```
import pandas as pd
import numpy as np
from sklearn.preprocessing import LabelEncoder
import matplotlib.pyplot as plt
import seaborn as sns
from scipy.stats import zscore
from scipy.stats import ttest_ind
from scipy.stats import pearsonr, spearmanr
from scipy.stats import kruskal
from scipy.stats import f_oneway
from scipy.stats import pearsonr, spearmanr

train_df= pd.read_csv('TRAIN.csv')
print(train_df.shape)
print(train_df.info())
print(train_df.describe())
```

```
(188340, 10)
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 188340 entries, 0 to 188339
Data columns (total 10 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   ID             188340 non-null  object
 1   Store_id       188340 non-null  int64
 2   Store_Type     188340 non-null  object
 3   Location_Type  188340 non-null  object
 4   Region_Code    188340 non-null  object
 5   Date           188340 non-null  object
 6   Holiday        188340 non-null  int64
 7   Discount       188340 non-null  object
 8   Order          188340 non-null  int64
 9   Sales          188340 non-null  float64
dtypes: float64(1), int64(3), object(6)
memory usage: 14.4+ MB
None
            Store_id        Holiday          Order          Sales
count  188340.000000  188340.000000  188340.000000  188340.000000
mean      183.000000       0.131783      68.205692   42784.327982
std       105.366308       0.338256      30.467415   18456.708302
min         1.000000       0.000000       0.000000       0.000000
25%        92.000000       0.000000      48.000000   30426.000000
50%       183.000000       0.000000      63.000000   39678.000000
75%       274.000000       0.000000      82.000000   51909.000000
max       365.000000       1.000000     371.000000  247215.000000
```

```
train_df['Date'] = pd.to_datetime(train_df['Date'], format="%d-%m-%Y")
train_df['Year'] = train_df['Date'].dt.year
train_df['Month'] = train_df['Date'].dt.month
train_df['Week'] = train_df['Date'].dt.isocalendar().week
```

```
train_df['DayOfWeek'] = train_df['Date'].dt.dayofweek  # Monday=0,
Sunday=6
train_df['Is_Weekend'] = train_df['DayOfWeek'].isin([5,
6]).astype(int)
train_df['YearMonth'] = train_df['Date'].dt.to_period('M')

categorical_columns=['Store_Type','Location_Type','Region_Code','Disco
unt','Holiday']
for columns in categorical_columns:
    train_df[columns]=train_df[columns].astype('category')

duplicates = train_df.duplicated(subset=['ID']).sum()
print(f"Duplicate IDs: {duplicates}")

print(train_df)
```

```
Duplicate IDs: 0
             ID  Store_id Store_Type Location_Type Region_Code
Date  \
0       T1000001         1         S1            L3          R1 2018-
01-01
1       T1000002       253         S4            L2          R1 2018-
01-01
2       T1000003       252         S3            L2          R1 2018-
01-01
3       T1000004       251         S2            L3          R1 2018-
01-01
4       T1000005       250         S2            L3          R4 2018-
01-01
...          ...       ...        ...           ...         ...
...
188335  T1188336       149         S2            L3          R2 2019-
05-31
188336  T1188337       153         S4            L2          R1 2019-
05-31
188337  T1188338       154         S1            L3          R2 2019-
05-31
188338  T1188339       155         S3            L1          R2 2019-
05-31
188339  T1188340       152         S2            L1          R1 2019-
05-31

       Holiday Discount  Order     Sales  Year  Month  Week  DayOfWeek
\
0            1      Yes      9   7011.84  2018      1     1          0

1            1      Yes     60  51789.12  2018      1     1          0

2            1      Yes     42  36868.20  2018      1     1          0
```

```
3            1      Yes     23  19715.16  2018      1     1          0

4            1      Yes     62  45614.52  2018      1     1          0

...        ...      ...    ...       ...   ...    ...   ...        ...

188335       1      Yes     51  37272.00  2019      5    22          4

188336       1       No     90  54572.64  2019      5    22          4

188337       1       No     56  31624.56  2019      5    22          4

188338       1      Yes     70  49162.41  2019      5    22          4

188339       1       No     47  37977.00  2019      5    22          4


        Is_Weekend YearMonth
0                0   2018-01
1                0   2018-01
2                0   2018-01
3                0   2018-01
4                0   2018-01
...            ...       ...
188335           0   2019-05
188336           0   2019-05
188337           0   2019-05
188338           0   2019-05
188339           0   2019-05

[188340 rows x 16 columns]
```

```
fig,ax=plt.subplots(1,2,figsize=(12,5))
sns.histplot(train_df['Sales'],kde=True,ax=ax[0])
sns.histplot(train_df['Order'],kde=True,ax=ax[1])
ax[1].set_title('order count distribution')
plt.show()

categorical_col=['Store_Type','Location_Type','Region_Code','Holiday',
'Discount']
for col in categorical_col:

sns.countplot(data=train_df,x=col,order=train_df[col].value_counts().i
ndex)
    plt.title(f'{col} Count')
    plt.xticks(rotation=45)
    plt.show()

    print(f"\n frequency table for {col}:")
    print(train_df[col].value_counts())
```

```
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating
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```
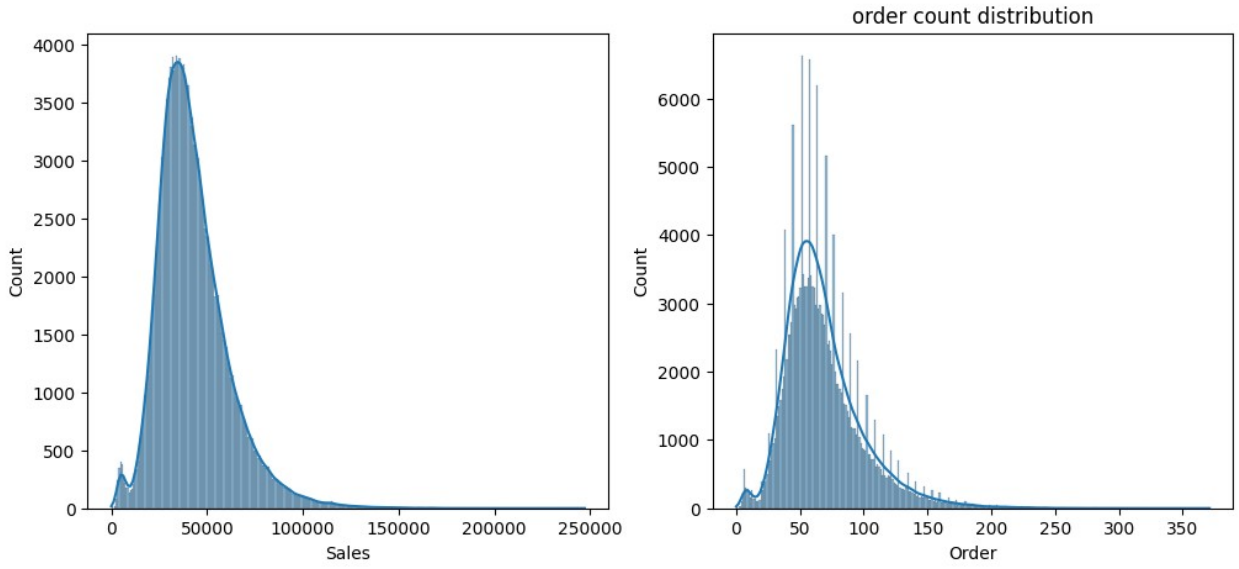
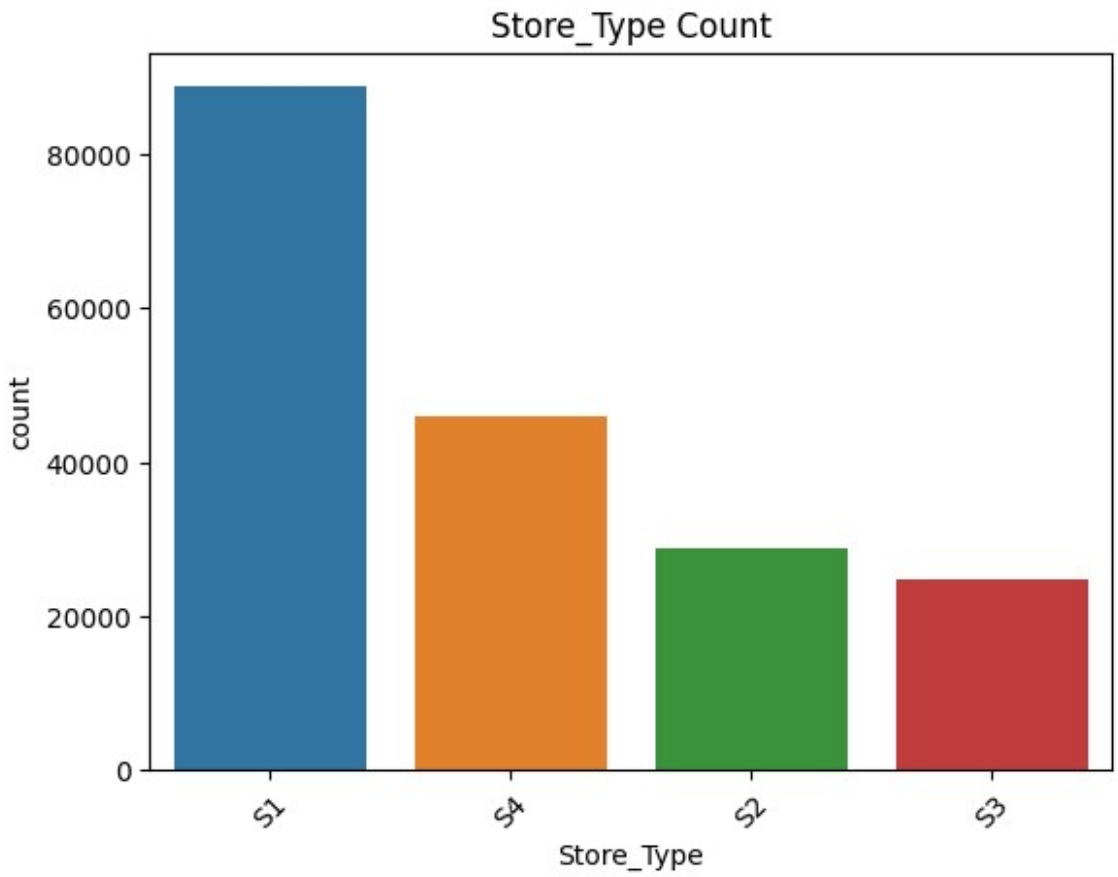




```
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\categorical.py:641:
FutureWarning: The default of observed=False is deprecated and will be
changed to True in a future version of pandas. Pass observed=False to
retain current behavior or observed=True to adopt the future default
and silence this warning.
  grouped_vals = vals.groupby(grouper)
```




```
 frequency table for Store_Type:
Store_Type
S1    88752
S4    45924
S2    28896
S3    24768
Name: count, dtype: int64

C:\Users\HP\anaconda3\Lib\site-packages\seaborn\categorical.py:641:
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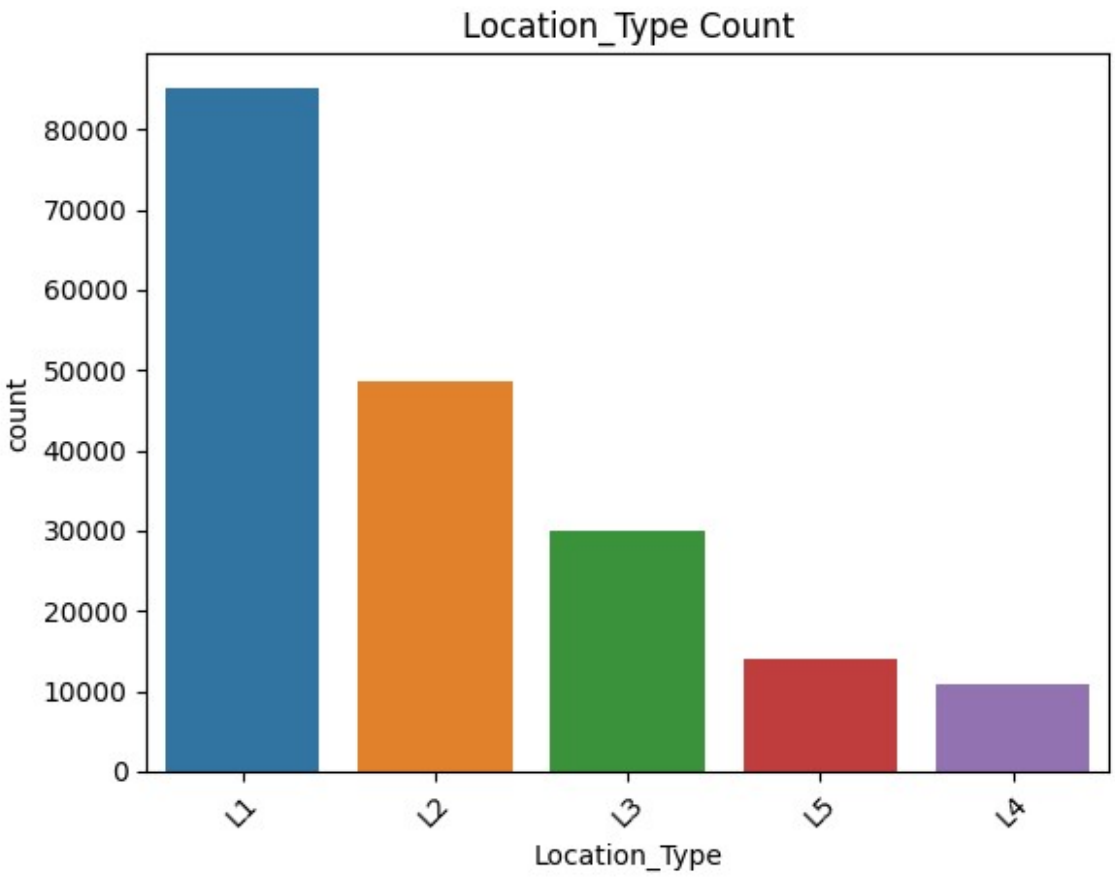


```
 frequency table for Location_Type:
Location_Type
L1    85140
L2    48504
L3    29928
L5    13932
L4    10836
Name: count, dtype: int64

C:\Users\HP\anaconda3\Lib\site-packages\seaborn\categorical.py:641:
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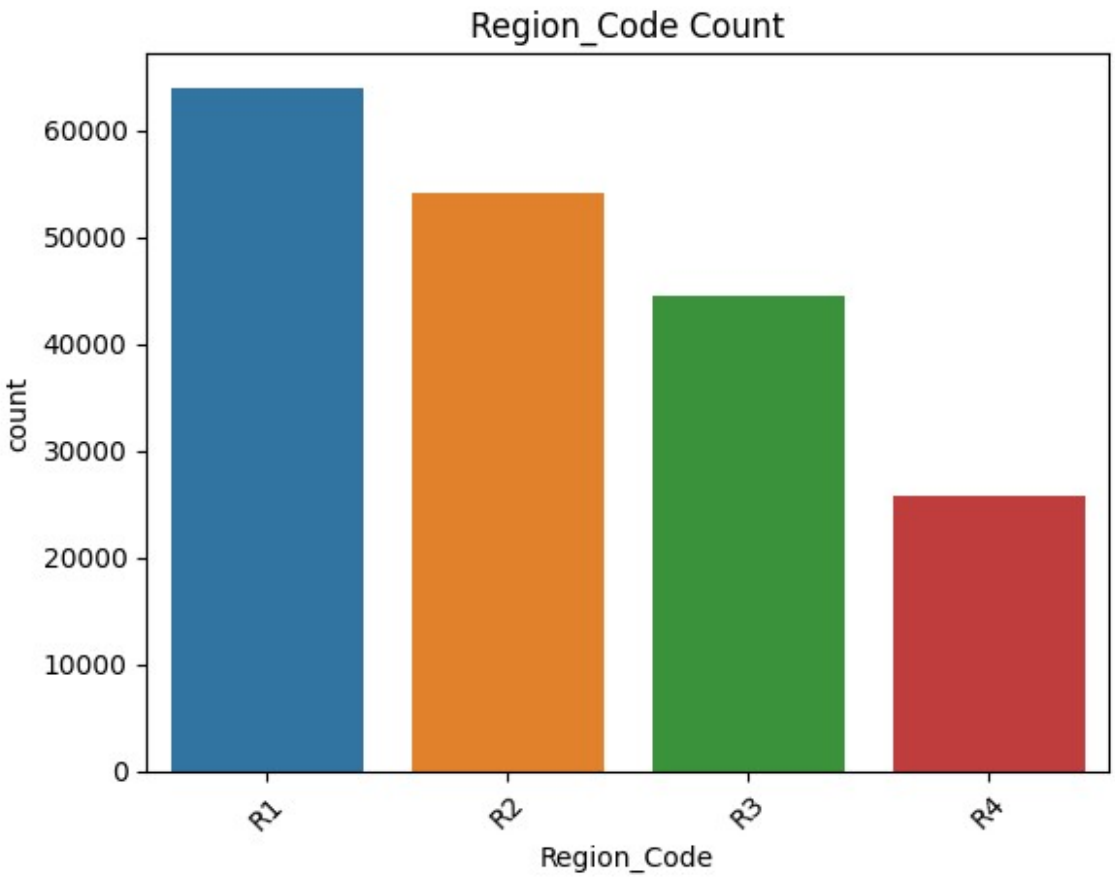


```
 frequency table for Region_Code:
Region_Code
R1    63984
R2    54180
R3    44376
R4    25800
Name: count, dtype: int64

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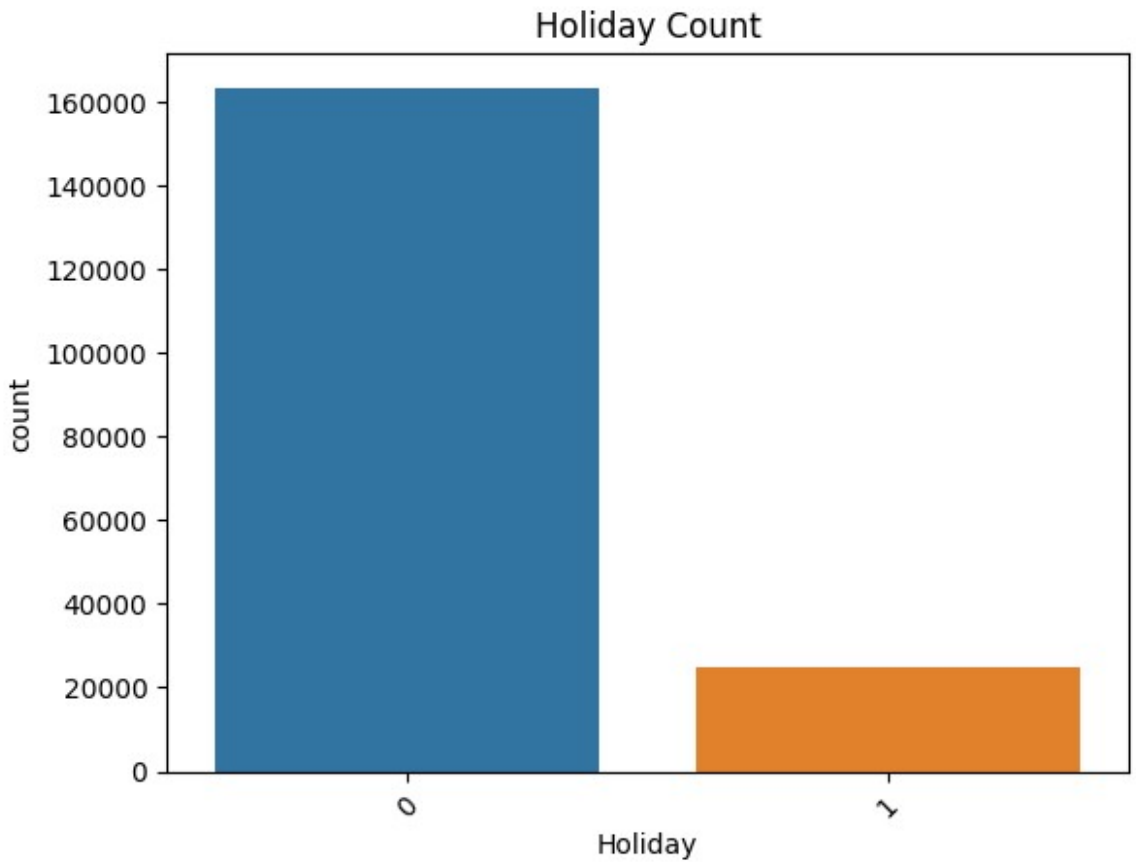


```
 frequency table for Holiday:
Holiday
0    163520
1     24820
Name: count, dtype: int64

C:\Users\HP\anaconda3\Lib\site-packages\seaborn\categorical.py:641:
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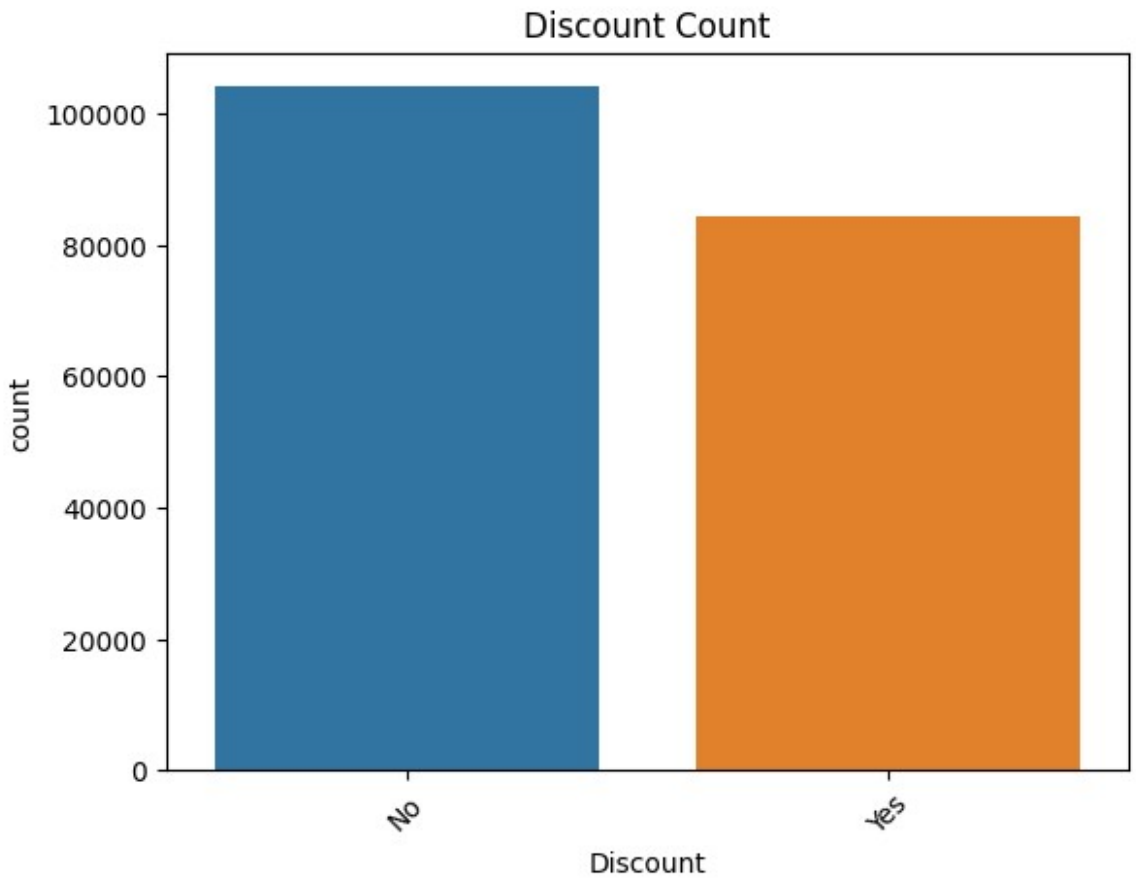


```
 frequency table for Discount:
Discount
No     104051
Yes     84289
Name: count, dtype: int64
```

```
plt.figure(figsize=(6,5))
sns.scatterplot(data=train_df,x='Order',y='Sales',hue='Discount',palet
te='coolwarm')
plt.title('order vs sales(discount highlighted)')
plt.show()

plt.figure(figsize=(6,5))
sns.scatterplot(data=train_df,x='Order',y='Sales',hue='Holiday',palett
e='Set2')
plt.title('order vs sales (holiday highlighted)')
plt.show()

plt.figure(figsize=(6,5))
sns.boxplot(data=train_df,x='Store_Type',y='Sales',palette='Set3')
plt.title('Sales by Store_Type')
plt.show()
```

```
plt.figure(figsize=(6,5))
sns.boxplot(data=train_df,x='Location_Type',y='Sales',palette='Set2')
plt.title('Sales by Location_Type')
plt.show()
```

```
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\categorical.py:641:
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```

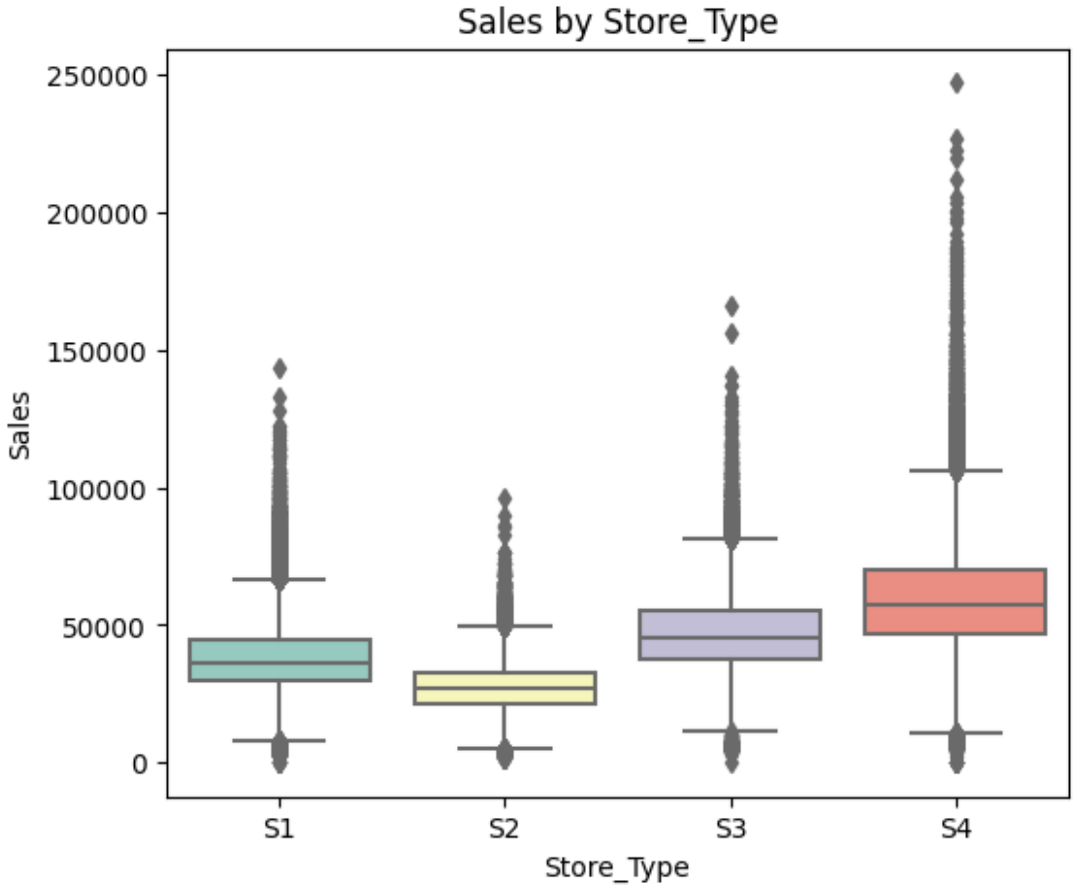


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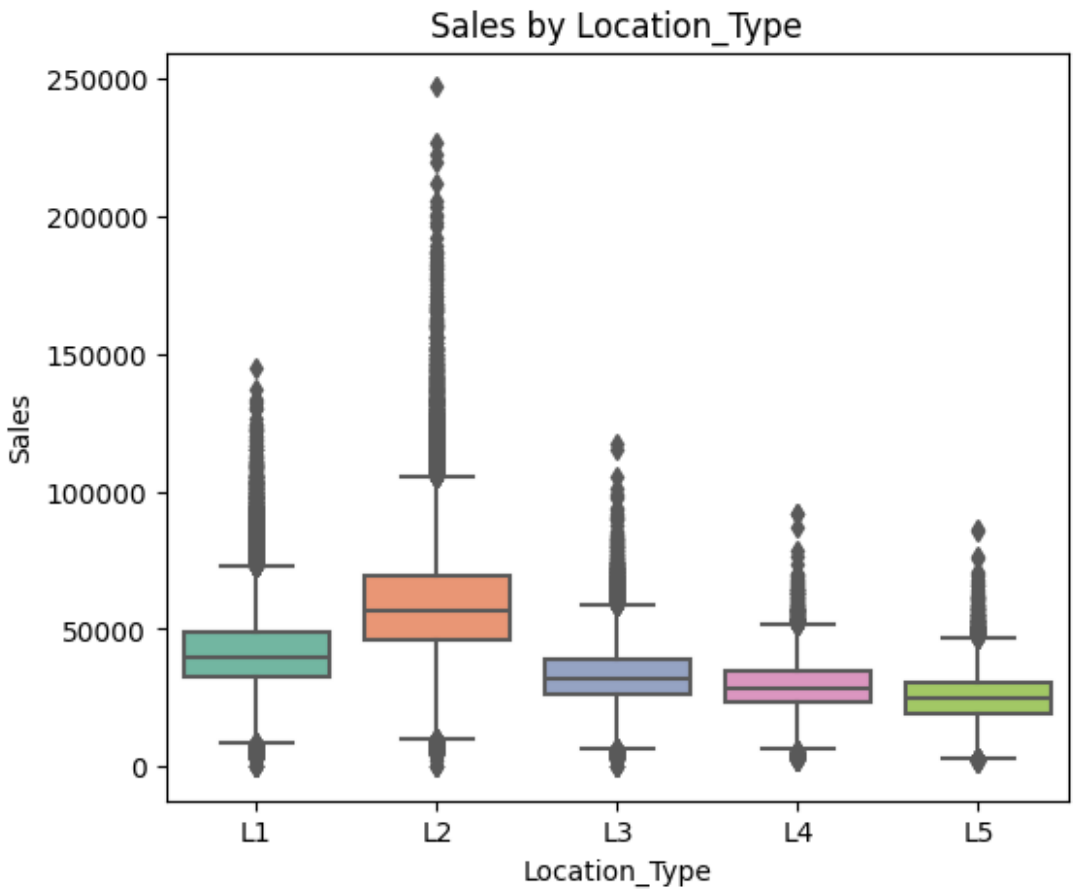
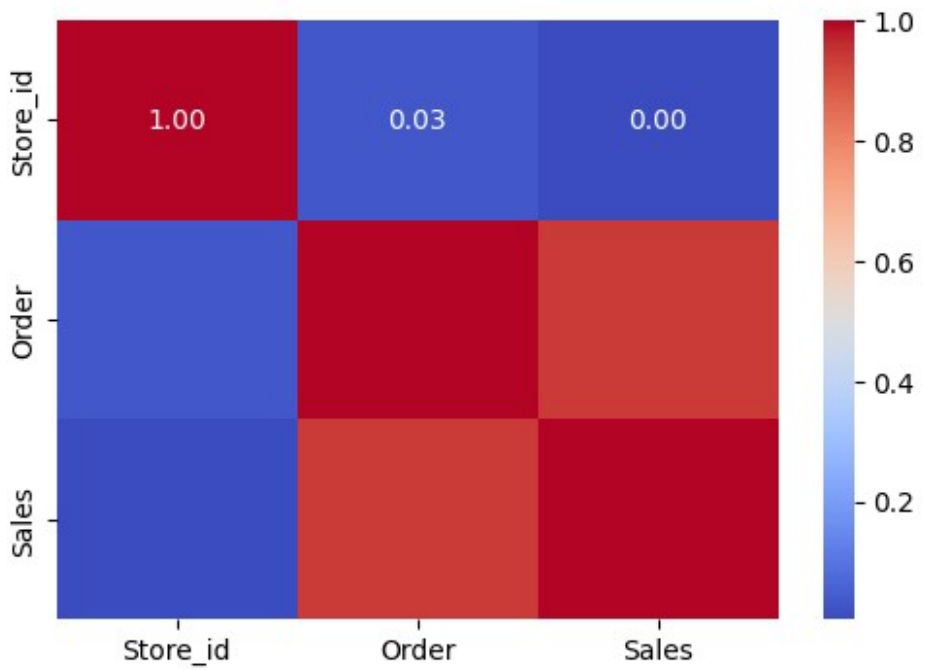
```




```
numerical_cols=train_df.select_dtypes(include=['int64','float64'])
plt.figure(figsize=(6,4))
sns.heatmap(numerical_cols.corr(),
annot=True,cmap='coolwarm',fmt=".2f")
plt.show()
```




```
train_df['Date']=pd.to_datetime(train_df['Date'],format='%d-%m-%y')
daily_sales=train_df.groupby('Date')['Sales'].sum().reset_index()

plt.figure(figsize=(12,5))
sns.lineplot(data=daily_sales,x='Date',y='Sales',color='blue')
plt.title('daily total sales over time')
plt.xlabel('Date')
plt.ylabel('total sales')
plt.show()

train_df['YearMonth']=train_df['Date'].dt.to_period('M').astype(str)
monthly_sales=train_df.groupby('YearMonth')
['Sales'].sum().reset_index()
plt.figure(figsize=(12,5))
sns.lineplot(data=monthly_sales,x='YearMonth',y='Sales',marker='o',col
or='green')
plt.xticks(rotation=45)
plt.title('monthly sales trends')
plt.xlabel('Month')
plt.ylabel('total sales')
plt.show()

train_df['dayofweek']=train_df['Date'].dt.day_name()
dow_sales=train_df.groupby('dayofweek')['Sales'].mean().reset_index()
dow_sales['dayofweek']=pd.Categorical(dow_sales['dayofweek'],categorie
s=['Monday','Tuesday','Wednesday','Thursday','Friday','Saturday','Sund
ay'],ordered=True)
plt.figure(figsize=(8,5))
sns.barplot(data=dow_sales,
```

```
x='dayofweek',y='Sales',palette='coolwarm')
plt.title('Average Sales by day of week')
plt.ylabel('Average Sales')
plt.show()

holiday_sales=train_df.groupby(['Date','Holiday'])
['Sales'].sum().reset_index()

plt.figure(figsize=(12,5))
sns.lineplot(data=holiday_sales,x='Date',y='Sales',hue='Holiday',palet
te='Set1')
plt.title('Holiday vs Non Hoiday sales trend')
plt.ylabel('total sales')
plt.xlabel('Date')
plt.show()
```

```
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
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  with pd.option_context('mode.use_inf_as_na', True):
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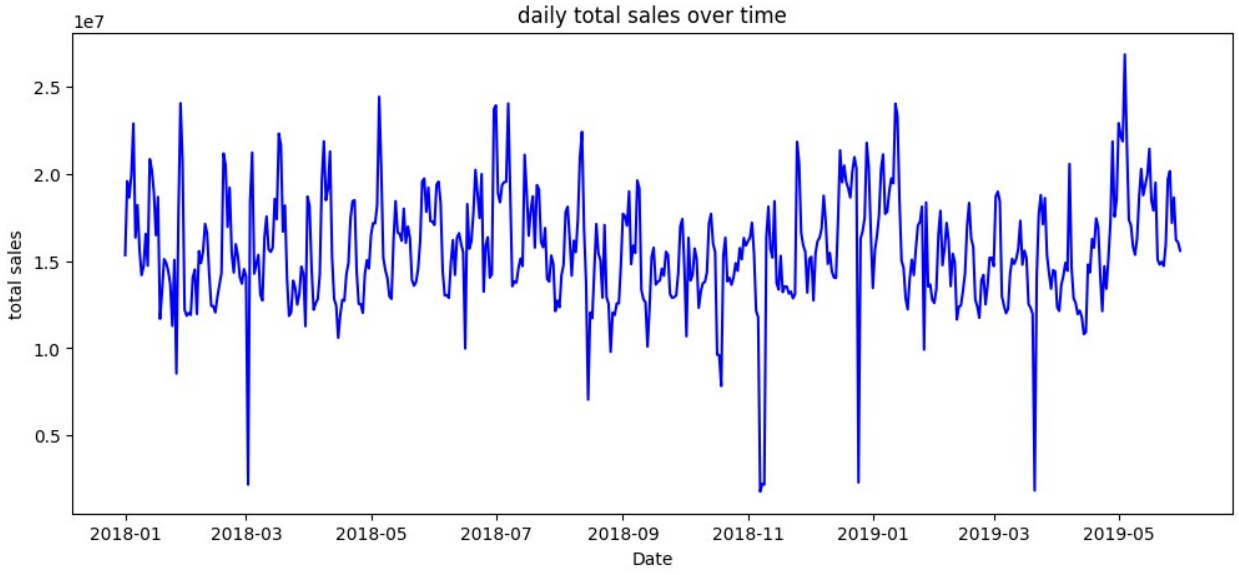
  with pd.option_context('mode.use_inf_as_na', True):
```




```
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instead.
```

```
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```


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  grouped_vals = vals.groupby(grouper)
```

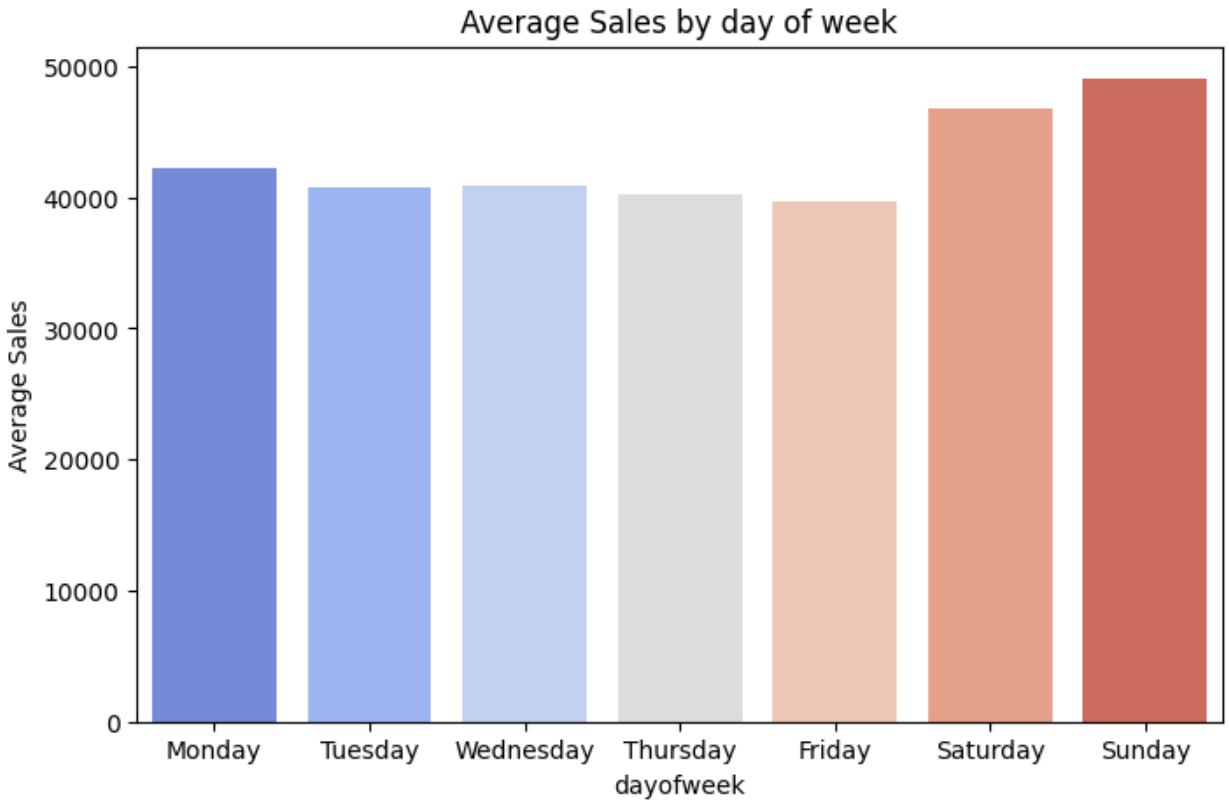


```
C:\Users\HP\AppData\Local\Temp\ipykernel_14368\3391780094.py:30:
FutureWarning: The default of observed=False is deprecated and will be
changed to True in a future version of pandas. Pass observed=False to
retain current behavior or observed=True to adopt the future default
and silence this warning.
  holiday_sales=train_df.groupby(['Date','Holiday'])
['Sales'].sum().reset_index()
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
FutureWarning: use_inf_as_na option is deprecated and will be removed
in a future version. Convert inf values to NaN before operating
instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119:
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instead.
  with pd.option_context('mode.use_inf_as_na', True):
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1057:
FutureWarning: The default of observed=False is deprecated and will be
changed to True in a future version of pandas. Pass observed=False to
retain current behavior or observed=True to adopt the future default
and silence this warning.
  grouped_data = data.groupby(
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1075:
FutureWarning: When grouping with a length-1 list-like, you will need
```
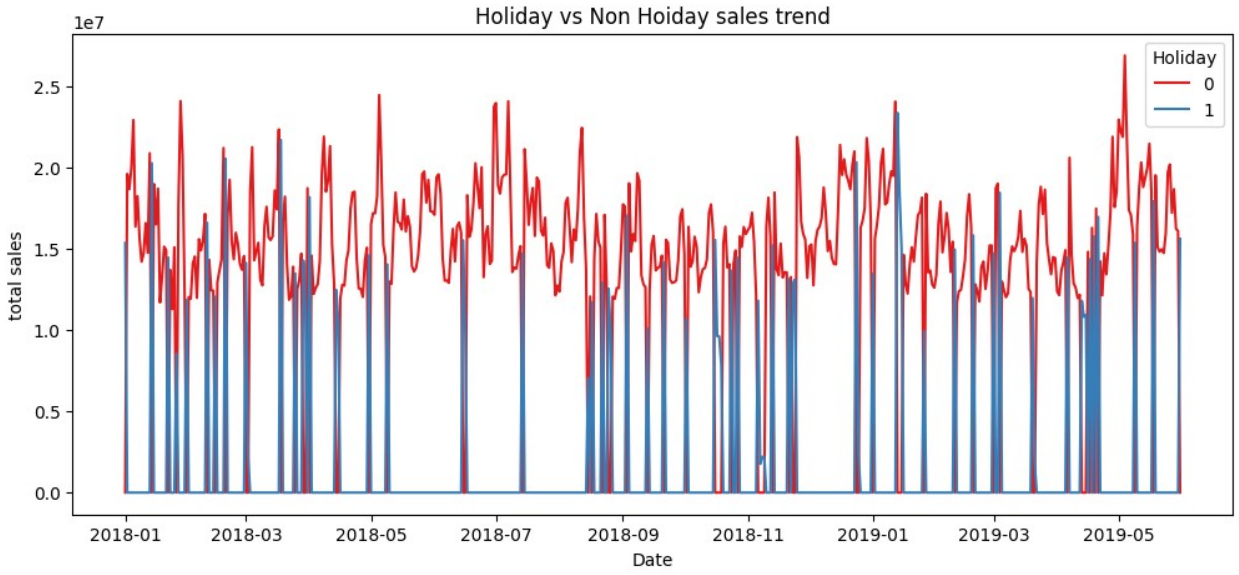

```
to pass a length-1 tuple to get_group in a future version of pandas.
Pass `(name,)` instead of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
C:\Users\HP\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1075:
FutureWarning: When grouping with a length-1 list-like, you will need
to pass a length-1 tuple to get_group in a future version of pandas.
Pass `(name,)` instead of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
```




```
q1=train_df['Sales'].quantile(0.25)
q3=train_df['Sales'].quantile(0.75)
iqr= q3-q1

lower_bound=q1-1.5*iqr
upper_bound=q3+1.5*iqr

outliers_iqr=train_df[(train_df['Sales']<lower_bound)|
(train_df['Sales']>upper_bound)]
print(f"Number of outliers(IQR method):{len(outliers_iqr)}")

train_df['Sales_z']=zscore(train_df['Sales'])

outliers_z=train_df[abs(train_df['Sales_z'])>3]
print(f"Number of outliers(z-score method):{len(outliers_z)}")

train_df['Sales'] = np.where(train_df['Sales'] > upper_bound,
upper_bound, train_df['Sales'])

train_df

Number of outliers(IQR method):5843
Number of outliers(z-score method):2421
```

```
              ID  Store_id Store_Type Location_Type Region_Code
Date  \
0       T1000001         1         S1            L3          R1 2018-
01-01
1       T1000002       253         S4            L2          R1 2018-
01-01
2       T1000003       252         S3            L2          R1 2018-
01-01
3       T1000004       251         S2            L3          R1 2018-
01-01
4       T1000005       250         S2            L3          R4 2018-
01-01
...          ...       ...        ...           ...         ...
...
188335  T1188336       149         S2            L3          R2 2019-
05-31
188336  T1188337       153         S4            L2          R1 2019-
05-31
188337  T1188338       154         S1            L3          R2 2019-
05-31
188338  T1188339       155         S3            L1          R2 2019-
05-31
188339  T1188340       152         S2            L1          R1 2019-
05-31

       Holiday Discount  Order     Sales  Year  Month  Week  DayOfWeek
\
0            1      Yes      9   7011.84  2018      1     1          0

1            1      Yes     60  51789.12  2018      1     1          0

2            1      Yes     42  36868.20  2018      1     1          0

3            1      Yes     23  19715.16  2018      1     1          0

4            1      Yes     62  45614.52  2018      1     1          0

...        ...      ...    ...       ...   ...    ...   ...        ...

188335       1      Yes     51  37272.00  2019      5    22          4

188336       1       No     90  54572.64  2019      5    22          4

188337       1       No     56  31624.56  2019      5    22          4

188338       1      Yes     70  49162.41  2019      5    22          4

188339       1       No     47  37977.00  2019      5    22          4


        Is_Weekend YearMonth dayofweek   Sales_z
```

```
0                0   2018-01    Monday -1.938189
1                0   2018-01    Monday  0.487889
2                0   2018-01    Monday -0.320542
3                0   2018-01    Monday -1.249910
4                0   2018-01    Monday  0.153343
...            ...       ...       ...       ...
188335           0   2019-05    Friday -0.298663
188336           0   2019-05    Friday  0.638702
188337           0   2019-05    Friday -0.604647
188338           0   2019-05    Friday  0.345571
188339           0   2019-05    Friday -0.260466

[188340 rows x 18 columns]
```

```
sales_discount=train_df[train_df['Discount']!='Yes']['Sales']
sales_no_discount=train_df[train_df['Discount']=='No']['Sales']

t_stat,p_val=ttest_ind(sales_discount,sales_no_discount,equal_var=Fals
e)

print(" Impact of Discounts on Sales:")
if p_val<0.05:
    print("Reject Null discounts significantly impact sales.")
else:
    print("fail to reject null Discounts Don't significantly impact
sales.")

sales_holiday= train_df[train_df['Holiday']==1]['Sales']
sales_nonholiday=train_df[train_df['Holiday']==0]['Sales']

t_stat, p_val= ttest_ind(sales_holiday,
sales_nonholiday,equal_var=False)

print("Effect of Holidays on Sales:")
if p_val<0.05:
    print("Reject Null holidays significantly impact sales.")
else:
    print("fail to reject null holidays significantly impact sales")



groups=[group['Sales'].values for name, group in
train_df.groupby('Store_Type')]
f_stat,p_val= f_oneway(*groups)

print("Sales Differences Across Store Types:")
if p_val<0.05:
    print("Reject Null store_type significantly impact sales.")
else:
    print("fail to reject null store_type significantly impact sales")
```

```
groups=[group['Sales'].values for name, group in
train_df.groupby('Region_Code')]
kruskal(*groups)

print("Regional Sales Variability:")
if p_val<0.05:
    print("Reject Null Region_code significantly impact sales.")
else:
    print("fail to reject null Region_code significantly impact
sales")

corr, p_val = pearsonr(train_df['Order'], train_df['Sales'])

print("Pearsonr Correlation between Orders and Sales:")
if p_val<0.05:
    print("Reject Null order significantly impact sales.")
else:
    print("fail to reject null order significantly impact sales")


# If data is skewed:

print("spearmanr Correlation between Orders and Sales:")
corr, p_val = spearmanr(train_df['Order'], train_df['Sales'])

if p_val<0.05:
    print("Reject Null order significantly impact sales.")
else:
    print("fail to reject null order significantly impact sales")
```

```
 Impact of Discounts on Sales:
fail to reject null Discounts Don't significantly impact sales.
Effect of Holidays on Sales:
Reject Null holidays significantly impact sales.

C:\Users\HP\AppData\Local\Temp\ipykernel_14368\3417656146.py:25:
FutureWarning: The default of observed=False is deprecated and will be
changed to True in a future version of pandas. Pass observed=False to
retain current behavior or observed=True to adopt the future default
and silence this warning.
  groups=[group['Sales'].values for name, group in
train_df.groupby('Store_Type')]
C:\Users\HP\AppData\Local\Temp\ipykernel_14368\3417656146.py:34:
FutureWarning: The default of observed=False is deprecated and will be
changed to True in a future version of pandas. Pass observed=False to
retain current behavior or observed=True to adopt the future default
and silence this warning.
  groups=[group['Sales'].values for name, group in
train_df.groupby('Region_Code')]
```

```
Sales Differences Across Store Types:
Reject Null store_type significantly impact sales.
Regional Sales Variability:
Reject Null Region_code significantly impact sales.
Pearsonr Correlation between Orders and Sales:
Reject Null order significantly impact sales.
spearmanr Correlation between Orders and Sales:
Reject Null order significantly impact sales.
```