In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
```

```
C:\Users\patil\anaconda3\lib\site-packages\pandas\core\computation\expressions.py:21: UserWarning: Pandas requires vers
ion '2.8.4' or newer of 'numexpr' (version '2.8.3' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
C:\Users\patil\anaconda3\lib\site-packages\pandas\core\arrays\masked.py:61: UserWarning: Pandas requires version '1.3.
6' or newer of 'bottleneck' (version '1.3.5' currently installed).
  from pandas.core import (
```

In [2]:
```
df = pd.read_csv('retail_sales_dataset.csv')
```

In [3]:
```
print("Dataset Shape:", df.shape)
df.head()
```

```
Dataset Shape: (1000, 9)
```

Out[3]:

	Transaction ID	Date	Customer ID	Gender	Age	Product Category	Quantity	Price per Unit	Total Amount
0	1	2023-11-24	CUST001	Male	34	Beauty	3	50	150
1	2	2023-02-27	CUST002	Female	26	Clothing	2	500	1000
2	3	2023-01-13	CUST003	Male	50	Electronics	1	30	30
3	4	2023-05-21	CUST004	Male	37	Clothing	1	500	500
4	5	2023-05-06	CUST005	Male	30	Beauty	2	50	100

In [4]:
```
print("Missing values per column:\n", df.isnull().sum())
```

```
Missing values per column:
 Transaction ID      0
Date                 0
Customer ID          0
Gender               0
Age                  0
Product Category     0
Quantity             0
Price per Unit       0
Total Amount         0
dtype: int64
```

In [5]:
```
df.drop_duplicates(inplace=True)
```

In [6]:
```
df['Date'] = pd.to_datetime(df['Date'], errors='coerce')
```

In [7]:
```
df = df.dropna(subset=['Date'])
```

In [8]:
```
print(df.info())
print("\nUnique values per column:\n", df.nunique())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 9 columns):
 #   Column            Non-Null Count  Dtype         
---  ------            --------------  -----         
 0   Transaction ID    1000 non-null   int64         
 1   Date              1000 non-null   datetime64[ns]
 2   Customer ID       1000 non-null   object        
 3   Gender            1000 non-null   object        
 4   Age               1000 non-null   int64         
 5   Product Category  1000 non-null   object        
 6   Quantity          1000 non-null   int64         
 7   Price per Unit    1000 non-null   int64         
 8   Total Amount      1000 non-null   int64         
dtypes: datetime64[ns](1), int64(5), object(3)
memory usage: 70.4+ KB
None

Unique values per column:
 Transaction ID      1000
Date                  345
Customer ID          1000
Gender                  2
Age                    47
Product Category        3
Quantity                4
Price per Unit          5
Total Amount           18
dtype: int64
```

In [9]:
```
print("===== DESCRIPTIVE STATISTICS =====")

print("\nMean:\n", df.mean(numeric_only=True))
print("\nMedian:\n", df.median(numeric_only=True))
```

```
print("\nMode:\n", df.mode(numeric_only=True).iloc[0])
print("\nStandard Deviation:\n", df.std(numeric_only=True))
```

```
===== DESCRIPTIVE STATISTICS =====

Mean:
 Transaction ID    500.500
Age                41.392
Quantity            2.514
Price per Unit    179.890
Total Amount      456.000
dtype: float64

Median:
 Transaction ID    500.5
Age                42.0
Quantity            3.0
Price per Unit     50.0
Total Amount      135.0
dtype: float64

Mode:
 Transaction ID     1.0
Age                43.0
Quantity            4.0
Price per Unit     50.0
Total Amount       50.0
Name: 0, dtype: float64

Standard Deviation:
 Transaction ID    288.819436
Age                13.681430
Quantity            1.132734
Price per Unit    189.681356
Total Amount      559.997632
dtype: float64
```

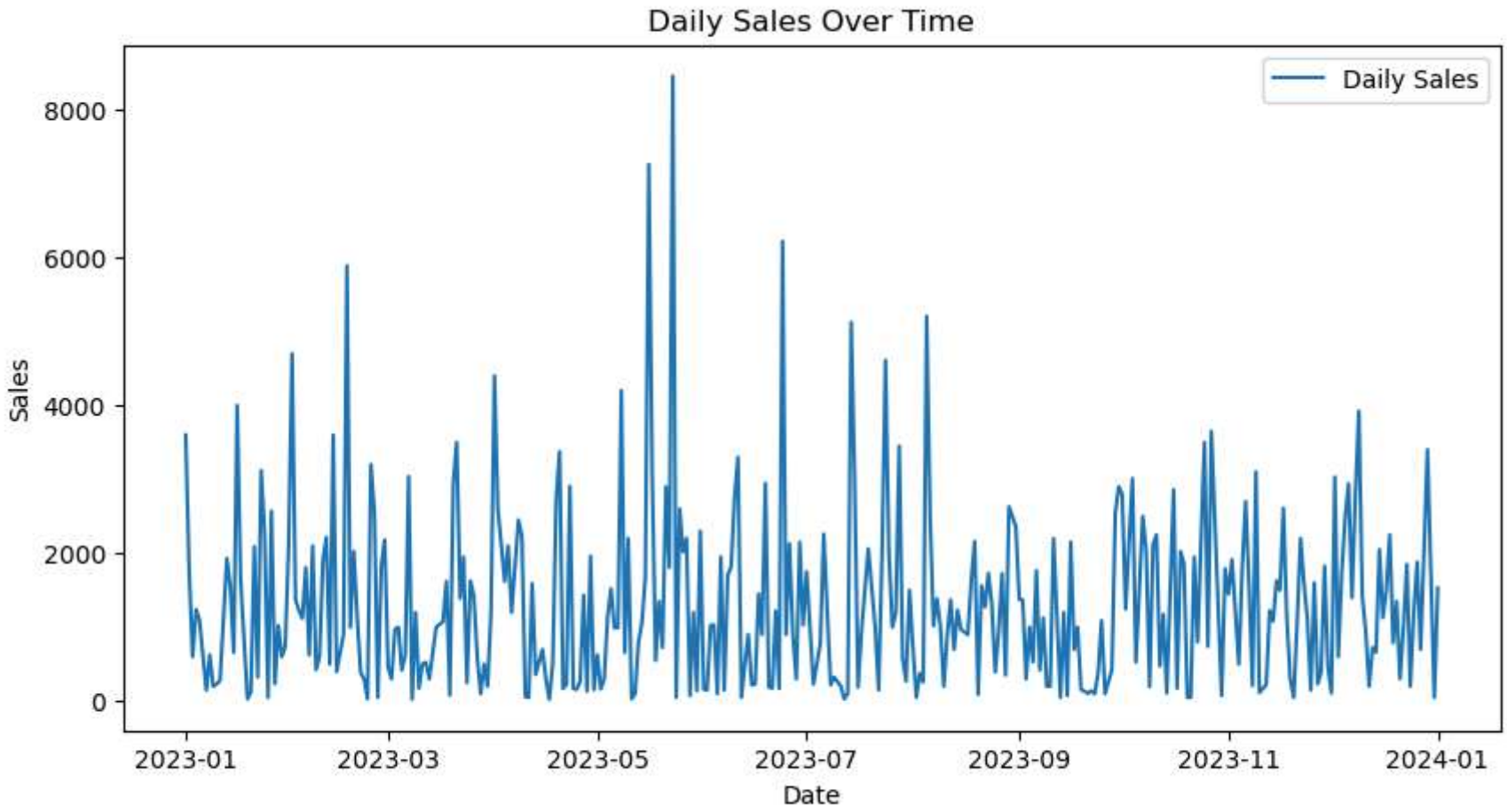
In [10]:
```
df.describe(include='all').T
```

Out[10]:

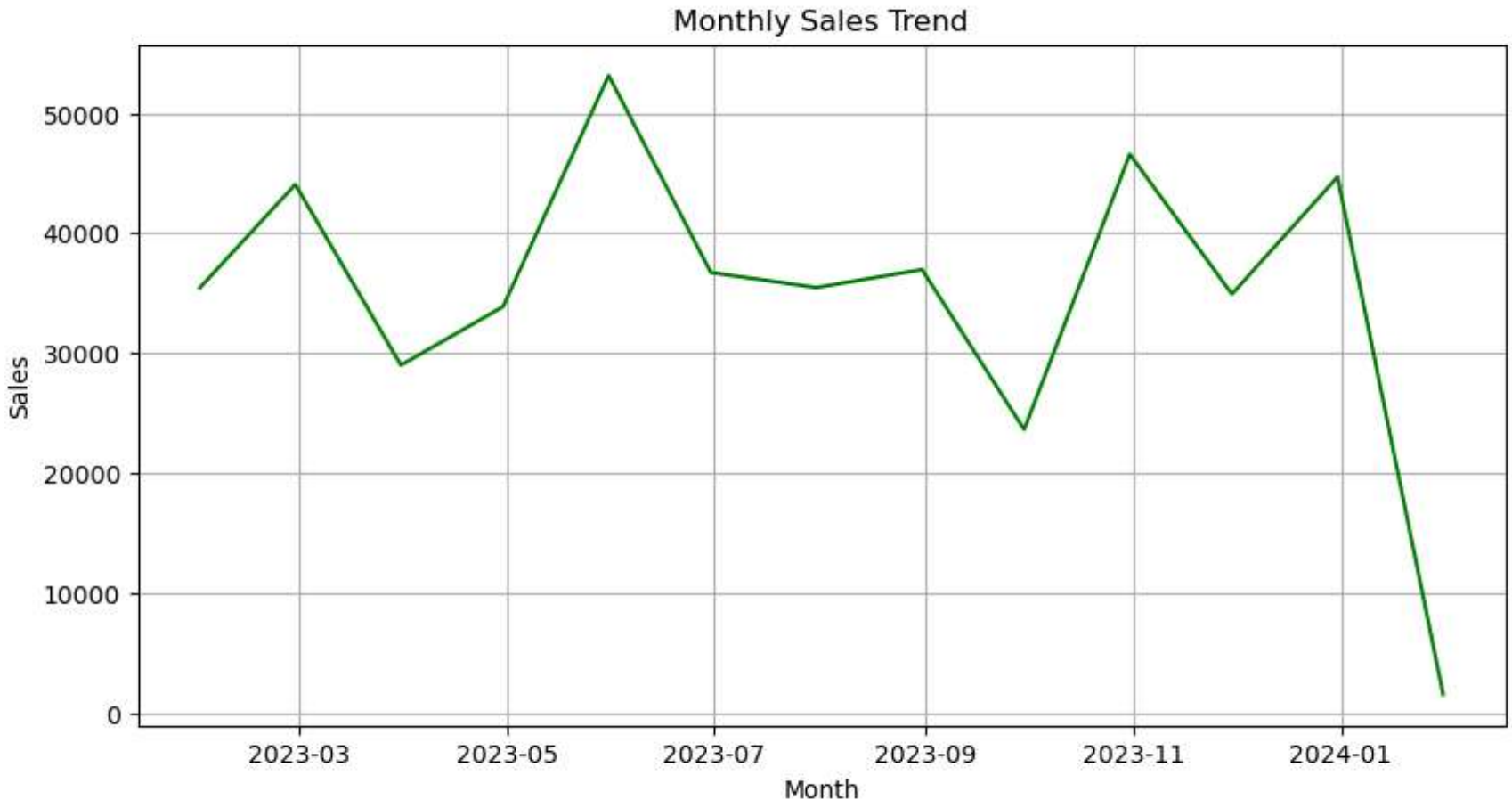
	count	unique	top	freq	mean	min	25%	50%	75%	max	std
Transaction ID	1000.0	NaN	NaN	NaN	500.5	1.0	250.75	500.5	750.25	1000.0	288.819436
Date	1000	NaN	NaN	NaN	2023-07-03 00:25:55.200000256	2023-01-01 00:00:00	2023-04-08 00:00:00	2023-06-29 12:00:00	2023-10-04 00:00:00	2024-01-01 00:00:00	NaN
Customer ID	1000	1000	CUST001	1	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Gender	1000	2	Female	510	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Age	1000.0	NaN	NaN	NaN	41.392	18.0	29.0	42.0	53.0	64.0	13.68143
Product Category	1000	3	Clothing	351	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Quantity	1000.0	NaN	NaN	NaN	2.514	1.0	1.0	3.0	4.0	4.0	1.132734
Price per Unit	1000.0	NaN	NaN	NaN	179.89	25.0	30.0	50.0	300.0	500.0	189.681356
Total Amount	1000.0	NaN	NaN	NaN	456.0	25.0	60.0	135.0	900.0	2000.0	559.997632

In [11]:
```
if 'Total Amount' in df.columns:
    df['Sales'] = df['Total Amount']
else:
    df['Sales'] = df['Quantity'] * df['Price per Unit']

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

In [12]:
```
daily_sales = df.groupby('Date')['Sales'].sum()

plt.figure(figsize=(10,5))
plt.plot(daily_sales.index, daily_sales.values, label='Daily Sales')
plt.title('Daily Sales Over Time')
plt.xlabel('Date')
plt.ylabel('Sales')
plt.legend()
plt.show()
```

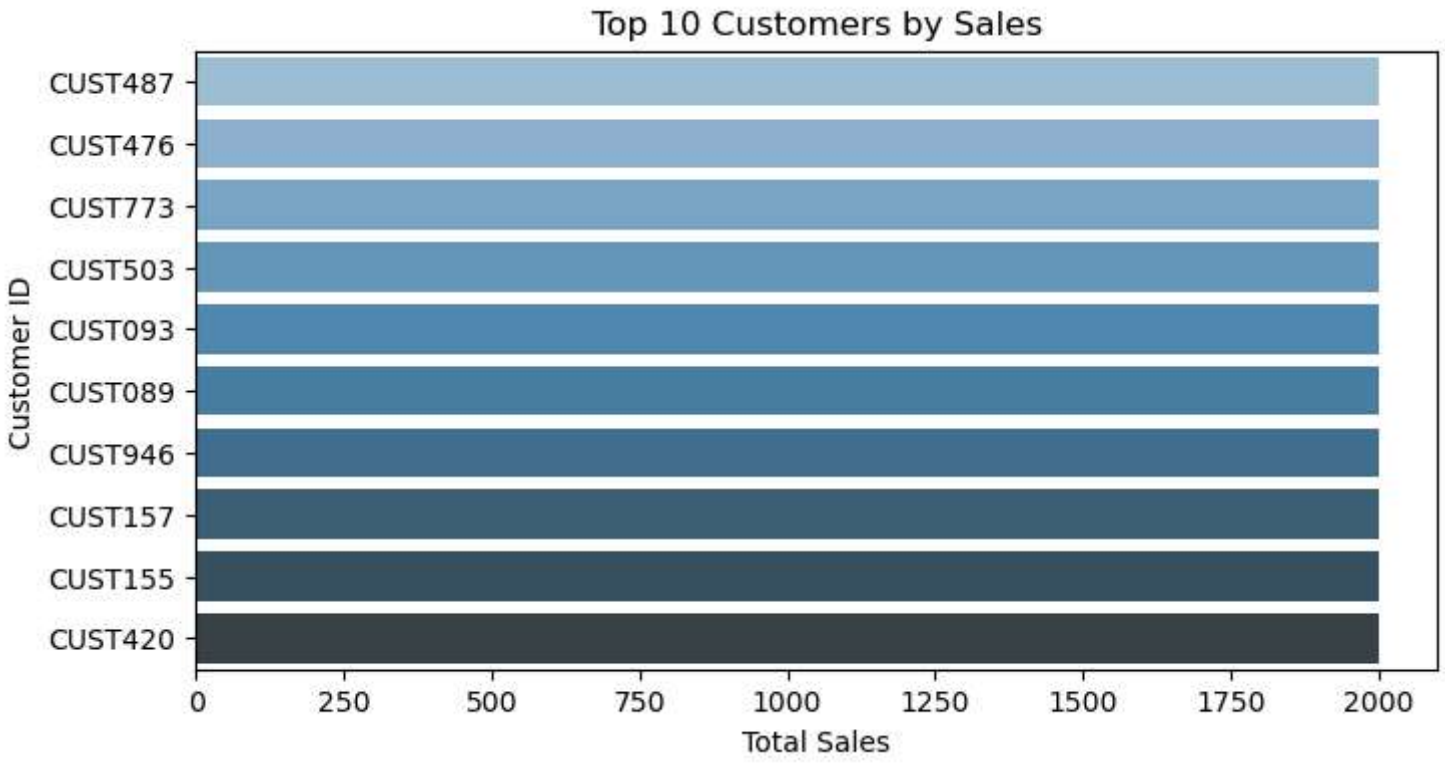


In [20]:
```
monthly_sales = df.resample('ME', on='Date')['Sales'].sum()
plt.figure(figsize=(10,5))
plt.plot(monthly_sales.index, monthly_sales.values, color='green')
plt.title('Monthly Sales Trend')
plt.xlabel('Month')
plt.ylabel('Sales')
plt.grid(True)
plt.show()
```



In [14]:
```
print("===== CUSTOMER ANALYSIS  =====")
if 'Customer ID' in df.columns:
    customer_sales = df.groupby('Customer ID')['Sales'].sum().sort_values(ascending=False).head(10)
    plt.figure(figsize=(8,4))
    sns.barplot(x=customer_sales.values, y=customer_sales.index, palette="Blues_d")
    plt.title('Top 10 Customers by Sales')
    plt.xlabel('Total Sales')
    plt.ylabel('Customer ID')
    plt.show()
```

```
===== CUSTOMER ANALYSIS  =====
```

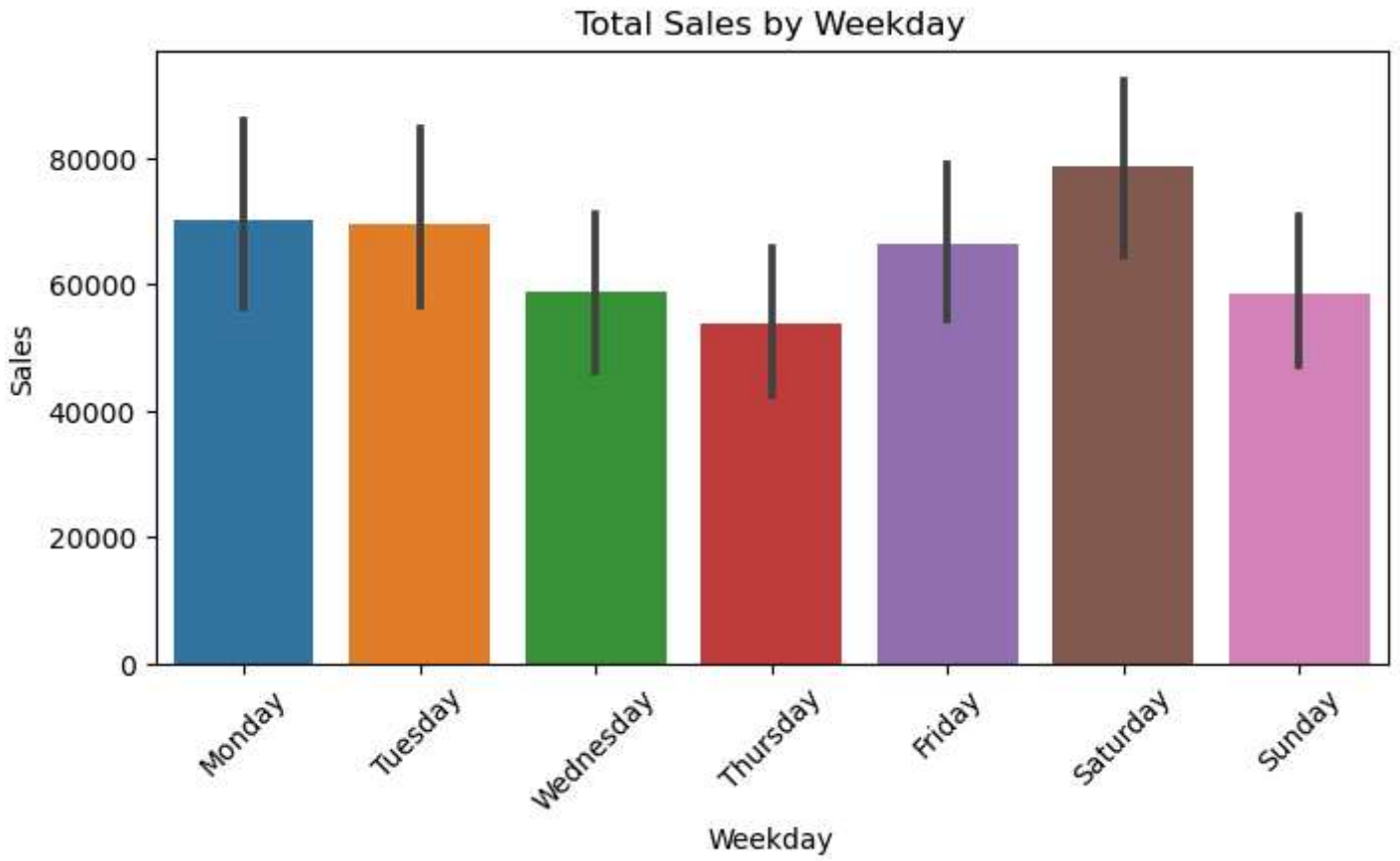


In [15]:
```
print('====  PRODUCT ANALYSIS  ====')
if 'Product' in df.columns:
    product_sales = df.groupby('Product')['Sales'].sum().sort_values(ascending=False).head(10)
    plt.figure(figsize=(8,4))
    sns.barplot(x=product_sales.values, y=product_sales.index, palette="viridis")
    plt.title('Top 10 Products by Sales')
    plt.xlabel('Total Sales')
    plt.ylabel('Product')
    plt.show()
```

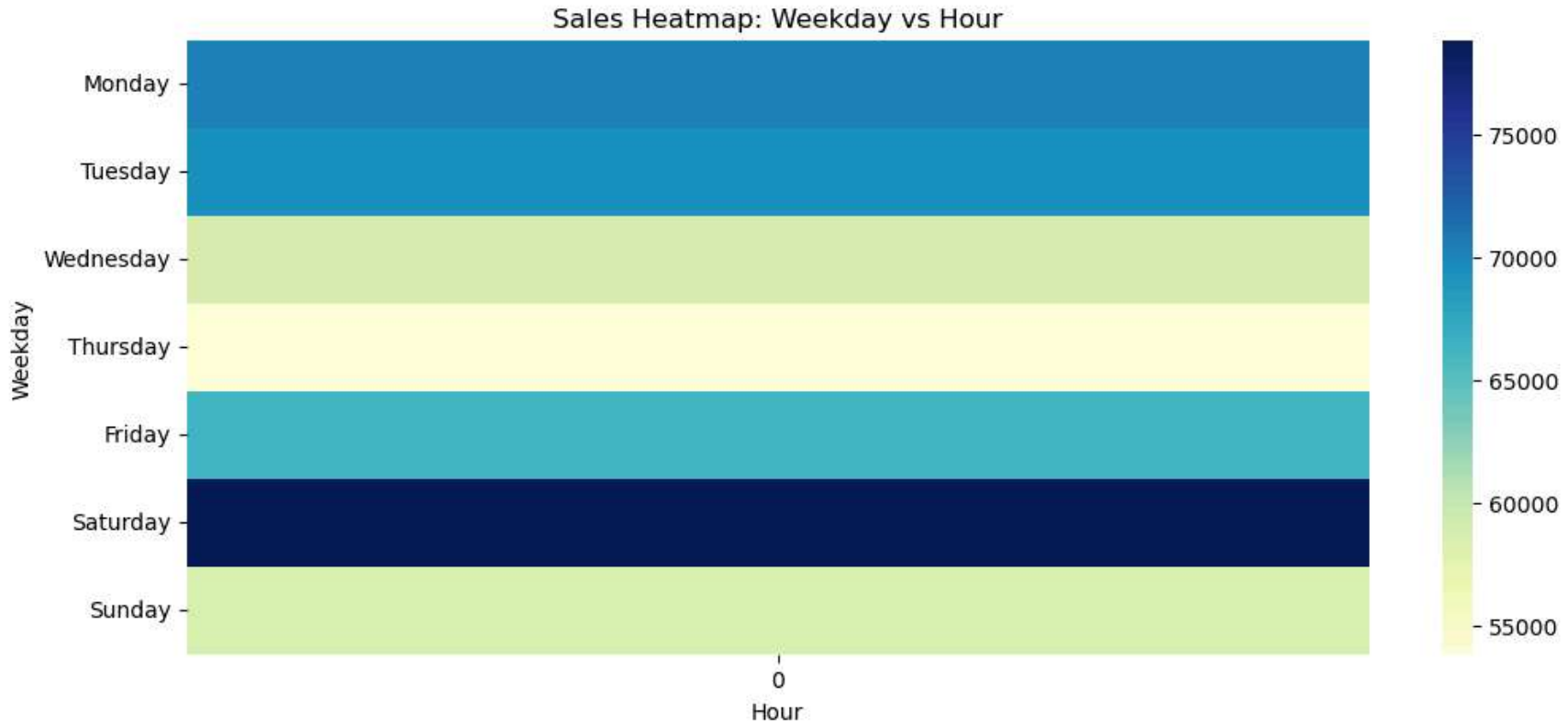
```
====  PRODUCT ANALYSIS  ====
```

In [16]:
```
df['Weekday'] = df['Date'].dt.day_name()
df['Hour'] = df['Date'].dt.hour
```

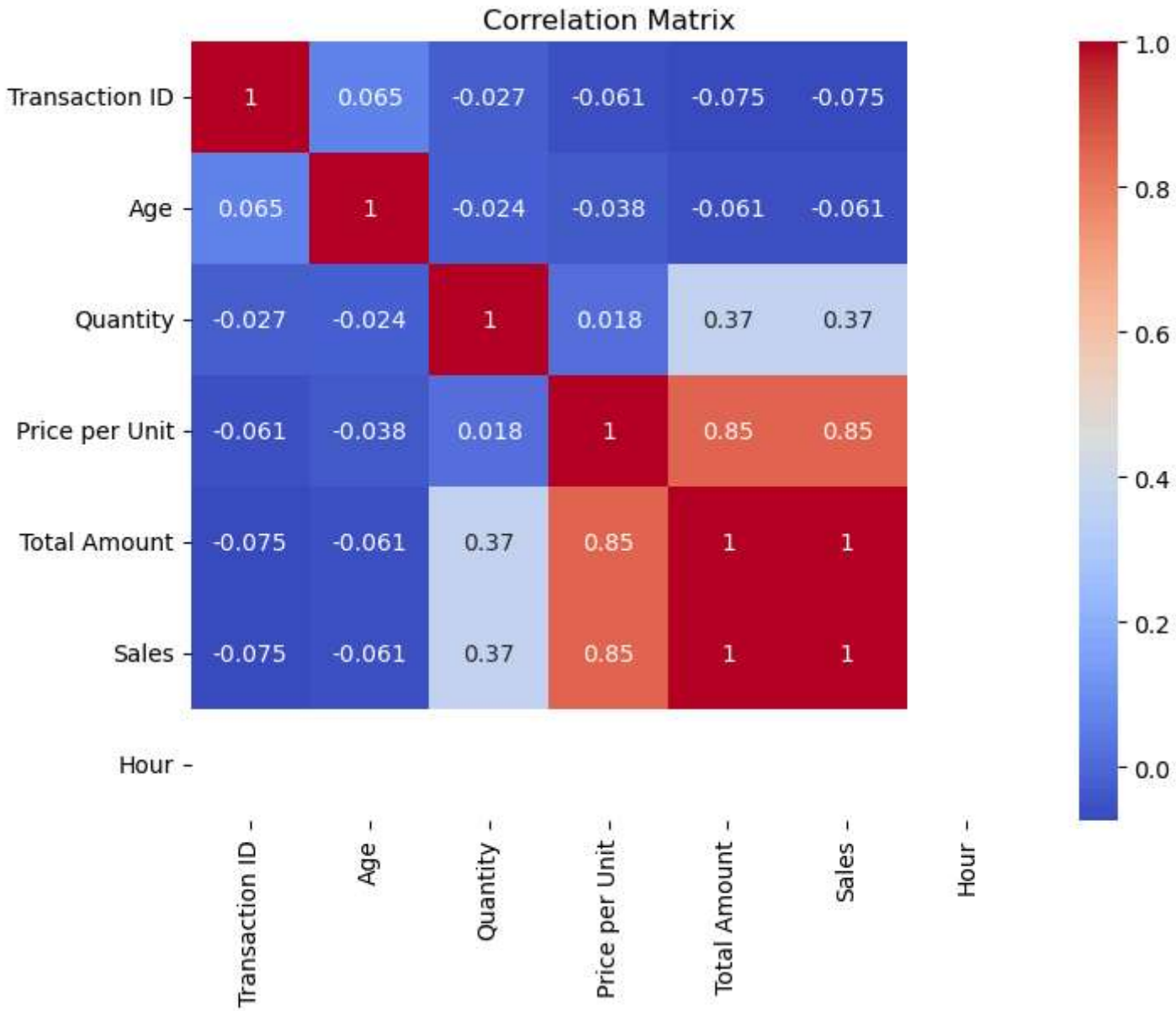
In [17]:
```
plt.figure(figsize=(8,4))
sns.barplot(x='Weekday', y='Sales', data=df, estimator=sum, order=['Monday','Tuesday','Wednesday','Thursday','Friday','
plt.title('Total Sales by Weekday')
plt.xticks(rotation=45)
plt.show()
```



In [18]:
```
pivot = df.pivot_table(index='Weekday', columns='Hour', values='Sales', aggfunc='sum', fill_value=0)
pivot = pivot.reindex(['Monday','Tuesday','Wednesday','Thursday','Friday','Saturday','Sunday'])
plt.figure(figsize=(12,5))
sns.heatmap(pivot, cmap='YlGnBu')
plt.title('Sales Heatmap: Weekday vs Hour')
plt.show()
```



In [19]:
```
plt.figure(figsize=(8,6))
sns.heatmap(df.corr(numeric_only=True), annot=True, cmap='coolwarm')
plt.title('Correlation Matrix')
plt.show()
```


Correlation Matrix
Transaction ID
Age
Quantity
Price per Unit
Total Amount
Sales
Hour
1
0.065
-0.027
-0.061
-0.075
-0.075
0.065
1
-0.024
-0.038
-0.061
-0.061
-0.027
-0.024
1
0.018
0.37
0.37
-0.061
-0.038
0.018
1
0.85
0.85
-0.075
-0.061
0.37
0.85
1
1
-0.075
-0.061
0.37
0.85
1
1
1.0
0.8
0.6
0.4
0.2
0.0

In [ ]: