Exploratory Data Analysis (EDA) – Descriptive Analysis

Monthly Sales Performance Analysis

Which month achieved the highest total sales, and what was the total sales figure recorded during that period?

1. Overview

This analysis aims to explore and visualize monthly sales trends to uncover insights into the temporal dynamics of business performance.By identifying the month with the highest total sales, stakeholders can make informed strategic decisions such as aligning marketing campaigns, inventory planning, and promotional activities with high-performing periods. Through an engaging bar chart visualization, this report transforms raw transactional data into a powerful narrative of revenue trends across the year.

2. Goal

- To conduct an exploratory data analysis (EDA) focused on monthly sales performance.
- To identify which month generated the highest total sales.
- To quantify the sales volume during that peak period.
- To derive actionable insights that can support data-driven decision-making and improve business strategy.

3. Business Challenge

- Lack of visibility into monthly sales patterns hampers effective planning and resource allocation.
- The business struggles to identify peak and off-peak sales months, limiting its ability to optimize promotional efforts and inventory cycles.
- Without clarity on seasonal sales trends, forecasting, and budgeting remain reactive rather than proactive.
- Decision-makers lack concrete evidence to justify strategic timing for marketing or product rollouts

4. Methodology

- Clean, preprocess, and aggregate sales data by month.
- Visualize monthly sales using an intuitive bar chart to enhance interpretability.
- Highlight the month with the highest total sales and annotate its value for clarity.
- Use visual storytelling and formatted labels to make the insights easily digestible for both technical and non-technical stakeholders.
- Share recommendations based on findings to optimize business planning and improve revenue targeting.

Import necessary libraries

In [10]:

```
import pandas as pd
import os
import glob
```

Combine the sales data from all months into a single consolidated CSV file

In [12]:

```
folder_path = r"C:\Monthly_Sales"

# Retrieve all CSV files from the folder using glob
all_files = glob.glob(os.path.join(folder_path, "*.csv"))

# All CSV files combined as one DataFrame
all_data = pd.concat([pd.read_csv(file) for file in all_files], ignore_index=True)

# Merged DataFrame saved into a new CSV
output_file = os.path.join(folder_path, "all_data.csv")
all_data.to_csv(output_file, index=False)

print("All files integrated into:", output_file)
```

```
All files integrated into: C:\Monthly_Sales\all_data.csv
```

Load the updated DataFrame

In [14]:

```
# Skip Blank Rows if present in the dataset

df = pd.read_csv(r'C:\Monthly_Sales\all_data.csv', skip_blank_lines=True)
df.head()
```

Out[14]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address
0	175667	iPhone	1	700.0	04/24/24 19:12	135 Meadow St, Boston, MA 02215
1	175668	AA Batteries (4-pack)	1	5.84	04/20/24 13:45	592 4th St, San Francisco, CA 94016
2	175669	AA Batteries (4-pack)	1	5.84	04/28/24 09:17	632 Park St, Dallas, TX 75001
3	175670	AA Batteries (4-pack)	2	5.84	04/23/24 14:06	131 Pine St, San Francisco, CA 94016
4	175671	Samsung Odyssey Monitor	1	409.99	04/23/24 12:13	836 Forest St, Boston, MA 02215

In [15]:

```
df.shape
```

Out[15]:

```
(10524393, 6)
```

Data Cleaning Process

Thoroughly clean and standardize the data to eliminate errors, ensure consistency, and build a solid foundation for meaningful insights.

Find and remove rows with NaN values

In [18]:

```
df.isna().sum()
```

Out[18]:

```
Order ID            27328
Product Name        27328
Units Purchased     27330
Unit Price          27330
Order Date          27331
Delivery Address    27332
dtype: int64
```

In [19]:

```
# If Nan value is present in Order ID and Unit Purchased, it will be impossible to
# Therefore, drop Nan values in Order ID and Units Purchased.

df.dropna(subset=['Order ID', 'Units Purchased'], inplace=True)
```

In [20]:

```
# Check if Nan value is present

df.isna().sum()
```

Out[20]:

```
Order ID            0
Product Name        0
Units Purchased     0
Unit Price          0
Order Date          1
Delivery Address    2
dtype: int64
```

In [21]:

```
# Further check if any NaN values or blank rows are present

blank_rows_na = df[df.isnull().any(axis=1)]
blank_rows_na
```

Out[21]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address
2195228	Charging Cable	1	14.95	05/24/24 07:04	852 Hickory St, San Francisco, CA 94016	NaN
3001506	150766	iPhone	1	7	NaN	NaN

Find and remove rows with duplicate values

In [23]:

```
# Find duplicate values

df.duplicated()
```

Out[23]:

```
0           False
1           False
2           False
3           False
4           False
            ...
10524388     True
10524389     True
10524390     True
10524391     True
10524392     True
Length: 10497063, dtype: bool
```

In [24]:

```
# Remove duplicated values

df.drop_duplicates(inplace = True)
```

In [25]:

```
# Check again for duplicated values

df.duplicated()
```

```
Out[25]: 0          False
         1          False
         2          False
         3          False
         4          False
                    ...
         172530     False
         2195228    False
         3001506    False
         6370083    False
         6403571    False
         Length: 171546, dtype: bool
```

Verify and fix incorrect data types in the dataset

```
In [27]: # check for data types

         df.dtypes
```

```
Out[27]: Order ID            object
         Product Name        object
         Units Purchased     object
         Unit Price          object
         Order Date          object
         Delivery Address    object
         dtype: object
```

Fix incorrect data types

```
In [29]: df['Order Date'] = pd.to_datetime(df['Order Date'], format='%m/%d/%y %H:%M', errors

         df['Units Purchased'] = pd. to_numeric(df['Units Purchased'], errors='coerce')

         df['Unit Price'] = pd. to_numeric(df['Unit Price'], errors='coerce')
```

```
In [30]: # Verify the presence of NaN values remaining in the columns as a result of using e

         df.isna().sum()
```

```
Out[30]: Order ID            0
         Product Name        0
         Units Purchased     1
         Unit Price          2
         Order Date          3
         Delivery Address    2
         dtype: int64
```

```
In [31]: df = df.dropna()
```

Change the data type to optimize memory usage (Optional)

```
In [33]: df['Order ID'] = pd.to_numeric(df['Order ID'], downcast='integer')
         df['Product Name'] = df['Product Name'].astype('category')
```

```
df['Units Purchased'] = df['Units Purchased']. astype('int8')
df['Unit Price'] = pd.to_numeric(df['Unit Price'], downcast='float')
df['Delivery Address'] = df['Delivery Address'].astype('category')
```

Expand the dataset with supplementary columns

Add month column

In [36]:

```
df['Month'] = df['Order Date'].dt.month
df
```

Out[36]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month
0	175667	iPhone	1	700.00000	2024-04-24 19:12:00	135 Meadow St, Boston, MA 02215	4
1	175668	AA Batteries (4-pack)	1	5.84000	2024-04-20 13:45:00	592 4th St, San Francisco, CA 94016	4
2	175669	AA Batteries (4-pack)	1	5.84000	2024-04-28 09:17:00	632 Park St, Dallas, TX 75001	4
3	175670	AA Batteries (4-pack)	2	5.84000	2024-04-23 14:06:00	131 Pine St, San Francisco, CA 94016	4
4	175671	Samsung Odyssey Monitor	1	409.98999	2024-04-23 12:13:00	836 Forest St, Boston, MA 02215	4
...	...	...	...	...	...	...	...
172528	248378	Google Phone	1	600.00000	2024-09-02 08:53:00	668 Wilson St, Boston, MA 02215	9
172529	248379	Alienware Monitor	1	400.98999	2024-09-04 22:58:00	466 2nd St, Boston, MA 02215	9
172530	248380	AAA Batteries (4-pack)	1	4.99000	2024-09-04 13:09:00	133 Walnut St, Seattle, WA 98101	9
6370083	252436	Apple Airpods Headphones	1	150.00000	2024-10-14 16:44:00	740 Dogwood St, Boston, \rA 02215	10
6403571	233092	USB-C Charging Cable	1	11.95000	2024-08-28 12:39:00	740 Dogwood St, Boston, \rA 02215	8

171543 rows × 7 columns

In [37]:

```
df['Month Name'] = df['Order Date'].dt.strftime('%B')
df
```

Out[37]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	M N
0	175667	iPhone	1	700.00000	2024-04-24 19:12:00	135 Meadow St, Boston, MA 02215	4	
1	175668	AA Batteries (4-pack)	1	5.84000	2024-04-20 13:45:00	592 4th St, San Francisco, CA 94016	4	
2	175669	AA Batteries (4-pack)	1	5.84000	2024-04-28 09:17:00	632 Park St, Dallas, TX 75001	4	
3	175670	AA Batteries (4-pack)	2	5.84000	2024-04-23 14:06:00	131 Pine St, San Francisco, CA 94016	4	
4	175671	Samsung Odyssey Monitor	1	409.98999	2024-04-23 12:13:00	836 Forest St, Boston, MA 02215	4	
...	...	...	...	...	...	...	...	
172528	248378	Google Phone	1	600.00000	2024-09-02 08:53:00	668 Wilson St, Boston, MA 02215	9	Septer
172529	248379	Alienware Monitor	1	400.98999	2024-09-04 22:58:00	466 2nd St, Boston, MA 02215	9	Septer
172530	248380	AAA Batteries (4-pack)	1	4.99000	2024-09-04 13:09:00	133 Walnut St, Seattle, WA 98101	9	Septer
6370083	252436	Apple Airpods Headphones	1	150.00000	2024-10-14 16:44:00	740 Dogwood St, Boston, \rA 02215	10	Oct

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	M N
6403571	233092	USB-C Charging Cable	1	11.95000	2024-08-28 12:39:00	740 Dogwood St, Boston, \rA 02215	8	Au

171543 rows × 8 columns

Add week day column

```
In [39]: df['Day of Week'] = df['Order Date'].dt.strftime('%a')
         df
```

Out[39]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	M N
0	175667	iPhone	1	700.00000	2024-04-24 19:12:00	135 Meadow St, Boston, MA 02215	4	
1	175668	AA Batteries (4-pack)	1	5.84000	2024-04-20 13:45:00	592 4th St, San Francisco, CA 94016	4	
2	175669	AA Batteries (4-pack)	1	5.84000	2024-04-28 09:17:00	632 Park St, Dallas, TX 75001	4	
3	175670	AA Batteries (4-pack)	2	5.84000	2024-04-23 14:06:00	131 Pine St, San Francisco, CA 94016	4	
4	175671	Samsung Odyssey Monitor	1	409.98999	2024-04-23 12:13:00	836 Forest St, Boston, MA 02215	4	
...	...	...	...	...	...	...	...	
172528	248378	Google Phone	1	600.00000	2024-09-02 08:53:00	668 Wilson St, Boston, MA 02215	9	Septer
172529	248379	Alienware Monitor	1	400.98999	2024-09-04 22:58:00	466 2nd St, Boston, MA 02215	9	Septer
172530	248380	AAA Batteries (4-pack)	1	4.99000	2024-09-04 13:09:00	133 Walnut St, Seattle, WA 98101	9	Septer
6370083	252436	Apple Airpods Headphones	1	150.00000	2024-10-14 16:44:00	740 Dogwood St, Boston, \rA 02215	10	Oct

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	M N
6403571	233092	USB-C Charging Cable	1	11.95000	2024-08-28 12:39:00	740 Dogwood St, Boston, \rA 02215	8	Au

171543 rows × 9 columns

Add hour column

In [41]:

```
df['Hour'] = df['Order Date'].dt.hour
df
```

Out[41]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	M N
0	175667	iPhone	1	700.00000	2024-04-24 19:12:00	135 Meadow St, Boston, MA 02215	4	
1	175668	AA Batteries (4-pack)	1	5.84000	2024-04-20 13:45:00	592 4th St, San Francisco, CA 94016	4	
2	175669	AA Batteries (4-pack)	1	5.84000	2024-04-28 09:17:00	632 Park St, Dallas, TX 75001	4	
3	175670	AA Batteries (4-pack)	2	5.84000	2024-04-23 14:06:00	131 Pine St, San Francisco, CA 94016	4	
4	175671	Samsung Odyssey Monitor	1	409.98999	2024-04-23 12:13:00	836 Forest St, Boston, MA 02215	4	
...	...	...	...	...	...	...	...	
172528	248378	Google Phone	1	600.00000	2024-09-02 08:53:00	668 Wilson St, Boston, MA 02215	9	Septer
172529	248379	Alienware Monitor	1	400.98999	2024-09-04 22:58:00	466 2nd St, Boston, MA 02215	9	Septer
172530	248380	AAA Batteries (4-pack)	1	4.99000	2024-09-04 13:09:00	133 Walnut St, Seattle, WA 98101	9	Septer
6370083	252436	Apple Airpods Headphones	1	150.00000	2024-10-14 16:44:00	740 Dogwood St, Boston, \rA 02215	10	Oct

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	M N
6403571	233092	USB-C Charging Cable	1	11.95000	2024-08-28 12:39:00	740 Dogwood St, Boston, \rA 02215	8	Au

171543 rows × 10 columns

Add city column

In [43]:
```
def city(address):
    return address.split(",")[1].strip(" ")

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

df['City'] = df['Delivery Address'].apply(lambda x: f"{city(x)}  ({state_abbrev(x)}
df.head()
```

Out[43]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	Month Name	Day of Week
0	175667	iPhone	1	700.00000	2024-04-24 19:12:00	135 Meadow St, Boston, MA 02215	4	April	Wed
1	175668	AA Batteries (4-pack)	1	5.84000	2024-04-20 13:45:00	592 4th St, San Francisco, CA 94016	4	April	Sat
2	175669	AA Batteries (4-pack)	1	5.84000	2024-04-28 09:17:00	632 Park St, Dallas, TX 75001	4	April	Sun
3	175670	AA Batteries (4-pack)	2	5.84000	2024-04-23 14:06:00	131 Pine St, San Francisco, CA 94016	4	April	Tue
4	175671	Samsung Odyssey Monitor	1	409.98999	2024-04-23 12:13:00	836 Forest St, Boston, MA 02215	4	April	Tue

Organize Data by Order Date Chronologically and Reindex

```
In [45]: df = df.sort_values(by = 'Order Date')
         df
```

Out[45]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	Month Name
78282	160155	Alienware Monitor	1	400.989990	2024-01-01 05:04:00	765 Ridge St, Portland, OR 97035	1	January
68761	151041	AAA Batteries (4-pack)	1	4.990000	2024-01-01 05:04:00	964 Lakeview St, Atlanta, GA 30301	1	January
64303	146765	AAA Batteries (4-pack)	1	4.990000	2024-01-01 05:20:00	546 10th St, San Francisco, CA 94016	1	January
63092	145617	Amana Washing Machine	1	600.000000	2024-01-01 05:24:00	961 Meadow St, Portland, OR 97035	1	January
74502	156535	iPhone	1	700.000000	2024-01-01 05:45:00	451 Elm St, Los Angeles, CA 90001	1	January
...	...	...	...	...	...	...	...	...
44457	297748	iPhone	1	700.000000	2025-01-01 02:37:00	258 Forest St, Los Angeles, CA 90001	1	January
30663	284606	Bose SoundSport Headphones	1	99.989998	2025-01-01 02:50:00	211 Johnson St, Boston, MA 02215	1	January
49246	302330	AA Batteries (4-pack)	1	5.840000	2025-01-01 03:03:00	665 6th St, San Francisco, CA 94016	1	January
30770	284711	AA Batteries (4-pack)	1	5.840000	2025-01-01 03:19:00	250 8th St, San Francisco, CA 94016	1	January

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	Month Name
50619	303626	USB-C Charging Cable	3	11.950000	2025-01-01 04:43:00	651 Lakeview St, Dallas, TX 75001	1	January

171543 rows × 11 columns

```
In [46]: df = df.reset_index(drop=True)
         df
```

Out[46]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	Mont Nam
0	160155	Alienware Monitor	1	400.989990	2024-01-01 05:04:00	765 Ridge St, Portland, OR 97035	1	Januar
1	151041	AAA Batteries (4-pack)	1	4.990000	2024-01-01 05:04:00	964 Lakeview St, Atlanta, GA 30301	1	Januar
2	146765	AAA Batteries (4-pack)	1	4.990000	2024-01-01 05:20:00	546 10th St, San Francisco, CA 94016	1	Januar
3	145617	Amana Washing Machine	1	600.000000	2024-01-01 05:24:00	961 Meadow St, Portland, OR 97035	1	Januar
4	156535	iPhone	1	700.000000	2024-01-01 05:45:00	451 Elm St, Los Angeles, CA 90001	1	Januar
...	...	...	...	...	...	...	...	.
171538	297748	iPhone	1	700.000000	2025-01-01 02:37:00	258 Forest St, Los Angeles, CA 90001	1	Januar
171539	284606	Bose SoundSport Headphones	1	99.989998	2025-01-01 02:50:00	211 Johnson St, Boston, MA 02215	1	Januar
171540	302330	AA Batteries (4-pack)	1	5.840000	2025-01-01 03:03:00	665 6th St, San Francisco, CA 94016	1	Januar
171541	284711	AA Batteries (4-pack)	1	5.840000	2025-01-01 03:19:00	250 8th St, San Francisco, CA 94016	1	Januar

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	Mont Nam
171542	303626	USB-C Charging Cable	3	11.950000	2025-01-01 04:43:00	651 Lakeview St, Dallas, TX 75001	1	Januar

171543 rows × 11 columns

Add Total Sales column

In [48]:
```
df['Total Sales'] = df['Units Purchased'] * df['Unit Price']
df.head()
```

Out[48]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	Month Name	Day of Week
0	160155	Alienware Monitor	1	400.98999	2024-01-01 05:04:00	765 Ridge St, Portland, OR 97035	1	January	Mon
1	151041	AAA Batteries (4-pack)	1	4.99000	2024-01-01 05:04:00	964 Lakeview St, Atlanta, GA 30301	1	January	Mon
2	146765	AAA Batteries (4-pack)	1	4.99000	2024-01-01 05:20:00	546 10th St, San Francisco, CA 94016	1	January	Mon
3	145617	Amana Washing Machine	1	600.00000	2024-01-01 05:24:00	961 Meadow St, Portland, OR 97035	1	January	Mon
4	156535	iPhone	1	700.00000	2024-01-01 05:45:00	451 Elm St, Los Angeles, CA 90001	1	January	Mon

Format Unit Price and Total Sales to 2 decimal places

In [50]:
```
df['Unit Price'] = df['Unit Price'].apply(lambda x: "%.2f" % x)
```

In [51]:
```
df['Total Sales'] = df['Total Sales'].apply(lambda x: "%.2f" % x)
df.head()
```

Out[51]:

	Order ID	Product Name	Units Purchased	Unit Price	Order Date	Delivery Address	Month	Month Name	Day of Week	Hc
0	160155	Alienware Monitor	1	400.99	2024-01-01 05:04:00	765 Ridge St, Portland, OR 97035	1	January	Mon	
1	151041	AAA Batteries (4-pack)	1	4.99	2024-01-01 05:04:00	964 Lakeview St, Atlanta, GA 30301	1	January	Mon	
2	146765	AAA Batteries (4-pack)	1	4.99	2024-01-01 05:20:00	546 10th St, San Francisco, CA 94016	1	January	Mon	
3	145617	Amana Washing Machine	1	600.00	2024-01-01 05:24:00	961 Meadow St, Portland, OR 97035	1	January	Mon	
4	156535	iPhone	1	700.00	2024-01-01 05:45:00	451 Elm St, Los Angeles, CA 90001	1	January	Mon	

Format Unit Price and Total Sales to 2 decimal places

In [53]:
```
df['Unit Price'] = pd.to_numeric(df['Unit Price'])
df['Total Sales'] = pd.to_numeric(df['Total Sales'])
```

In [54]:
```
df.dtypes
```

```
Out[54]: Order ID                       int32
         Product Name                category
         Units Purchased                 int8
         Unit Price                   float64
         Order Date            datetime64[ns]
         Delivery Address            category
         Month                          int32
         Month Name                    object
         Day of Week                   object
         Hour                           int32
         City                          object
         Total Sales                  float64
         dtype: object
```

Determine which month recorded the highest total sales, and provide the corresponding sales figure for that period.

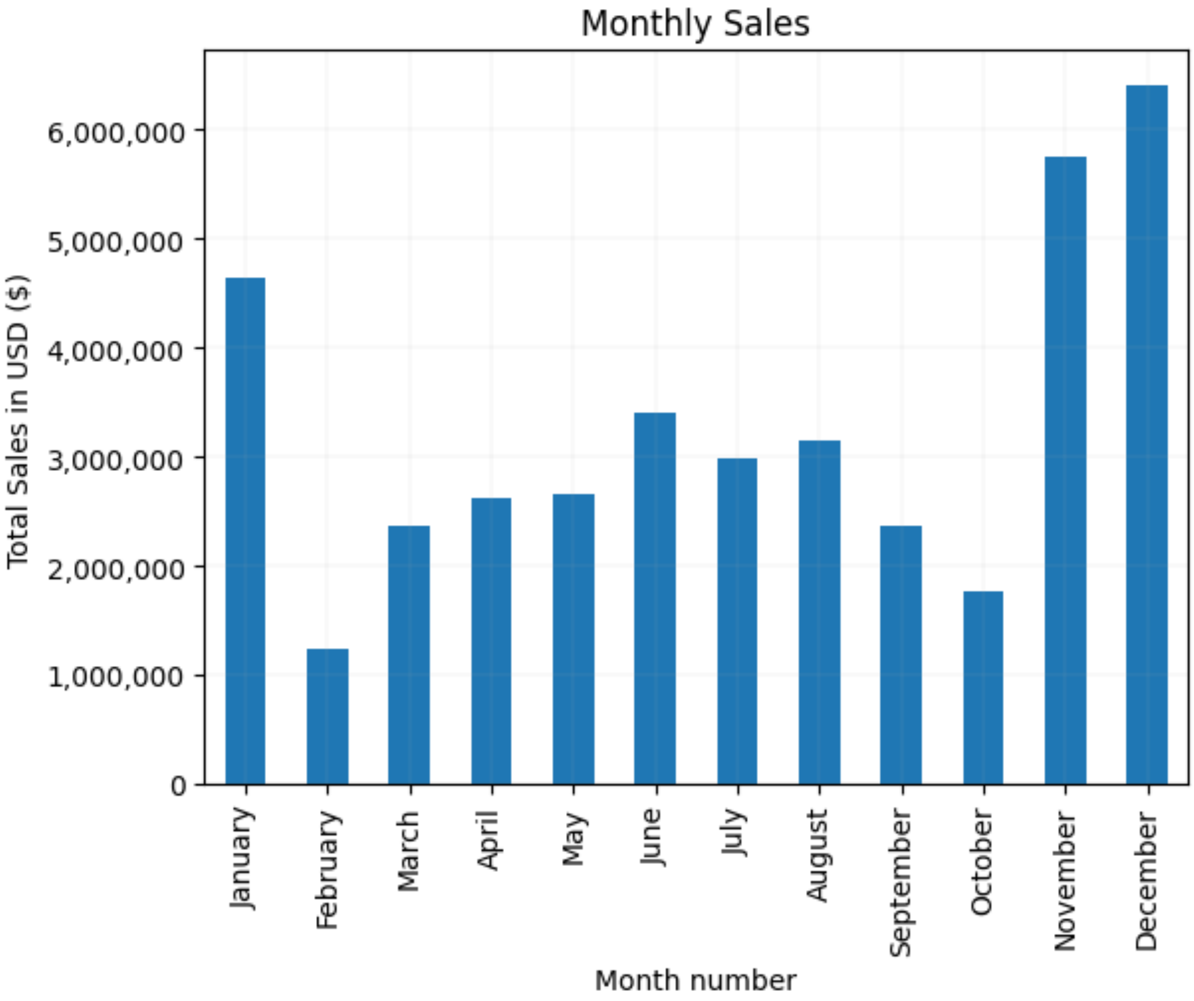
```
In [56]: monthly_sales = df.groupby('Month')['Total Sales'].sum()
         monthly_sales
```

```
Out[56]: Month
         1     4639312.17
         2     1235017.71
         3     2358783.67
         4     2619873.83
         5     2657978.27
         6     3408613.54
         7     2990038.42
         8     3143681.87
         9     2368652.05
         10    1760182.98
         11    5743349.24
         12    6404121.28
         Name: Total Sales, dtype: float64
```

Plot Monthly Sales

```
In [58]: import matplotlib.pyplot as plt
         import matplotlib.ticker as tick

         # Grouping by Month, ensuring Month is treated as a string or integer and not datet
         monthly_sales = df.groupby(df['Month Name'])['Total Sales'].sum()

         # Reorder the months
         month_order = ['January', 'February', 'March','April','May', 'June', 'July', 'Augus
         monthly_sales = monthly_sales.reindex(month_order)


         # Plotting
         ax = monthly_sales.plot(kind='bar', title="Monthly Sales")

         ax.set_xlabel('Month number')
         ax.set_ylabel('Total Sales in USD ($)')
```

```
# Format y-axis with comma separators
ax.get_yaxis().set_major_formatter(plt.FuncFormatter(lambda x, _: f'{int(x):,}'))

plt.xticks(rotation=90)
plt.grid(linewidth=0.1)

plt.savefig(r"C:/Users/DELL/OneDrive - COVENANT UNIVERSITY/Desktop/1/Monthly Sales

plt.show()
```



Key Insights

1. December recorded the highest total sales, with a revenue of $6,404,121.28, making it the most profitable month of the year.

2. November followed as the second-highest month with $5,743,349.24, indicating a strong year-end sales trend.

3. February was the weakest month, with the lowest total sales of $1,235,017.71.

A noticeable sales surge begins from June onward, suggesting a buildup toward the end-ofyear peak.

Strategic Recommendations

1. Capitalize on Q4 sales momentum: Invest heavily in marketing, promotions, and inventory during November and December,

as these months are proven high performers—likely driven by holidays, year-end bonuses, and seasonal demand.

2. Launch pre-holiday campaigns starting Q3 (around July–September) to create demand early and ride the momentum.

3. Investigate low performance in February: Look into potential causes

(example, post-holiday fatigue, customer spending behavior, or operational lags) and explore strategies like targeted promotions or loyalty incentives to boost engagement.

4. Use seasonality to guide forecasting: Align production, staffing, and budget planning with high

and low-performing months for optimized operations and cost efficiency.