Machine Learning Assignment 1 - Statistical Measures

In [5]:
```
import warnings
import sys
if not sys.warnoptions:
    warnings.simplefilter("ignore")
```

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

Q1. Perform basic EDA

In [7]:
```
# Load the dataset
df=pd.read_csv("house_price.csv")
df
```

Out[7]:

	location	size	total_sqft	bath	price	bhk	price_per_sqft
0	Electronic City Phase II	2 BHK	1056.0	2.0	39.07	2	3699
1	Chikka Tirupathi	4 Bedroom	2600.0	5.0	120.00	4	4615
2	Uttarahalli	3 BHK	1440.0	2.0	62.00	3	4305
3	Lingadheeranahalli	3 BHK	1521.0	3.0	95.00	3	6245
4	Kothanur	2 BHK	1200.0	2.0	51.00	2	4250
...	...	...	...	...	...	...	...
13195	Whitefield	5 Bedroom	3453.0	4.0	231.00	5	6689
13196	other	4 BHK	3600.0	5.0	400.00	4	11111
13197	Raja Rajeshwari Nagar	2 BHK	1141.0	2.0	60.00	2	5258
13198	Padmanabhanagar	4 BHK	4689.0	4.0	488.00	4	10407
13199	Doddathoguru	1 BHK	550.0	1.0	17.00	1	3090

13200 rows × 7 columns

In [8]:
```
# Create a copy of the dataset
df2 = df.copy()
df2
```

Out[8]:

	location	size	total_sqft	bath	price	bhk	price_per_sqft
0	Electronic City Phase II	2 BHK	1056.0	2.0	39.07	2	3699
1	Chikka Tirupathi	4 Bedroom	2600.0	5.0	120.00	4	4615
2	Uttarahalli	3 BHK	1440.0	2.0	62.00	3	4305
3	Lingadheeranahalli	3 BHK	1521.0	3.0	95.00	3	6245
4	Kothanur	2 BHK	1200.0	2.0	51.00	2	4250
...	...	...	...	...	...	...	...
13195	Whitefield	5 Bedroom	3453.0	4.0	231.00	5	6689
13196	other	4 BHK	3600.0	5.0	400.00	4	11111
13197	Raja Rajeshwari Nagar	2 BHK	1141.0	2.0	60.00	2	5258
13198	Padmanabhanagar	4 BHK	4689.0	4.0	488.00	4	10407
13199	Doddathoguru	1 BHK	550.0	1.0	17.00	1	3090

13200 rows × 7 columns

In [9]:
```
# Display first few rows
print("Displaying first few rows:")
df2.head(10)
```

```
Displaying first few rows:
```

Out[9]:

	location	size	total_sqft	bath	price	bhk	price_per_sqft
0	Electronic City Phase II	2 BHK	1056.0	2.0	39.07	2	3699
1	Chikka Tirupathi	4 Bedroom	2600.0	5.0	120.00	4	4615
2	Uttarahalli	3 BHK	1440.0	2.0	62.00	3	4305
3	Lingadheeranahalli	3 BHK	1521.0	3.0	95.00	3	6245
4	Kothanur	2 BHK	1200.0	2.0	51.00	2	4250
5	Whitefield	2 BHK	1170.0	2.0	38.00	2	3247
6	Old Airport Road	4 BHK	2732.0	4.0	204.00	4	7467
7	Rajaji Nagar	4 BHK	3300.0	4.0	600.00	4	18181
8	Marathahalli	3 BHK	1310.0	3.0	63.25	3	4828
9	other	6 Bedroom	1020.0	6.0	370.00	6	36274

In [10]:
```
# Display last few rows
print("Displaying last few rows:")
df2.tail(10)
```

```
Displaying last few rows:
```

Out[10]:

	location	size	total_sqft	bath	price	bhk	price_per_sqft
13190	Rachenahalli	2 BHK	1050.0	2.0	52.71	2	5020
13191	Ramamurthy Nagar	7 Bedroom	1500.0	9.0	250.00	7	16666
13192	Bellandur	2 BHK	1262.0	2.0	47.00	2	3724
13193	Uttarahalli	3 BHK	1345.0	2.0	57.00	3	4237
13194	Green Glen Layout	3 BHK	1715.0	3.0	112.00	3	6530
13195	Whitefield	5 Bedroom	3453.0	4.0	231.00	5	6689
13196	other	4 BHK	3600.0	5.0	400.00	4	11111
13197	Raja Rajeshwari Nagar	2 BHK	1141.0	2.0	60.00	2	5258
13198	Padmanabhanagar	4 BHK	4689.0	4.0	488.00	4	10407
13199	Doddathoguru	1 BHK	550.0	1.0	17.00	1	3090

In [11]:
```
# Display shape of the dataset
df2.shape
```

Out[11]:
```
(13200, 7)
```

In [12]:
```
# Display data type of each column
df2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13200 entries, 0 to 13199
Data columns (total 7 columns):
 #   Column          Non-Null Count  Dtype  
---  ------          --------------  -----  
 0   location        13200 non-null  object 
 1   size            13200 non-null  object 
 2   total_sqft      13200 non-null  float64
 3   bath            13200 non-null  float64
 4   price           13200 non-null  float64
 5   bhk             13200 non-null  int64  
 6   price_per_sqft  13200 non-null  int64  
dtypes: float64(3), int64(2), object(2)
memory usage: 722.0+ KB
```

In [13]:
```
# Display column names in the dataset
df2.columns
```

Out[13]:
```
Index(['location', 'size', 'total_sqft', 'bath', 'price', 'bhk',
       'price_per_sqft'],
      dtype='object')
```

In [14]:
```
# Display statistical summary of numerical column
df2.describe()
```

Out[14]:

	total_sqft	bath	price	bhk	price_per_sqft
count	13200.000000	13200.000000	13200.000000	13200.000000	1.320000e+04
mean	1555.302783	2.691136	112.276178	2.800833	7.920337e+03
std	1237.323445	1.338915	149.175995	1.292843	1.067272e+05
min	1.000000	1.000000	8.000000	1.000000	2.670000e+02
25%	1100.000000	2.000000	50.000000	2.000000	4.267000e+03
50%	1275.000000	2.000000	71.850000	3.000000	5.438000e+03
75%	1672.000000	3.000000	120.000000	3.000000	7.317000e+03
max	52272.000000	40.000000	3600.000000	43.000000	1.200000e+07

In [15]:
```
# Display missing/null values
missing_values = df2.isnull().sum()
print("Missing/Null values in each column:")
print(missing_values)
```

```
Missing/Null values in each column:
location          0
size              0
total_sqft        0
bath              0
price             0
bhk               0
price_per_sqft    0
dtype: int64
```

In [21]:
```
# Display duplicate values in the dataset
df2.duplicated().sum()
```

Out[21]: np.int64(0)

In [17]:
```
df2.shape
```

Out[17]: (13200, 7)

In [18]:
```
df2.drop_duplicates(inplace=True)
```

In [19]:
```
df2.shape
```

Out[19]: (12151, 7)

Outlier Detection and Removal

Objective#

Detect and remove outliers from the dataset using the following methods:

Mean and Standard Deviation Percentile Method Interquartile Range (IQR) Method Z-Score Method

a) Mean and Standard Deviation Method Description This method identifies outliers by calculating the mean and standard deviation for the target column and establishing an acceptable range. Any value outside this range is considered an outlier.

Steps

Compute the mean and standard deviation of the price_per_sqft column. Define the acceptable range as: Acceptable Range =(mean−3·std,mean+3·std) Acceptable Range= (mean−3·std,mean+3·std) Remove rows where the price_per_sqft values fall outside this range.

In [23]:
```
mean = df2['price_per_sqft'].mean()
std = df2['price_per_sqft'].std()
threshold = 3
lower_limit = mean - threshold * std
upper_limit = mean + threshold * std

df2_trimmed_mean_std = df2[(df2['price_per_sqft'] >= lower_limit) & (df2['price_per

rows_cleared = len(df2) - len(df2_trimmed_mean_std)
print("The number of rows cleared:",rows_cleared)
```

```
The number of rows cleared: 5
```

b) Percentile Method Description The percentile method identifies outliers by defining thresholds based on a specified percentile range. Data points outside this range are treated as outliers.

Steps

Define lower and upper percentiles (e.g., 1st and 99th percentiles). Remove rows where price_per_sqft values are outside these percentiles.

In [24]:
```
lower_limit = np.percentile(df2['price_per_sqft'], 5)
upper_limit = np.percentile(df2['price_per_sqft'], 95)

df2_trimmed_percentiles = df2[(df2['price_per_sqft'] >= lower_limit) & (df2['price_

rows_cleared = len(df2) - len(df2_trimmed_percentiles)
print("The number of rows cleared:",rows_cleared)
```

```
The number of rows cleared: 1211
```

In [ ]:
```

```

c) Interquartile Range (IQR) Method Description The IQR method identifies outliers based on the interquartile range (difference between the 75th and 25th percentiles). Data points outside 1.5 times the IQR are considered outliers.

In [25]:
```
Q1 = df2['price_per_sqft'].quantile(0.25)
Q3 = df2['price_per_sqft'].quantile(0.75)
IQR = Q3 - Q1
lower_limit = Q1 - 1.5 * IQR
upper_limit = Q3 + 1.5 * IQR

df2_trimmed_IQR = df2[(df2['price_per_sqft'] >= lower_limit) & (df2['price_per_sqft

rows_cleared = len(df2) - len(df2_trimmed_IQR)
print("The number of rows cleared:",rows_cleared)
```

```
The number of rows cleared: 1142
```

In [ ]:

d) Z-Score Method Description The Z-Score method calculates the Z-Score for each data point, which measures how many standard deviations a point is from the mean. Values beyond a specified threshold (commonly ±3) are treated as outliers.

In [26]:
```
from scipy.stats import zscore

# Calculate Z-scores for the 'price_per_sqft' column
df2['z_score'] = zscore(df2['price_per_sqft'])

# Define the critical value
critical_value = 3

# Remove rows where the Z-score is greater than 3 or less than -3
df2_trimmed_z_score = df2[(df2['z_score'] > critical_value) | (df2['z_score'] < -cr

# Check the number of rows removed
rows_cleared = len(df2) - len(df2_trimmed_z_score)
print("The number of rows cleared:",rows_cleared)
```

```
The number of rows cleared: 12146
```

In [ ]:

In [27]:
```
df2
```

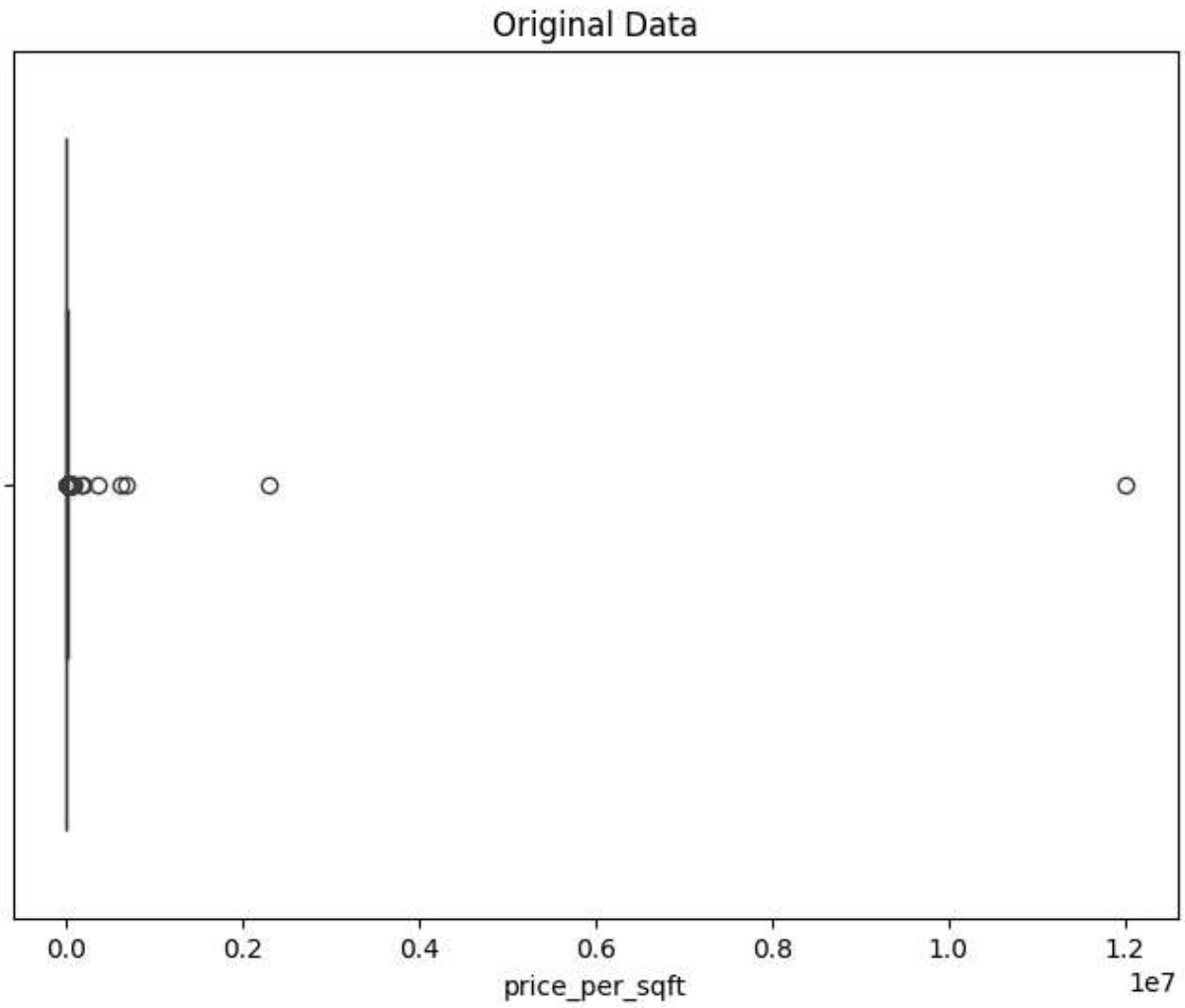
Out[27]:

	location	size	total_sqft	bath	price	bhk	price_per_sqft	z_score
0	Electronic City Phase II	2 BHK	1056.0	2.0	39.07	2	3699	-0.039861
1	Chikka Tirupathi	4 Bedroom	2600.0	5.0	120.00	4	4615	-0.031625
2	Uttarahalli	3 BHK	1440.0	2.0	62.00	3	4305	-0.034412
3	Lingadheeranahalli	3 BHK	1521.0	3.0	95.00	3	6245	-0.016971
4	Kothanur	2 BHK	1200.0	2.0	51.00	2	4250	-0.034907
...	...	...	...	...	...	...	...	...
13194	Green Glen Layout	3 BHK	1715.0	3.0	112.00	3	6530	-0.014409
13195	Whitefield	5 Bedroom	3453.0	4.0	231.00	5	6689	-0.012979
13196	other	4 BHK	3600.0	5.0	400.00	4	11111	0.026777
13197	Raja Rajeshwari Nagar	2 BHK	1141.0	2.0	60.00	2	5258	-0.025845
13198	Padmanabhanagar	4 BHK	4689.0	4.0	488.00	4	10407	0.020448

12151 rows × 8 columns

Box Plot of Original Data

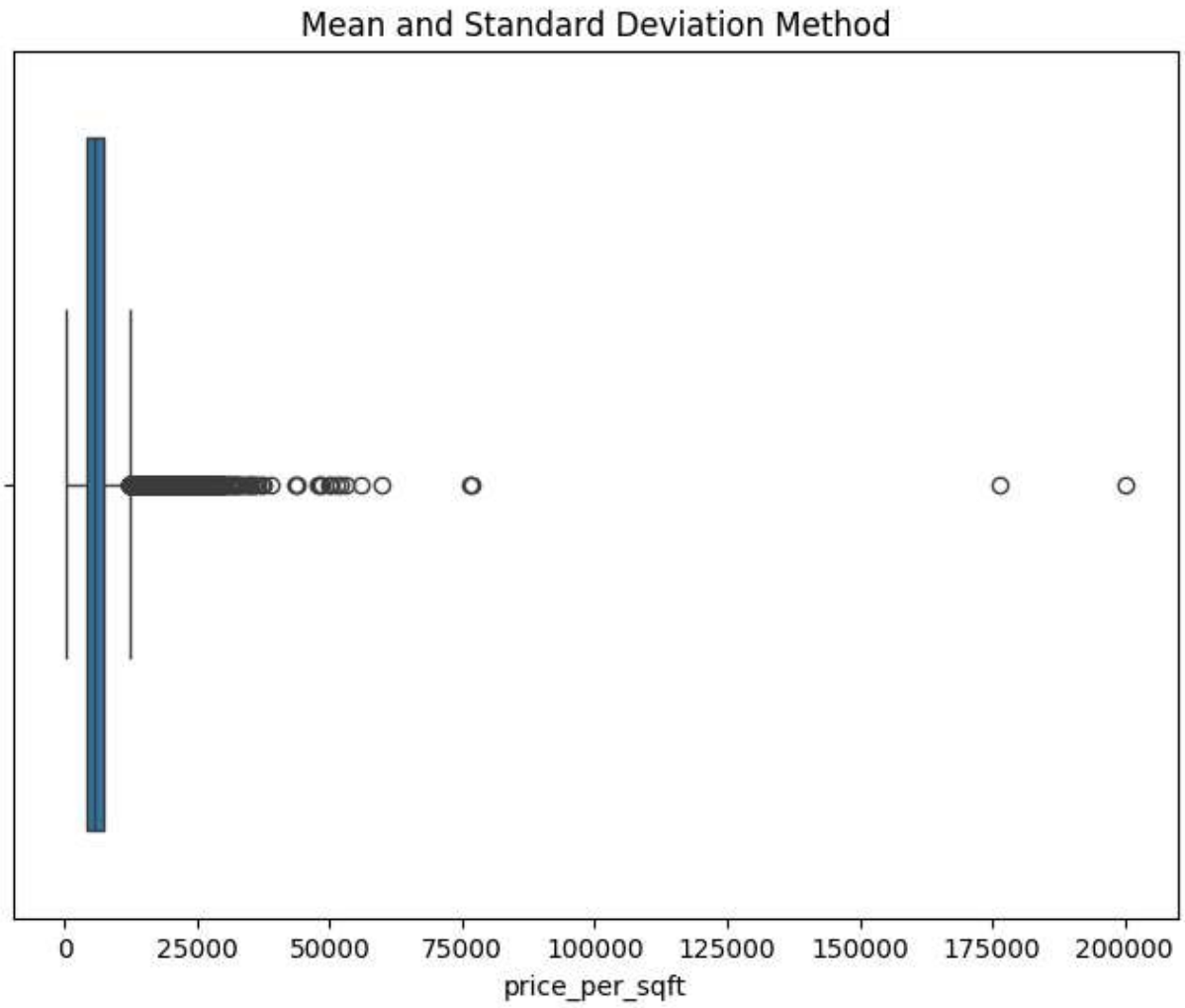
In [28]:
```
plt.figure(figsize=(8, 6))
sns.boxplot(x=df2['price_per_sqft'])
plt.title('Original Data')
plt.show()
```



In [ ]:

Box Plot of Mean and Standard Deviation Method

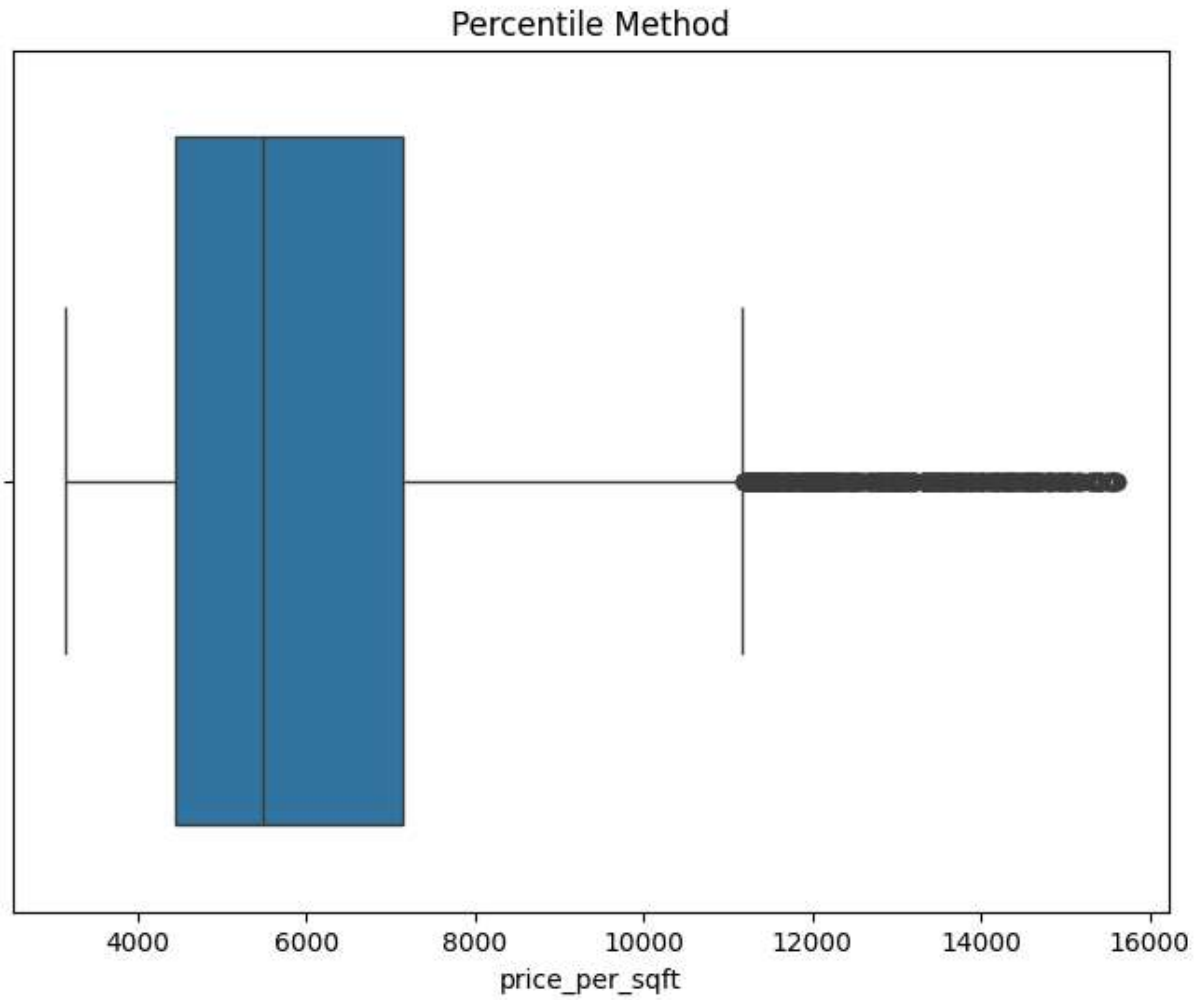
In [29]:
```
plt.figure(figsize=(8, 6))
sns.boxplot(x=df2_trimmed_mean_std['price_per_sqft'])
plt.title('Mean and Standard Deviation Method')
plt.show()
```



In [ ]:

Box Plot of Percentile Method

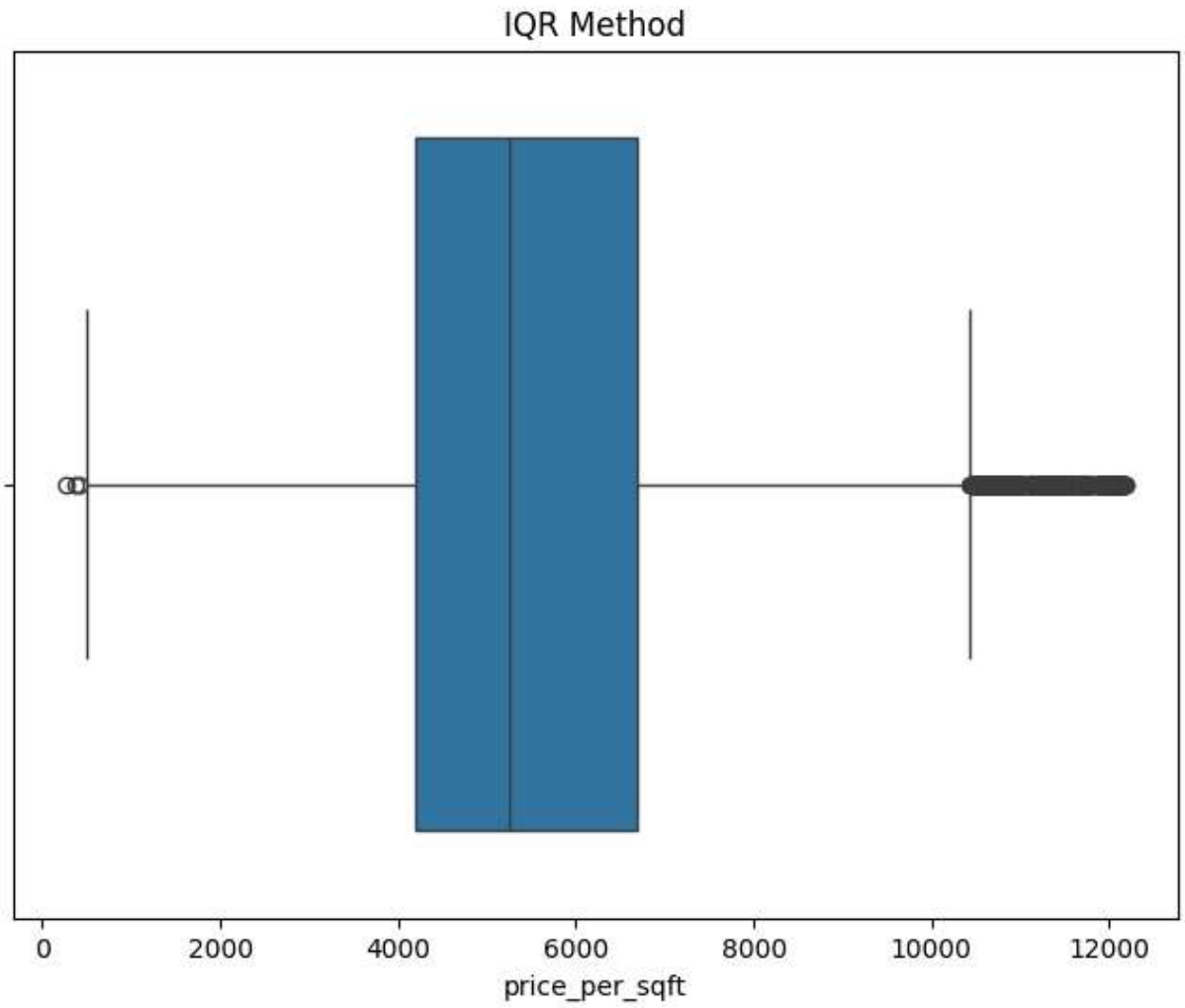
In [30]:
```
plt.figure(figsize=(8, 6))
sns.boxplot(x=df2_trimmed_percentiles['price_per_sqft'])
plt.title('Percentile Method')
plt.show()
```



In [ ]:

Box Plot of IQR

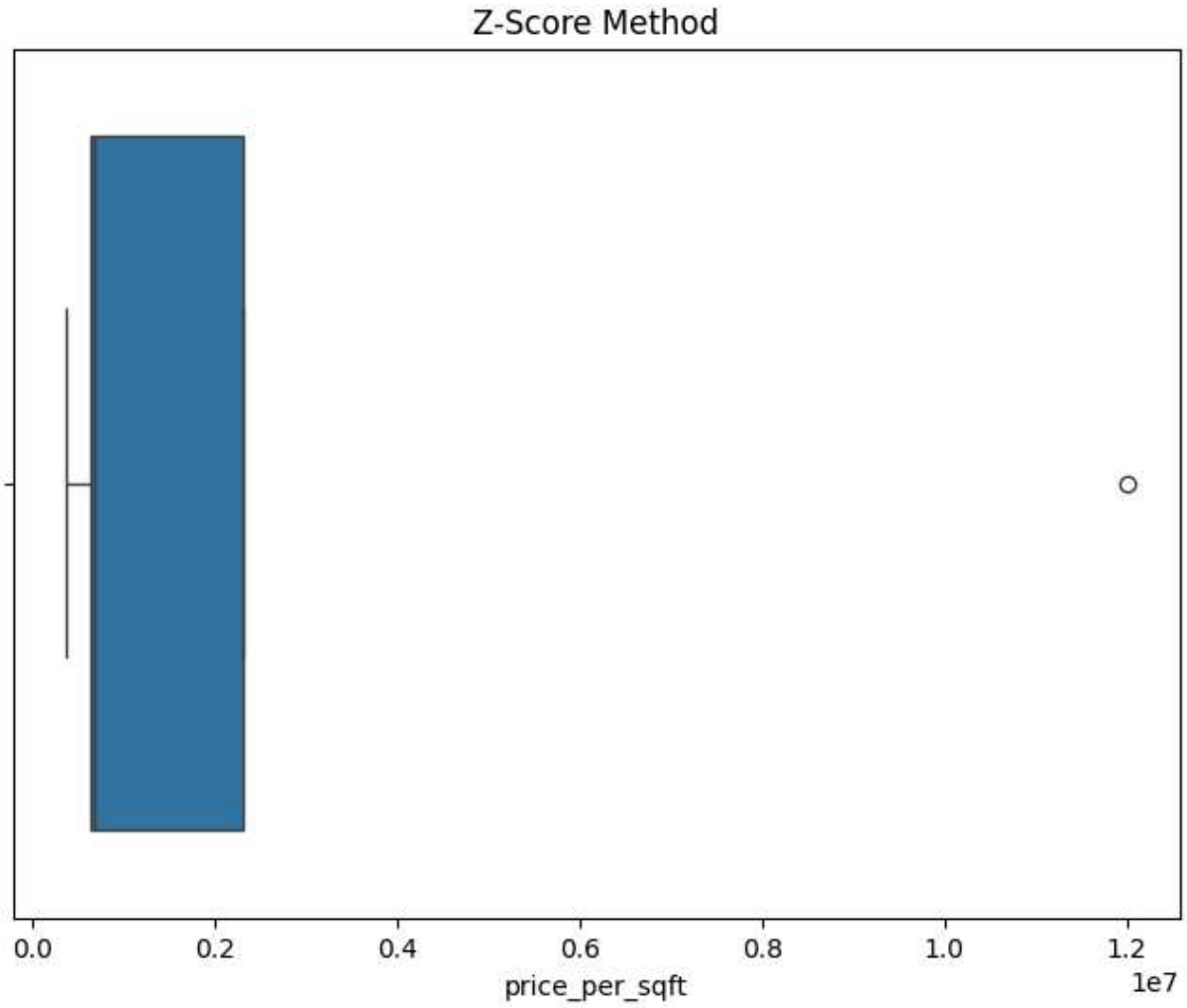
In [31]:
```
plt.figure(figsize=(8, 6))
sns.boxplot(x=df2_trimmed_IQR['price_per_sqft'])
plt.title('IQR Method')
plt.show()
```



In [ ]:

Box Plot of Z-Score Method

In [32]:
```
plt.figure(figsize=(8, 6))
sns.boxplot(x=df2_trimmed_z_score['price_per_sqft'])
plt.title('Z-Score Method')
plt.show()
```



In [ ]:

Q4. Draw histplot to check the normality of the column(price per sqft column) and perform transformations if needed. Check the skewness and kurtosis before and after the transformation.##

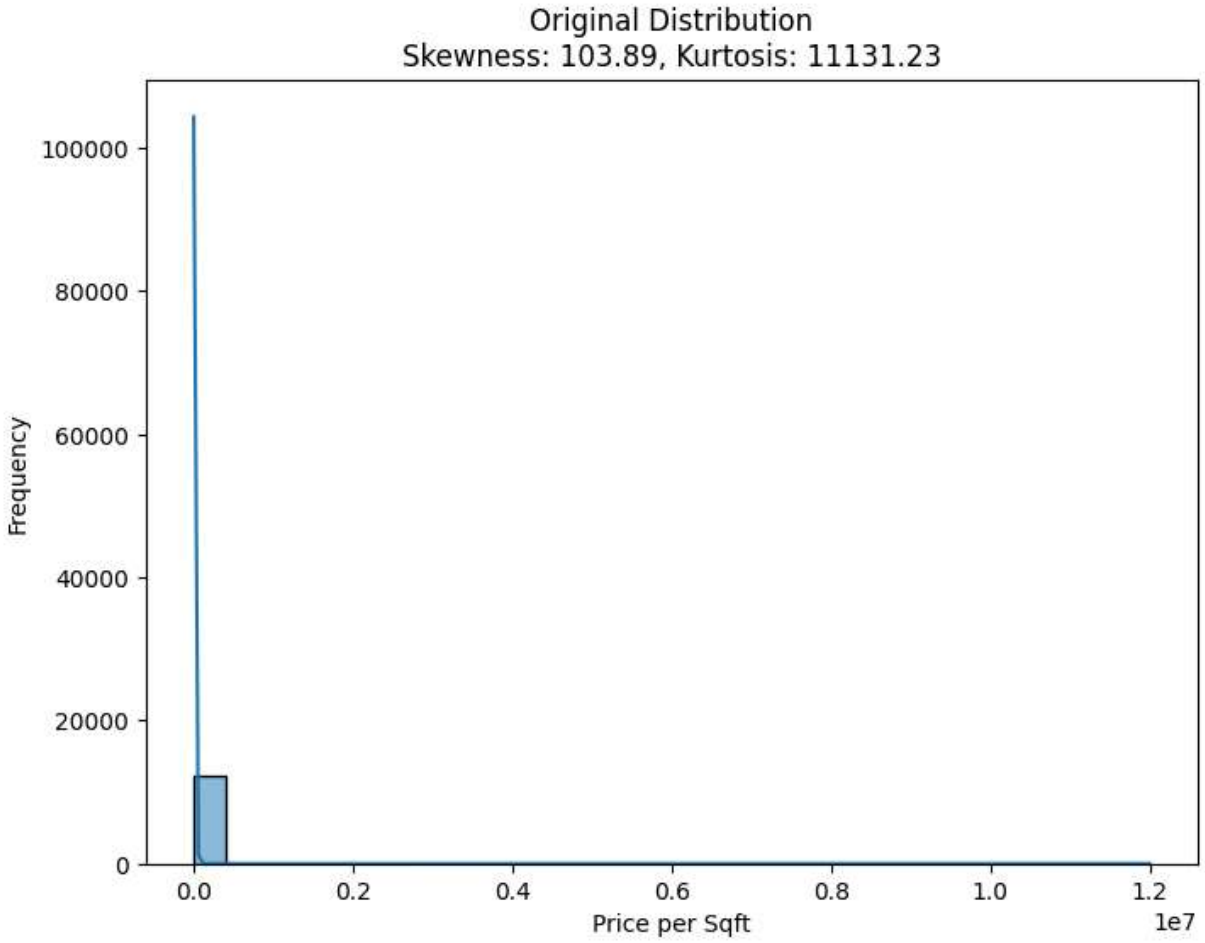
In [33]:
```
# Skewness and Kurtosis BEFORE transformation
import scipy.stats as stats
original_skewness = stats.skew(df2['price_per_sqft'])
original_kurtosis = stats.kurtosis(df2['price_per_sqft'])

print("Original Skewness:", original_skewness)
print("Original Kurtosis:", original_kurtosis)
```

```
Original Skewness: 103.88920549434178
Original Kurtosis: 11131.230839805388
```

In [ ]:

In [34]:
```
# Hisplot to check normality of price_per_sqft column
plt.figure(figsize=(8, 6))
sns.histplot(df2['price_per_sqft'], kde=True, bins=30)
plt.title(f'Original Distribution\nSkewness: {original_skewness:.2f}, Kurtosis: {or
plt.xlabel('Price per Sqft')
plt.ylabel('Frequency')
plt.show()
```



In [ ]:
```
```

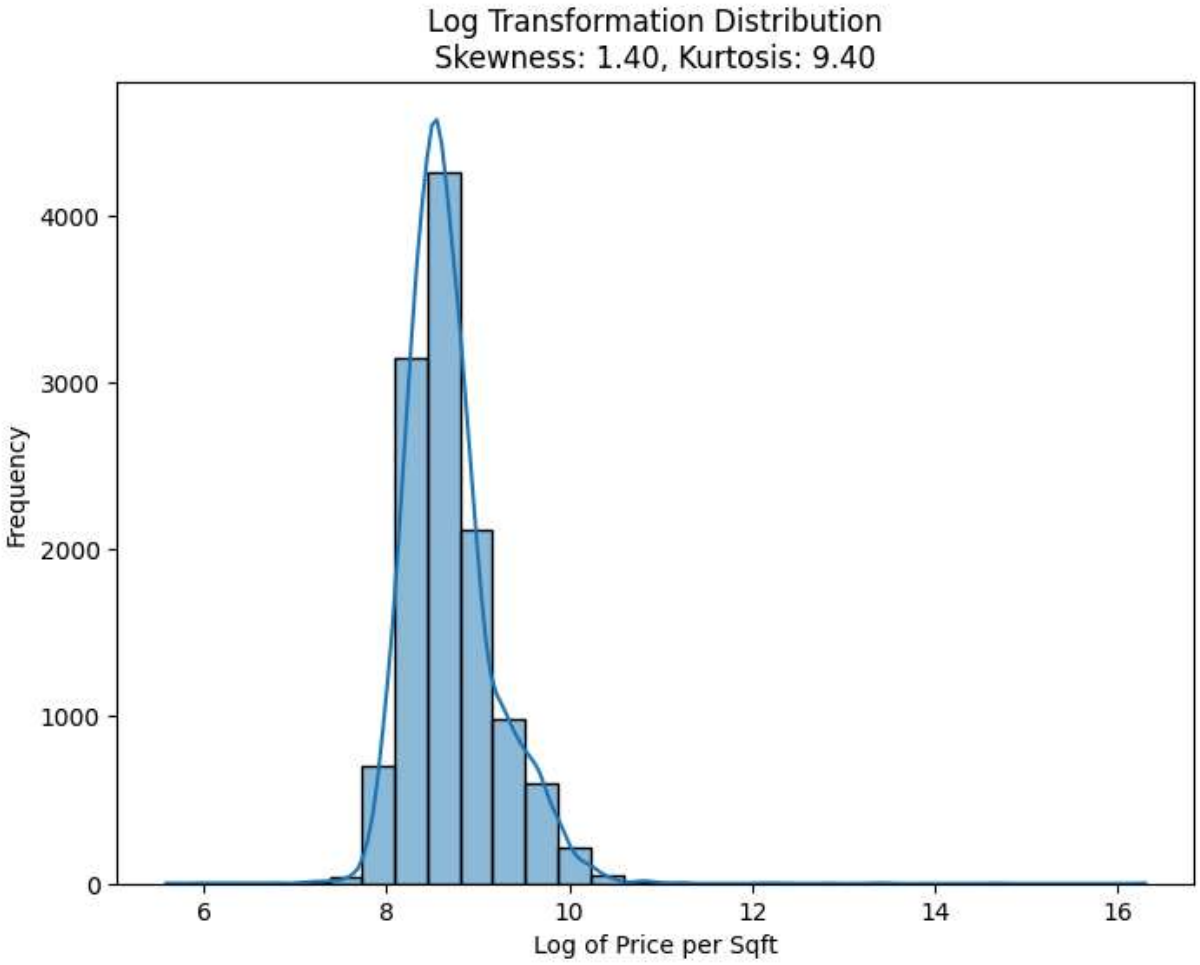
In [35]:
```
# Apply Log Transformation
df2['log_price_per_sqft'] = np.log1p(df2['price_per_sqft'])
# Skewness and Kurtosis AFTER Log Transformation
import scipy.stats as stats
log_skewness = stats.skew(df2['log_price_per_sqft'])
log_kurtosis = stats.kurtosis(df2['log_price_per_sqft'])

print("Log Transformation Skewness:", log_skewness)
print("Log Transformation Kurtosis:", log_kurtosis)
```

```
Log Transformation Skewness: 1.400870354404583
Log Transformation Kurtosis: 9.404434549652514
```

In [36]:
```
# Hisplot to check normality of AFTER Log Transformation
plt.figure(figsize=(8, 6))
sns.histplot(df2['log_price_per_sqft'], kde=True, bins=30)
```

```
plt.title(f'Log Transformation Distribution\nSkewness: {log_skewness:.2f}, Kurtosis
plt.xlabel('Log of Price per Sqft')
plt.ylabel('Frequency')
plt.show()
```



Q5. Check the correlation between all the numerical columns and plot heatmap.##

In [37]:
```
# View the dataset
df2.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 12151 entries, 0 to 13198
Data columns (total 9 columns):
 #   Column              Non-Null Count  Dtype  
---  ------              --------------  -----  
 0   location            12151 non-null  object 
 1   size                12151 non-null  object 
 2   total_sqft          12151 non-null  float64
 3   bath                12151 non-null  float64
 4   price               12151 non-null  float64
 5   bhk                 12151 non-null  int64  
 6   price_per_sqft      12151 non-null  int64  
 7   z_score             12151 non-null  float64
 8   log_price_per_sqft  12151 non-null  float64
dtypes: float64(5), int64(2), object(2)
memory usage: 949.3+ KB
```

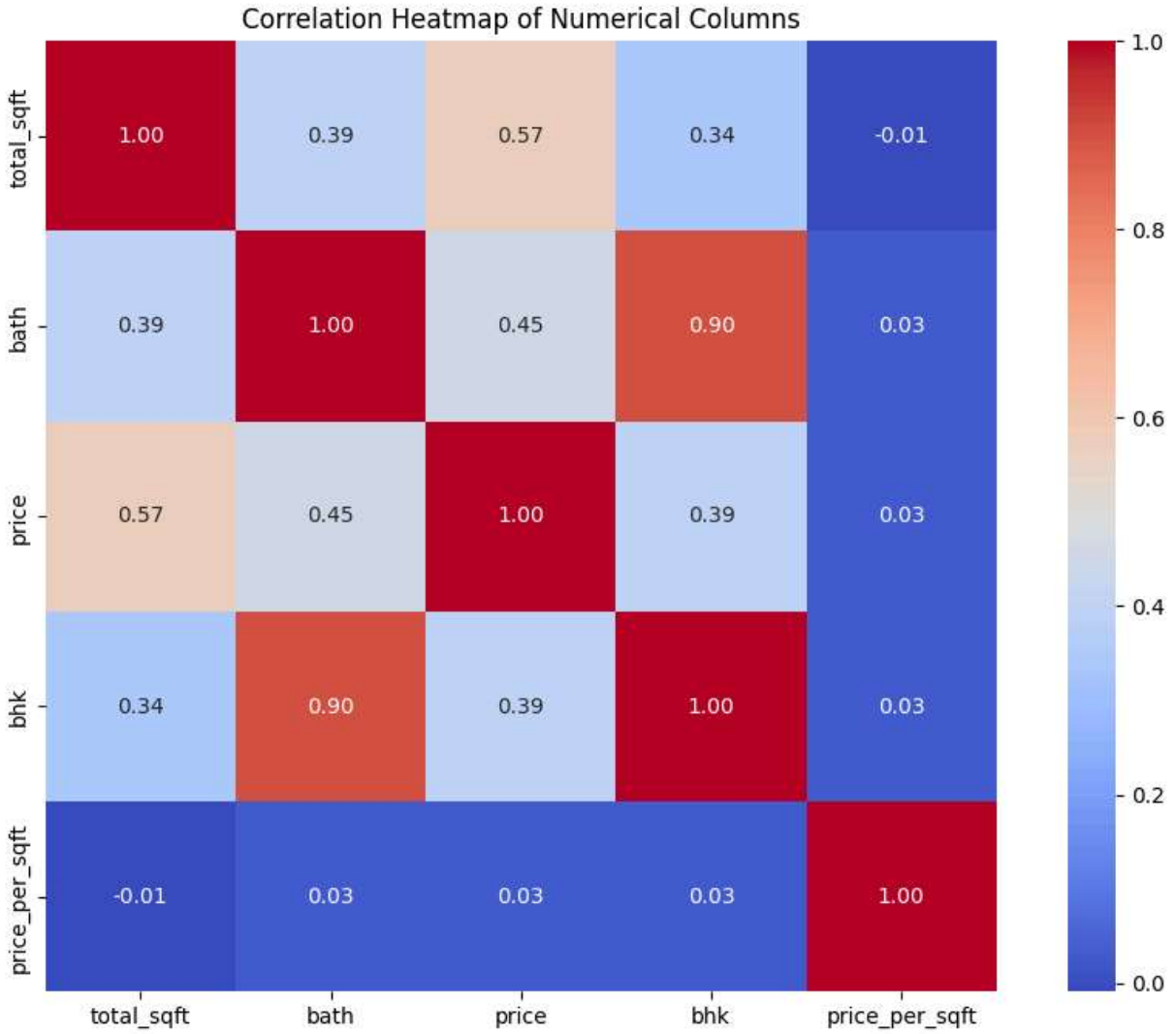
In [38]:
```
# Select numerical columns to create a correlation matrix
num_columns = df2[['total_sqft', 'bath', 'price', 'bhk', 'price_per_sqft']]

# Calculate the correlation matrix
correlation_matrix = num_columns.corr()
correlation_matrix
```

Out[38]:

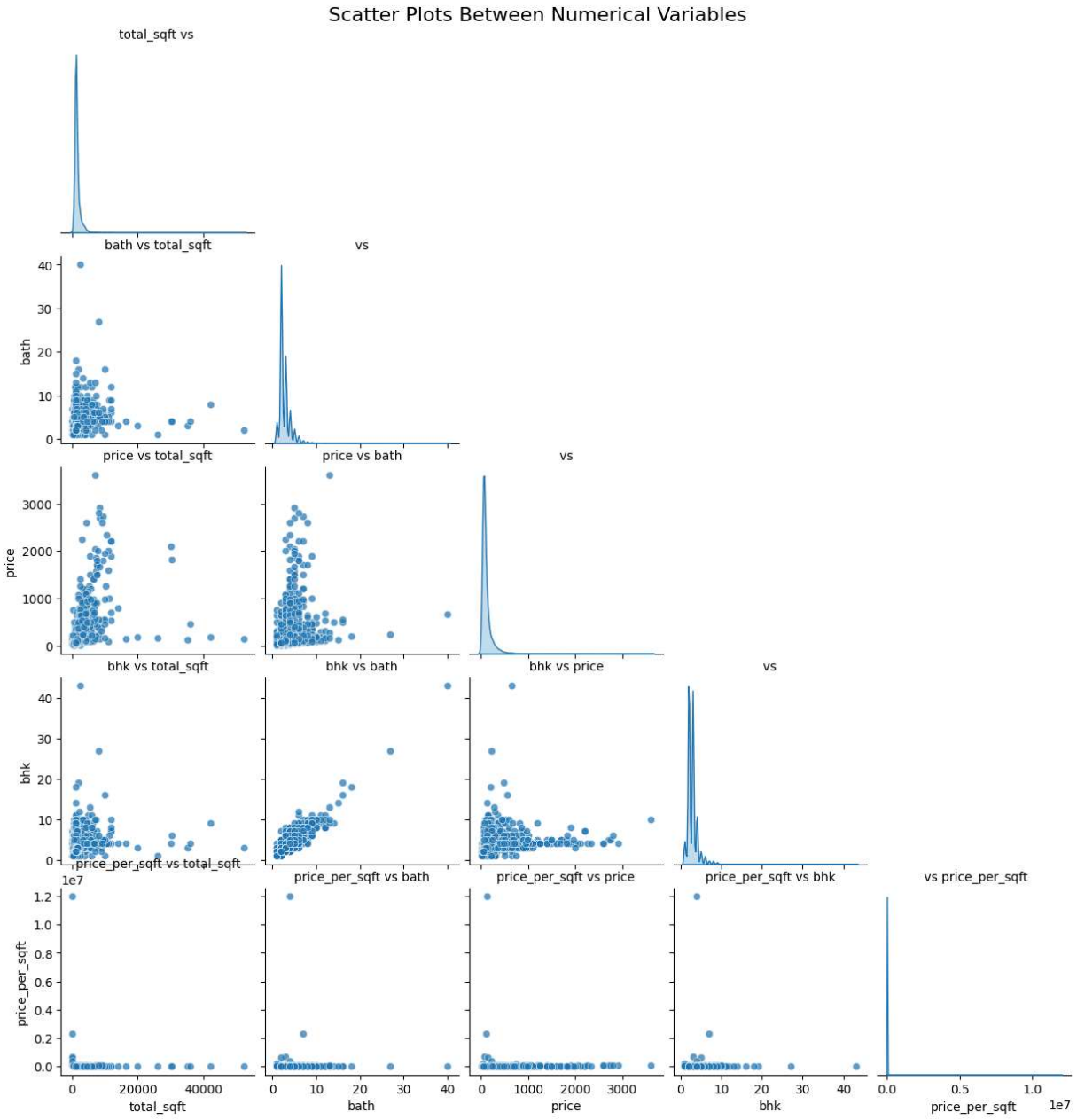
	total_sqft	bath	price	bhk	price_per_sqft
total_sqft	1.000000	0.386694	0.572516	0.339936	-0.008877
bath	0.386694	1.000000	0.448802	0.898875	0.030133
price	0.572516	0.448802	1.000000	0.390008	0.027415
bhk	0.339936	0.898875	0.390008	1.000000	0.030294
price_per_sqft	-0.008877	0.030133	0.027415	0.030294	1.000000

In [39]:
```
# Plot Heatmap for Correlation Matrix
plt.figure(figsize=(12, 8))
sns.heatmap(correlation_matrix, annot=True, fmt=".2f", cmap="coolwarm", cbar=True,
plt.title('Correlation Heatmap of Numerical Columns')
plt.show()
```



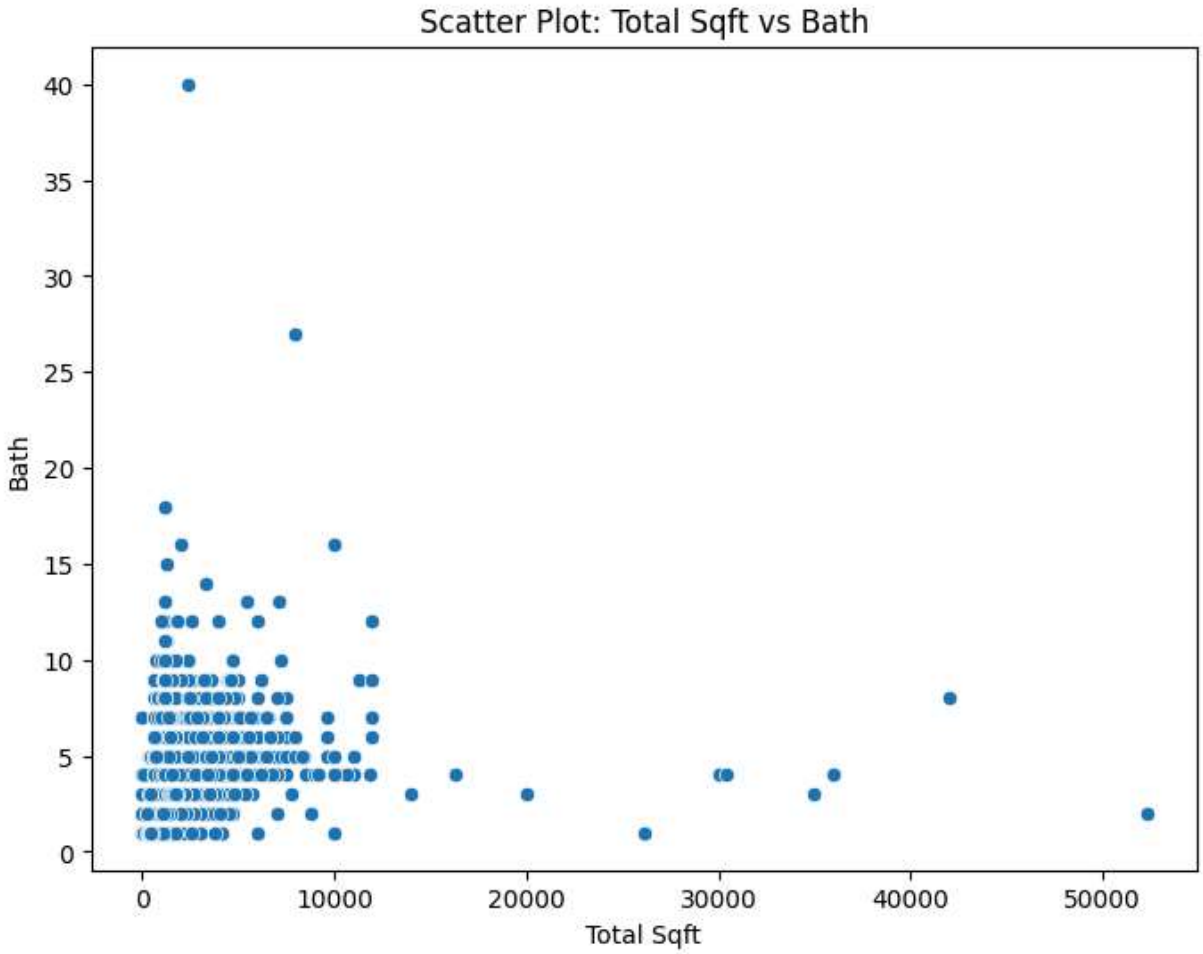
In [40]:
```
# Select numerical columns only
num_columns = df2[['total_sqft', 'bath', 'price', 'bhk', 'price_per_sqft']]

# Pairplot to create scatter plots between each pair of variables
pairplot = sns.pairplot(num_columns, diag_kind='kde', corner=True, plot_kws={'alpha
# Add labels and titles
for ax in pairplot.axes.flat:
    if ax:  # Check if the subplot exists (some may be None due to corner=True)
        ax.set_xlabel(ax.get_xlabel(), fontsize=10)
        ax.set_ylabel(ax.get_ylabel(), fontsize=10)
        ax.set_title(f'{ax.get_ylabel()} vs {ax.get_xlabel()}', fontsize=10, loc='c
plt.suptitle('Scatter Plots Between Numerical Variables', y=1.02, fontsize=16)
plt.show()
```



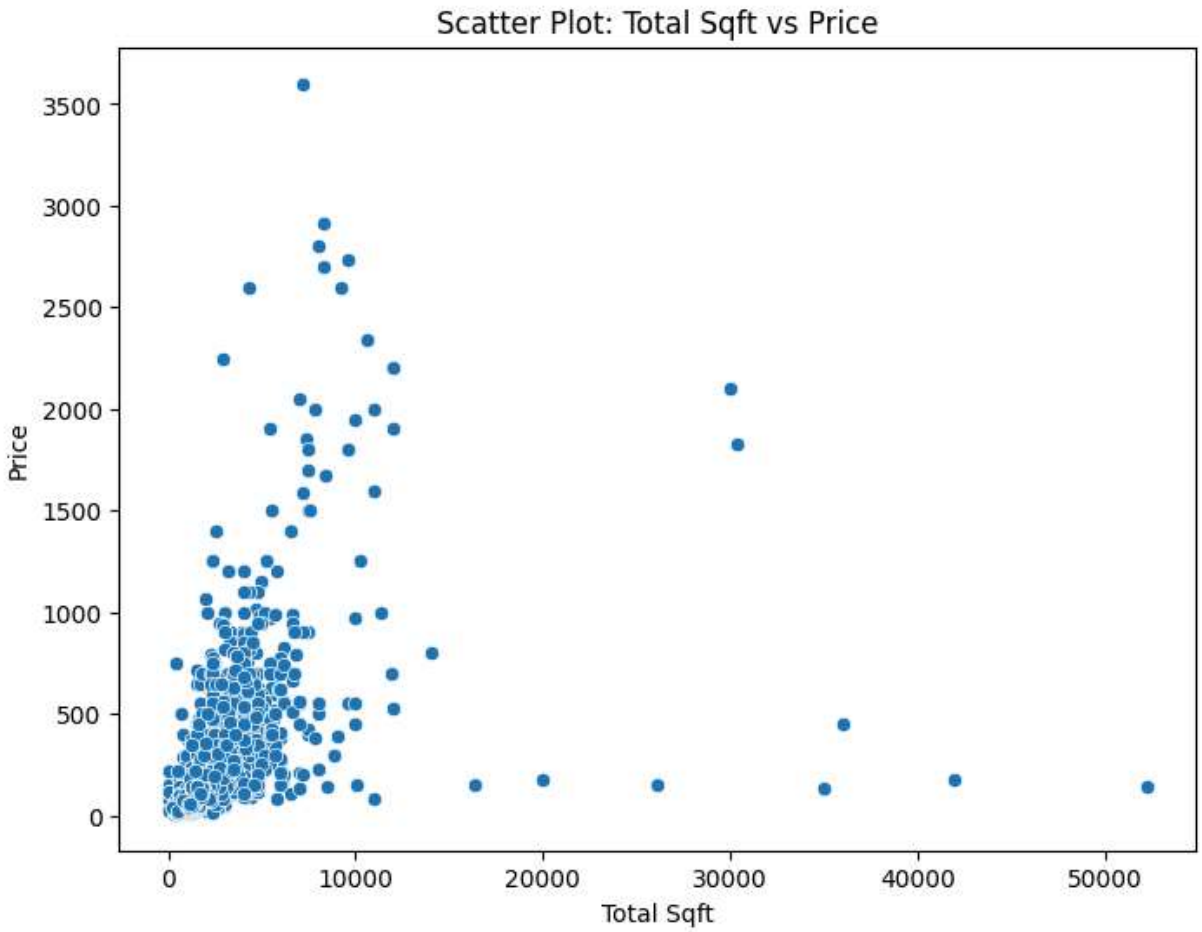
In [ ]:

In [41]:
```
# Total Sqft vs Bath
plt.figure(figsize=(8, 6))
sns.scatterplot(x='total_sqft', y='bath',data=df2)
plt.title('Scatter Plot: Total Sqft vs Bath')
plt.xlabel('Total Sqft')
plt.ylabel('Bath')
plt.show()
```

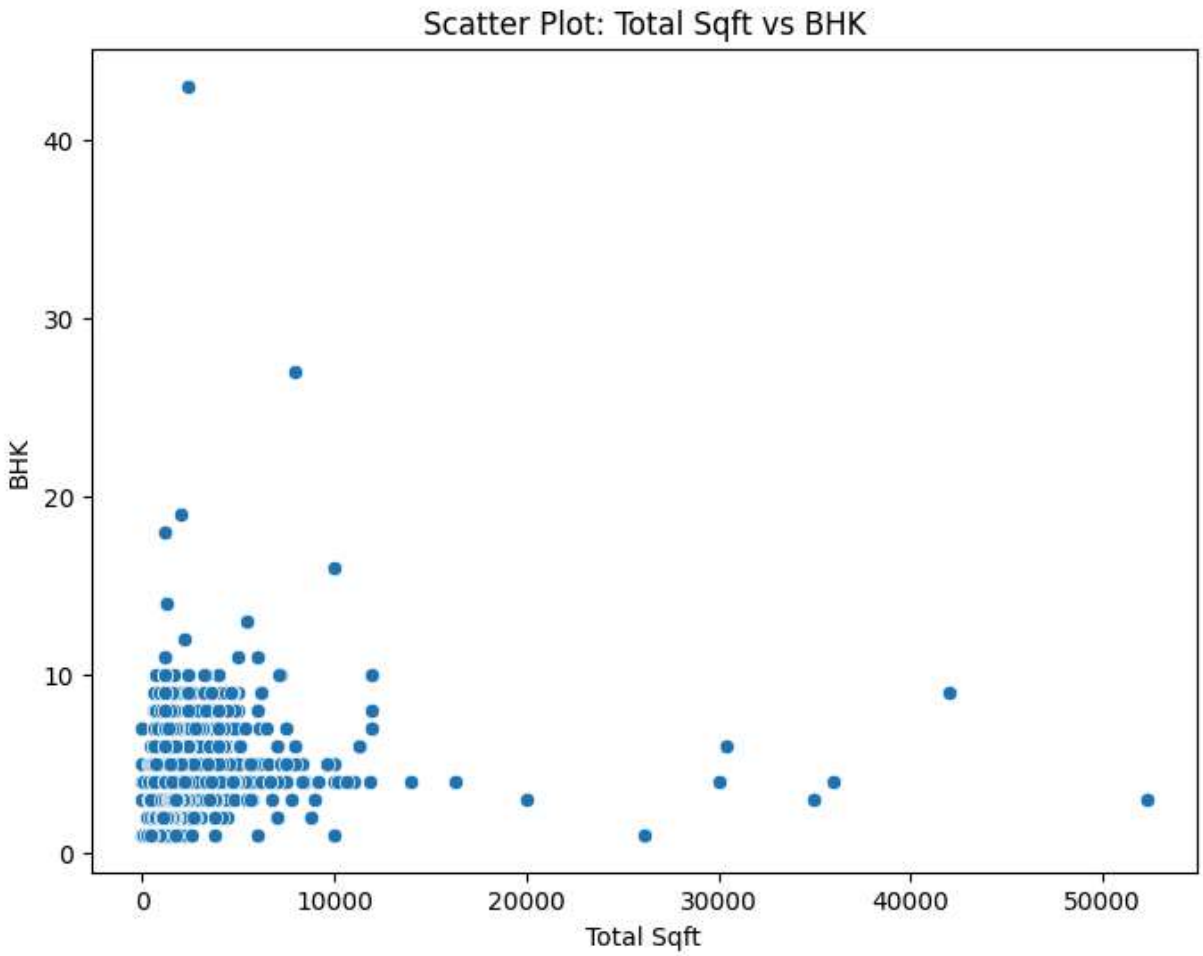


In [ ]:

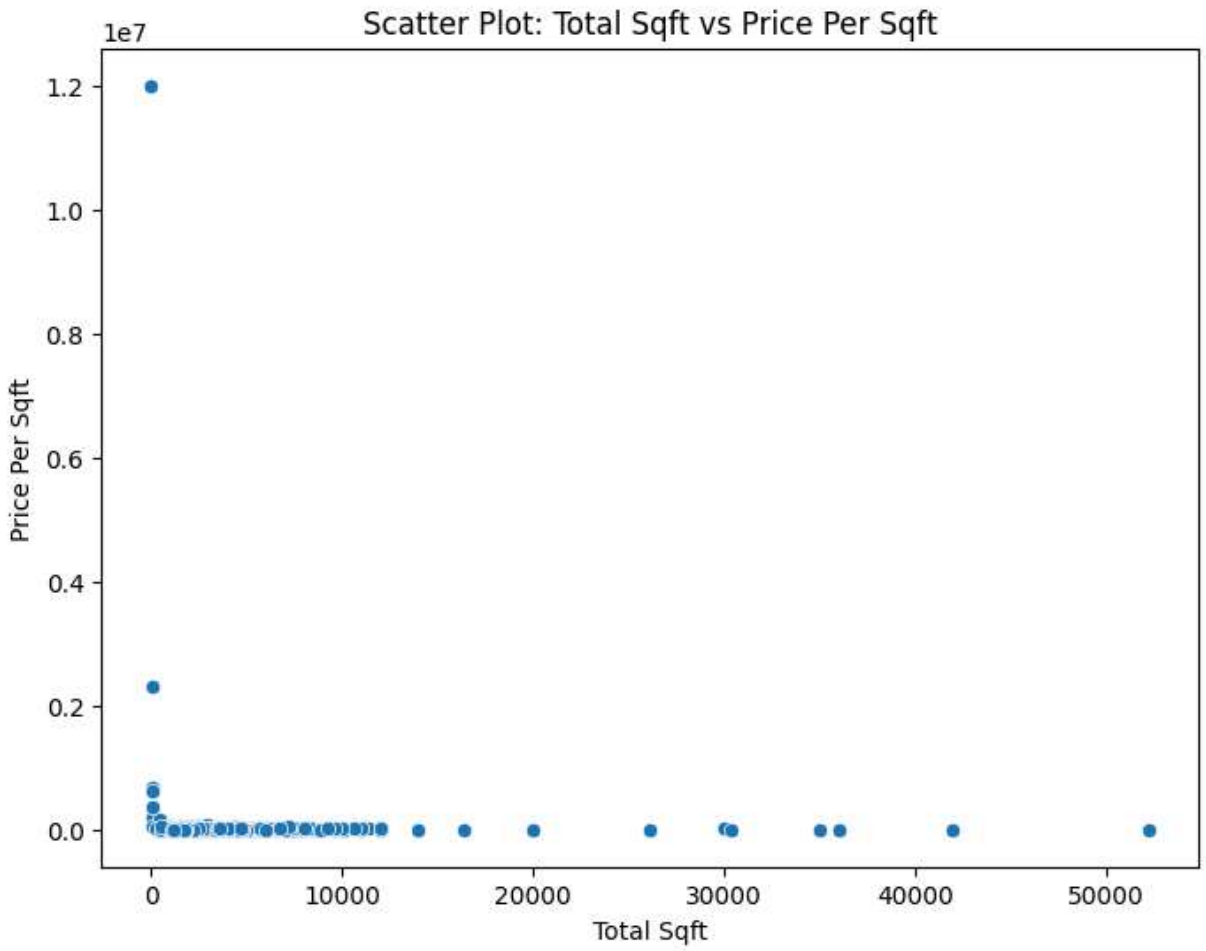
In [42]:
```
# Total_sqft vs Price
plt.figure(figsize=(8, 6))
sns.scatterplot(x='total_sqft', y='price',data=df2)
plt.title('Scatter Plot: Total Sqft vs Price')
plt.xlabel('Total Sqft')
plt.ylabel('Price')
plt.show()
```



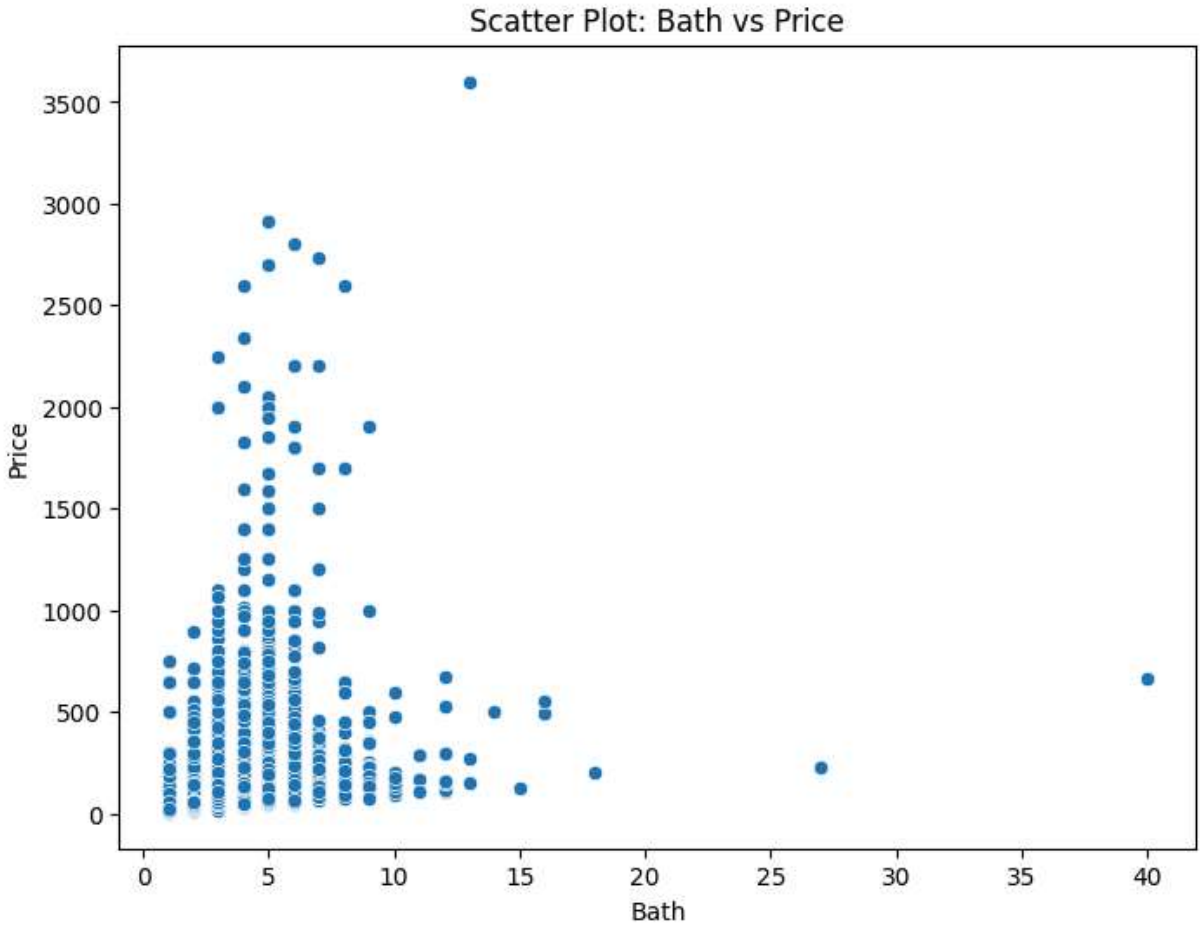
In [43]:
```
# Total_Sqft vs BHK
plt.figure(figsize=(8, 6))
sns.scatterplot(x='total_sqft', y='bhk',data=df2)
plt.title('Scatter Plot: Total Sqft vs BHK')
plt.xlabel('Total Sqft')
plt.ylabel('BHK')
plt.show()
```



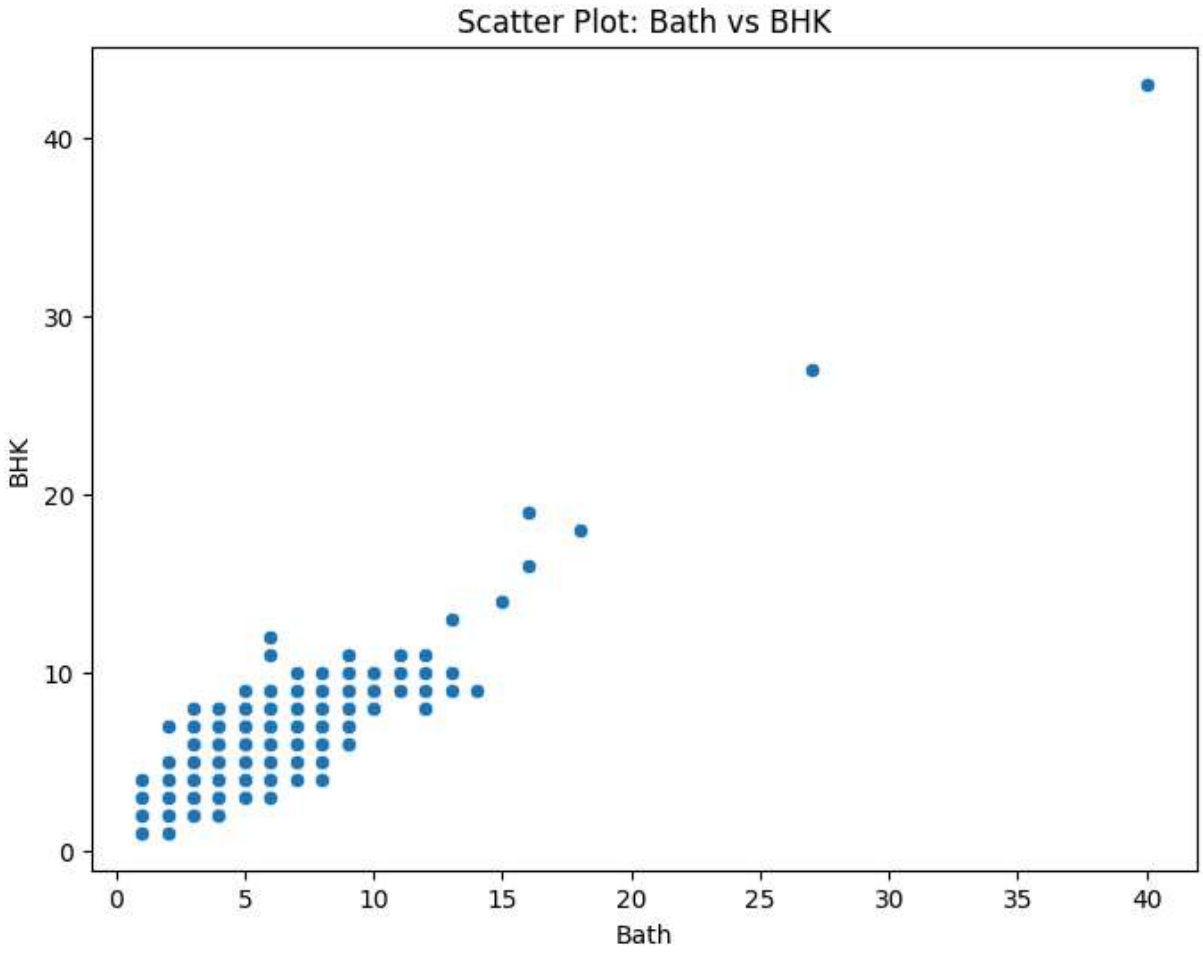
In [44]:
```
# Total_sqft vs Price_per_sqft
plt.figure(figsize=(8, 6))
sns.scatterplot(x='total_sqft', y='price_per_sqft',data=df2)
plt.title('Scatter Plot: Total Sqft vs Price Per Sqft')
plt.xlabel('Total Sqft')
plt.ylabel('Price Per Sqft')
plt.show()
```



In [45]:
```
# Bath vs Price
plt.figure(figsize=(8, 6))
sns.scatterplot(x='bath', y='price',data=df2)
plt.title('Scatter Plot: Bath vs Price')
plt.xlabel('Bath')
plt.ylabel('Price')
plt.show()
```

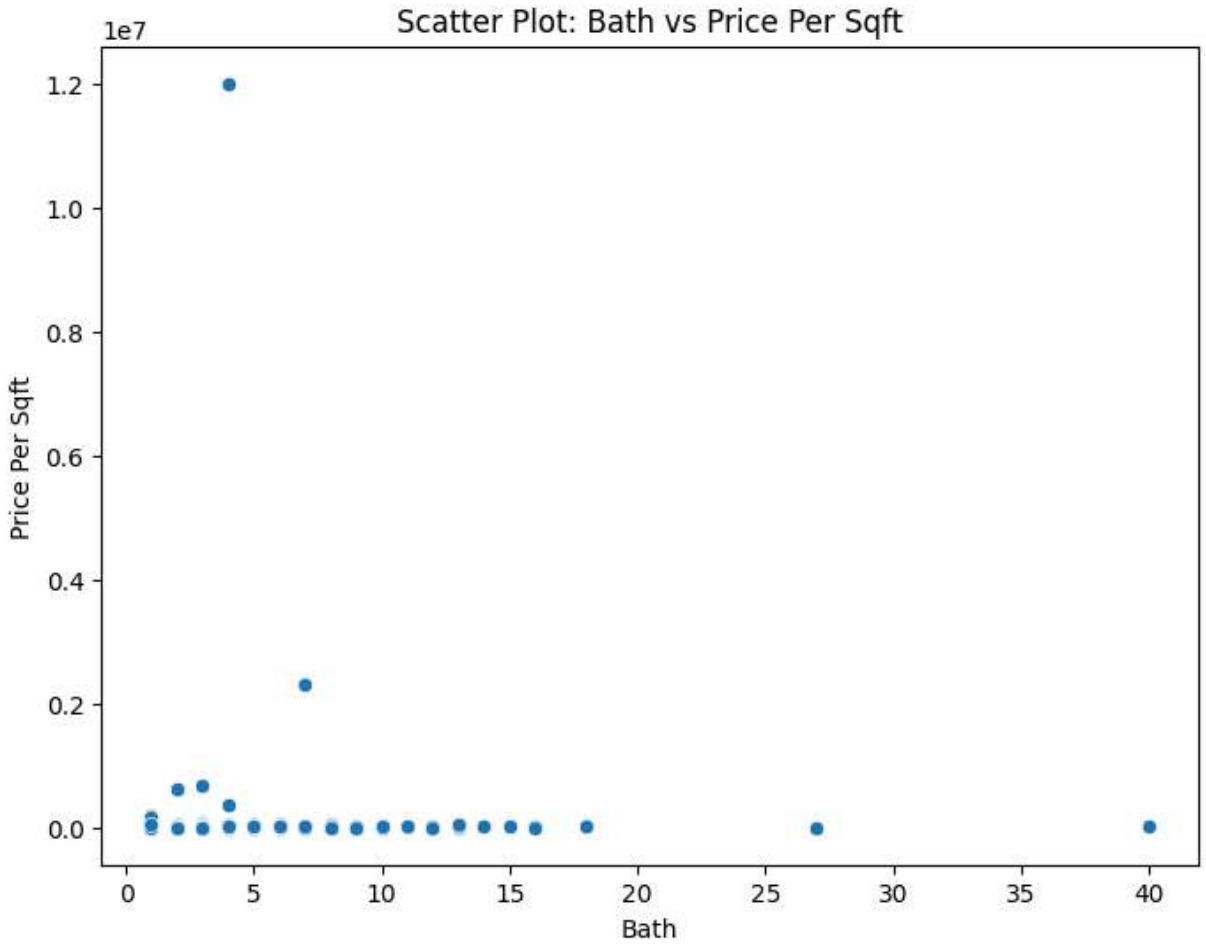


In [46]:
```
# Bath vs BHK
plt.figure(figsize=(8, 6))
sns.scatterplot(x='bath', y='bhk',data=df2)
plt.title('Scatter Plot: Bath vs BHK')
plt.xlabel('Bath')
plt.ylabel('BHK')
plt.show()
```

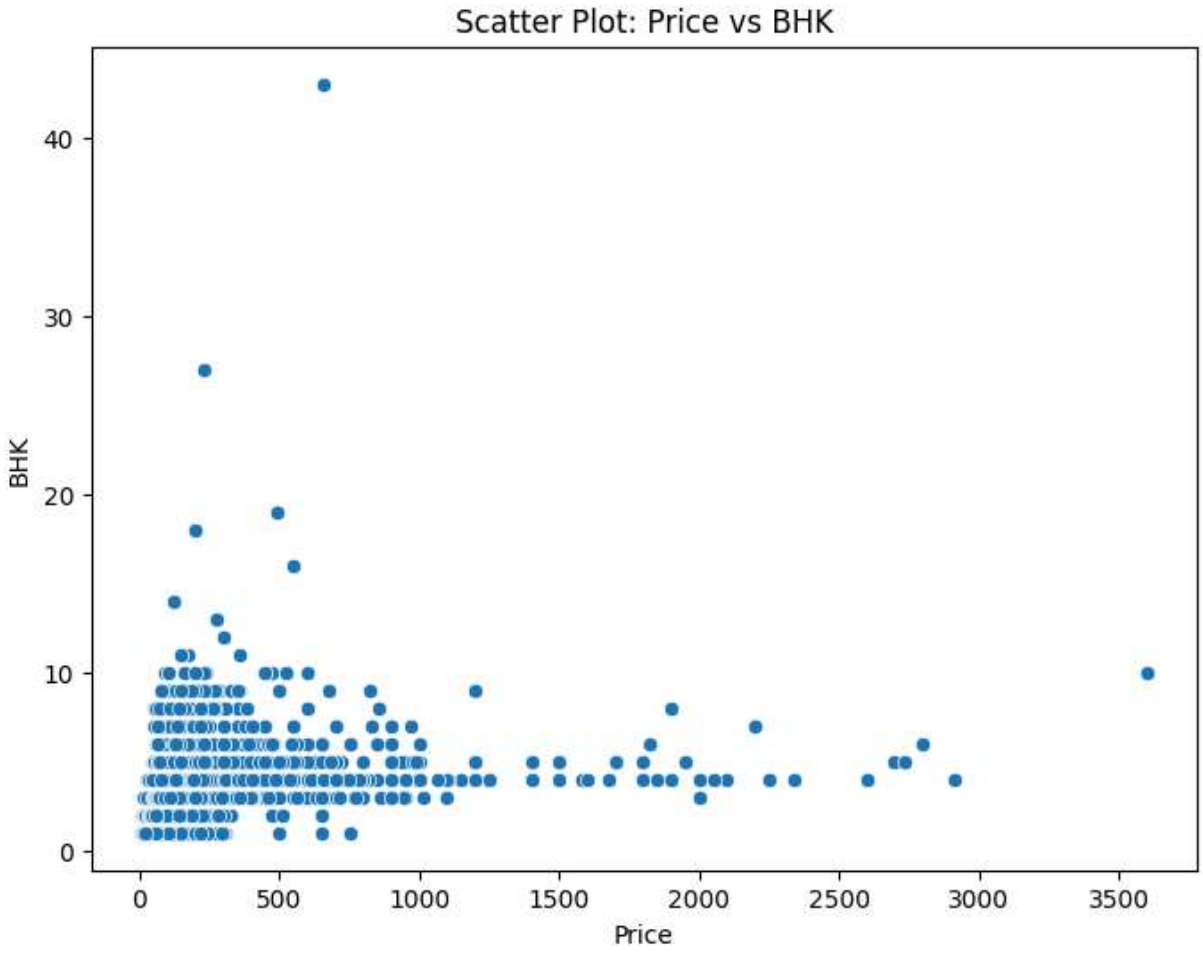


In [ ]:

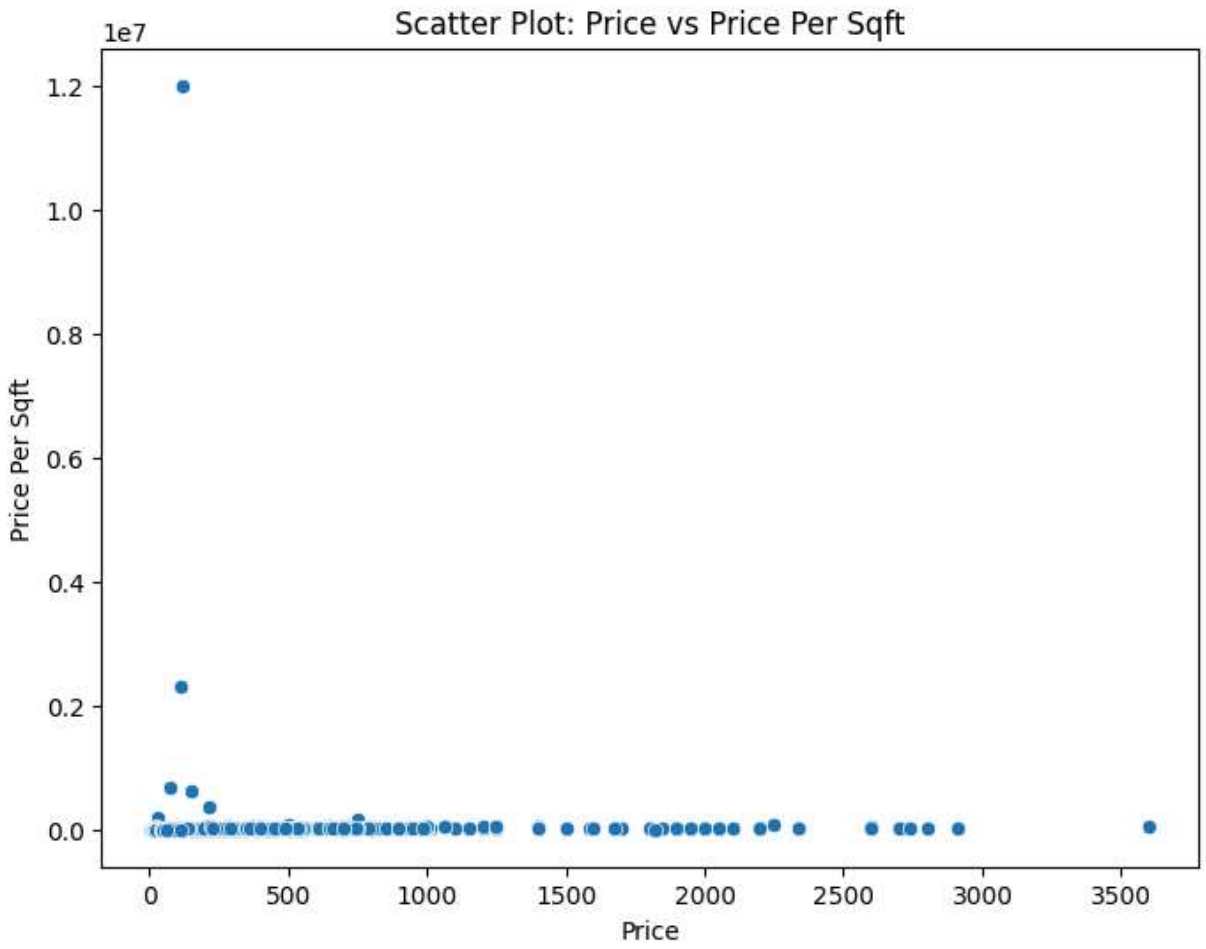
In [47]:
```
# Bath vs Price_per_sqft
plt.figure(figsize=(8, 6))
sns.scatterplot(x='bath', y='price_per_sqft',data=df2)
plt.title('Scatter Plot: Bath vs Price Per Sqft')
plt.xlabel('Bath')
plt.ylabel('Price Per Sqft')
plt.show()
```



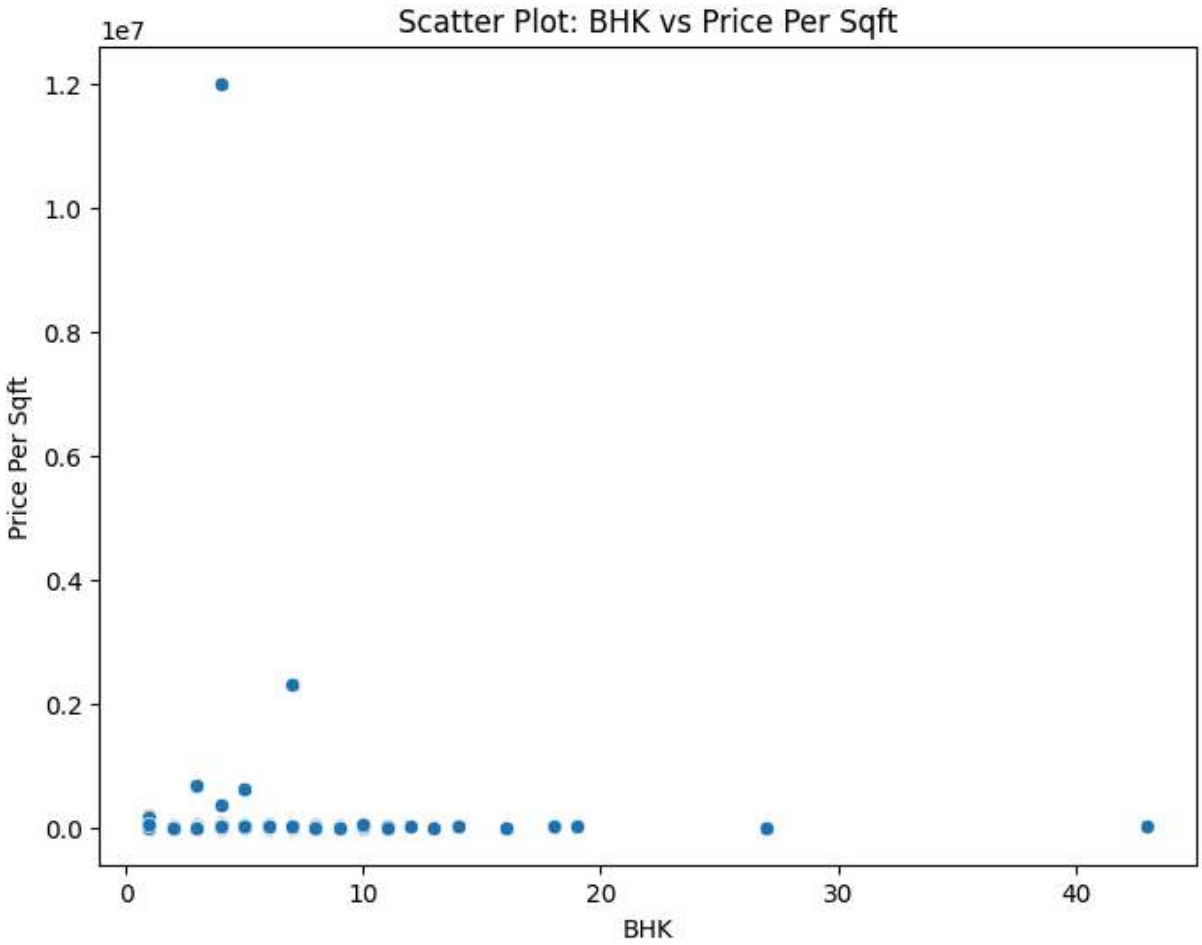
In [48]:
```
# Price vs BHK
plt.figure(figsize=(8, 6))
sns.scatterplot(x='price', y='bhk',data=df2)
plt.title('Scatter Plot: Price vs BHK')
plt.xlabel('Price')
plt.ylabel('BHK')
plt.show()
```



In [49]:
```
# Price vs Price Per Sqft
plt.figure(figsize=(8, 6))
sns.scatterplot(x='price', y='price_per_sqft',data=df2)
plt.title('Scatter Plot: Price vs Price Per Sqft')
plt.xlabel('Price')
plt.ylabel('Price Per Sqft')
plt.show()
```



In [50]:
```
# BHK vs Price_per_sqft
plt.figure(figsize=(8, 6))
sns.scatterplot(x='bhk', y='price_per_sqft',data=df2)
plt.title('Scatter Plot: BHK vs Price Per Sqft')
plt.xlabel('BHK')
plt.ylabel('Price Per Sqft')
plt.show()
```


Scatter Plot: BHK vs Price Per Sqft
1e7
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Price Per Sqft
0
10
20
30
40
BHK