In [397]:

```
import numpy as np
import pandas as pd
```

##Data Description Area_type - Description of the area Availability - When it can be possessed or when it is ready Location - Where it is located in Bengaluru Size - BHK or Bedrooms Society - To which society it belongs Total_sqft - Size of the property in sq.ft Bath - No. of Bathrooms Balcony - No. of the Balcony Price - Value of the property in lakhs (Indian Rupee - ₹)df=pd.read_csv('Bengaluru_House_Data.csv')

In [399]:

```
df.head()
```

Out[399]:

	area_type	availability	location	size	society	total_sqft	bath	balcony	price
0	Super built-up Area	19-Dec	Electronic City Phase II	2 BHK	Coomee	1056	2.0	1.0	39.07
1	Plot Area	Ready To Move	Chikka Tirupathi	4 Bedroom	Theanmp	2600	5.0	3.0	120.00
2	Built-up Area	Ready To Move	Uttarahalli	3 BHK	NaN	1440	2.0	3.0	62.00
3	Super built-up Area	Ready To Move	Lingadheeranahalli	3 BHK	Soiewre	1521	3.0	1.0	95.00
4	Super built-up Area	Ready To Move	Kothanur	2 BHK	NaN	1200	2.0	1.0	51.00

In [400]:

```
df.shape
```

Out[400]:

```
(13320, 9)
```

In [436]:

```
#Exploratory Data Analysis (EDA)
```

In [401]:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13320 entries, 0 to 13319
Data columns (total 9 columns):
 #   Column        Non-Null Count  Dtype  
---  ------        --------------  -----  
 0   area_type     13320 non-null  object 
 1   availability  13320 non-null  object 
 2   location      13319 non-null  object 
 3   size          13304 non-null  object 
 4   society       7818 non-null   object 
 5   total_sqft    13320 non-null  object 
 6   bath          13247 non-null  float64
 7   balcony       12711 non-null  float64
 8   price         13320 non-null  float64
dtypes: float64(3), object(6)
memory usage: 936.7+ KB
```

In [435]:

```
#Check for NULL values
```

In [402]:

```
df.isnull().sum()
```

Out[402]:

Out[402]:

```
area_type          0
availability       0
location           1
size              16
society         5502
total_sqft         0
bath              73
balcony          609
price              0
dtype: int64
```

In [403]:

```
df.isnull().sum()/len(df)*100
```

Out[403]:

```
area_type         0.000000
availability      0.000000
location          0.007508
size              0.120120
society          41.306306
total_sqft        0.000000
bath              0.548048
balcony           4.572072
price             0.000000
dtype: float64
```

In [434]:

```
#Removing NaN Values and Unnecessary Columns
```

In [404]:

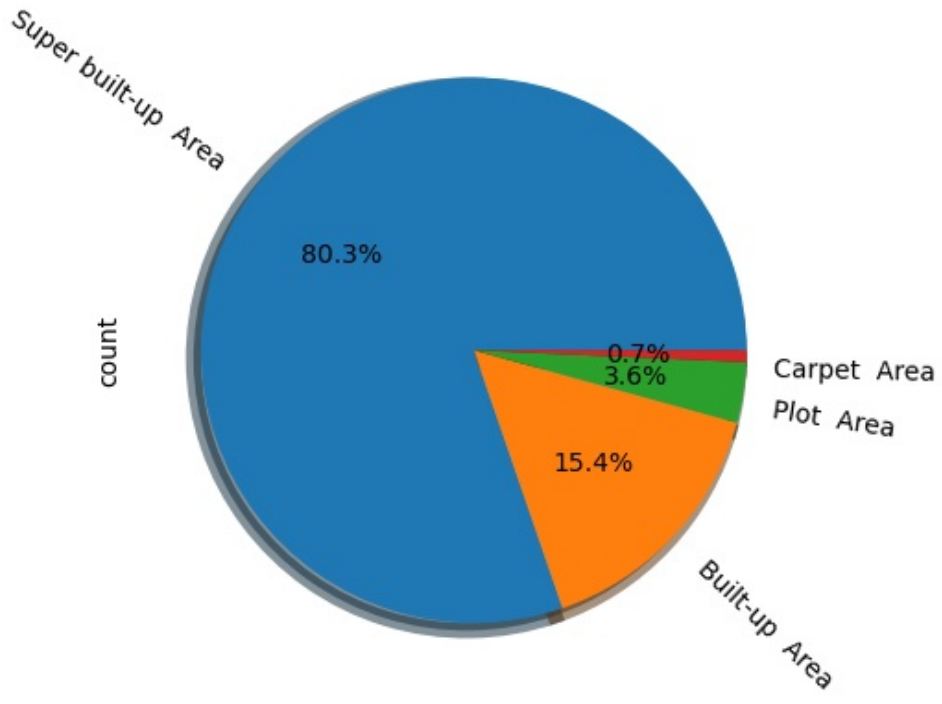
```
df.dropna(inplace =True)
```

In [405]:

```
df = df.drop(columns='society')
```

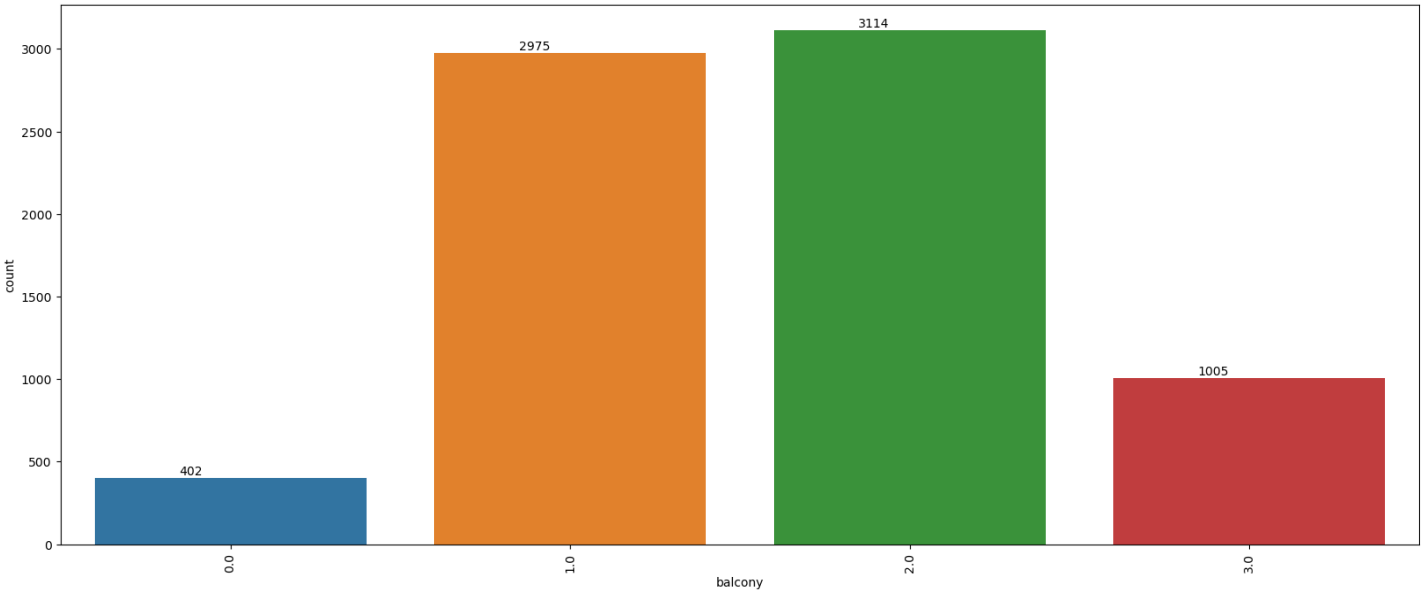
In [406]:

```
import matplotlib.pyplot as plt
(df["area_type"].value_counts()).plot.pie(autopct="%.1f%%", shadow=True,rotatelabels=True, wedgeprops={'linewidth': 6}, radius=1)
plt.show()
```



In [407]:

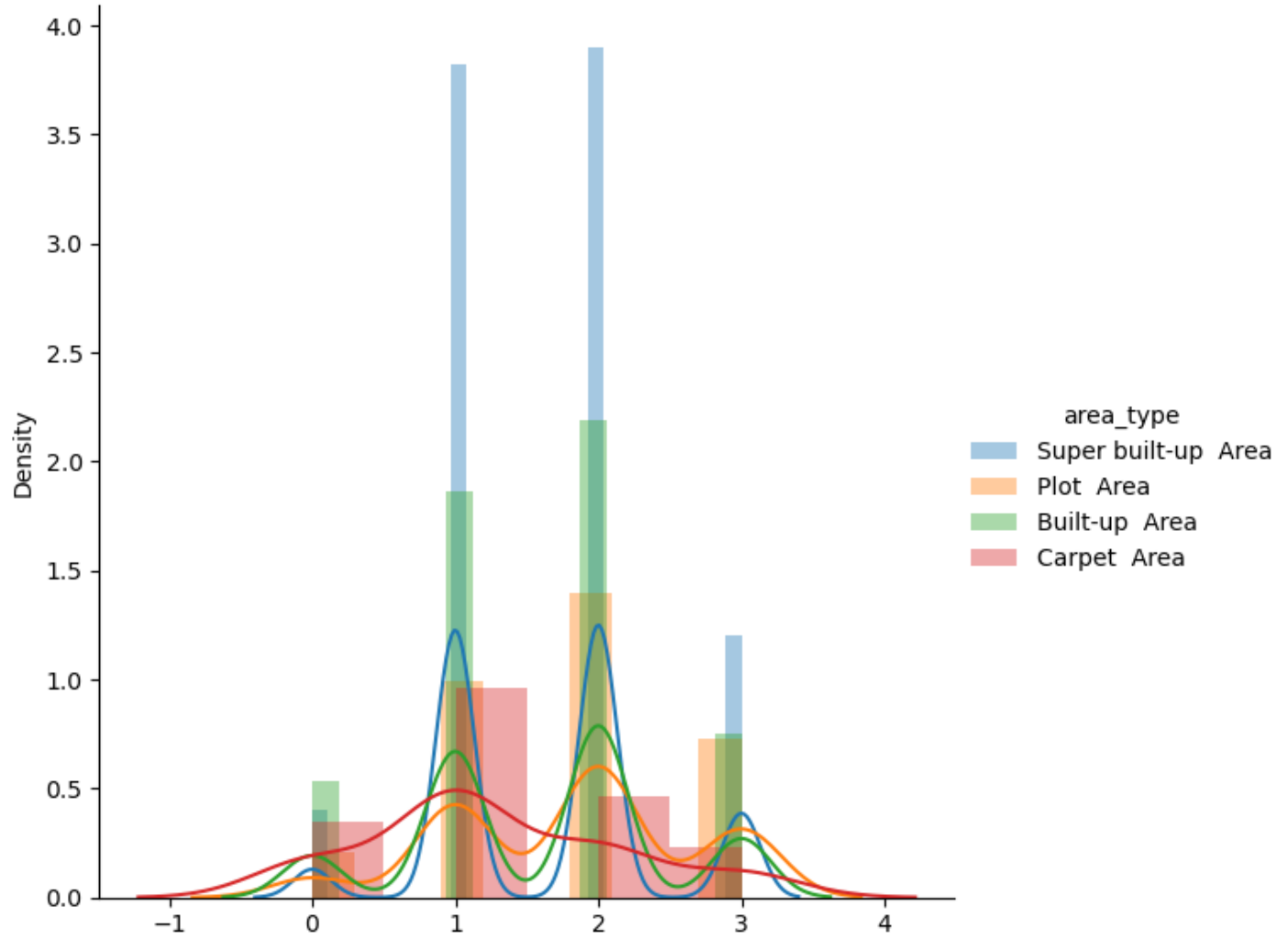
```
plt.figure(figsize = (20,8))
ax=sns.countplot(x = 'balcony', data = df)
plt.xticks(rotation = 90)
for p in ax.patches:
    ax.annotate(int(p.get_height()), (p.get_x()+0.25, p.get_height()+1), va = 'bottom',
color = 'black')
```



In [408]:

```
import warnings
warnings.filterwarnings('ignore')

sns.FacetGrid(df, hue='area_type', height=6).map(sns.distplot, 'balcony').add_legend()
plt.show()
```

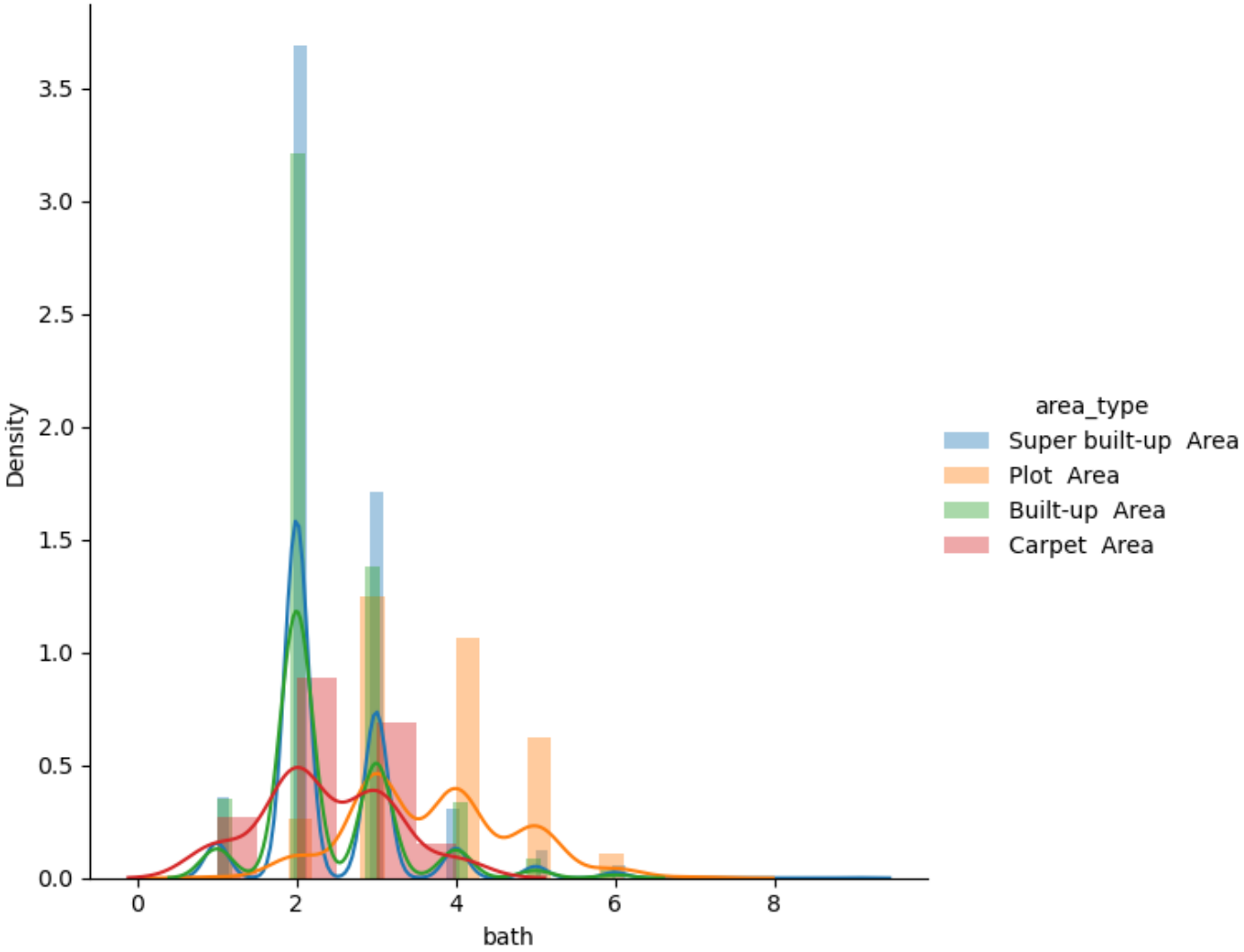


balcony

In [409]:

```
import warnings
warnings.filterwarnings('ignore')

sns.FacetGrid(df, hue='area_type', height=6).map(sns.distplot, 'bath').add_legend()
plt.show()
```



In [433]:

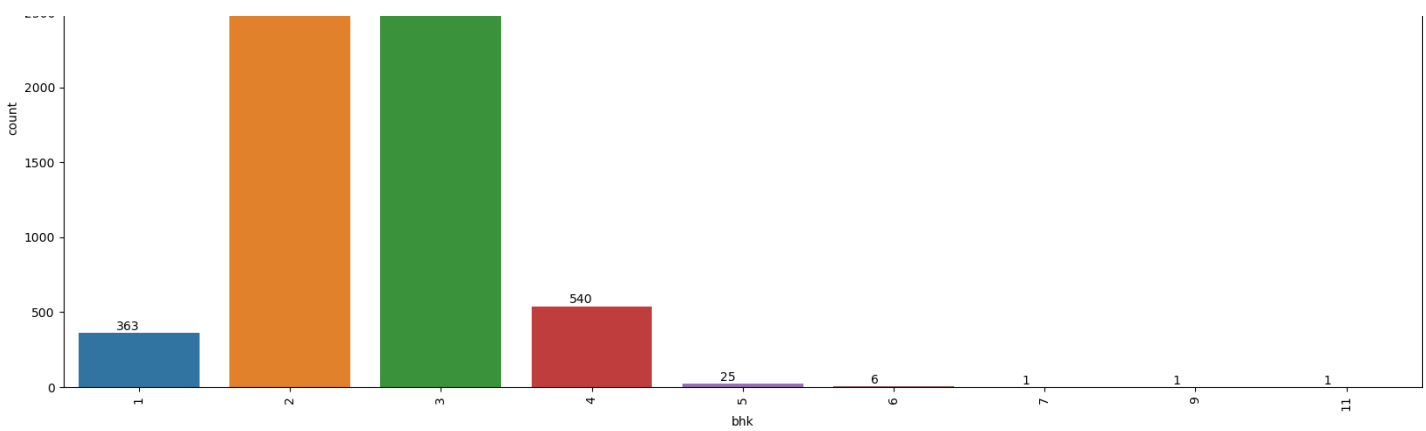
```
#Convert BHK to integer type
```

In [411]:

```
df['bhk'] = df['size'].str.split().str[0]
df['bhk'].dropna(inplace = True)
df['bhk'] = df['bhk'].astype('int')
```

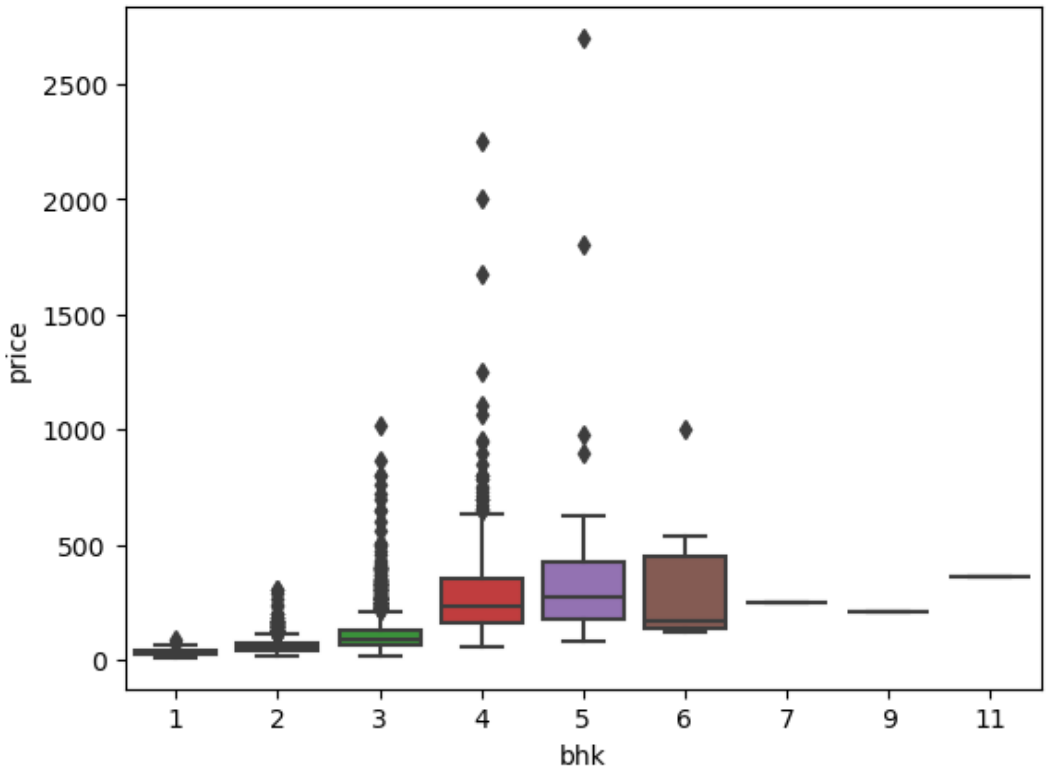
In [412]:

```
plt.figure(figsize = (20,8))
ax=sns.countplot(x = 'bhk', data = df)
plt.xticks(rotation = 90)
for p in ax.patches:
    ax.annotate(int(p.get_height()), (p.get_x()+0.25, p.get_height()+1), va = 'bottom',
color = 'black')
```



In [413]:

```
sns.boxplot(x = 'bhk', y = 'price', data = df)
plt.show()
```



In [414]:

```
print(df['total_sqft'].iloc[[17]])

def convert_sqft_to_num(x):
    tokens = x.split('-')
    if len(tokens) == 2:
        return (float(tokens[0])+float(tokens[1]))/2
    try:
        return float(x)
    except:
        return None
```

```
30    2100 - 2850
Name: total_sqft, dtype: object
```

In [415]:

```
df.total_sqft = df.total_sqft.apply(convert_sqft_to_num)
df = df[df.total_sqft.notnull()]
df.head(2)
```

Out[415]:

	area_type	availability	location	size	total_sqft	bath	balcony	price	bhk

	area_type	availability	location	size	total_sqft	bath	balcony	price	bhk
0	Super built-up Area	19-Dec	Electronic City Phase II	2 BHK	1056.0	2.0	1.0	39.07	2
1	Plot Area	Ready To Move	Chikka Tirupathi	4 Bedroom	2600.0	5.0	3.0	120.00	4

In [432]:

```
#Removing Invalid Data Entries

#Example: The total sqft divided by the number of BHK should always be more than 300
```

In [416]:

```
df = df[~(df.total_sqft/df.bhk<300)]
df.shape
```

Out[416]:

```
(7439, 9)
```

In [431]:

```
#Extract Numerical and Categorical Data
```

In [417]:

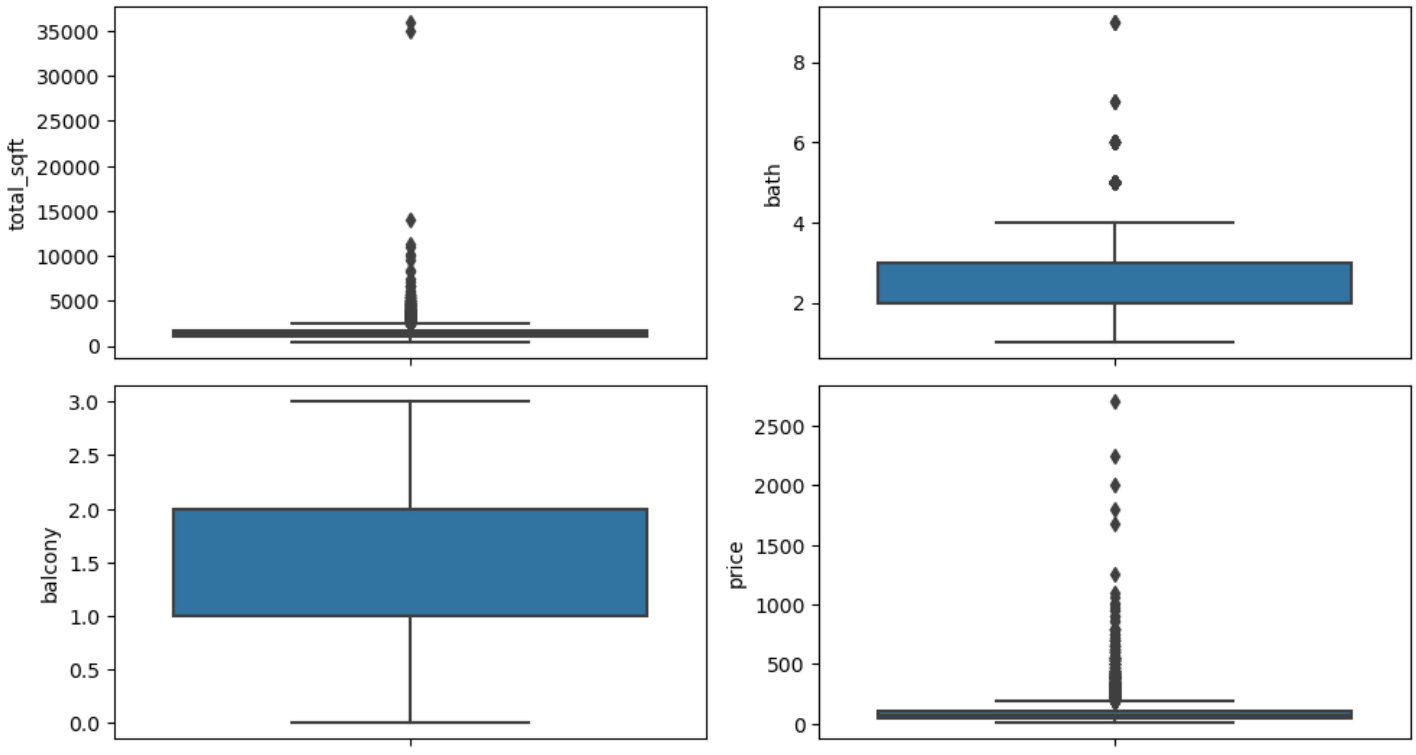
```
numerical = df.select_dtypes(include = 'float64')
categorical = df.select_dtypes(include  = 'object')
```

In [418]:

```
import seaborn as sns
```

In [419]:

```
fig = plt.figure(figsize = (10,8))
for index,col in enumerate(numerical):
    plt.subplot(3,2,index+1)
    sns.boxplot(y = numerical.loc[:,col])
fig.tight_layout(pad = 1.0)
```



In [420]:

```
df = df.drop(df[df['bath']>6].index)
df = df.drop(df[df['bhk']>7.0].index)
```

In [421]:

```
df['price_per_sqft'] = df['price']*100000/df['total_sqft']
df.head()
```

Out[421]:

	area_type	availability	location	size	total_sqft	bath	balcony	price	bhk	price_per_sqft
0	Super built-up Area	19-Dec	Electronic City Phase II	2 BHK	1056.0	2.0	1.0	39.07	2	3699.810606
1	Plot Area	Ready To Move	Chikka Tirupathi	4 Bedroom	2600.0	5.0	3.0	120.00	4	4615.384615
3	Super built-up Area	Ready To Move	Lingadheeranahalli	3 BHK	1521.0	3.0	1.0	95.00	3	6245.890861
5	Super built-up Area	Ready To Move	Whitefield	2 BHK	1170.0	2.0	1.0	38.00	2	3247.863248
11	Plot Area	Ready To Move	Whitefield	4 Bedroom	2785.0	5.0	3.0	295.00	4	10592.459605

In [430]:

```
#Taking Values Within 1st Standard Deviation

#As per Normal Distribution, 95% of our data lies within 1st Standard Deviation
```

In [422]:

```
def remove_pps_outliers(df):
    df_out = pd.DataFrame()
    for key, subdf in df.groupby('location'):
        mean = np.mean(subdf.price_per_sqft)
        sd = np.std(subdf.price_per_sqft)
        reduced_df = subdf[(subdf.price_per_sqft>(mean-sd)) & (subdf.price_per_sqft<=(me
an+sd))]
        df_out = pd.concat([df_out,reduced_df],ignore_index=True)
    return df_out
df = remove_pps_outliers(df)
df.shape
```

Out[422]:

```
(5360, 10)
```

In [429]:

```
#Finding Correlation Values

#Removing features highly correlated with each other as they do not provide additional si
gnificance to the model
```

In [423]:

```
import plotly.graph_objects as go
```

In [424]:

```
corr = df.corr(numeric_only=True)
mask = corr < 0.8
corr_masked = corr.copy()
corr_masked[mask] = np.nan

fig = go.Figure(data=go.Heatmap(
    z=corr_masked.values,
    x=corr_masked.columns,
    y=corr_masked.columns,
    colorscale='Blues',
    zmin=-1, zmax=1,
```

```
    colorbar=dict(title='Correlation'),
    showscale=True
))

fig.update_layout(
    title='Correlation Heatmap',
    xaxis_title='Features',
    yaxis_title='Features',
    xaxis=dict(tickvals=list(corr_masked.columns), ticktext=list(corr_masked.columns)),
    yaxis=dict(tickvals=list(corr_masked.columns), ticktext=list(corr_masked.columns)),
    height=1000,
    width=1000,
    margin=dict(l=50, r=50, t=50, b=50)
)

fig.show()
```

In [425]:

```
df.drop(columns=['availability','size','area_type'],inplace = True)
```

In [428]:

```
#Checking Dataset with Highest Location Data

#Because having values for a location less than 10 won't provide significant information
for the dataset
```

In [426]:

```
df.location = df.location.str.strip()
location_counts = df['location'].value_counts(ascending=False)
location_counts
```

Out[426]:

```
location
Whitefield          357
Sarjapur  Road      237
Electronic City     217
Kanakpura Road      157
Yelahanka           141
                   ...
Mylasandra            1
Sanne Amanikere       1
Chikka Banaswadi      1
Ferrar Nagar          1
Kammagondahalli       1
Name: count, Length: 428, dtype: int64
```

In [427]:

```
#Creating a Series of Locations with Fewer Than 10 Entries
#Identifying locations with less than 10 entries to assess their impact on the dataset
```

In [308]:

```
location_counts_less_10 = location_counts[location_counts<=10]
location_counts_less_10
```

Out[308]:

```
location
Munnekollal         10
Neeladri Nagar      10
Gubbalala           10
Kannamangala        10
Anandapura          10
                    ..
Mylasandra           1
Sanne Amanikere      1
Chikka Banaswadi     1
Ferrar Nagar         1
Kammagondahalli      1
Name: count, Length: 317, dtype: int64
```

In [310]:

```
df.location = df.location.apply(lambda x: 'Other' if x in location_counts_less_10 else x
)

df = df[df.location != 'Other']
```

In [439]:

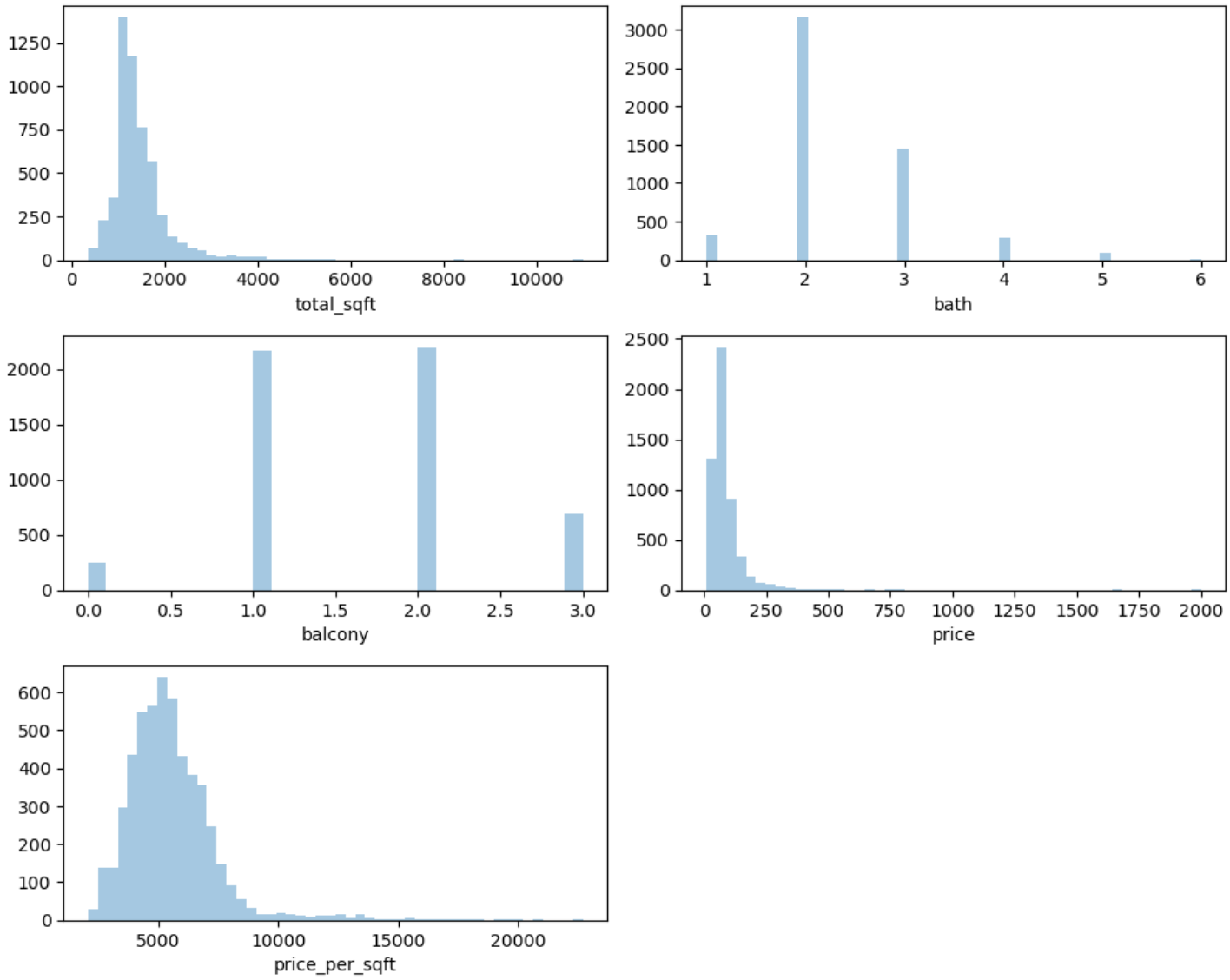
```
#Checking for bathrooms <= bhk+2
```

In [440]:

```
df = df[df.bath<df.bhk+2]
```

In [441]:

```
numerical = df.select_dtypes(include = 'float64')
fig = plt.figure(figsize =(10,8))
for index, col in enumerate(numerical):
    plt.subplot(3,2,index+1)
    sns.distplot(numerical.loc[:,col],kde = False)
fig.tight_layout(pad = 1.0)
```



In [442]:

```
#Encoding the categorial variables
```

In [313]:

```
dummies = pd.get_dummies(df.location)
```

In [314]:

```
df = pd.concat([df,dummies],axis='columns')

df1 = df.drop('location',axis = 1)

df1 = df1.drop(columns=['balcony','price_per_sqft'])
```

In [315]:

```
df1.reset_index(drop = True)
```

Out[315]:

	total_sqft	bath	price	bhk	7th Phase JP Nagar	8th Phase JP Nagar	9th Phase JP Nagar	Abbigere	Akshaya Nagar	Ambalipura	...	Thubarahalli	Tumkur Road	Uttarahal
0	550.0	1.0	27.00	1	False	False	False	False	False	False	...	False	False	Fals
1	440.0	1.0	28.00	1	False	False	False	False	False	False	...	False	False	Fals
2	510.0	1.0	25.25	1	False	False	False	False	False	False	...	False	False	Fals
3	510.0	1.0	25.25	1	False	False	False	False	False	False	...	False	False	Fals
4	1080.0	2.0	72.00	2	True	False	False	False	False	False	...	False	False	Fals
...	...	...	...	...	...	...	...	...	...	...	...	...	...	
4280	1169.0	2.0	64.08	2	False	False	False	False	False	False	...	False	False	Fals
4281	2500.0	3.0	138.00	3	False	False	False	False	False	False	...	False	False	Fals
4282	1160.0	2.0	64.08	2	False	False	False	False	False	False	...	False	False	Fals
4283	2503.0	3.0	138.00	3	False	False	False	False	False	False	...	False	False	Fals
4284	1855.0	3.0	135.00	3	False	False	False	False	False	False	...	False	False	Fals

4285 rows × 115 columns

In [443]:

```
#Separate the price column
```

In [316]:

```
X = df1.drop('price',axis = 1).values
y = df1.price.values
```

In [317]:

```
y = y[:,np.newaxis]
```

In [444]:

```
#Scale the numerical features
```

In [346]:

```
from sklearn import preprocessing
```

In [361]:

```
Scaler=preprocessing.StandardScaler()
X1 = Scaler.fit_transform(X)
```

In [445]:

```
#Model Training
```

In [362]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X1,y,test_size=0.3,random_state=10)
```

In [446]:

```
#Linear Regression Model, Decision Tree Regression, Random Forest Regressor, Gradient Boo
sting Regression
```

In [363]:

```
from sklearn.linear_model import LinearRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.ensemble import RandomForestRegressor, GradientBoostingRegressor
from sklearn.metrics import mean_absolute_error, root_mean_squared_error, r2_score
```

In [364]:

```
models = [
    LinearRegression(),
    DecisionTreeRegressor(),
    RandomForestRegressor(),
    GradientBoostingRegressor(),
]
```

In [382]:

```
model_names = []
mae_Accuracy=[]
rmse_Accuracy=[]
r2_Accuracy=[]

for model in models:
    model.fit(X_train,y_train)
    y_pred = model.predict(X_test)
    mae = mean_absolute_error(y_test,y_pred)
    rmse = root_mean_squared_error(y_test,y_pred)
    r2 = r2_score(y_test, y_pred)
    model_names.append(model.__class__.__name__)
    mae_Accuracy.append(mae)
    rmse_Accuracy.append(rmse)
    r2_Accuracy.append(r2)
```

In [383]:

```
model_df = pd.DataFrame({
    'Model': model_names,
    'mae_Accuracy': mae_Accuracy,
    'rmse_Accuracy': rmse_Accuracy,
    'r2_Accuracy': r2_Accuracy,
        })
```

In [384]:

```
model_df.sort_values(by='r2_Accuracy',ascending=False)
```

Out[384]:

	Model	mae_Accuracy	rmse_Accuracy	r2_Accuracy
0	LinearRegression	10.070871	14.958011	0.912366
2	RandomForestRegressor	9.176727	15.302816	0.908279
3	GradientBoostingRegressor	11.589150	15.837619	0.901756
1	DecisionTreeRegressor	10.359237	18.049088	0.872404

In [447]:

```
#Choose the best model and save as a pickle file
```

In [448]:

```
import pickle
```

In [449]:

```
with open ('house_price_predictor_model.pickle' , 'wb') as f:
    pickle.dump(LinearRegression() ,f)
```

In [ ]:

```
```