Essential Libraries for Data Cleaning, Preprocessing, and Visualization

In [6]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import  seaborn as sns
```

In [13]:
```
# load dataset into notebook
```

In [14]:
```
df = pd.read_csv('sales_data_sample.csv',encoding='ISO=8859-1')
```

In [15]:
```
# check first five of dataset
```

In [16]:
```
df.head()
```

Out[16]:

	ORDERNUMBER	QUANTITYORDERED	PRICEEACH	ORDERLINENUMBER	SALES	OR
0	10107	30	95.70	2	2871.00	
1	10121	34	81.35	5	2765.90	
2	10134	41	94.74	2	3884.34	
3	10145	45	83.26	6	3746.70	
4	10159	49	100.00	14	5205.27	1

5 rows × 25 columns

In [17]:
```
# last five row of dataset
```

In [18]:
```
df.tail()
```

Out[18]:

	ORDERNUMBER	QUANTITYORDERED	PRICEEACH	ORDERLINENUMBER	SALES
2818	10350	20	100.00	15	2244.40
2819	10373	29	100.00	1	3978.51
2820	10386	43	100.00	4	5417.57
2821	10397	34	62.24	1	2116.16
2822	10414	47	65.52	9	3079.44

5 rows × 25 columns

In [19]:
```
# Total number of rows and colums present dataset
```

In [20]:
```
df.shape
```

Out[20]:
```
(2823, 25)
```

In [21]:
```
#check datatype of columns
```

In [22]:
```
df.dtypes
```

Out[22]:
```
ORDERNUMBER           int64
QUANTITYORDERED       int64
PRICEEACH           float64
ORDERLINENUMBER       int64
SALES               float64
ORDERDATE            object
STATUS               object
QTR_ID                int64
MONTH_ID              int64
YEAR_ID               int64
PRODUCTLINE          object
MSRP                  int64
PRODUCTCODE          object
CUSTOMERNAME         object
PHONE                object
ADDRESSLINE1         object
ADDRESSLINE2         object
CITY                 object
STATE                object
POSTALCODE           object
COUNTRY              object
TERRITORY            object
CONTACTLASTNAME      object
CONTACTFIRSTNAME     object
DEALSIZE             object
dtype: object
```

In [23]:
```
# an overview on dataset
```

In [ ]:

df.info()

Data refinement and preprocessing

In [ ]:

In [ ]:

In [ ]:

Drop Rows with Missing (Null) Values

In [24]:
```
# total number of null value present in the dataset
```

In [25]:
```
df.isnull().sum()
```

Out[25]:
```
ORDERNUMBER           0
QUANTITYORDERED       0
PRICEEACH             0
ORDERLINENUMBER       0
SALES                 0
ORDERDATE             0
STATUS                0
QTR_ID                0
MONTH_ID              0
YEAR_ID               0
PRODUCTLINE           0
MSRP                  0
PRODUCTCODE           0
CUSTOMERNAME          0
PHONE                 0
ADDRESSLINE1          0
ADDRESSLINE2       2521
CITY                  0
STATE              1486
POSTALCODE           76
COUNTRY               0
TERRITORY          1074
CONTACTLASTNAME       0
CONTACTFIRSTNAME      0
DEALSIZE              0
dtype: int64
```

In [26]:
```
# check total % of null value present in overall dataset
```

In [27]:
```
df.isnull().sum().sum()/(df.shape[0]*df.shape[1])*100
```

Out[27]:
```
np.float64(7.30712008501594)
```

In [28]:
```
# total 7% of data is missing from the dataset
```

In [29]:
```
#check  % of null values in each column
```

In [30]:
```
(df.isnull().sum()/df.shape[0]*100)
```

Out[30]:
```
ORDERNUMBER          0.000000
QUANTITYORDERED      0.000000
PRICEEACH            0.000000
ORDERLINENUMBER      0.000000
SALES                0.000000
ORDERDATE            0.000000
STATUS               0.000000
QTR_ID               0.000000
MONTH_ID             0.000000
YEAR_ID              0.000000
PRODUCTLINE          0.000000
MSRP                 0.000000
PRODUCTCODE          0.000000
CUSTOMERNAME         0.000000
PHONE                0.000000
ADDRESSLINE1         0.000000
ADDRESSLINE2        89.302161
CITY                 0.000000
STATE               52.639036
POSTALCODE           2.692171
COUNTRY              0.000000
TERRITORY           38.044633
CONTACTLASTNAME      0.000000
CONTACTFIRSTNAME     0.000000
DEALSIZE             0.000000
dtype: float64
```

In [31]:
```
# here we got to know that in
# column     % of nulll value
#ADDRESSLINE2      89.302161
#STATE    52.639036
#POSTALCODE   2.692171
#TERRITORY    38.044633
# %  of nulll value present
```

In [32]:
```
# if our column contain more than 80-90 percantage of null value then  we have t
# b'coz fillthis much of data manually can give oinaccurate output
```

In [33]:
```
# droping column
df.drop('ADDRESSLINE2',axis =1,inplace=True)
```

In [34]:
```
df.columns
```

Out[34]:
```
Index(['ORDERNUMBER', 'QUANTITYORDERED', 'PRICEEACH', 'ORDERLINENUMBER',
       'SALES', 'ORDERDATE', 'STATUS', 'QTR_ID', 'MONTH_ID', 'YEAR_ID',
       'PRODUCTLINE', 'MSRP', 'PRODUCTCODE', 'CUSTOMERNAME', 'PHONE',
       'ADDRESSLINE1', 'CITY', 'STATE', 'POSTALCODE', 'COUNTRY', 'TERRITORY',
       'CONTACTLASTNAME', 'CONTACTFIRSTNAME', 'DEALSIZE'],
      dtype='object')
```

In [35]:
```
 # sucessfully drop the column
```

"Handling Missing Data using Imputation Techniques"

In [36]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2823 entries, 0 to 2822
Data columns (total 24 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   ORDERNUMBER       2823 non-null   int64  
 1   QUANTITYORDERED   2823 non-null   int64  
 2   PRICEEACH         2823 non-null   float64
 3   ORDERLINENUMBER   2823 non-null   int64  
 4   SALES             2823 non-null   float64
 5   ORDERDATE         2823 non-null   object 
 6   STATUS            2823 non-null   object 
 7   QTR_ID            2823 non-null   int64  
 8   MONTH_ID          2823 non-null   int64  
 9   YEAR_ID           2823 non-null   int64  
 10  PRODUCTLINE       2823 non-null   object 
 11  MSRP              2823 non-null   int64  
 12  PRODUCTCODE       2823 non-null   object 
 13  CUSTOMERNAME      2823 non-null   object 
 14  PHONE             2823 non-null   object 
 15  ADDRESSLINE1      2823 non-null   object 
 16  CITY              2823 non-null   object 
 17  STATE             1337 non-null   object 
 18  POSTALCODE        2747 non-null   object 
 19  COUNTRY           2823 non-null   object 
 20  TERRITORY         1749 non-null   object 
 21  CONTACTLASTNAME   2823 non-null   object 
 22  CONTACTFIRSTNAME  2823 non-null   object 
 23  DEALSIZE          2823 non-null   object 
dtypes: float64(2), int64(7), object(15)
memory usage: 529.4+ KB
```

In [37]:
```
df.isnull().sum()
```

Out[37]:
```
ORDERNUMBER            0
QUANTITYORDERED        0
PRICEEACH              0
ORDERLINENUMBER        0
SALES                  0
ORDERDATE              0
STATUS                 0
QTR_ID                 0
MONTH_ID               0
YEAR_ID                0
PRODUCTLINE            0
MSRP                   0
PRODUCTCODE            0
CUSTOMERNAME           0
PHONE                  0
ADDRESSLINE1           0
CITY                   0
STATE               1486
POSTALCODE            76
COUNTRY                0
TERRITORY           1074
CONTACTLASTNAME        0
CONTACTFIRSTNAME       0
DEALSIZE               0
dtype: int64
```

In [38]:
```
# here the column which  contain  null values are of object datatypes
```

In [39]:
```
for i in df.select_dtypes(include='object').columns:
    df[i].fillna(df[i].mode()[0],inplace=True)
```

```
C:\Users\sunstone\AppData\Local\Temp\ipykernel_14892\2459431018.py:2: FutureWarni
ng: A value is trying to be set on a copy of a DataFrame or Series through chaine
d assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work becau
se the intermediate object on which we are setting values always behaves as a cop
y.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.meth
od({col: value}, inplace=True)' or df[col] = df[col].method(value) instead, to pe
rform the operation inplace on the original object.


  df[i].fillna(df[i].mode()[0],inplace=True)
```

In [40]:
```
df.isnull().sum
```

Out[40]:
```
<bound method DataFrame.sum of       ORDERNUMBER  QUANTITYORDERED  PRICEEACH  O
RDERLINENUMBER  SALES  \
0           False            False      False            False  False
1           False            False      False            False  False
2           False            False      False            False  False
3           False            False      False            False  False
4           False            False      False            False  False
...           ...              ...        ...              ...    ...
2818        False            False      False            False  False
2819        False            False      False            False  False
2820        False            False      False            False  False
2821        False            False      False            False  False
2822        False            False      False            False  False

      ORDERDATE  STATUS  QTR_ID  MONTH_ID  YEAR_ID  ...  PHONE  ADDRESSLINE1  \
0         False   False   False     False    False  ...  False         False
1         False   False   False     False    False  ...  False         False
2         False   False   False     False    False  ...  False         False
3         False   False   False     False    False  ...  False         False
4         False   False   False     False    False  ...  False         False
...         ...     ...     ...       ...      ...  ...    ...           ...
2818      False   False   False     False    False  ...  False         False
2819      False   False   False     False    False  ...  False         False
2820      False   False   False     False    False  ...  False         False
2821      False   False   False     False    False  ...  False         False
2822      False   False   False     False    False  ...  False         False

       CITY  STATE  POSTALCODE  COUNTRY  TERRITORY  CONTACTLASTNAME  \
0     False  False       False    False      False            False
1     False  False       False    False      False            False
2     False  False       False    False      False            False
3     False  False       False    False      False            False
4     False  False       False    False      False            False
...     ...    ...         ...      ...        ...              ...
2818  False  False       False    False      False            False
2819  False  False       False    False      False            False
2820  False  False       False    False      False            False
2821  False  False       False    False      False            False
2822  False  False       False    False      False            False

      CONTACTFIRSTNAME  DEALSIZE
0                False     False
1                False     False
2                False     False
3                False     False
4                False     False
...                ...       ...
2818             False     False
2819             False     False
2820             False     False
2821             False     False
2822             False     False

[2823 rows x 24 columns]>
```

In [41]:
```
#we sucessfully able to fill missing values
```

Finding and Dropping Duplicate Rows in a Dataset

In [42]:
```
df.duplicated().sum()
```

Out[42]:
```
np.int64(0)
```

Improving Data Uniformity through Date and Number Format Standardization

In [43]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2823 entries, 0 to 2822
Data columns (total 24 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   ORDERNUMBER       2823 non-null   int64  
 1   QUANTITYORDERED   2823 non-null   int64  
 2   PRICEEACH         2823 non-null   float64
 3   ORDERLINENUMBER   2823 non-null   int64  
 4   SALES             2823 non-null   float64
 5   ORDERDATE         2823 non-null   object 
 6   STATUS            2823 non-null   object 
 7   QTR_ID            2823 non-null   int64  
 8   MONTH_ID          2823 non-null   int64  
 9   YEAR_ID           2823 non-null   int64  
 10  PRODUCTLINE       2823 non-null   object 
 11  MSRP              2823 non-null   int64  
 12  PRODUCTCODE       2823 non-null   object 
 13  CUSTOMERNAME      2823 non-null   object 
 14  PHONE             2823 non-null   object 
 15  ADDRESSLINE1      2823 non-null   object 
 16  CITY              2823 non-null   object 
 17  STATE             2823 non-null   object 
 18  POSTALCODE        2823 non-null   object 
 19  COUNTRY           2823 non-null   object 
 20  TERRITORY         2823 non-null   object 
 21  CONTACTLASTNAME   2823 non-null   object 
 22  CONTACTFIRSTNAME  2823 non-null   object 
 23  DEALSIZE          2823 non-null   object 
dtypes: float64(2), int64(7), object(15)
memory usage: 529.4+ KB
```

In [44]:
```
# ORDERDATE column should be in date format but it is in object
```

In [45]:
```
df['ORDERDATE']= pd.to_datetime(df['ORDERDATE'])
```

In [46]:
```
# drive year from ORDERDATE column
df['YEAR']= df['ORDERDATE'].dt.year
df['YEAR']= df['YEAR'].round().astype(int)
```

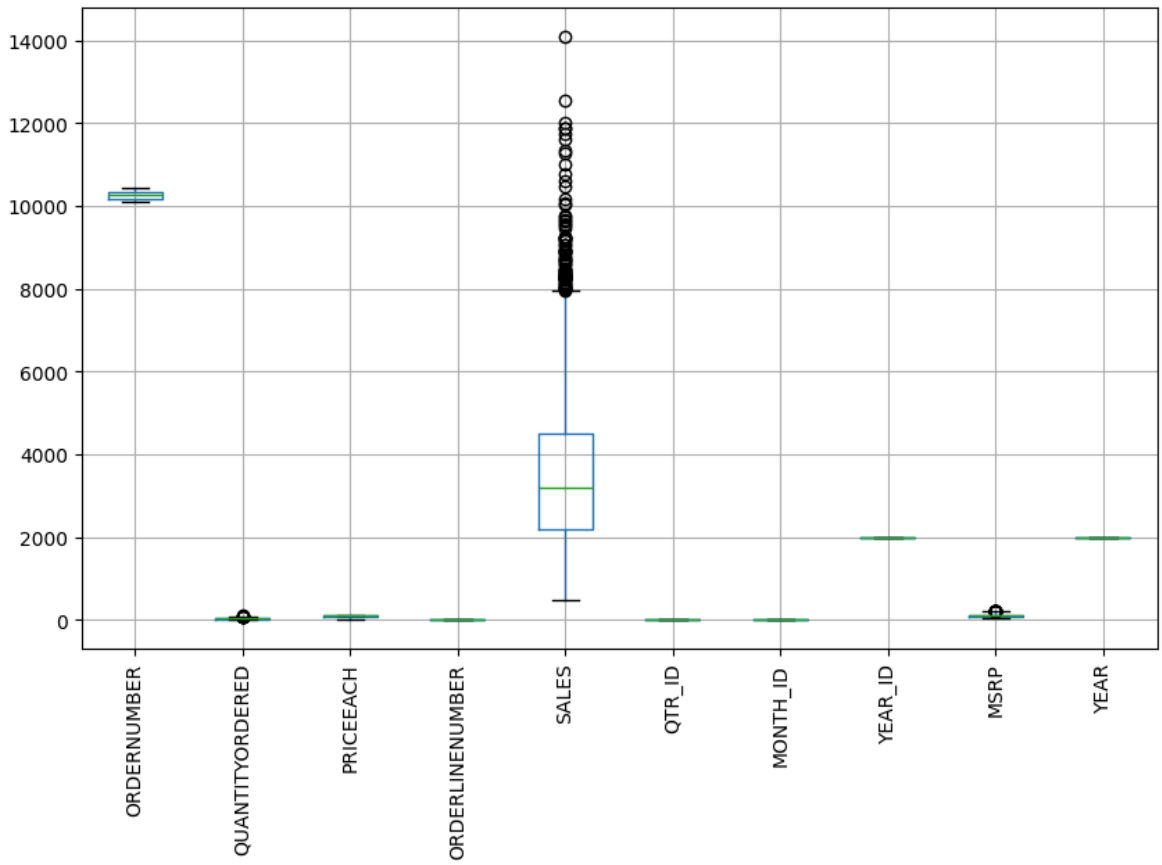
In [47]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2823 entries, 0 to 2822
Data columns (total 25 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   ORDERNUMBER       2823 non-null   int64
 1   QUANTITYORDERED   2823 non-null   int64
 2   PRICEEACH         2823 non-null   float64
 3   ORDERLINENUMBER   2823 non-null   int64
 4   SALES             2823 non-null   float64
 5   ORDERDATE         2823 non-null   datetime64[ns]
 6   STATUS            2823 non-null   object
 7   QTR_ID            2823 non-null   int64
 8   MONTH_ID          2823 non-null   int64
 9   YEAR_ID           2823 non-null   int64
 10  PRODUCTLINE       2823 non-null   object
 11  MSRP              2823 non-null   int64
 12  PRODUCTCODE       2823 non-null   object
 13  CUSTOMERNAME      2823 non-null   object
 14  PHONE             2823 non-null   object
 15  ADDRESSLINE1      2823 non-null   object
 16  CITY              2823 non-null   object
 17  STATE             2823 non-null   object
 18  POSTALCODE        2823 non-null   object
 19  COUNTRY           2823 non-null   object
 20  TERRITORY         2823 non-null   object
 21  CONTACTLASTNAME   2823 non-null   object
 22  CONTACTFIRSTNAME  2823 non-null   object
 23  DEALSIZE          2823 non-null   object
 24  YEAR              2823 non-null   int64
dtypes: datetime64[ns](1), float64(2), int64(8), object(14)
memory usage: 551.5+ KB
```

Outlier Detection and Treatment for High-Quality Data Analysis

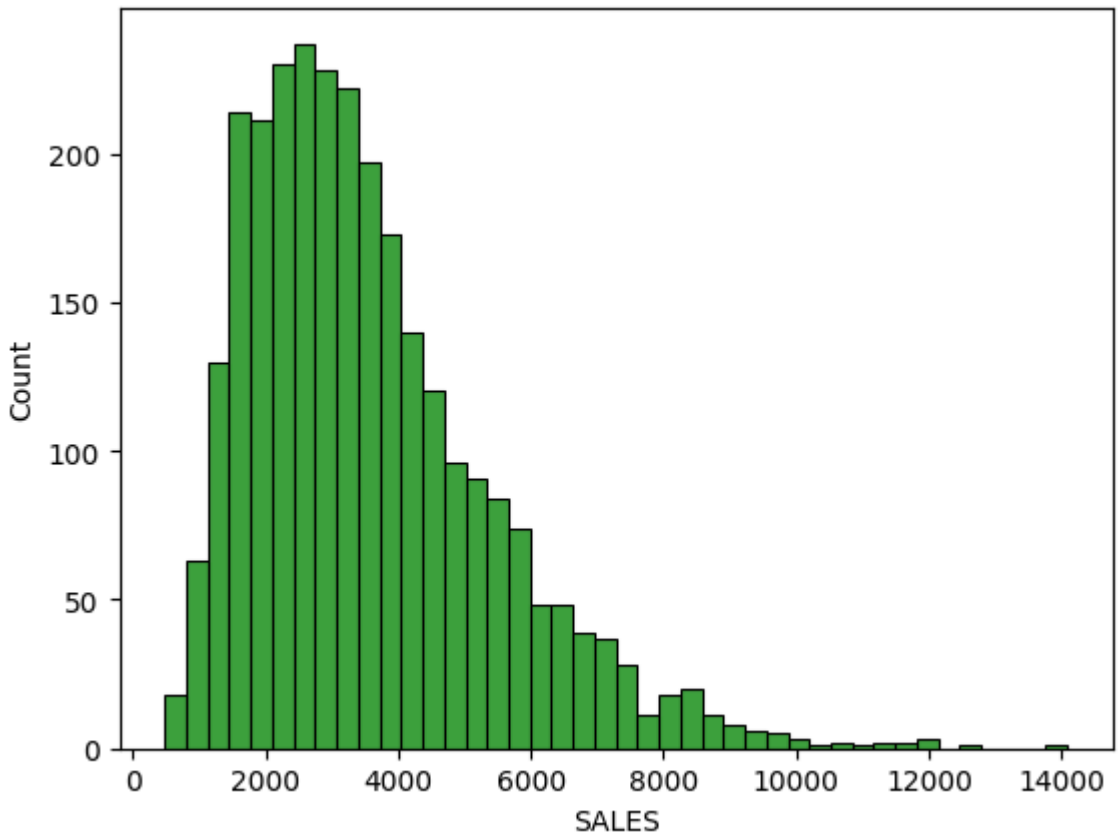
In [48]:
```
# for multiple columns
```

In [49]:
```
df.select_dtypes(include=['int64','float64']).boxplot(figsize=(10,6))
plt.xticks(rotation=90)
plt.show()
```



In [50]:
```
# for single columns
```

In [51]:
```
sns.histplot(df['SALES'],color='green')
plt.show()
```



Understanding Summary Statistics in Data Analysis

In [52]:
```
df.describe()
```

Out[52]:

	ORDERNUMBER	QUANTITYORDERED	PRICEEACH	ORDERLINENUMBER	S
count	2823.000000	2823.000000	2823.000000	2823.000000	2823.0
mean	10258.725115	35.092809	83.658544	6.466171	3553.8
min	10100.000000	6.000000	26.880000	1.000000	482.1
25%	10180.000000	27.000000	68.860000	3.000000	2203.4
50%	10262.000000	35.000000	95.700000	6.000000	3184.8
75%	10333.500000	43.000000	100.000000	9.000000	4508.0
max	10425.000000	97.000000	100.000000	18.000000	14082.8
std	92.085478	9.741443	20.174277	4.225841	1841.8

In [53]:
```
# for categorical datatype
```

In [54]:
```
df.describe(include='object')
```

Out[54]:

	STATUS	PRODUCTLINE	PRODUCTCODE	CUSTOMERNAME	PHONE	ADDRESSL
count	2823	2823	2823	2823	2823	
unique	6	7	109	92	91	
top	Shipped	Classic Cars	S18_3232	Euro Shopping Channel	(91) 555 94 44	C/ Moralz
freq	2617	967	52	259	259	

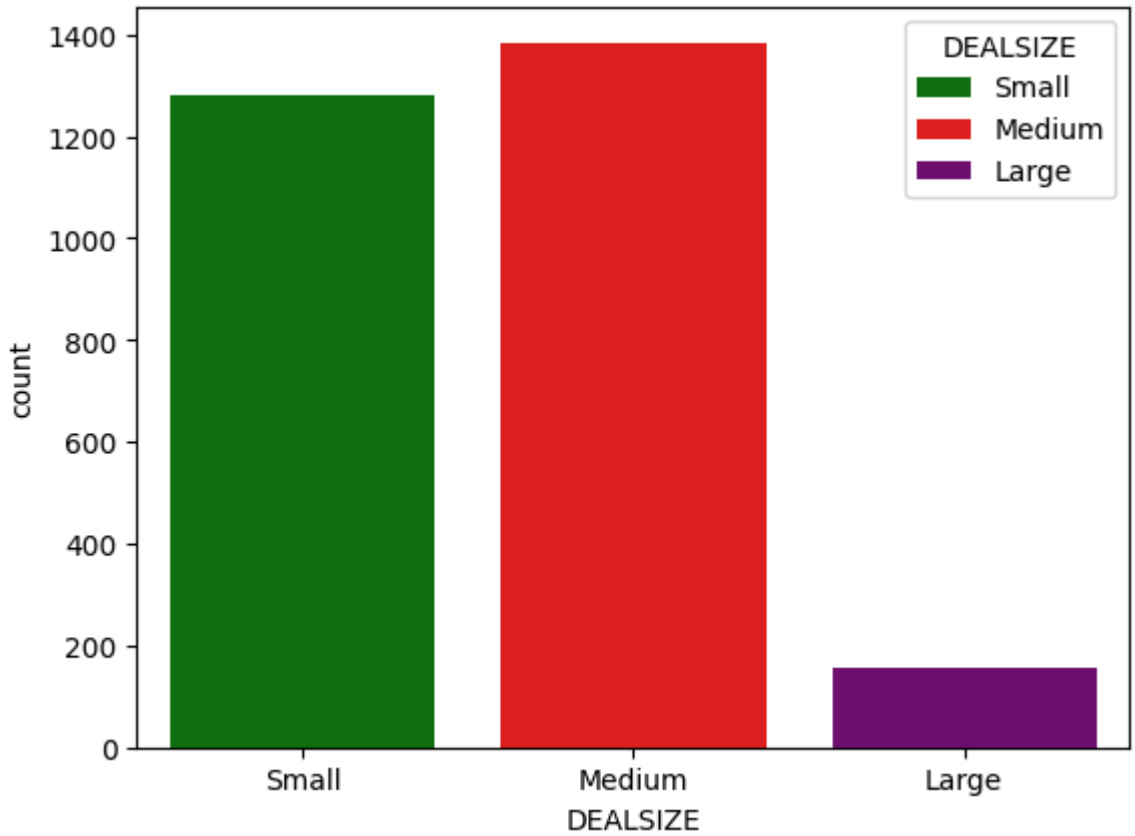
Statistical and Machine Learning Approaches for Managing Data Gaps and Anomalies

univariate analysis

In [ ]:

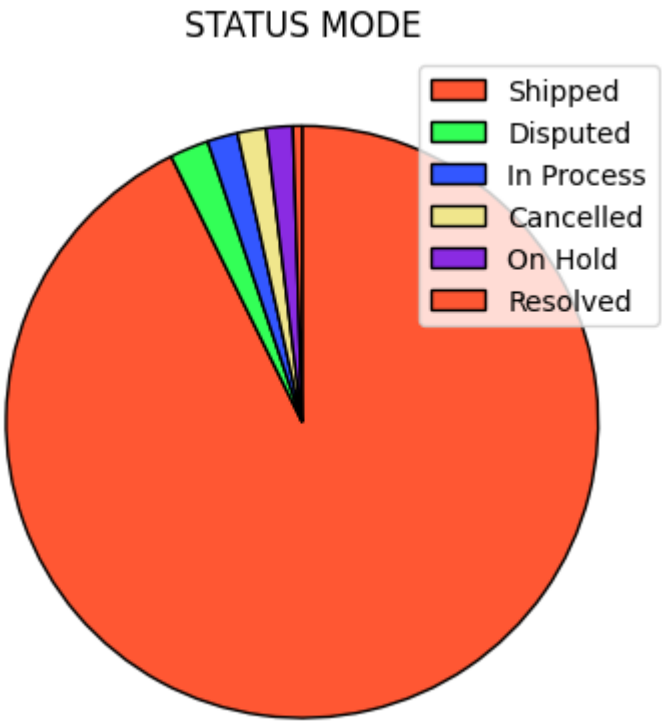
In [55]:
```
sns.countplot(x = df['DEALSIZE'],palette=['green', 'red', 'purple'])
plt.legend(title="DEALSIZE", labels=df['DEALSIZE'].unique())
plt.show()
```

```
C:\Users\sunstone\AppData\Local\Temp\ipykernel_14892\2098529877.py:1: FutureWarni
ng:

Passing `palette` without assigning `hue` is deprecated and will be removed in v
0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effe
ct.

  sns.countplot(x = df['DEALSIZE'],palette=['green', 'red', 'purple'])
```



In [56]:
```
# Moderate Deal Size Leading to High Revenue
```

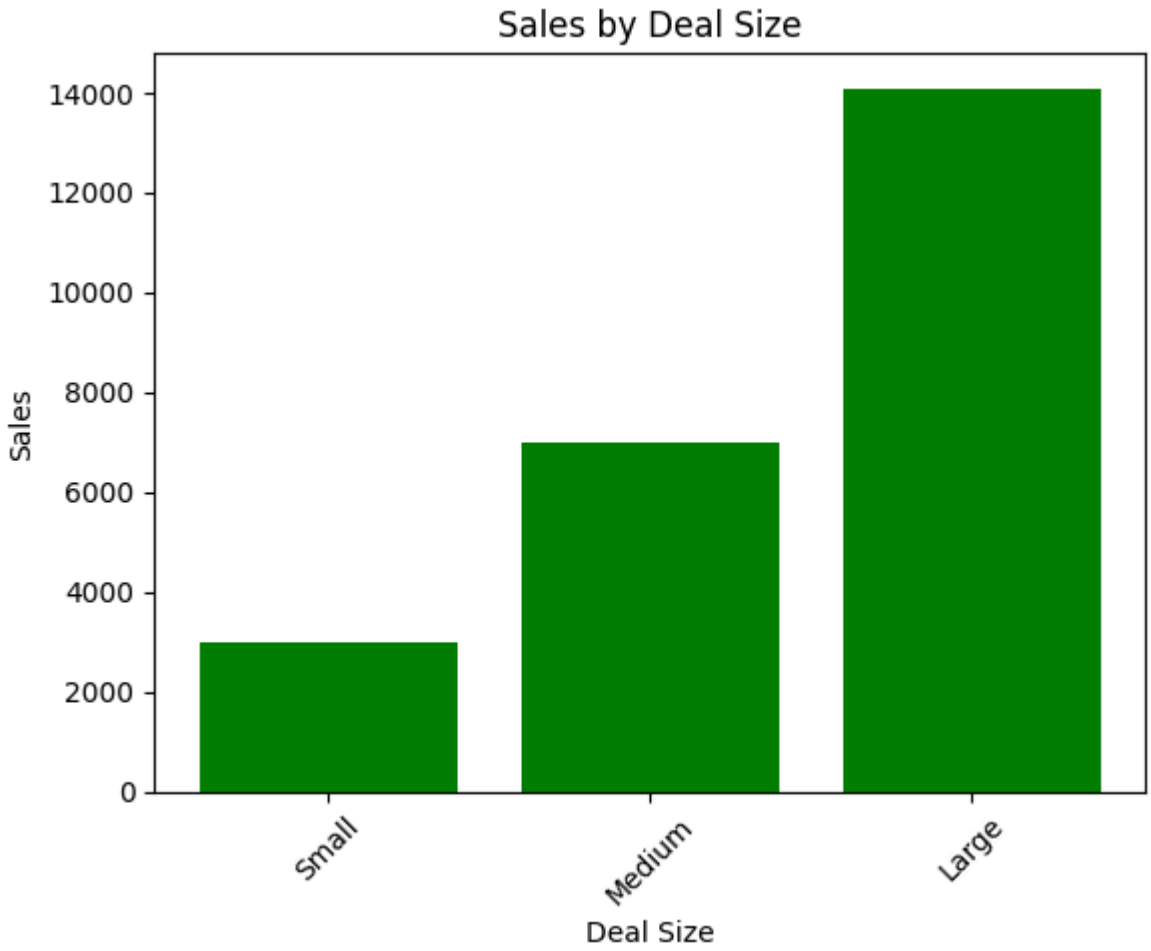
In [75]:
```
plt.pie(df['STATUS'].value_counts(),startangle=90,counterclock=False,wedgeprops=
)
plt.title("STATUS MODE")
plt.legend(df['STATUS'].unique())
plt.show()
```



In [58]:
```
# shipped mode have best performance
```

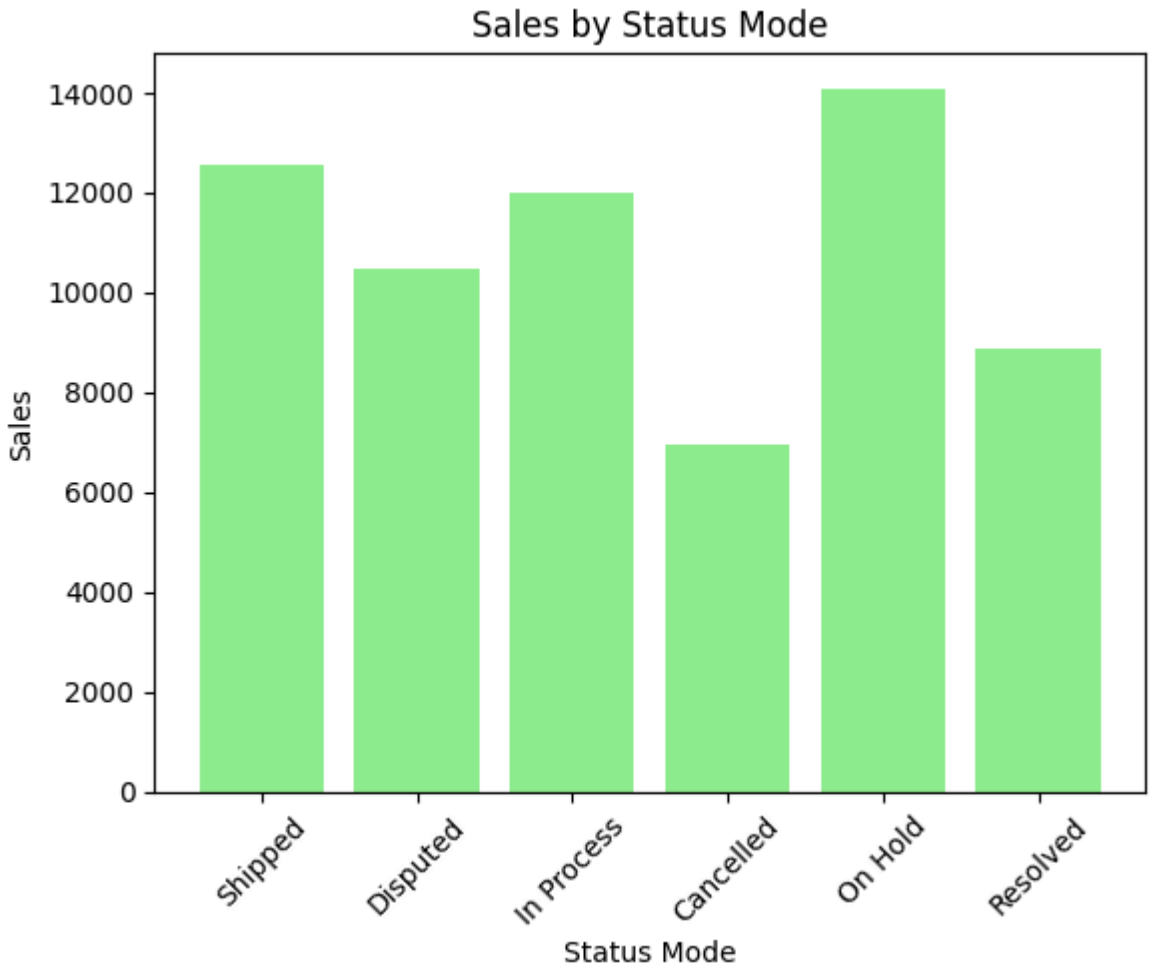
Bivariate analyis

In [76]:
```
plt.bar(df['DEALSIZE'], df['SALES'],color='green')
plt.xlabel('Deal Size')
plt.ylabel('Sales')
plt.title('Sales by Deal Size')
plt.xticks(rotation=45)
plt.show()
```



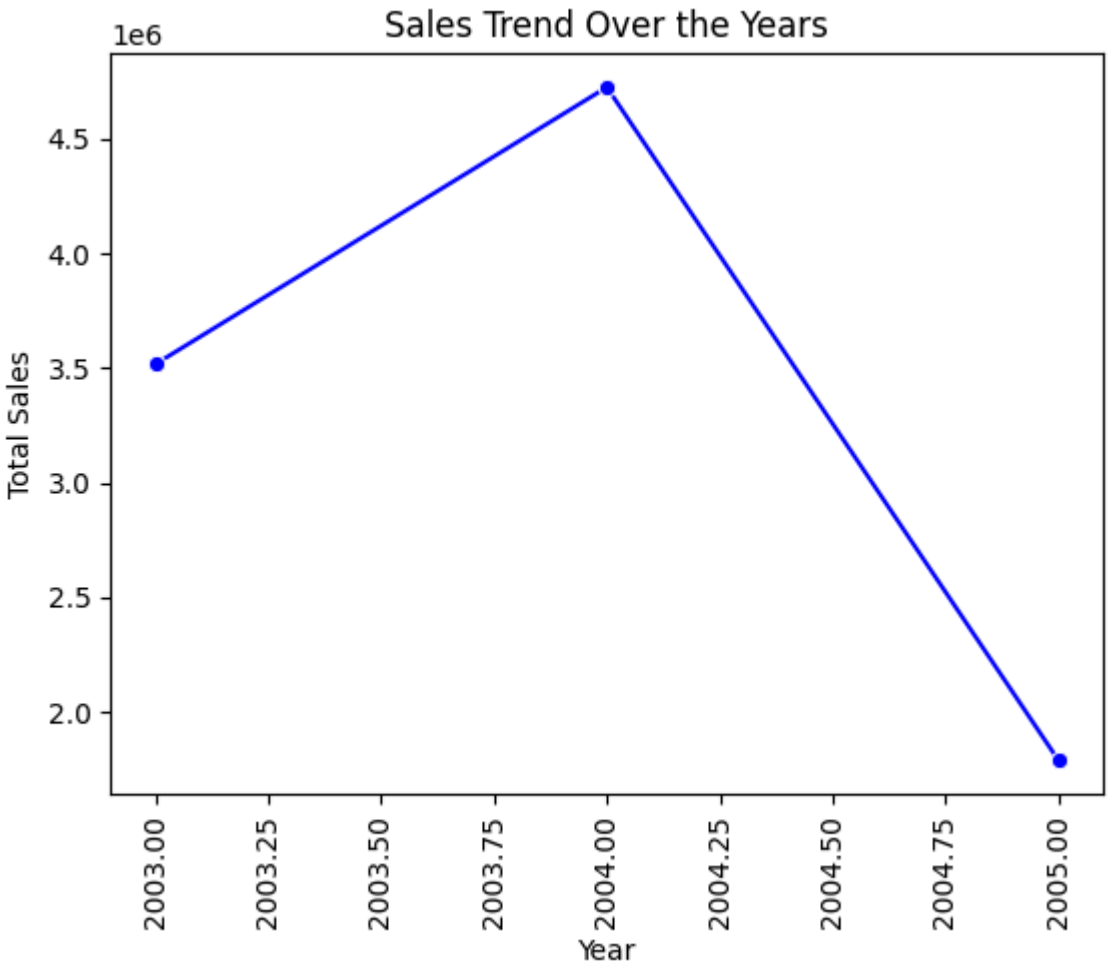
In [60]:
```
# large deal sixe have high sales
```

In [77]:
```
plt.bar(df['STATUS'], df['SALES'],color='lightgreen')
plt.xlabel('Status Mode')
plt.ylabel('Sales')
plt.title('Sales by Status Mode')
plt.xticks(rotation=45)
plt.show()
```

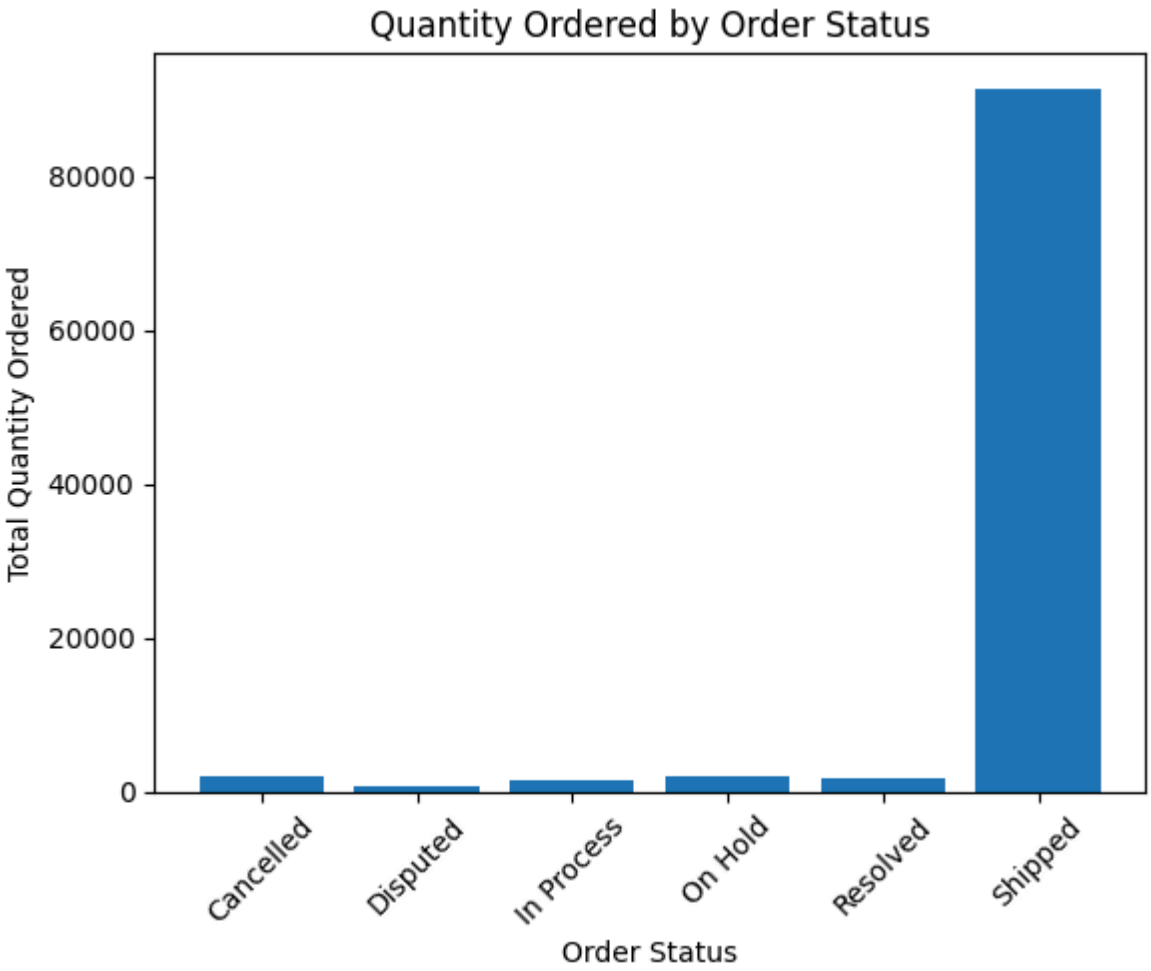


In [62]:
```
# in 2005 year company generate high revenue
```

In [63]:
```
yearly_sales = df.groupby('YEAR')['SALES'].sum().reset_index()
sns.lineplot(x=yearly_sales['YEAR'], y=yearly_sales['SALES'], marker='o', color=
plt.xlabel('Year')
plt.xticks(rotation=90)
plt.ylabel('Total Sales')
plt.title('Sales Trend Over the Years')
plt.show()
```

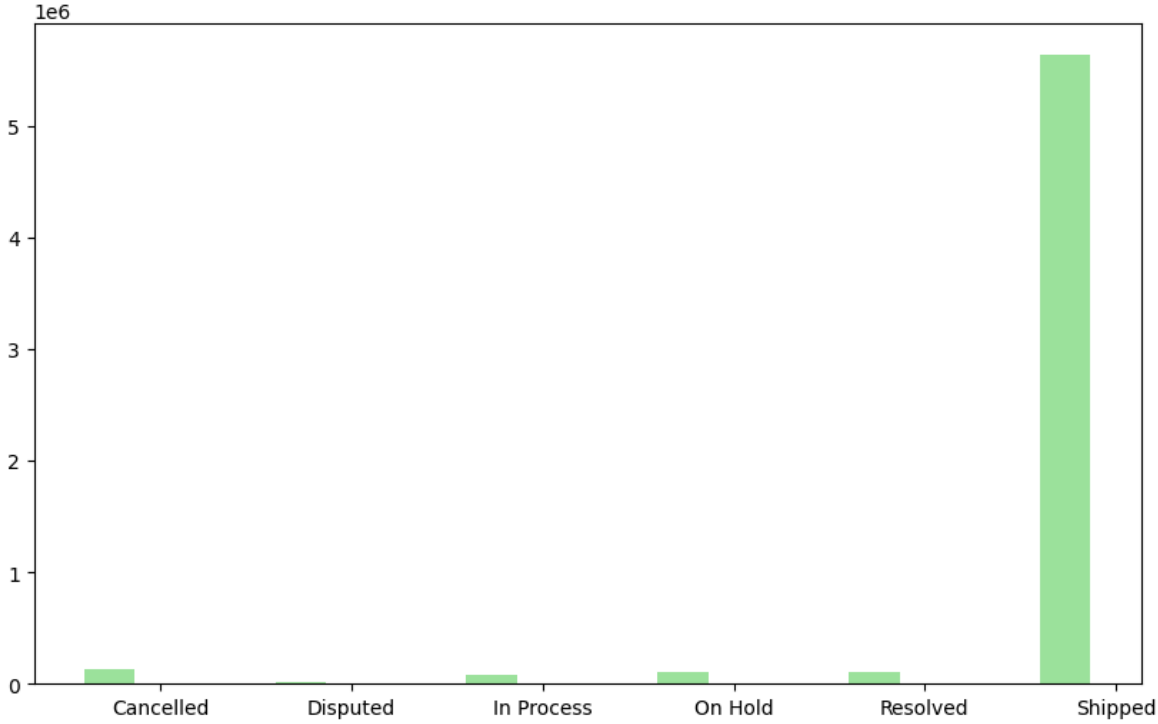


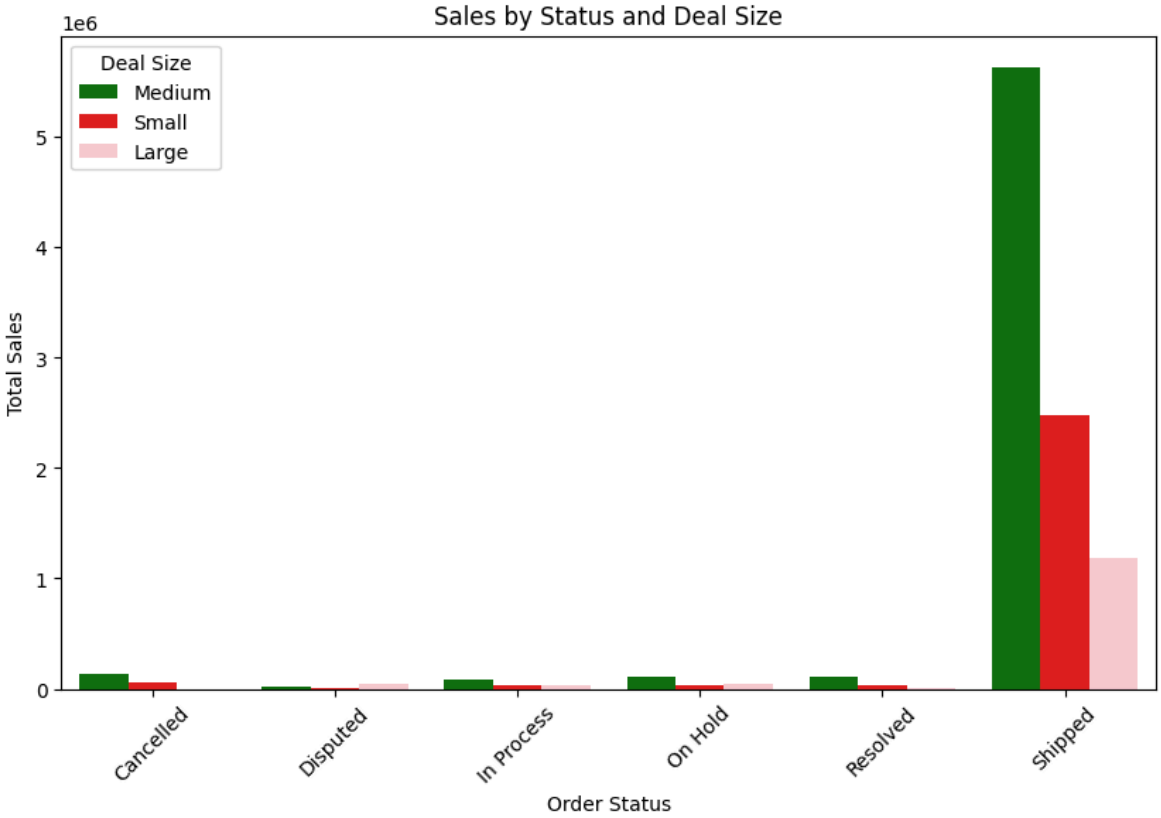
In [64]:
```
status_quantity = df.groupby('STATUS')['QUANTITYORDERED'].sum()
plt.bar(status_quantity.index, status_quantity.values)

plt.xlabel('Order Status')
plt.ylabel('Total Quantity Ordered')
plt.title('Quantity Ordered by Order Status')
plt.xticks(rotation=45)
plt.show()
```



In [65]:
```
## multivariate analysis
```

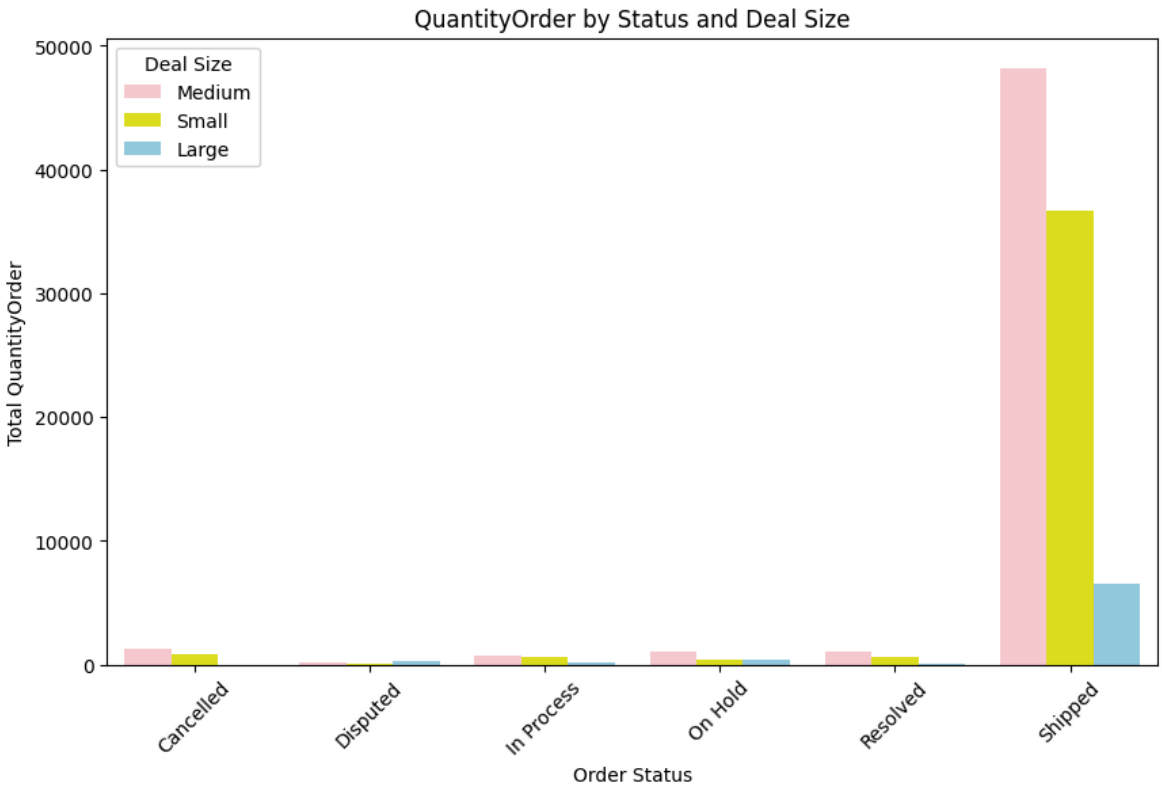
In [79]:
```
status_dealsize_sales = df.groupby(['STATUS', 'DEALSIZE'])['SALES'].sum().reset_
plt.figure(figsize=(10, 6))
sns.barplot(x='STATUS', y='SALES', hue='DEALSIZE', data=status_dealsize_sales, p
plt.xlabel('Order Status')
plt.ylabel('Total Sales')
plt.title('Sales by Status and Deal Size')
plt.xticks(rotation=45)
plt.legend(title='Deal Size')
plt.show()
```





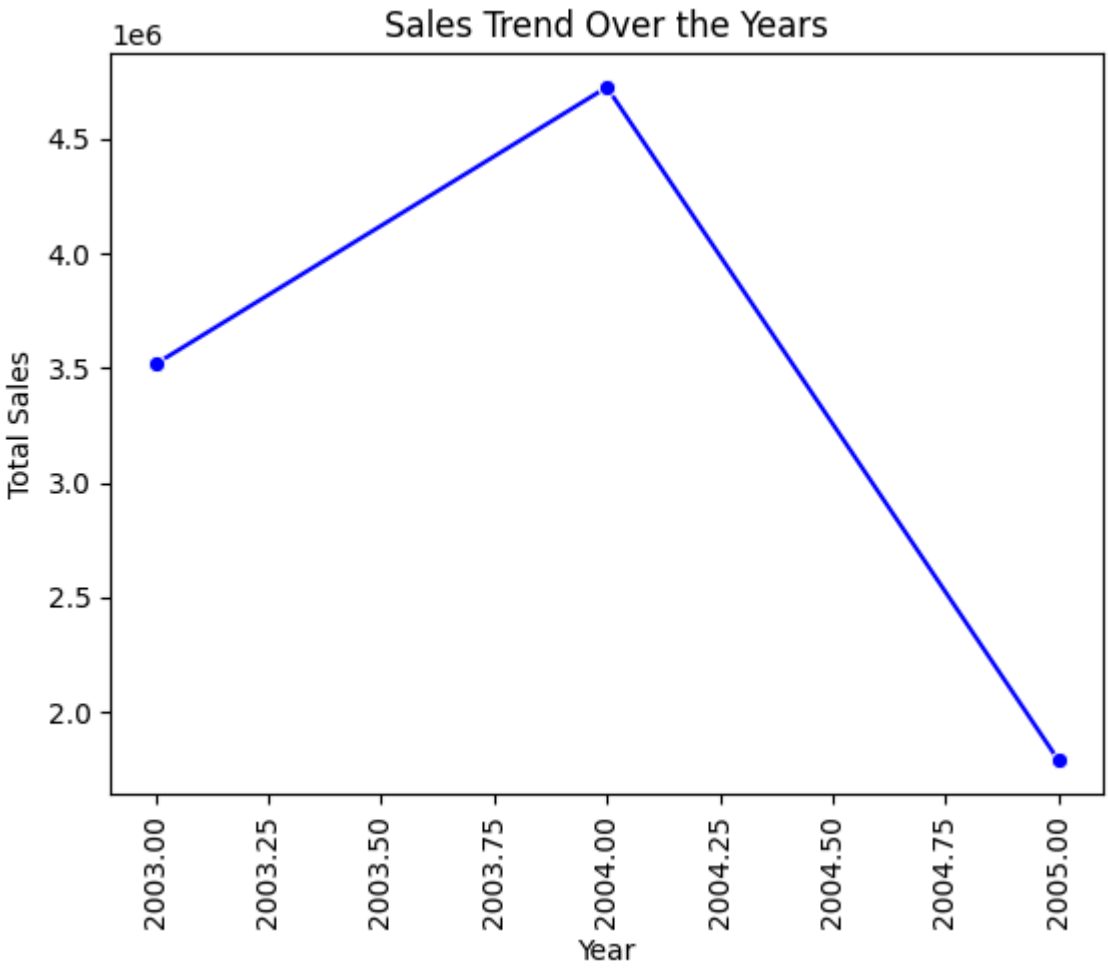
In [67]:
```
# In shipped mode medium dealsize performance is good
```

In [68]:
```
status_dealsize_QuantityOrder = df.groupby(['STATUS', 'DEALSIZE'])['QUANTITYORDE
plt.figure(figsize=(10, 6))
sns.barplot(x='STATUS', y='QUANTITYORDERED', hue='DEALSIZE', data=status_dealsiz
plt.xlabel('Order Status')
plt.ylabel('Total QuantityOrder')
plt.title('QuantityOrder by Status and Deal Size')
plt.xticks(rotation=45)
plt.legend(title='Deal Size')
plt.show()
```



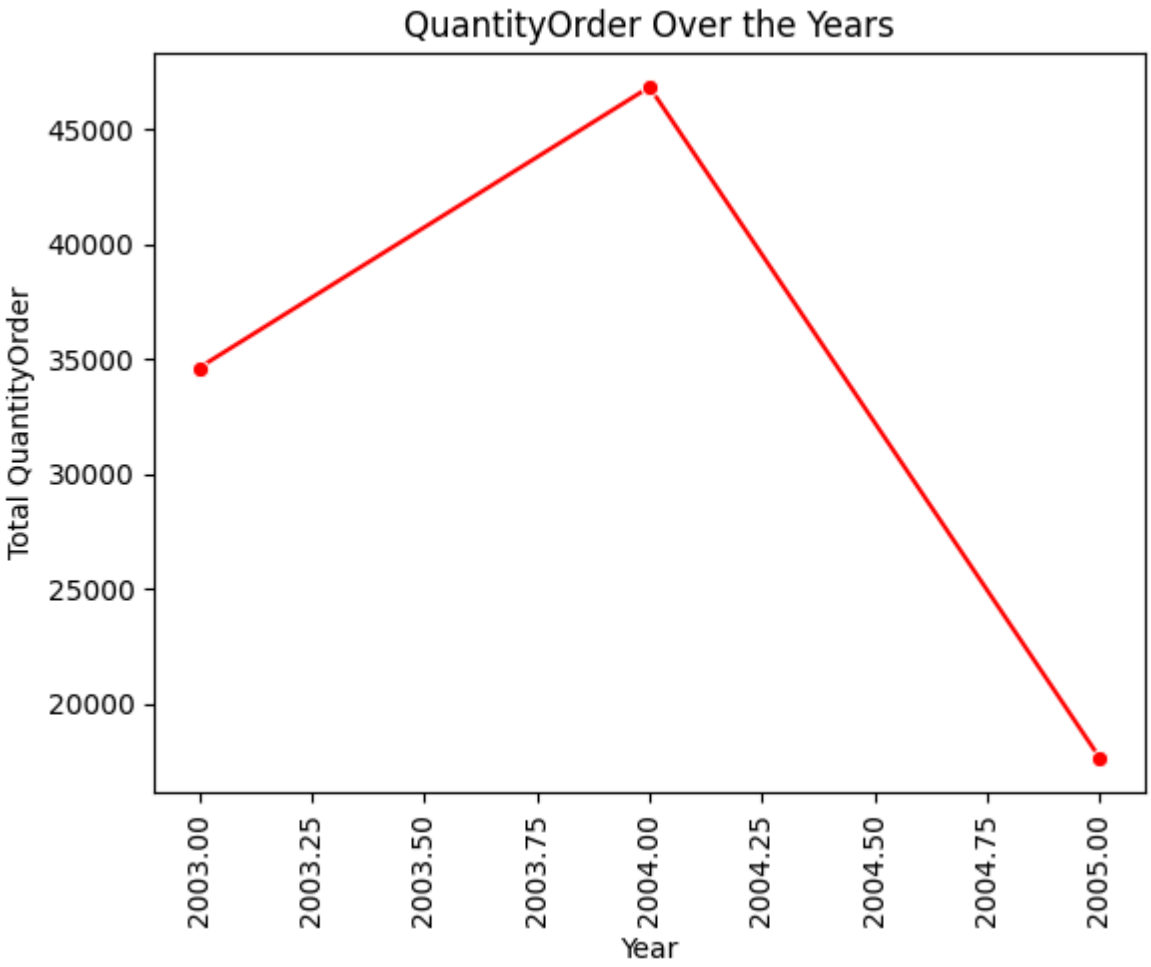
Sales Insights: Trends, Seasonal Patterns, and Best-Performing Products

In [69]:
```
yearly_sales = df.groupby('YEAR')['SALES'].sum().reset_index()
sns.lineplot(x=yearly_sales['YEAR'], y=yearly_sales['SALES'], marker='o', color=
plt.xlabel('Year')
plt.xticks(rotation=90)
plt.ylabel('Total Sales')
plt.title('Sales Trend Over the Years')
plt.show()
```



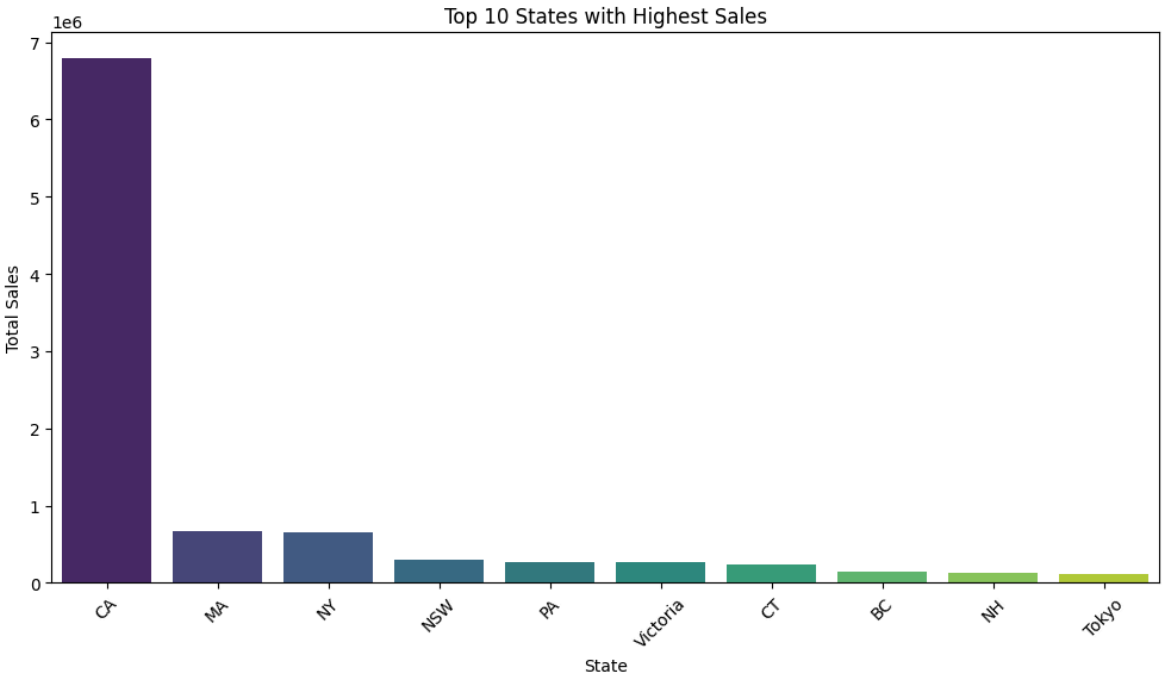
In [70]:
```
# sales fist increase after that it deacrease overe year
```

In [71]:
```
yearly_sales = df.groupby('YEAR')['QUANTITYORDERED'].sum().reset_index()
sns.lineplot(x=yearly_sales['YEAR'], y=yearly_sales['QUANTITYORDERED'], marker='
plt.xlabel('Year')
plt.xticks(rotation=90)
plt.ylabel('Total QuantityOrder')
plt.title('QuantityOrder Over the Years')
plt.show()
```



In [72]:
```
top_states = df.groupby('STATE')['SALES'].sum().nlargest(10).reset_index()
plt.figure(figsize=(12, 6))
sns.barplot(x='STATE', y='SALES', data=top_states, palette='viridis')

plt.xlabel('State')
plt.ylabel('Total Sales')
plt.title('Top 10 States with Highest Sales')
plt.xticks(rotation=45)
plt.show()
```

```
C:\Users\sunstone\AppData\Local\Temp\ipykernel_14892\3974003812.py:3: FutureWarni
ng:

Passing `palette` without assigning `hue` is deprecated and will be removed in v
0.14.0. Assign the `x` variable to `hue` and set `legend=False` for the same effe
ct.

  sns.barplot(x='STATE', y='SALES', data=top_states, palette='viridis')
```



I sincerely appreciate this opportunity. Thank you!

In [ ]: