In [1]:
```
import os
os.environ['AWS_ACCESS_KEY_ID'] = "*******"
os.environ['AWS_SECRET_ACCESS_KEY'] = "*******"
```

In [2]:
```
from pyspark.sql import SparkSession
import os
import pandas as pd
from sklearn.preprocessing import MinMaxScaler


spark = (SparkSession.builder
             .appName("quant-etl")
             .master("local[*]")
             .config("spark.driver.memory", "10g")
             .config("spark.sql.execution.arrow.pyspark.enabled", "true")
             .config("spark.databricks.delta.schema.autoMerge.enabled", "tru
             .config("spark.sql.debug.maxToStringFields", 1000)
             .config(
                    "spark.jars.packages",
                    "io.delta:delta-core_2.12:2.4.0,"
                    "org.apache.hadoop:hadoop-aws:3.3.4,"
                    "com.amazonaws:aws-java-sdk-bundle:1.12.670"
                )
             .config("spark.sql.extensions", "io.delta.sql.DeltaSparkSessionr
             .config("spark.sql.catalog.spark_catalog", "org.apache.spark.so
             .config("spark.hadoop.fs.s3a.access.key", os.getenv("AWS_ACCESS
             .config("spark.hadoop.fs.s3a.secret.key", os.getenv("AWS_SECRET
             .config("spark.hadoop.fs.s3a.endpoint", "s3.amazonaws.com")
             .config("spark.sql.warehouse.dir", "s3a://quantdata-warehouse")
             .getOrCreate())
```

```
24/03/04 21:20:55 WARN Utils: Your hostname, Mohammads-MacBook-Pro.local re
solves to a loopback address: 127.0.0.1; using 192.168.1.102 instead (on in
terface en0)
24/03/04 21:20:55 WARN Utils: Set SPARK_LOCAL_IP if you need to bind to ano
ther address
:: loading settings :: url = jar:file:/Users/mohammadshbaita/miniforge3/li
b/python3.9/site-packages/pyspark/jars/ivy-2.5.1.jar!/org/apache/ivy/core/s
ettings/ivysettings.xml
```

```
Ivy Default Cache set to: /Users/mohammadshbaita/.ivy2/cache
The jars for the packages stored in: /Users/mohammadshbaita/.ivy2/jars
io.delta#delta-core_2.12 added as a dependency
org.apache.hadoop#hadoop-aws added as a dependency
com.amazonaws#aws-java-sdk-bundle added as a dependency
:: resolving dependencies :: org.apache.spark#spark-submit-parent-0d2e933f-
82ae-44bc-ab93-f1a90ca08607;1.0
        confs: [default]
        found io.delta#delta-core_2.12;2.4.0 in central
        found io.delta#delta-storage;2.4.0 in central
        found org.antlr#antlr4-runtime;4.9.3 in central
        found org.apache.hadoop#hadoop-aws;3.3.4 in central
        found org.wildfly.openssl#wildfly-openssl;1.0.7.Final in central
        found com.amazonaws#aws-java-sdk-bundle;1.12.670 in central
:: resolution report :: resolve 536ms :: artifacts dl 14ms
        :: modules in use:
        com.amazonaws#aws-java-sdk-bundle;1.12.670 from central in [defaul
t]
        io.delta#delta-core_2.12;2.4.0 from central in [default]
        io.delta#delta-storage;2.4.0 from central in [default]
        org.antlr#antlr4-runtime;4.9.3 from central in [default]
        org.apache.hadoop#hadoop-aws;3.3.4 from central in [default]
        org.wildfly.openssl#wildfly-openssl;1.0.7.Final from central in [de
fault]
        :: evicted modules:
        com.amazonaws#aws-java-sdk-bundle;1.12.262 by [com.amazonaws#aws-ja
va-sdk-bundle;1.12.670] in [default]
        ---------------------------------------------------------------------
--
        |                  |            modules            ||   artifacts
|
        |       conf       | number| search|dwnlded|evicted|| number|dwnlde
d|
        ---------------------------------------------------------------------
--
        |      default     |   7   |   0   |   0   |   1   ||   6   |   0
|
        ---------------------------------------------------------------------
--
:: retrieving :: org.apache.spark#spark-submit-parent-0d2e933f-82ae-44bc-ab
93-f1a90ca08607
        confs: [default]
        0 artifacts copied, 6 already retrieved (0kB/10ms)
24/03/04 21:20:56 WARN NativeCodeLoader: Unable to load native-hadoop libra
ry for your platform... using builtin-java classes where applicable
Setting default log level to "WARN".
To adjust logging level use sc.setLogLevel(newLevel). For SparkR, use setLo
gLevel(newLevel).
```

Load the three tables from our warehouse (ad_details, district, property_type)

In [31]:
```
ad_table = spark.read.format("delta").load(f"s3a://quantdata-warehouse/ad_de
district_table = spark.read.format("delta").load(f"s3a://quantdata-warehouse
property_type_table = spark.read.format("delta").load(f"s3a://quantdata-ware
```

Part Two

1.Calculate the average rate increase in rent prices when switching from a 2-Bedroom Apartment to a 3-bedroom Apartment in Riyadh for both families and singles.

2.Calculate the average duration it takes to close a post and mention the parameters that affect this duration. Also, mention the district with the shortest duration it takes to close a post with property type of villa.

3.Provide the correlation matrix for the effects on prices after normalization for both rents and sales, and comment on the most price affecting parameters.

4.Give a sales price valuation of rental properties (convert rental properties to sales properties) based on 6% ROI (Return on Investment) then estimate the meter price distribution per property type and district and comment on the result.

5.Add any general insights you find during your work on the data

Data Preprocessing

Hot Encoders

In [34]:
```
def encode_swimming_pool(value):
    if value == 'مسبح':
        return 1
    else:
        return 0

def encode_is_closed(value):
    if value=='مغلق':
        return 0
    else:
        return 1
def encode_is_commercial(value):
     if value == 'تجاري':
        return 0
     elif value == 'سكني':
        return 1
     elif value == 'كلاهما':
        return 2
     else:
        return 3

def encode_is_driver_room_exist(value):
```

```
     if value == 'غرفة سائق':
        return 1
     else:
        return 0

def encode_is_duplex(value):
    if value == 'دوبلكس':
        return 1
    else:
        return 0

def encode_is_couple(value):
    if value == 'عزاب':
        return 0
    else:
        return 1

def encode_is_furnished(value):
    if value == 'مؤثثة':
        return 1
    else:
        return 0

def encode_is_maid_room_exist(value):

     if value == 'غرفة خادمة':
        return 1
     else:
        return 0

def encode_is_owner(value):
     if value == 'مالك':
        return 1
     else:
        return 0

def encode_is_rent_type(value):
     if value == 'سنوي':
        return 0
     elif value == 'يومي':
        return 1
     elif value == 'شهري':
        return 2
     else:
        return 3

def encode_is_street_direction(value):
     if value == 'شرق':
        return 0
     elif value == '3 شوارع':
        return 1
     elif value == 'جنوب غربي':
        return 2
     elif value == 'جنوب':
        return 3
     elif value == 'جنوب غربي':
```

```
        return 4
    elif value == 'شمال':
        return 5
    elif value == 'غرب':
        return 6
    elif value == 'شمال غربي':
        return 7
    elif value == '4 شوارع':
        return 8
    elif value == 'جنوب شرقي':
        return 9
    elif value == 'شمال شرقي':
        return 10
    else:
        return 11

def encode_is_rent_or_sale(value):
     if value == 'للإيجار':
        return 1
     elif value == 'للبيع':
        return 0
     elif value == 'SALE':
        return 0
     elif value == 'RENT':
        return 1
     else:
        return 2

def encode_is_paid(value):
     if value == 'مجاني':
        return 0
     elif value == 'مدفوع':
        return 1
     else:
        return 2
```

In [35]:
```
ad_table['has_swimming_pool'] = ad_table['has_swimming_pool'].apply(encode_s
ad_table['is_closed'] = ad_table['is_closed'].apply(encode_is_closed)
ad_table['residential_or_commercial'] = ad_table['residential_or_commercial'
ad_table['driver_room'] = ad_table['driver_room'].apply(encode_is_driver_roo
ad_table['is_duplex'] = ad_table['is_duplex'].apply(encode_is_duplex)
ad_table['families_or_singles'] = ad_table['families_or_singles'].apply(enco
ad_table['is_furnished'] = ad_table['is_furnished'].apply(encode_is_furnishe
ad_table['maid_room'] = ad_table['maid_room'].apply(encode_is_maid_room_exis
ad_table['advertiser_type'] = ad_table['advertiser_type'].apply(encode_is_ow
ad_table['rent_type'] = ad_table['rent_type'].apply(encode_is_rent_type)
ad_table['street_direction'] = ad_table['street_direction'].apply(encode_is_
ad_table['purpose'] = ad_table['purpose'].apply(encode_is_rent_or_sale)
ad_table['is_paid'] = ad_table['is_paid'].apply(encode_is_paid)
```

In [36]:
```
ad_table["rent_type"].unique()
```

Out[36]:
```
array([0, 3, 2, 1])
```

In [37]:
```
ad_table['purpose'].unique()
```

Out[37]:
```
array([1, 0])
```

Change Data Types

In [66]:
```
ad_table['price'] = pd.to_numeric(ad_table['price'], errors='coerce')
ad_table['number_of_bedrooms'] = pd.to_numeric(ad_table['number_of_bedrooms'
ad_table['number_of_apartments'] = pd.to_numeric(ad_table['number_of_apartme
ad_table['floor'] = pd.to_numeric(ad_table['floor'], downcast='integer', err
ad_table['number_of_kitchens'] = pd.to_numeric(ad_table['number_of_kitchens'
ad_table['has_swimming_pool'] = pd.to_numeric(ad_table['has_swimming_pool'],
ad_table['is_closed'] = pd.to_numeric(ad_table['is_closed'], downcast='integ
ad_table['residential_or_commercial'] = pd.to_numeric(ad_table['residential_
ad_table['driver_room'] = pd.to_numeric(ad_table['driver_room'], downcast='i
ad_table['is_duplex'] = pd.to_numeric(ad_table['is_duplex'], downcast='integ
ad_table['families_or_singles'] = pd.to_numeric(ad_table['families_or_single
ad_table['is_furnished'] = pd.to_numeric(ad_table['is_furnished'], downcast=
ad_table['maid_room'] = pd.to_numeric(ad_table['maid_room'], downcast='integ
ad_table['advertiser_type'] = pd.to_numeric(ad_table['advertiser_type'], dow
ad_table['street_direction'] = pd.to_numeric(ad_table['street_direction'], d
ad_table['purpose'] = pd.to_numeric(ad_table['purpose'], downcast='integer',
ad_table['is_paid'] = pd.to_numeric(ad_table['is_paid'], downcast='integer',
ad_table['created_at'] = pd.to_datetime(ad_table['created_at'], errors='coer
ad_table['updated_at'] = pd.to_datetime(ad_table['updated_at'], errors='coer
```

==========

Average Rate Increase

Calculate the average rate increase in rent prices when switching from a 2-Bedroom Apartment to a 3-bedroom Apartment in Riyadh for both families and singles.

==========

Filter district table for Riyadh

In [67]:
```
riyadh_district_ids = district_table[(district_table['city_name_en'] == 'Riy
riyadh_ads = ad_table[ad_table['district_id'].isin(riyadh_district_ids)]
```

Filter only the apartment porperty type

In [68]:
```
property_type_ids = property_type_table[(property_type_table['property_type'
apartment_ads = ad_table[ad_table['property_type_id'].isin(property_type_ids
len(apartment_ads.index)
```

Out[68]:
```
24850
```

In [85]:
```
apartment_ads.columns
```

Out[85]:
```
Index(['id', 'district_id', 'property_type_id', 'district_name_en',
       'property_type', 'property_age_less_than', 'number_of_apartments',
       'number_of_bedrooms', 'floor', 'number_of_kitchens', 'is_closed',
       'residential_or_commercial', 'driver_room', 'is_duplex',
       'families_or_singles', 'is_furnished', 'halls_Num', 'maid_room',
       'price_per_meter', 'advertiser_type', 'has_swimming_pool', 'is_pai
d',
       'price', 'purpose', 'rent_type', 'rooms_num', 'space',
       'street_direction', 'street_width_range', 'toilets_num', 'latitude',
       'longitude', 'property_age_range', 'created_at', 'updated_at',
       'data_source'],
      dtype='object')
```

Filter on rent type = Monthly, purpose = For Rent and is not furnished

In [86]:
```
rent_ads = apartment_ads[(apartment_ads['purpose'] == 1) & (apartment_ads['r
len(rent_ads.index)
```

Out[86]:
```
730
```

Two bedrooms and three bedrooms for families and singles

In [70]:
```
two_bedroom_families = rent_ads[(rent_ads['number_of_bedrooms'] == 2) & (ren
three_bedroom_families = rent_ads[(rent_ads['number_of_bedrooms'] == 3) & (r

two_bedroom_singles = rent_ads[(rent_ads['number_of_bedrooms'] == 2) & (rent
three_bedroom_singles = rent_ads[(rent_ads['number_of_bedrooms'] == 3) & (re

(print(f"number of records for two_bedroom_families: {len(two_bedroom_famili
      f"number of records for three_bedroom_families: {len(three_bedroom_fam
      f"number of records for two_bedroom_singles: {len(two_bedroom_singles.
      f"number of records for three_bedroom_singles: {len(three_bedroom_sing
)
```

```
number of records for two_bedroom_families: 92
number of records for three_bedroom_families: 201
number of records for two_bedroom_singles: 67
number of records for three_bedroom_singles: 21
```

In [163…
```
two_bedroom_families.to_csv("two_bedroom_families.csv")
three_bedroom_families.to_csv("three_bedroom_families.csv")
two_bedroom_singles.to_csv("two_bedroom_singles.csv")
three_bedroom_singles.to_csv("three_bedroom_singles.csv")
```

In [77]:
```
df_zero_or_below = three_bedroom_singles[three_bedroom_singles['price'] <= 0
# three_bedroom_families['price'].isna().sum()
# two_bedroom_singles['price'].isna().sum()
# three_bedroom_singles['price'].isna().sum()
df_zero_or_below
```

Out[77]:

id	district_id	property_type_id	district_name_en	property_type	property_age_less_than

0 rows × 36 columns

Calculate average prices

In [78]:
```
avg_price_two_bedroom_families = two_bedroom_families['price'].mean()
avg_price_three_bedroom_families = three_bedroom_families['price'].mean()
avg_price_two_bedroom_singles = two_bedroom_singles['price'].mean()
avg_price_three_bedroom_singles = three_bedroom_singles['price'].mean()
(print(f"avg_price_two_bedroom_families: {avg_price_two_bedroom_families}\n"
      f"avg_price_three_bedroom_families: {avg_price_three_bedroom_families}
      f"two_bedroom_singles: {avg_price_two_bedroom_singles}\n"
      f"three_bedroom_singles: {avg_price_three_bedroom_singles}\n")
)
```

```
avg_price_two_bedroom_families: 120204.6171875
avg_price_three_bedroom_families: 58250572.0
two_bedroom_singles: 13007.4482421875
three_bedroom_singles: 23981276.0
```

Calculate rate increase

In [79]:
```
rate_increase_families = ((avg_price_three_bedroom_families - avg_price_two_
rate_increase_singles = ((avg_price_three_bedroom_singles - avg_price_two_be
```

Calculate the average rate increase in rent prices when switching from a 2-Bedroom Apartment to a 3-bedroom Apartment in Riyadh for both families and singles.

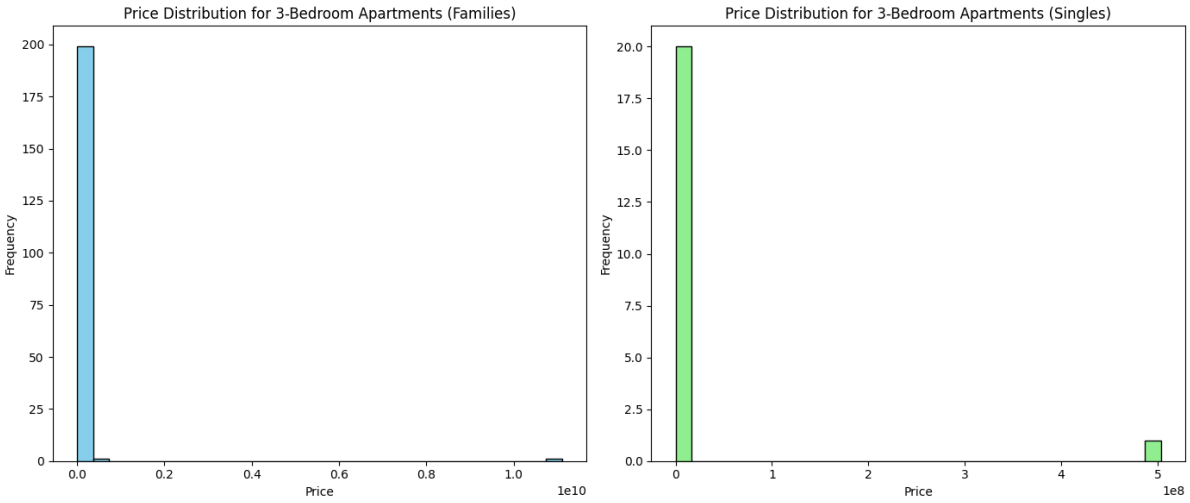
In [80]:
```
rate_increase_families, rate_increase_singles
```

Out[80]:
```
(48359.51232910156, 184265.72265625)
```

The above data indicates that there is a problem in it

Step 1: Analyze and Visualize Price Distributions

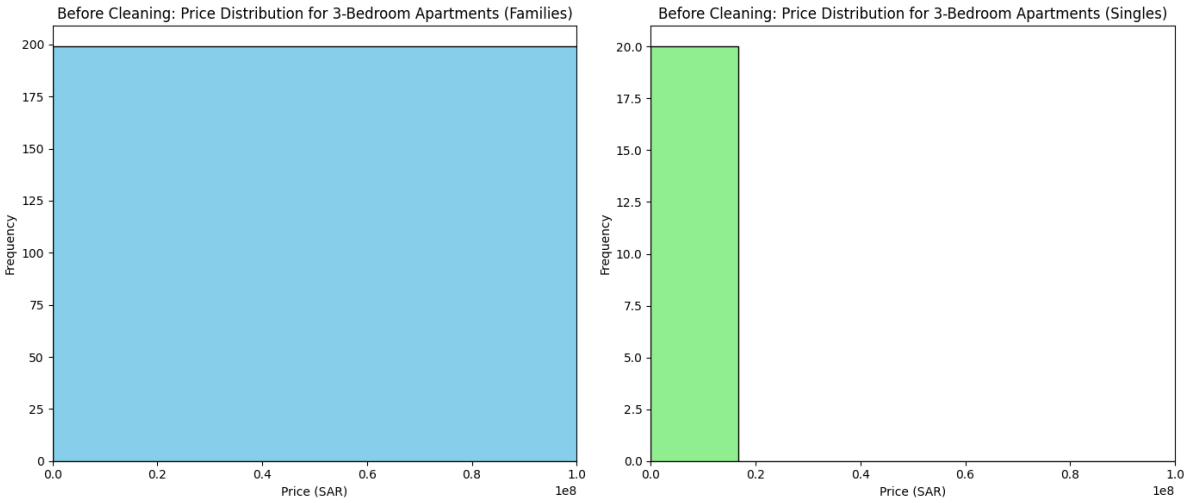
In [164…
```
fig, ax = plt.subplots(1, 2, figsize=(14, 6))

# Distribution of prices for 3-bedroom families apartments
ax[0].hist(three_bedroom_families['price'], bins=30, color='skyblue', edgeco
ax[0].set_title('Price Distribution for 3-Bedroom Apartments (Families)')
ax[0].set_xlabel('Price')
ax[0].set_ylabel('Frequency')

# Distribution of prices for 3-bedroom singles apartments
ax[1].hist(three_bedroom_singles['price'], bins=30, color='lightgreen', edge
ax[1].set_title('Price Distribution for 3-Bedroom Apartments (Singles)')
ax[1].set_xlabel('Price')
ax[1].set_ylabel('Frequency')

plt.tight_layout()
plt.show()
```



Function to remove outliers

In [166…
```python
def remove_outliers(df, column_name):
    """
    Remove outliers from a dataframe based on the column specified.
    Outliers are defined as values more than 3 standard deviations from the
    """
    mean = df[column_name].mean()
    std_dev = df[column_name].std()
    cutoff = std_dev * 3
    lower_bound = mean - cutoff
    upper_bound = mean + cutoff

    # Filter out the outliers
    cleaned_df = df[(df[column_name] >= lower_bound) & (df[column_name] <= u
    return cleaned_df
```

In [167…
```python
# Initial visualization of price distributions for 3-bedroom apartments
fig, ax = plt.subplots(1, 2, figsize=(14, 6))

# 3-bedroom families apartments before cleaning
ax[0].hist(three_bedroom_families['price'], bins=30, color='skyblue', edgecc
ax[0].set_title('Before Cleaning: Price Distribution for 3-Bedroom Apartment
ax[0].set_xlabel('Price (SAR)')
ax[0].set_ylabel('Frequency')
ax[0].set_xlim([0, 100000000])  # Adjust based on your data to improve reada

# 3-bedroom singles apartments before cleaning
ax[1].hist(three_bedroom_singles['price'], bins=30, color='lightgreen', edge
ax[1].set_title('Before Cleaning: Price Distribution for 3-Bedroom Apartment
ax[1].set_xlabel('Price (SAR)')
ax[1].set_ylabel('Frequency')
ax[1].set_xlim([0, 100000000])  # Adjust based on your data to improve reada

plt.tight_layout()
plt.show()
```



Before Cleaning (Families and Singles): These histograms show the original price distributions for 3-bedroom apartments, catering to families and singles. The wide range of prices, especially with some extremely high values, indicates the presence of outliers that could significantly affect the average price calculations.

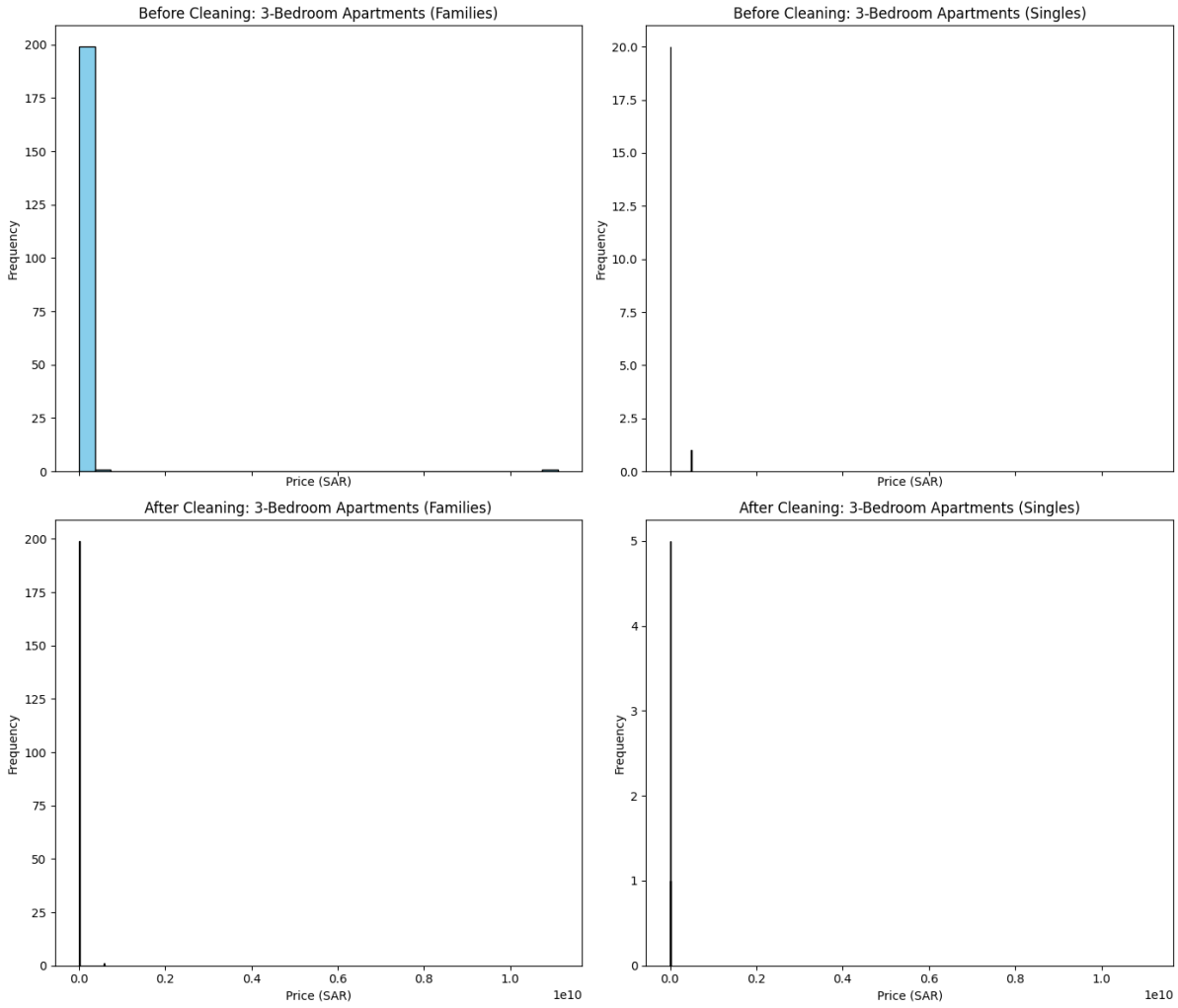
Remove outliers from the 3-bedroom datasets

In [168…
```
three_bedroom_families_cleaned = remove_outliers(three_bedroom_families, 'pr
three_bedroom_singles_cleaned = remove_outliers(three_bedroom_singles, 'pric
```

Visualization of price distributions after removing outliers

In [169…
```
fig, ax = plt.subplots(2, 2, figsize=(14, 12), sharex=True)

# Before cleaning - families
ax[0, 0].hist(three_bedroom_families['price'], bins=30, color='skyblue', edg
ax[0, 0].set_title('Before Cleaning: 3-Bedroom Apartments (Families)')
ax[0, 0].set_xlabel('Price (SAR)')
ax[0, 0].set_ylabel('Frequency')

# After cleaning - families
ax[1, 0].hist(three_bedroom_families_cleaned['price'], bins=30, color='skybl
ax[1, 0].set_title('After Cleaning: 3-Bedroom Apartments (Families)')
ax[1, 0].set_xlabel('Price (SAR)')
ax[1, 0].set_ylabel('Frequency')

# Before cleaning - singles
ax[0, 1].hist(three_bedroom_singles['price'], bins=30, color='lightgreen', e
ax[0, 1].set_title('Before Cleaning: 3-Bedroom Apartments (Singles)')
ax[0, 1].set_xlabel('Price (SAR)')
ax[0, 1].set_ylabel('Frequency')

# After cleaning - singles
ax[1, 1].hist(three_bedroom_singles_cleaned['price'], bins=30, color='lightg
ax[1, 1].set_title('After Cleaning: 3-Bedroom Apartments (Singles)')
ax[1, 1].set_xlabel('Price (SAR)')
ax[1, 1].set_ylabel('Frequency')
```

```
plt.tight_layout()
plt.show()
```



After Cleaning (Families and Singles): After removing outliers (defined as prices more than 3 standard deviations from the mean), these histograms present the cleaned price distributions. The distributions are now more concentrated, indicating a removal of extreme values. This cleaning process should lead to more representative average price calculations.

Recalculate the average prices without outliers

In [170…
```
avg_price_three_bedroom_families_cleaned = three_bedroom_families_cleaned['p
avg_price_three_bedroom_singles_cleaned = three_bedroom_singles_cleaned['pri

print(f"Average price for a 3-bedroom apartment for families (cleaned): {avg
print(f"Average price for a 3-bedroom apartment for singles (cleaned): {avg_
```

```
Average price for a 3-bedroom apartment for families (cleaned): 2986318.75
SAR
Average price for a 3-bedroom apartment for singles (cleaned): 5840.00 SAR
```

In [171…
```
# Recalculate the average prices without outliers
rate_increase_families = ((avg_price_three_bedroom_families_cleaned - avg_pr
rate_increase_singles = ((avg_price_three_bedroom_singles_cleaned - avg_pric
```

In [172…
```
rate_increase_families, rate_increase_singles
```

Out[172]: (2384.36279296875, -55.102646350860596)

These rates suggest a substantial increase in rent prices for families when moving from a 2-bedroom to a 3-bedroom apartment, while indicating a decrease for singles. However, the negative rate for singles seems counterintuitive since it implies that moving to a larger apartment would, on average, cost less, which is generally not expected in real estate markets.

==========

2.Calculate the average duration it takes to close a post and mention the parameters that affect this duration. Also, mention the district with the shortest duration it takes to close a post with property type of villa.

==========

I will consider the difference between updated and created date without checking is_closed it the duration to close the post

Step 1: Calculate Duration to Close a Post

In [115…
```
ad_table['created_at'] = pd.to_datetime(ad_table['created_at'])
ad_table['updated_at'] = pd.to_datetime(ad_table['updated_at'])
ad_table['closing_duration'] = (ad_table['updated_at'] - ad_table['created_a
```

Step 2: Identify Parameters Affecting Duration

In [114…
```
ad_table.columns
```

Out[114]:
```
Index(['id', 'district_id', 'property_type_id', 'district_name_en',
       'property_type', 'property_age_less_than', 'number_of_apartments',
       'number_of_bedrooms', 'floor', 'number_of_kitchens', 'is_closed',
       'residential_or_commercial', 'driver_room', 'is_duplex',
       'families_or_singles', 'is_furnished', 'halls_Num', 'maid_room',
       'price_per_meter', 'advertiser_type', 'has_swimming_pool', 'is_pai
d',
       'price', 'purpose', 'rent_type', 'rooms_num', 'space',
       'street_direction', 'street_width_range', 'toilets_num', 'latitud
e',
       'longitude', 'property_age_range', 'created_at', 'updated_at',
       'data_source', 'closing_duration'],
      dtype='object')
```

In [127…
```
# This step involves statistical analysis. As a simple approach, you can sta
correlations = ad_table[['closing_duration','price', 'number_of_bedrooms', '
correlations
```

Out[127]:

	closing_duration	price	number_of_bedrooms	is_furnished	has
closing_duration	1.000000	-0.004561	-0.049748	-0.013467	
price	-0.004561	1.000000	-0.004130	0.007733	
number_of_bedrooms	-0.049748	-0.004130	1.000000	0.099894	
is_furnished	-0.013467	0.007733	0.099894	1.000000	
has_swimming_pool	0.046696	-0.000483	0.221229	0.117984	
maid_room	0.062801	-0.004159	0.534709	0.114554	
driver_room	0.068518	-0.003818	0.490236	0.097253	

Step 3: Find the District with the Shortest Duration for Villas

Step 3.a identify villas from property_type_table

In [128…
```
#property_type_table["property_type"].unique
```

In [129…
```
villa_type_ids = property_type_table[(property_type_table['property_type'].s
```

Step 3.b Group by district_id and calculate average closing_duration

In [130…
```
villa_ads = ad_table[ad_table['property_type_id'].isin(villa_type_ids)]
avg_duration_by_district = villa_ads.groupby('district_id')['closing_duratic
```

Step 3.c Find the district with the shortest duration

In [131…
```
shortest_duration_district = avg_duration_by_district.loc[avg_duration_by_di
```

Step 3.e Get district details

In [132…
```
district_details = district_table[district_table['district_id'] == shortest_
```

Output

In [133…
```
average_duration = ad_table['closing_duration'].mean()
print(f"Average closing duration: {average_duration} days")
print("Correlation with other parameters:\n", correlations)
print(f"District with shortest closing duration for villas: {district_detail
```

```
Average closing duration: 50.11803646396776 days
Correlation with other parameters:
                     closing_duration     price  number_of_bedrooms  \
closing_duration             1.000000 -0.004561           -0.049748
price                       -0.004561  1.000000           -0.004130
number_of_bedrooms          -0.049748 -0.004130            1.000000
is_furnished                -0.013467  0.007733            0.099894
has_swimming_pool            0.046696 -0.000483            0.221229
maid_room                    0.062801 -0.004159            0.534709
driver_room                  0.068518 -0.003818            0.490236

                    is_furnished  has_swimming_pool  maid_room  driver_room

closing_duration       -0.013467           0.046696   0.062801     0.068518

price                   0.007733          -0.000483  -0.004159    -0.003818

number_of_bedrooms      0.099894           0.221229   0.534709     0.490236

is_furnished            1.000000           0.117984   0.114554     0.097253

has_swimming_pool       0.117984           1.000000   0.334912     0.352679

maid_room               0.114554           0.334912   1.000000     0.788474

driver_room             0.097253           0.352679   0.788474     1.000000

District with shortest closing duration for villas: Siyah (ID: 159844990f03
2677bdc2c66b26191c62ebb6ffab80747a56e7e63702c4352d29)
```

==========

3.Provide the correlation matrix for the effects on prices after normalization for both rents and sales, and comment on the most price affecting parameters.

==========

In [134…

```
ad_table.columns
```

Out[134]:
```
Index(['id', 'district_id', 'property_type_id', 'district_name_en',
       'property_type', 'property_age_less_than', 'number_of_apartments',
       'number_of_bedrooms', 'floor', 'number_of_kitchens', 'is_closed',
       'residential_or_commercial', 'driver_room', 'is_duplex',
       'families_or_singles', 'is_furnished', 'halls_Num', 'maid_room',
       'price_per_meter', 'advertiser_type', 'has_swimming_pool', 'is_pai
d',
       'price', 'purpose', 'rent_type', 'rooms_num', 'space',
       'street_direction', 'street_width_range', 'toilets_num', 'latitud
e',
       'longitude', 'property_age_range', 'created_at', 'updated_at',
       'data_source', 'closing_duration'],
      dtype='object')
```

In [136…
```python
# Assuming 'ad_table' contains your data, including both rent and sale price
# and a 'for_sale_or_rent' column to differentiate between sale (e.g., value

# Step 1: Normalize the price data
scaler = MinMaxScaler()
ad_table['normalized_price'] = scaler.fit_transform(ad_table[['price']])

# Step 2: Select relevant parameters (assuming these columns exist in your d
parameters = ['number_of_bedrooms', 'space', 'toilets_num', 'property_age_ra

# Step 3: Calculate the correlation matrix
correlation_matrix = ad_table[parameters].corr()

# Display the correlation matrix
print(correlation_matrix)
```

```
                    number_of_bedrooms     space  normalized_price  \
number_of_bedrooms            1.000000 -0.011265         -0.004130
space                        -0.011265  1.000000          0.207093
normalized_price             -0.004130  0.207093          1.000000
has_swimming_pool             0.221229  0.012604         -0.000483
maid_room                     0.534709 -0.003503         -0.004159
driver_room                   0.490236 -0.002513         -0.003818

                    has_swimming_pool  maid_room  driver_room
number_of_bedrooms           0.221229   0.534709     0.490236
space                        0.012604  -0.003503    -0.002513
normalized_price            -0.000483  -0.004159    -0.003818
has_swimming_pool            1.000000   0.334912     0.352679
maid_room                    0.334912   1.000000     0.788474
driver_room                  0.352679   0.788474     1.000000
```

==========

4.Give a sales price valuation of rental properties (convert rental properties to sales properties) based on 6% ROI (Return on Investment) then estimate the meter price distribution per property type and district and comment on the result.

==========

RENT_TYPE :-> Yearly = 0, Daily = 1, Monthly = 2

PURPOSE :-> SALE = 0 RENT = 1

1. Filter for rental properties (purpose = 1 for rent)

In [138…
```
rentals = ad_table[ad_table['purpose'] == 1]
```

2. Convert rental price to annual basis

Daily to yearly: Multiply by 365 Monthly to yearly: Multiply by 12 Yearly remains the same

In [139…
```
rentals['annual_rent'] = rentals.apply(
    lambda x: x['price'] * 365 if x['rent_type'] == 1 else (x['price'] * 12
    axis=1
)
```

```
/var/folders/fw/2jnclknn08g378bkr2zksm5h0000gn/T/ipykernel_10323/325415596
9.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  rentals['annual_rent'] = rentals.apply(
```

3. Calculate sales price valuation based on 6% ROI

In [140…
```
rentals['sales_price_valuation'] = rentals['annual_rent'] / 0.06
```

```
/var/folders/fw/2jnclknn08g378bkr2zksm5h0000gn/T/ipykernel_10323/201328349
1.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  rentals['sales_price_valuation'] = rentals['annual_rent'] / 0.06
```

4. Calculate price per meter

In [141…
```
rentals['price_per_meter'] = rentals['sales_price_valuation'] / rentals['spa
```

```
/var/folders/fw/2jnclknn08g378bkr2zksm5h0000gn/T/ipykernel_10323/267291610
9.py:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-doc
s/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  rentals['price_per_meter'] = rentals['sales_price_valuation'] / rentals
['space']
```

5. Group by property type and district, and calculate descriptive statistics for price per meter

In [142…

```
grouped_data = rentals.groupby(['property_type', 'district_name_en'])['price
```

```
/Users/mohammadshbaita/miniforge3/lib/python3.9/site-packages/numpy/lib/fun
ction_base.py:4011: RuntimeWarning: invalid value encountered in multiply
  lerp_interpolation = asanyarray(add(a, diff_b_a*t, out=out))
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```
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```
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ction_base.py:4009: RuntimeWarning: invalid value encountered in subtract
  diff_b_a = subtract(b, a)
/Users/mohammadshbaita/miniforge3/lib/python3.9/site-packages/numpy/lib/fun
ction_base.py:4009: RuntimeWarning: invalid value encountered in subtract
  diff_b_a = subtract(b, a)
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  diff_b_a = subtract(b, a)
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ction_base.py:4009: RuntimeWarning: invalid value encountered in subtract
  diff_b_a = subtract(b, a)
/Users/mohammadshbaita/miniforge3/lib/python3.9/site-packages/numpy/lib/fun
ction_base.py:4009: RuntimeWarning: invalid value encountered in subtract
  diff_b_a = subtract(b, a)
/Users/mohammadshbaita/miniforge3/lib/python3.9/site-packages/numpy/lib/fun
ction_base.py:4011: RuntimeWarning: invalid value encountered in multiply
  lerp_interpolation = asanyarray(add(a, diff_b_a*t, out=out))
/Users/mohammadshbaita/miniforge3/lib/python3.9/site-packages/numpy/lib/fun
ction_base.py:4011: RuntimeWarning: invalid value encountered in multiply
  lerp_interpolation = asanyarray(add(a, diff_b_a*t, out=out))
/Users/mohammadshbaita/miniforge3/lib/python3.9/site-packages/numpy/lib/fun
ction_base.py:4012: RuntimeWarning: invalid value encountered in subtract
  subtract(b, diff_b_a * (1 - t), out=lerp_interpolation, where=t>=0.5)
/Users/mohammadshbaita/miniforge3/lib/python3.9/site-packages/numpy/lib/fun
ction_base.py:4012: RuntimeWarning: invalid value encountered in subtract
  subtract(b, diff_b_a * (1 - t), out=lerp_interpolation, where=t>=0.5)
```

In [ ]:

```
print(grouped_data.head(100))
```

In [145…

```
# Assuming 'grouped_data' is the DataFrame you want to clean
cleaned_grouped_data = grouped_data.dropna()
print(cleaned_grouped_data.head(100))
```

property_type	district_name_en	count	mean	std	min	25%	50%	75%	max
أرض	Ad Dar Al Baida	2.0	2.644231e+03	7.932288e+02	2083.333333	2363.782051	2644.230769	2924.679487	3.205128e+03
	Al Aqiq	5.0	5.134377e+03	3.281292e+03	1632.653061	2052.545156	5566.666667	7160.759040	9.259259e+03
	Al Faiha	2.0	1.482143e+03	1.271109e+03	583.333333	1032.738095	1482.142857	1931.547619	2.380952e+03
	Al Faisaliyah	4.0	3.165412e+03	2.125569e+03	1129.943503	1556.263050	2932.518116	4541.666667	5.666667e+03
	Al Ghnamiah	5.0	1.960140e+03	2.005449e+03	250.000000	583.333333	666.666667	4150.000000	4.150702e+03
...	...	...	...	...	...	...	...	...	...
استراحة	As Sulai	31.0	1.105599e+04	3.538762e+04	1083.333333	1483.333333	3205.128205	5107.142857	2.000000e+05
	Ash Sharq	88.0	1.415873e+04	8.636449e+04	16.666667	1833.333333	2443.438914	3645.833333	8.111111e+05
	Ash Shifa	5.0	3.457204e+04	6.481482e+04	202.777778	250.000000	7407.407407	15000.000000	1.500000e+05
	Badr	13.0	4.058979e+03	7.243406e+03	137.254902	1555.555556	2166.666667	2823.529412	2.800000e+04
	Banban	29.0	5.993984e+07	3.227551e+08	92.592593	1703.333333	2380.952381	10428.571429	1.738095e+09

[100 rows x 8 columns]

In [146…
```
cleaned_grouped_data.to_csv("cleaned_grouped_data.csv")
```

Highest and Lowest Average Price per Meter

In [148…
```
highest_avg = cleaned_grouped_data.sort_values(by='mean', ascending=False).h
lowest_avg = cleaned_grouped_data.sort_values(by='mean', ascending=True).hea
```

Highest and Lowest Standard Deviation

In [149…
```
highest_std = cleaned_grouped_data.sort_values(by='std', ascending=False).he
lowest_std = cleaned_grouped_data.sort_values(by='std', ascending=True).head
```

Potential Outliers based on Max and Min Values

In [151…
```
potential_outliers_max = cleaned_grouped_data.sort_values(by='max', ascendin
potential_outliers_min = cleaned_grouped_data.sort_values(by='min', ascendin
```

In [152…
```
print("Highest Average Price per Meter:")
print(highest_avg)
```

```
Highest Average Price per Meter:
                                        count          mean           std  \
property_type district_name_en
استراحة       Dhahrat Namar              23.0  2.938877e+09  1.409401e+10
              Al Maizilah                25.0  3.753019e+08  1.875861e+09
محل           Al Amal                     2.0  8.516669e+07  1.204438e+08
              An Nasim Ash Sharqi        23.0  8.238752e+07  3.949045e+08
              Laban                      13.0  7.147974e+07  2.567302e+08

                                             min           25%           50%
\
property_type district_name_en

استراحة       Dhahrat Namar        1481.481481  4.416667e+03  9.125000e+03

              Al Maizilah             0.888889  2.756892e+03  4.245283e+03

محل           Al Amal                41.025641  4.258336e+07  8.516669e+07

              An Nasim Ash Sharqi    67.500068  7.256944e+03  1.041667e+04

              Laban                 333.333333  8.333333e+03  1.822917e+04


                                             75%           max
property_type district_name_en
استراحة       Dhahrat Namar        1.993981e+04  6.759259e+10
              Al Maizilah          1.169872e+04  9.379435e+09
محل           Al Amal              1.277500e+08  1.703333e+08
              An Nasim Ash Sharqi  2.416667e+04  1.893939e+09
              Laban                3.431373e+04  9.259250e+08
```

In [153…
```
print("\nLowest Average Price per Meter:")
print(lowest_avg)
```

```
Lowest Average Price per Meter:
                                    count        mean         std        min
\
property_type district_name_en

بيت           Qurtubah              2.0    9.333051   10.370500   2.000000

أرض           Al Muhammadiyah       2.0   84.258333  116.542983   1.850000

مستودع        Hyt                   2.0   86.937500  117.939519   3.541667

استراحة       Al Uraija Al Wusta    2.0   91.666667  106.066017  16.666667

              Al Haer               2.0  101.273148   77.749010  46.296296


                                         25%         50%         75%  \
property_type district_name_en
بيت           Qurtubah             5.666526    9.333051   12.999577
أرض           Al Muhammadiyah     43.054167   84.258333  125.462500
مستودع        Hyt                 45.239583   86.937500  128.635417
استراحة       Al Uraija Al Wusta  54.166667   91.666667  129.166667
              Al Haer             73.784722  101.273148  128.761574

                                        max
property_type district_name_en
بيت           Qurtubah             16.666102
أرض           Al Muhammadiyah     166.666667
مستودع        Hyt                 170.333333
استراحة       Al Uraija Al Wusta  166.666667
              Al Haer             156.250000
```

In [154…

```
print("\nHighest Standard Deviation in Price per Meter:")
print(highest_std)
```

```
Highest Standard Deviation in Price per Meter:
                                     count          mean           std  \
property_type district_name_en
استراحة       Dhahrat Namar          23.0  2.938877e+09  1.409401e+10
              Al Maizilah            25.0  3.753019e+08  1.875861e+09
محل           An Nasim Ash Sharqi    23.0  8.238752e+07  3.949045e+08
استراحة       Banban                 29.0  5.993984e+07  3.227551e+08
محل           Laban                  13.0  7.147974e+07  2.567302e+08

                                            min          25%           50%
\
property_type district_name_en

استراحة       Dhahrat Namar        1481.481481  4416.666667   9125.000000

              Al Maizilah             0.888889  2756.892231   4245.283019

محل           An Nasim Ash Sharqi    67.500068  7256.944444  10416.666667

استراحة       Banban                 92.592593  1703.333333   2380.952381

محل           Laban                 333.333333  8333.333333  18229.166667


                                            75%           max
property_type district_name_en
استراحة       Dhahrat Namar        19939.814815  6.759259e+10
              Al Maizilah          11698.717949  9.379435e+09
محل           An Nasim Ash Sharqi  24166.666667  1.893939e+09
استراحة       Banban               10428.571429  1.738095e+09
محل           Laban                34313.725490  9.259250e+08
```

In [156…

```
print("\nLowest Standard Deviation in Price per Meter:")
print(lowest_std)
```

```
Lowest Standard Deviation in Price per Meter:
                                    count          mean  std           min  \
property_type district_name_en
محل           Al Mikal              2.0  15277.777778  0.0  15277.777778
استراحة       Al Faiha              4.0  16222.222222  0.0  16222.222222
مستودع        Al Yarmuk             2.0   5333.333333  0.0   5333.333333
مكتب تجاري    An Nazim              3.0   5000.000000  0.0   5000.000000
بيت           Jarir                 2.0   4772.727273  0.0   4772.727273

                                           25%           50%           75%  \
property_type district_name_en
محل           Al Mikal          15277.777778  15277.777778  15277.777778
استراحة       Al Faiha          16222.222222  16222.222222  16222.222222
مستودع        Al Yarmuk          5333.333333   5333.333333   5333.333333
مكتب تجاري    An Nazim           5000.000000   5000.000000   5000.000000
بيت           Jarir              4772.727273   4772.727273   4772.727273

                                           max
property_type district_name_en
محل           Al Mikal          15277.777778
استراحة       Al Faiha          16222.222222
مستودع        Al Yarmuk          5333.333333
مكتب تجاري    An Nazim           5000.000000
بيت           Jarir              4772.727273
```

In [157…

```
print("\nPotential Outliers with Highest Max Value:")
print(potential_outliers_max)
```

```
Potential Outliers with Highest Max Value:
                                      count          mean           std  \
property_type district_name_en
استراحة       Dhahrat Namar          23.0  2.938877e+09  1.409401e+10
              Al Maizilah            25.0  3.753019e+08  1.875861e+09
محل           An Nasim Ash Sharqi    23.0  8.238752e+07  3.949045e+08
استراحة       Banban                 29.0  5.993984e+07  3.227551e+08
محل           Laban                  13.0  7.147974e+07  2.567302e+08

                                             min          25%           50%
\
property_type district_name_en

استراحة       Dhahrat Namar        1481.481481  4416.666667   9125.000000

              Al Maizilah             0.888889  2756.892231   4245.283019

محل           An Nasim Ash Sharqi    67.500068  7256.944444  10416.666667

استراحة       Banban                 92.592593  1703.333333   2380.952381

محل           Laban                 333.333333  8333.333333  18229.166667


                                             75%           max
property_type district_name_en
استراحة       Dhahrat Namar        19939.814815  6.759259e+10
              Al Maizilah          11698.717949  9.379435e+09
محل           An Nasim Ash Sharqi  24166.666667  1.893939e+09
استراحة       Banban               10428.571429  1.738095e+09
محل           Laban                34313.725490  9.259250e+08
```

In [158…

```
print("\nProperties with Lowest Min Value indicating potential outliers or d
print(potential_outliers_min)
```

```
Properties with Lowest Min Value indicating potential outliers or data issu
es:
                                    count          mean           std       m
in  \
property_type district_name_en

عمارة         Al Uraija             5.0  2.086621e+04  2.688352e+04  0.0000
00
أرض           An Nasim Al Gharbi   35.0  2.697102e+06  1.066860e+07  0.0000
14
استراحة       An Nasim Al Gharbi   47.0  4.487947e+04  1.397048e+05  0.0004
50
فيلا          King Abdul Aziz      32.0  7.114926e+03  1.439826e+04  0.00166
7
أرض           Ishbiliyah            9.0  4.258184e+03  2.869291e+03  0.0041
67

                                           25%           50%           75%
\
property_type district_name_en

عمارة         Al Uraija           5442.176871  10000.000000  22222.222222

أرض           An Nasim Al Gharbi   291.666720   2272.727273   5773.907104

استراحة       An Nasim Al Gharbi  1644.444444   3111.111111   7650.000000

فيلا          King Abdul Aziz     1163.213377   3827.838828   5354.166667
أرض           Ishbiliyah          3030.303030   5362.318841   5797.101449


                                           max
property_type district_name_en
عمارة         Al Uraija           6.666667e+04
أرض           An Nasim Al Gharbi  6.083327e+07
استراحة       An Nasim Al Gharbi  6.400000e+05
فيلا          King Abdul Aziz     6.687243e+04
أرض           Ishbiliyah          8.333333e+03
```

==========

5.Add any general insights you find during your work on the data

==========

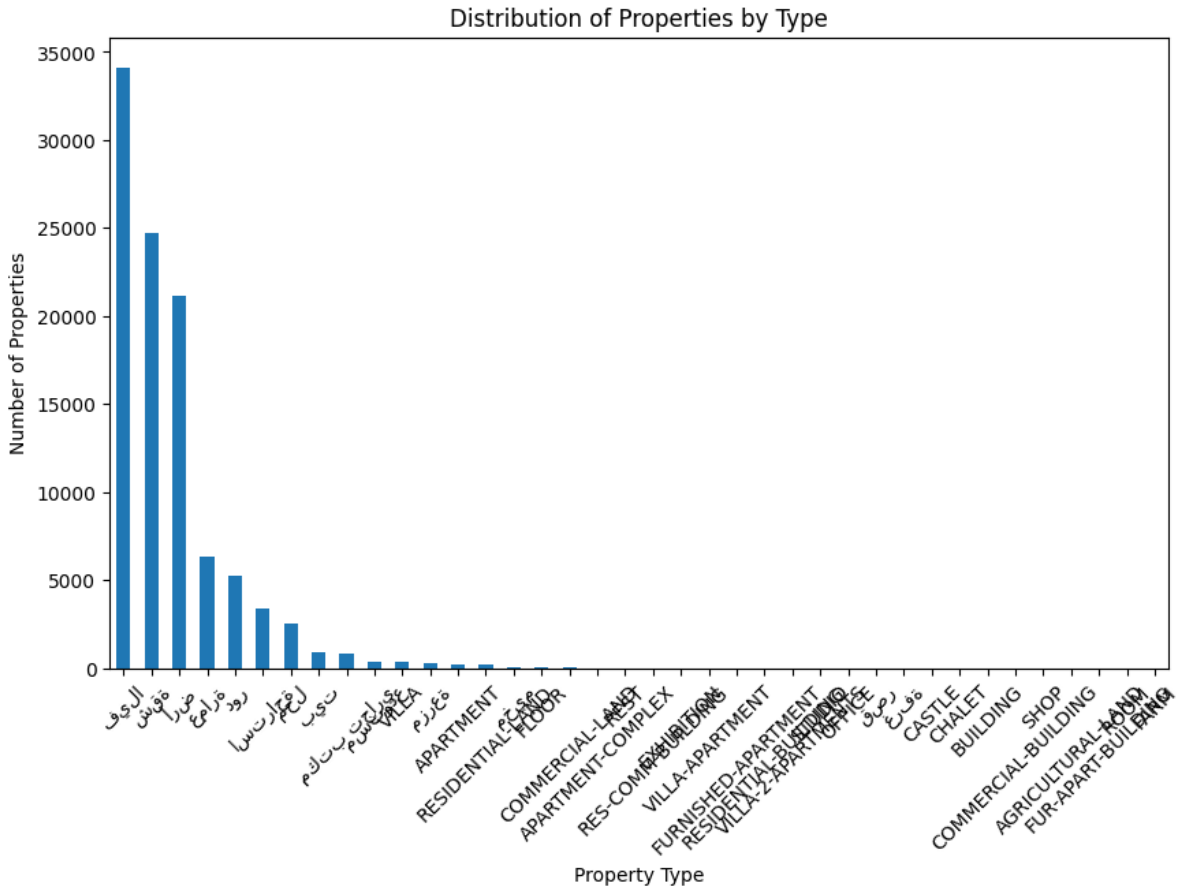
In [161…

```python
# Distribution of Properties by Type
property_type_distribution = ad_table['property_type'].value_counts()

# Plotting the distribution
import matplotlib.pyplot as plt
```

```
plt.figure(figsize=(10, 6))
property_type_distribution.plot(kind='bar')
plt.title('Distribution of Properties by Type')
plt.xlabel('Property Type')
plt.ylabel('Number of Properties')
plt.xticks(rotation=45)
plt.show()

# Output the distribution
print(property_type_distribution)
```



```
34123                      فيلا
24675                      شقة
21142                      أرض
6329                      عمارة
5250                       دور
3397                   استراحة
2555                       محل
917                        بيت
820                 مكتب تجاري
383                     مستودع
VILLA                      327
289                      مزرعة
APARTMENT                  175
RESIDENTIAL-LAND           173
73                        مخيم
FLOOR                       53
COMMERCIAL-LAND             27
APARTMENT-COMPLEX            6
REST                         6
RES-COMM-BUILDING            6
EXHIBITION                   4
VILLA-APARTMENT              3
FURNISHED-APARTMENT          3
RESIDENTIAL-BUILDING         2
VILLA-2-APARTMENTS           2
STUDIO                       2
OFFICE                       2
2                         قصر
2                         غرفة
CASTLE                       1
CHALET                       1
BUILDING                     1
COMMERCIAL-BUILDING          1
SHOP                         1
AGRICULTURAL-LAND            1
FUR-APART-BUILDING           1
ROOM                         1
FARM                         1
Name: property_type, dtype: int64
```

Recommendations for Further Analysis:

1- Standardization of Property Types: Combining the counts of similarly named property types listed in both English and Arabic (e.g., VILLA and فيلا) could provide a more accurate distribution and understanding of the market.

2- In-depth Analysis of Niche Properties: Exploring the characteristics and pricing of less common or unique properties might uncover specific market trends or investment opportunities.

3- Market Segmentation: Further analysis could segment the market based on property types, identifying trends, demands, and pricing within each segment.

In [ ]: