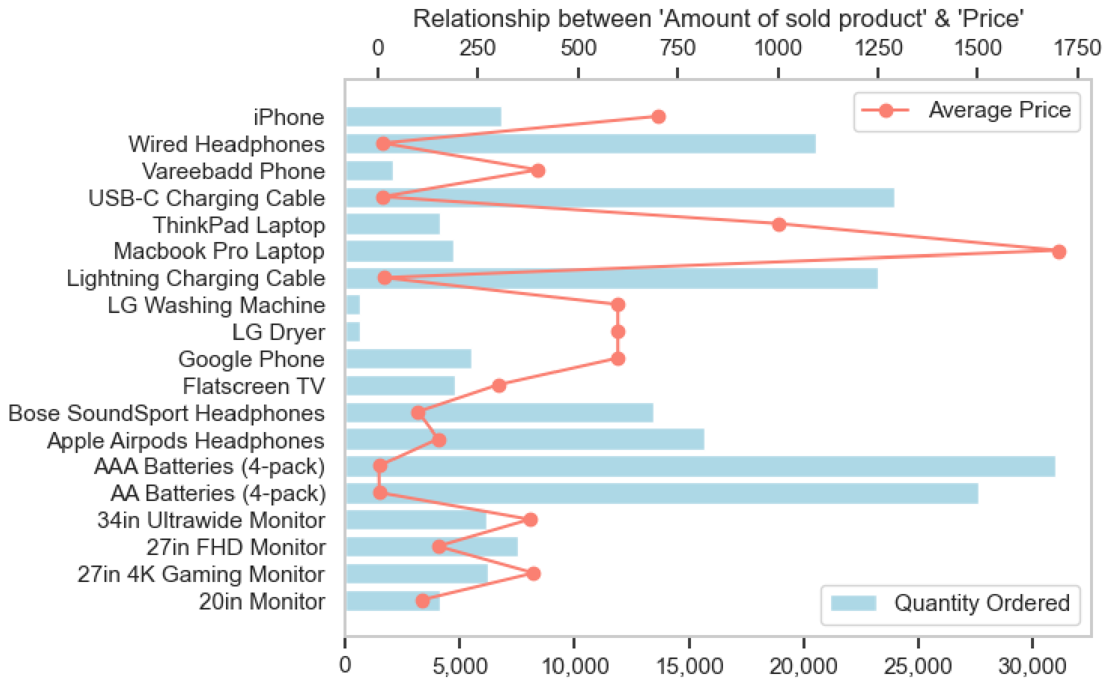
```
prices = df.groupby('Product')['Price Each'].mean().reset_index()
prices
```

[203]:

```
                       Product  Price Each
0                  20in Monitor      109.99
1        27in 4K Gaming Monitor      389.99
2              27in FHD Monitor      149.99
3        34in Ultrawide Monitor      379.99
4          AA Batteries (4-pack)        3.84
5         AAA Batteries (4-pack)        2.99
6      Apple Airpods Headphones      150.00
7    Bose SoundSport Headphones       99.99
8                 Flatscreen TV      300.00
9                  Google Phone      600.00
10                     LG Dryer      600.00
11           LG Washing Machine      600.00
12     Lightning Charging Cable       14.95
13           Macbook Pro Laptop     1700.00
14              ThinkPad Laptop      999.99
15         USB-C Charging Cable       11.95
16              Vareebadd Phone      400.00
17             Wired Headphones       11.99
18                       iPhone      700.00
```

[208]:

```
# final version version
# Group the DataFrame by 'Product' and calculate the sum of 'Quantity Ordered' for each product
quantity_ordered = df.groupby('Product')['Quantity Ordered'].sum().reset_index()

# Group the DataFrame by 'Product' and calculate the mean of 'Price Each' for each product
prices = df.groupby('Product')['Price Each'].mean().reset_index()

# Create the figure and the first set of axes (for quantity ordered)
fig, ax1 = plt.subplots()

# Create the horizontal bar chart for quantity ordered
products = ax1.barh(quantity_ordered['Product'], quantity_ordered['Quantity Ordered'], color='lightblue', label='Quantity Ordered')

# Set labels for the first y-axis and a title for the chart
ax1.set_title("Relationship between 'Amount of sold product' & 'Price'")

# Format the first y-axis (quantity ordered) x-axis numbers to have commas for thousands separator
ax1.xaxis.set_major_formatter('{:,.0f}'.format)



# Create the second set of axes (for average prices) using twinx()
ax2 = ax1.twiny()  # use the same x-axis for both chart

# Create the line plot for average prices on the second axes
ax2.plot(prices['Price Each'], prices['Product'], marker='o', color='salmon', label='Average Price')

# Show the legend for both sets of data
ax1.legend(loc='lower right')
ax2.legend(loc='upper right')

# Remove grid lines
ax1.grid(False)
ax2.grid(False)

# Display the chart
#plt.tight_layout()
plt.show()
```



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

Answer: AA Batteries (4-pack) are the cheapest product with a short usage life cycle, making them a frequent choice for people to buy.

Conclusions

```
1. Advertising in December, October, and April, as the highest order generation revenues as fol
           - December ($4,613,443)
       - October ($3,736,726)
           - April ($3,390,670)

2.The top three cities with the highest total sales are as follows:
           - San Francisco ($8,262,203)
       - Los Angeles ($5,452,570)
           - New York City ($4,664,317)

3.The best times for advertising were between 11:00-12:00 and 18:00-19:00.

4.The frequently co-purchased products are as follows:
          - iPhone and Lightning Charging Cable - 1005 orders
          - Google Phone and USB-C Charging Cable - 987 orders
          - iPhone and Wired Headphones - 447 orders
```

```
5.The top 5 best-selling products are as follows:
          - AAA Batteries (4-pack)  31017
          - AA Batteries (4-pack)   27635
          - USB-C Charging Cable    23975
          - Lightning Charging Cable    23217
          - Wired Headphones    20557
  note: Products with lower prices are more likely to be sold in higher quantities
```

[1]:

```
# PDF export
!pip install Pyppeteer
!pyppeteer-install
```

```
Collecting Pyppeteer
  Downloading pyppeteer-1.0.2-py3-none-any.whl (83 kB)
                                              0.0/83.4 kB ? eta -:--:--
     ---------------------------------------- 83.4/83.4 kB 4.6 MB/s eta 0:00:00
Requirement already satisfied: appdirs<2.0.0,>=1.4.3 in
c:\users\avs_ktb\anaconda3\lib\site-packages (from Pyppeteer) (1.4.4)
Requirement already satisfied: certifi>=2021 in
c:\users\avs_ktb\anaconda3\lib\site-packages (from Pyppeteer) (2023.5.7)
Requirement already satisfied: importlib-metadata>=1.4 in
c:\users\avs_ktb\anaconda3\lib\site-packages (from Pyppeteer) (6.0.0)
Collecting pyee<9.0.0,>=8.1.0 (from Pyppeteer)
  Downloading pyee-8.2.2-py2.py3-none-any.whl (12 kB)
Requirement already satisfied: tqdm<5.0.0,>=4.42.1 in
c:\users\avs_ktb\anaconda3\lib\site-packages (from Pyppeteer) (4.65.0)
Requirement already satisfied: urllib3<2.0.0,>=1.25.8 in
c:\users\avs_ktb\anaconda3\lib\site-packages (from Pyppeteer) (1.26.16)
Collecting websockets<11.0,>=10.0 (from Pyppeteer)
  Downloading websockets-10.4-cp311-cp311-win_amd64.whl (101 kB)
                                              0.0/101.4 kB ? eta -:--:--
     ---------------------------------------- 101.4/101.4 kB ? eta 0:00:00
Requirement already satisfied: zipp>=0.5 in c:\users\avs_ktb\anaconda3\lib\site-
packages (from importlib-metadata>=1.4->Pyppeteer) (3.11.0)
Requirement already satisfied: colorama in c:\users\avs_ktb\anaconda3\lib\site-
packages (from tqdm<5.0.0,>=4.42.1->Pyppeteer) (0.4.6)
Installing collected packages: pyee, websockets, Pyppeteer
Successfully installed Pyppeteer-1.0.2 pyee-8.2.2 websockets-10.4
```

```
[INFO] Starting Chromium download.

  0%|          | 0.00/137M [00:00<?, ?b/s]
  0%|          | 20.5k/137M [00:00<11:56, 191kb/s]
  0%|          | 51.2k/137M [00:00<13:11, 173kb/s]
  0%|          | 81.9k/137M [00:00<13:23, 170kb/s]
  0%|          | 154k/137M [00:00<07:13, 316kb/s]
  0%|          | 215k/137M [00:00<05:43, 398kb/s]
  0%|          | 307k/137M [00:00<04:11, 544kb/s]
  0%|          | 492k/137M [00:00<02:30, 904kb/s]
  1%|          | 727k/137M [00:00<01:43, 1.31Mb/s]
  1%|          | 1.15M/137M [00:01<01:03, 2.14Mb/s]
  1%|1         | 1.76M/137M [00:01<00:41, 3.29Mb/s]
  2%|1         | 2.72M/137M [00:01<00:26, 5.13Mb/s]
  3%|3         | 4.19M/137M [00:01<00:16, 7.93Mb/s]
  5%|4         | 6.46M/137M [00:01<00:10, 12.3Mb/s]
  6%|6         | 8.84M/137M [00:01<00:08, 15.7Mb/s]
  8%|8         | 11.4M/137M [00:01<00:09, 12.6Mb/s]
 11%|#1        | 15.3M/137M [00:02<00:07, 16.2Mb/s]
 14%|#3        | 19.1M/137M [00:02<00:06, 18.3Mb/s]
 17%|#6        | 23.0M/137M [00:02<00:05, 20.0Mb/s]
 20%|#9        | 26.9M/137M [00:02<00:05, 21.2Mb/s]
 22%|##2       | 30.8M/137M [00:02<00:04, 21.9Mb/s]
 25%|##5       | 34.7M/137M [00:02<00:04, 22.6Mb/s]
 28%|##8       | 38.5M/137M [00:03<00:04, 22.9Mb/s]
 31%|###       | 42.4M/137M [00:03<00:04, 23.2Mb/s]
 34%|###3      | 46.2M/137M [00:03<00:03, 23.4Mb/s]
 37%|###6      | 50.1M/137M [00:03<00:03, 23.6Mb/s]
 39%|###9      | 54.0M/137M [00:03<00:03, 23.6Mb/s]
 42%|####2     | 57.8M/137M [00:03<00:03, 23.6Mb/s]
 45%|####5     | 61.7M/137M [00:03<00:03, 23.4Mb/s]
 48%|####7     | 65.5M/137M [00:04<00:03, 23.5Mb/s]
 51%|#####     | 69.4M/137M [00:04<00:02, 23.6Mb/s]
 53%|#####3    | 73.2M/137M [00:04<00:02, 23.6Mb/s]
 56%|#####6    | 77.1M/137M [00:04<00:02, 23.7Mb/s]
 59%|#####9    | 80.9M/137M [00:04<00:02, 23.7Mb/s]
 62%|######1   | 84.8M/137M [00:04<00:02, 23.7Mb/s]
 65%|######4   | 88.6M/137M [00:05<00:02, 23.6Mb/s]
 68%|######7   | 92.5M/137M [00:05<00:01, 23.8Mb/s]
 70%|#######   | 96.4M/137M [00:05<00:01, 23.8Mb/s]
 73%|#######3  | 100M/137M [00:05<00:01, 23.8Mb/s]
 76%|#######6  | 104M/137M [00:05<00:01, 23.8Mb/s]
 79%|#######8  | 108M/137M [00:05<00:01, 23.7Mb/s]
 82%|########1 | 112M/137M [00:06<00:01, 23.8Mb/s]
 84%|########4 | 116M/137M [00:06<00:00, 23.7Mb/s]
 87%|########7 | 119M/137M [00:06<00:00, 23.7Mb/s]
 90%|######### | 123M/137M [00:06<00:00, 23.7Mb/s]
 93%|#########2| 127M/137M [00:06<00:00, 23.7Mb/s]
 96%|#########5| 131M/137M [00:06<00:00, 23.8Mb/s]
 99%|#########8| 135M/137M [00:07<00:00, 23.7Mb/s]
100%|##########| 137M/137M [00:07<00:00, 19.2Mb/s]
[INFO] Beginning extraction
[INFO] Chromium extracted to:
C:\Users\AVS_KTB\AppData\Local\pyppeteer\pyppeteer\local-chromium\588429
```

```
[ ]:
```