```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

from bokeh.io import output_notebook, show
from bokeh.plotting import figure
from bokeh.models import ColumnDataSource, HoverTool
from bokeh.transform import cumsum
from math import pi

# File location
df = pd.read_csv('Housing_Uk.csv')
df.head()
```

```
            Transaction_unique_identifier  Price Date_of_Transfer
Postcode  \
0  {40FD4DF2-5362-407C-92BC-566E2CCE89E9}  44500       1995-02-03  SR6
0AQ
1  {7A99F89E-7D81-4E45-ABD5-566E49A045EA}  56500       1995-01-13  CO6
1SQ
2  {28225260-E61C-4E57-8B56-566E5285B1C1}  58000       1995-07-28  B90
4TG
3  {444D34D7-9BA6-43A7-B695-4F48980E0176}  51000       1995-06-28  DY5
1SA
4  {AE76CAF1-F8CC-43F9-8F63-4F48A2857D41}  17000       1995-03-10  S65
1QJ

   Property_Type Old/New   Duration PAON     SAON
Street  ...  \
0       Terraced     New   Freehold   50  Unknown       HOWICK
PARK  ...
1       Terraced     New   Freehold   19  Unknown  BRICK KILN
CLOSE  ...
2       Terraced     New   Freehold   37  Unknown  RAINSBROOK
DRIVE  ...
3  Semi-detached     New   Freehold   59  Unknown        MERRY
HILL  ...
4       Terraced     New  Leasehold   22  Unknown     DENMAN
STREET  ...

       Town/City    District           County
Transaction_type  \
0     SUNDERLAND  SUNDERLAND    TYNE AND WEAR  Standard Price Paid
entry
1     COLCHESTER   BRAINTREE            ESSEX  Standard Price Paid
entry
2       SOLIHULL    SOLIHULL    WEST MIDLANDS  Standard Price Paid
entry
3  BRIERLEY HILL      DUDLEY    WEST MIDLANDS  Standard Price Paid
```

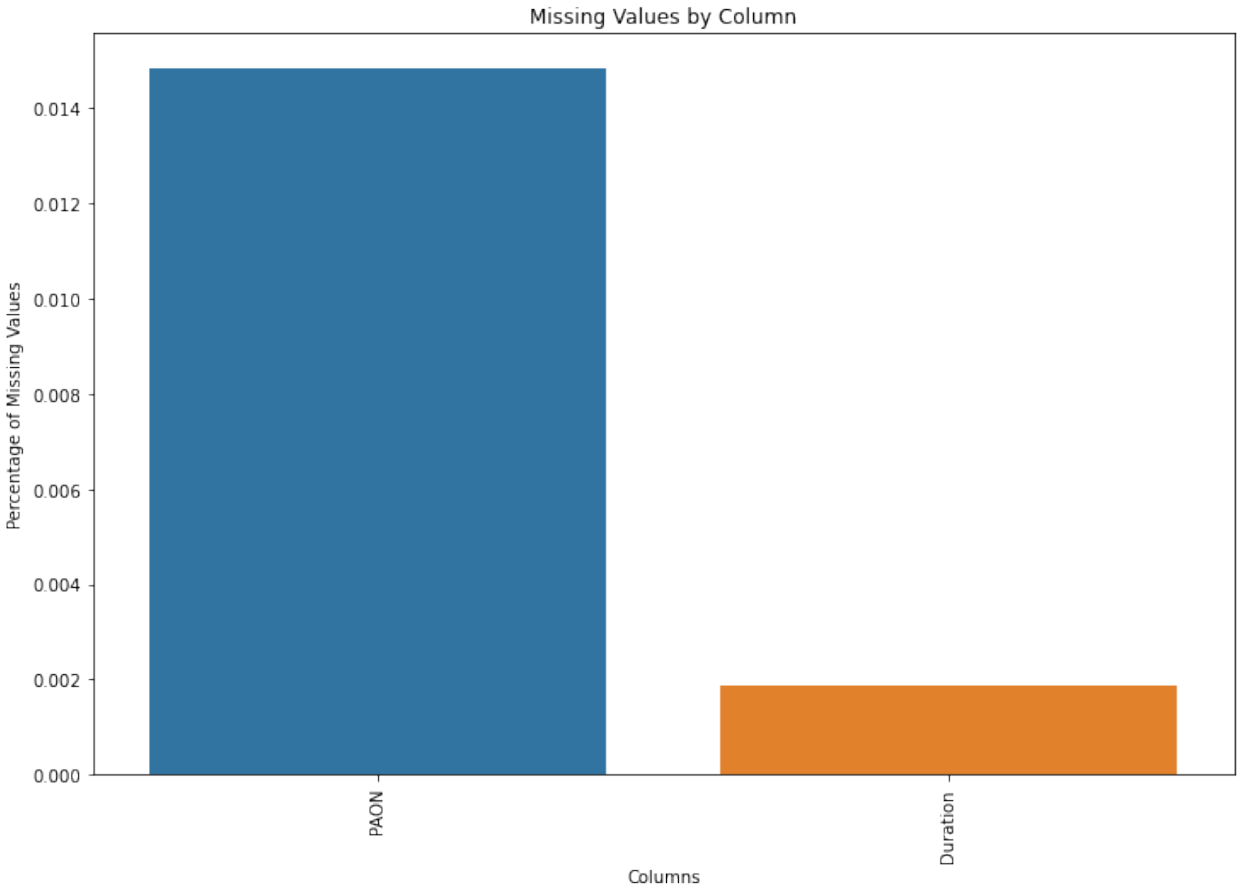
```
entry
4      ROTHERHAM   ROTHERHAM  SOUTH YORKSHIRE  Standard Price Paid
entry

       Record_status        Date Day  Month  Year
Region
0  Add (a new entry)  1995-02-03   3      2  1995        North East
England
1  Add (a new entry)  1995-01-13  13      1  1995           East of
England
2  Add (a new entry)  1995-07-28  28      7  1995             West
Midlands
3  Add (a new entry)  1995-06-28  28      6  1995             West
Midlands
4  Add (a new entry)  1995-03-10  10      3  1995  Yorkshire and the
Humber

[5 rows x 21 columns]
```

```python
# Checking for missing values
missing_values = df.isnull().sum().sort_values(ascending=False)
missing_percentage = (missing_values / len(df)) * 100

missing_data = pd.DataFrame({'Missing Values': missing_values,
'Percentage': missing_percentage})
missing_data = missing_data[missing_data['Missing Values'] > 0]

plt.figure(figsize=(12, 8))
sns.barplot(x=missing_data.index, y=missing_data['Percentage'])
plt.title('Missing Values by Column')
plt.xlabel('Columns')
plt.ylabel('Percentage of Missing Values')
plt.xticks(rotation=90)
plt.show()

missing_data
```




```
          Missing Values  Percentage
PAON                4188    0.014835
Duration             533    0.001888

df.info()

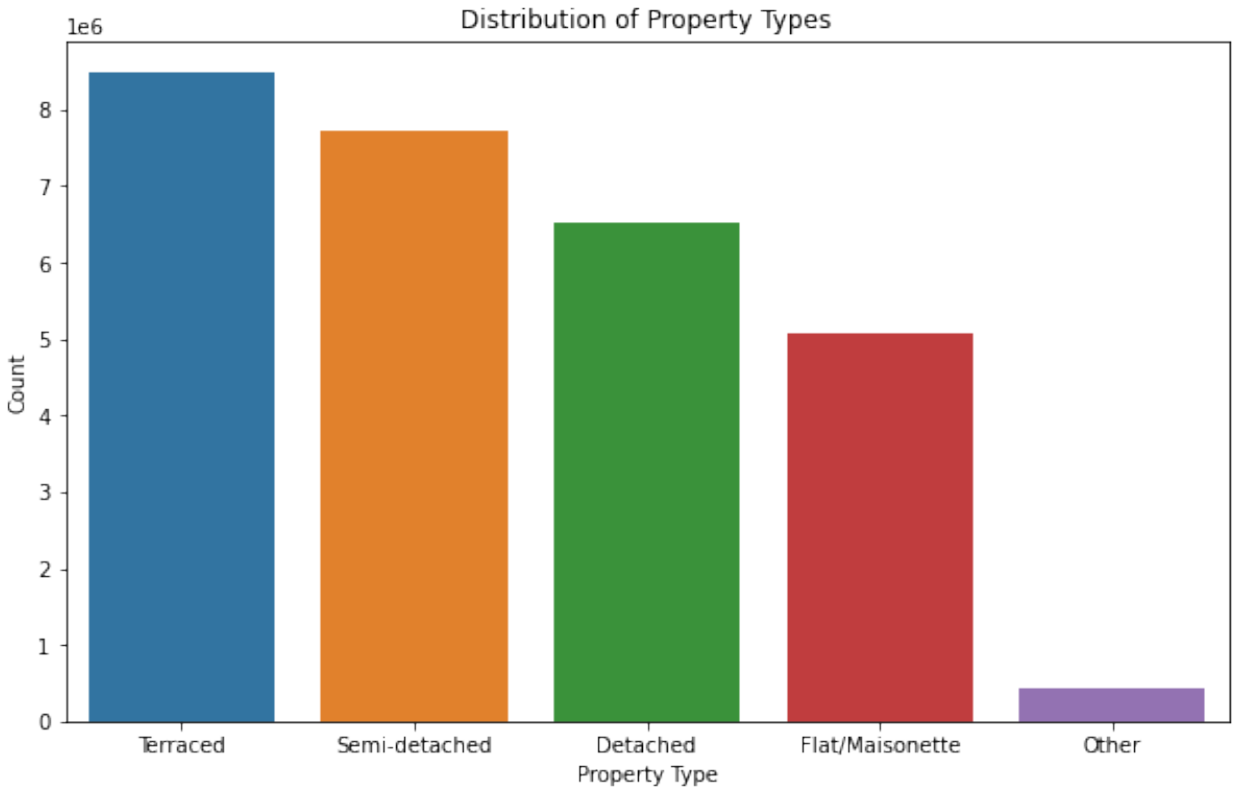
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 28230258 entries, 0 to 28230257
Data columns (total 21 columns):
 #   Column                          Dtype
---  ------                          -----
 0   Transaction_unique_identifier  object
 1   Price                           int64
 2   Date_of_Transfer                object
 3   Postcode                        object
 4   Property_Type                   object
 5   Old/New                         object
 6   Duration                        object
 7   PAON                            object
 8   SAON                            object
 9   Street                          object
 10  Locality                        object
 11  Town/City                       object
```

```
 12  District                         object
 13  County                           object
 14  Transaction_type                 object
 15  Record_status                    object
 16  Date                             object
 17  Day                              int64
 18  Month                            int64
 19  Year                             int64
 20  Region                           object
dtypes: int64(4), object(17)
memory usage: 4.4+ GB
```

```
# Summary statistics of the dataset
summary_stats = df.describe()
summary_stats
```

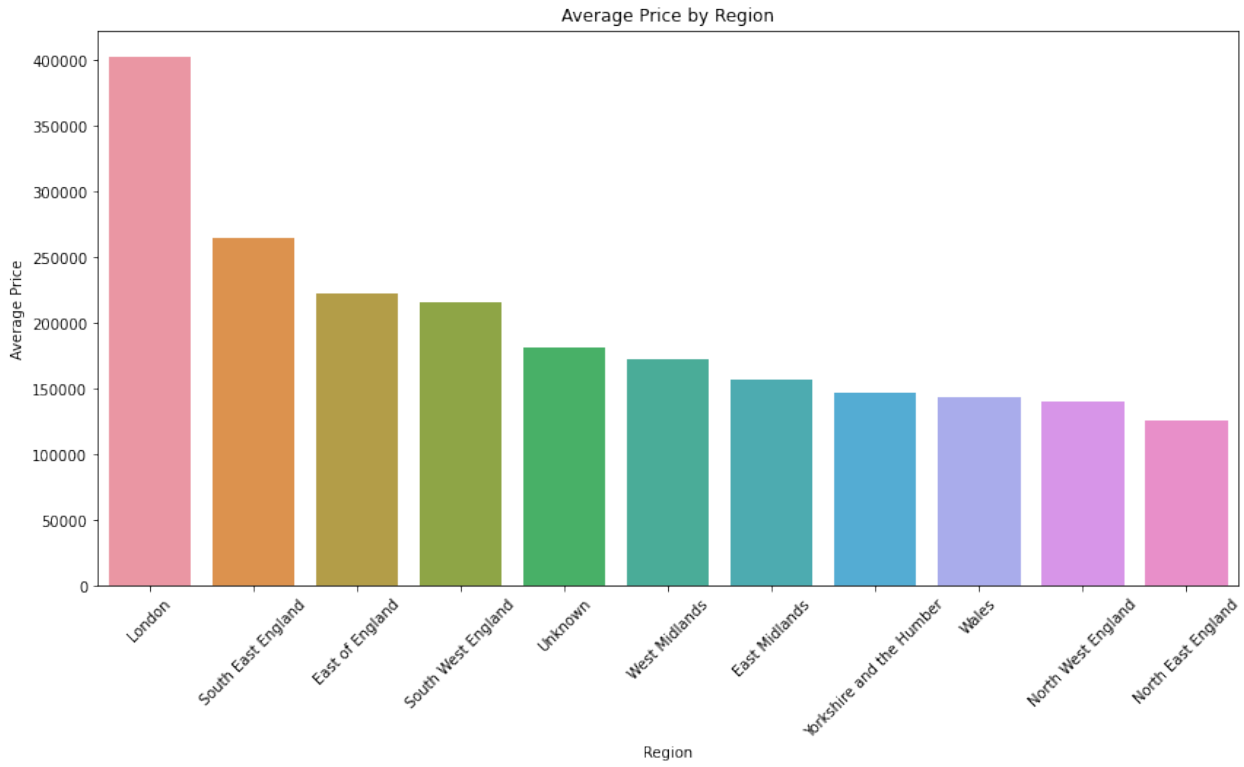
```
              Price           Day         Month          Year
count  2.823026e+07  2.823026e+07  2.823026e+07  2.823026e+07
mean   2.173630e+05  1.710951e+01  6.768861e+00  2.008139e+03
std    8.399395e+05  9.035888e+00  3.352921e+00  8.175643e+00
min    1.000000e+00  1.000000e+00  1.000000e+00  1.995000e+03
25%    8.499500e+04  9.000000e+00  4.000000e+00  2.001000e+03
50%    1.499500e+05  1.800000e+01  7.000000e+00  2.007000e+03
75%    2.475000e+05  2.500000e+01  1.000000e+01  2.016000e+03
max    5.943000e+08  3.100000e+01  1.200000e+01  2.023000e+03
```

```
# Exploring Property Type Distribution
plt.figure(figsize=(10, 6))
sns.countplot(data=df, x='Property_Type')
plt.title('Distribution of Property Types')
plt.xlabel('Property Type')
plt.ylabel('Count')
plt.show()
```

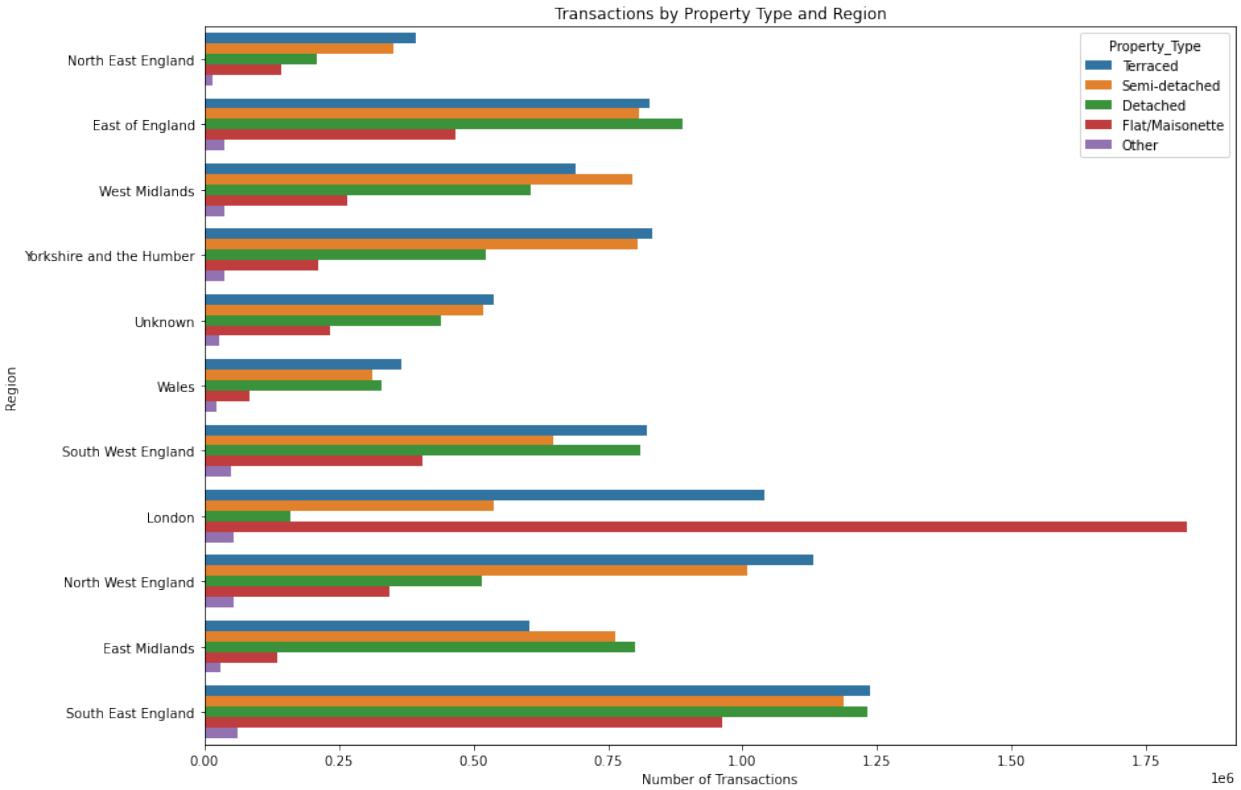



```
# Exploring Average price by region
avg_price_region = df.groupby('Region')
['Price'].mean().sort_values(ascending=False)

plt.figure(figsize=(14, 7))
sns.barplot(x=avg_price_region.index, y=avg_price_region.values)
plt.title('Average Price by Region')
plt.xlabel('Region')
plt.ylabel('Average Price')
plt.xticks(rotation=45)
plt.show()
```

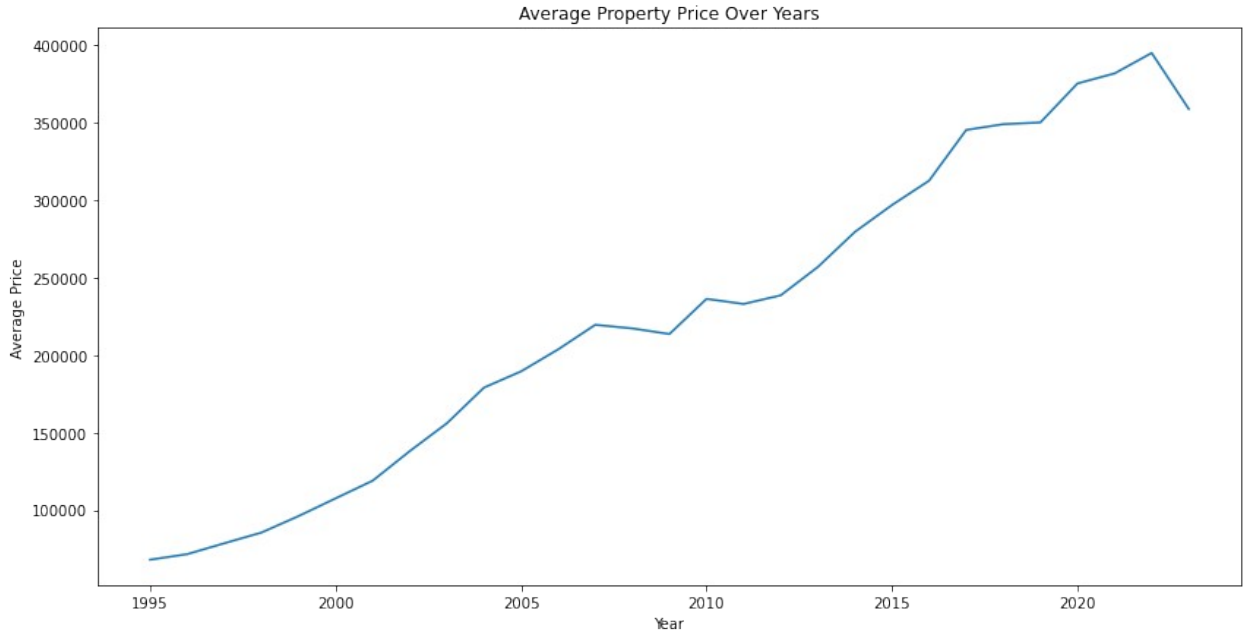



```
# Exploring Transactions by property type and region using legends
plt.figure(figsize=(14, 10))
sns.countplot(y='Region', hue='Property_Type',
data=df.dropna(subset=['Region', 'Property_Type']))
plt.title('Transactions by Property Type and Region')
plt.xlabel('Number of Transactions')
plt.ylabel('Region')
plt.show()
```




```
# Average price trends over the years
avg_price_year = df.groupby('Year')['Price'].mean()

plt.figure(figsize=(14, 7))
avg_price_year.plot()
plt.title('Average Property Price Over Years')
plt.xlabel('Year')
plt.ylabel('Average Price')
plt.show()
```




```
import pandas as pd
import matplotlib.pyplot as plt

# Assuming 'df' is already loaded and preprocessed as before

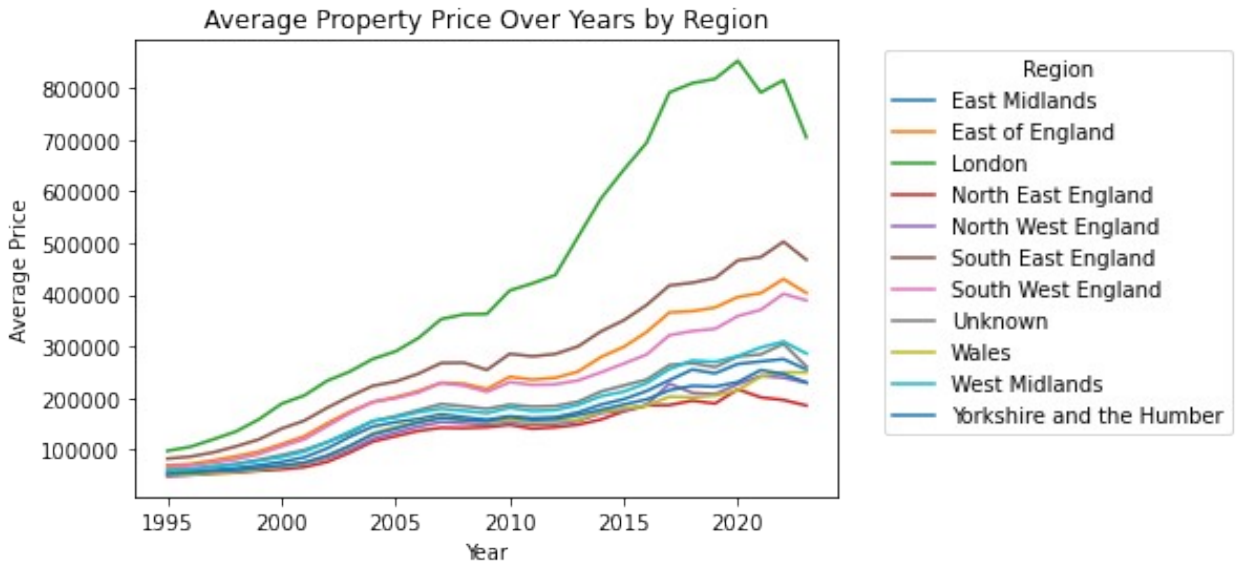
# Convert 'Date_of_Transfer' to datetime if not already done
df['Date_of_Transfer'] = pd.to_datetime(df['Date_of_Transfer'])

# Create 'Year' column
df['Year'] = df['Date_of_Transfer'].dt.year

# Calculate average price trends over the years for each region
avg_price_year_region = df.groupby(['Year', 'Region'])
['Price'].mean().unstack()

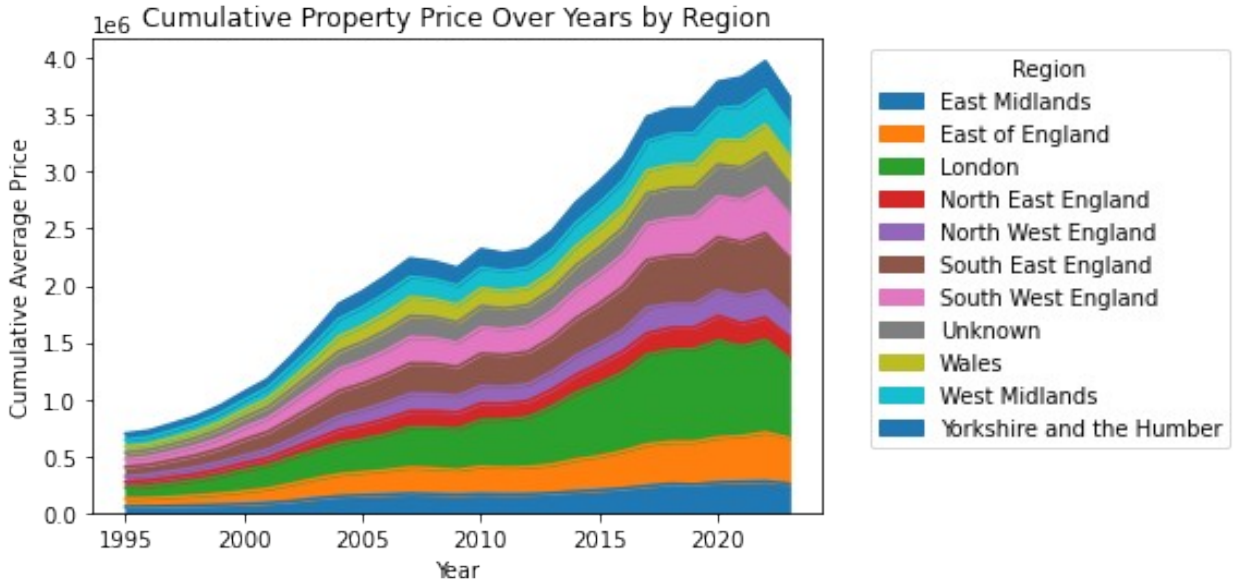
# Plot average price trends for each region
plt.figure(figsize=(18, 10))
avg_price_year_region.plot()
plt.title('Average Property Price Over Years by Region')
plt.xlabel('Year')
plt.ylabel('Average Price')
plt.legend(title='Region', bbox_to_anchor=(1.05, 1), loc='upper left')
plt.show()
```

```
<Figure size 1296x720 with 0 Axes>
```




```
# Stacked Area Chart
plt.figure(figsize=(18, 10))
avg_price_year_region.plot.area()
plt.title('Cumulative Property Price Over Years by Region')
plt.xlabel('Year')
plt.ylabel('Cumulative Average Price')
plt.legend(title='Region', bbox_to_anchor=(1.05, 1), loc='upper left')
plt.show()
```

```
<Figure size 1296x720 with 0 Axes>
```




```
# Calculate average price trends over the years for each region
avg_price_year_region = df.groupby(['Year', 'Region'])
```

```
['Price'].mean().unstack()

# Determine the number of regions
num_regions = avg_price_year_region.shape[1]

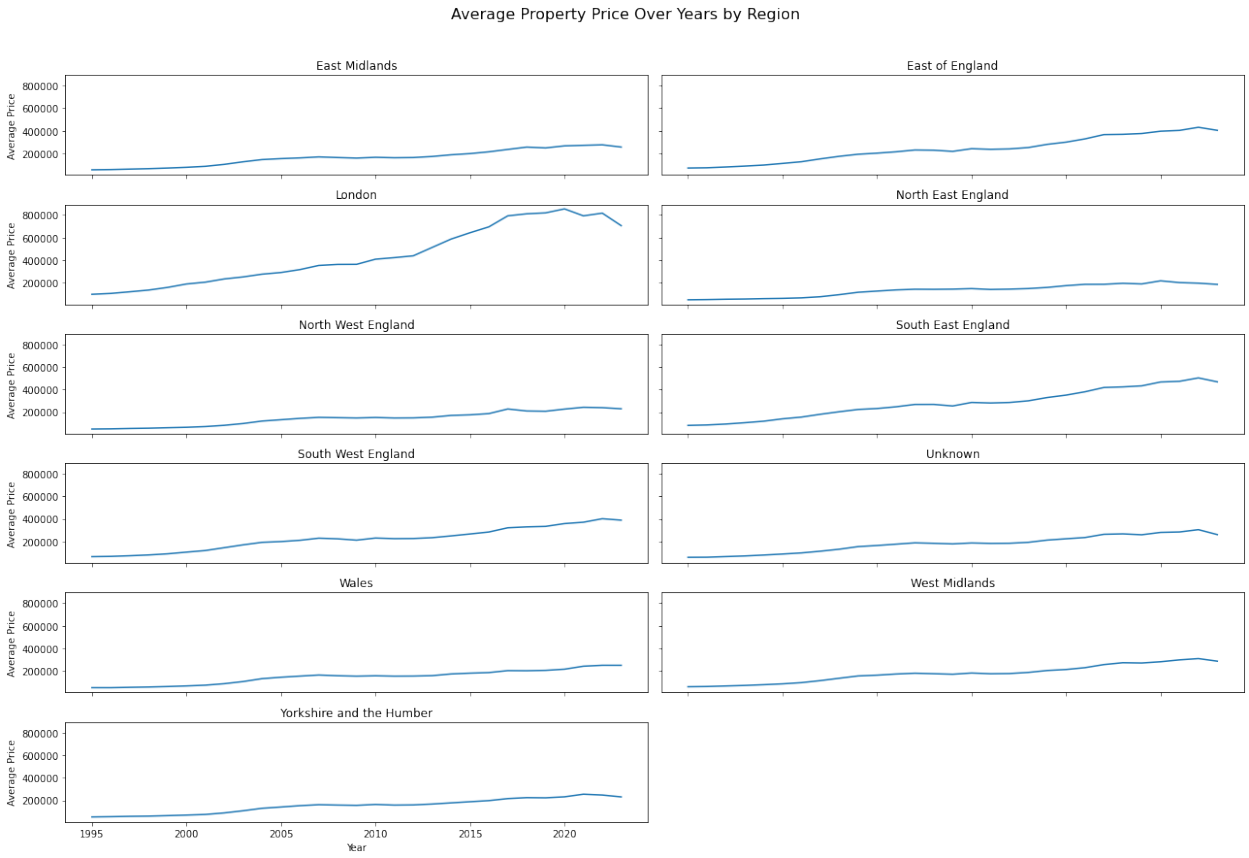
# Calculate rows and columns for subplots
ncols = 2
nrows = (num_regions + ncols - 1) // ncols

# Plot average price trends for each region with subplots
fig, axes = plt.subplots(nrows=nrows, ncols=ncols, figsize=(18, 12),
sharex=True, sharey=True)
axes = axes.flatten()

for i, region in enumerate(avg_price_year_region.columns):
    avg_price_year_region[region].plot(ax=axes[i], title=region)
    axes[i].set_xlabel('Year')
    axes[i].set_ylabel('Average Price')

# Remove empty subplots
for i in range(num_regions, len(axes)):
    fig.delaxes(axes[i])

plt.suptitle('Average Property Price Over Years by Region', y=1.02,
fontsize=16)
plt.tight_layout()
plt.show()
```




```
# Convert 'date_of_transfer' to datetime
df['Date_of_Transfer'] = pd.to_datetime(df['Date_of_Transfer'])

# Display basic information
df.info()

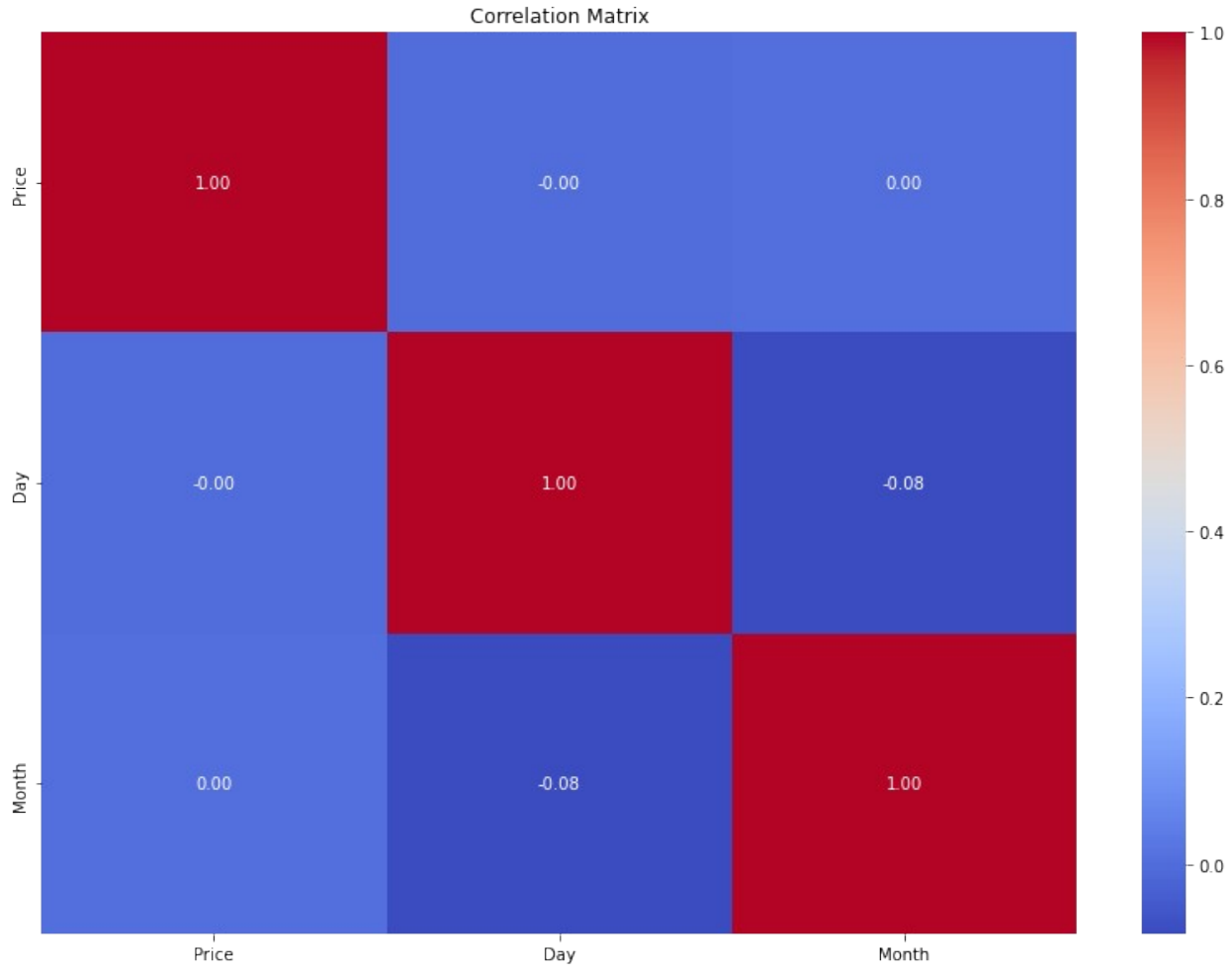
# Select only numeric columns
numeric_df = df.select_dtypes(include=['float64', 'int64'])

# Calculate the correlation matrix
corr_matrix = numeric_df.corr()

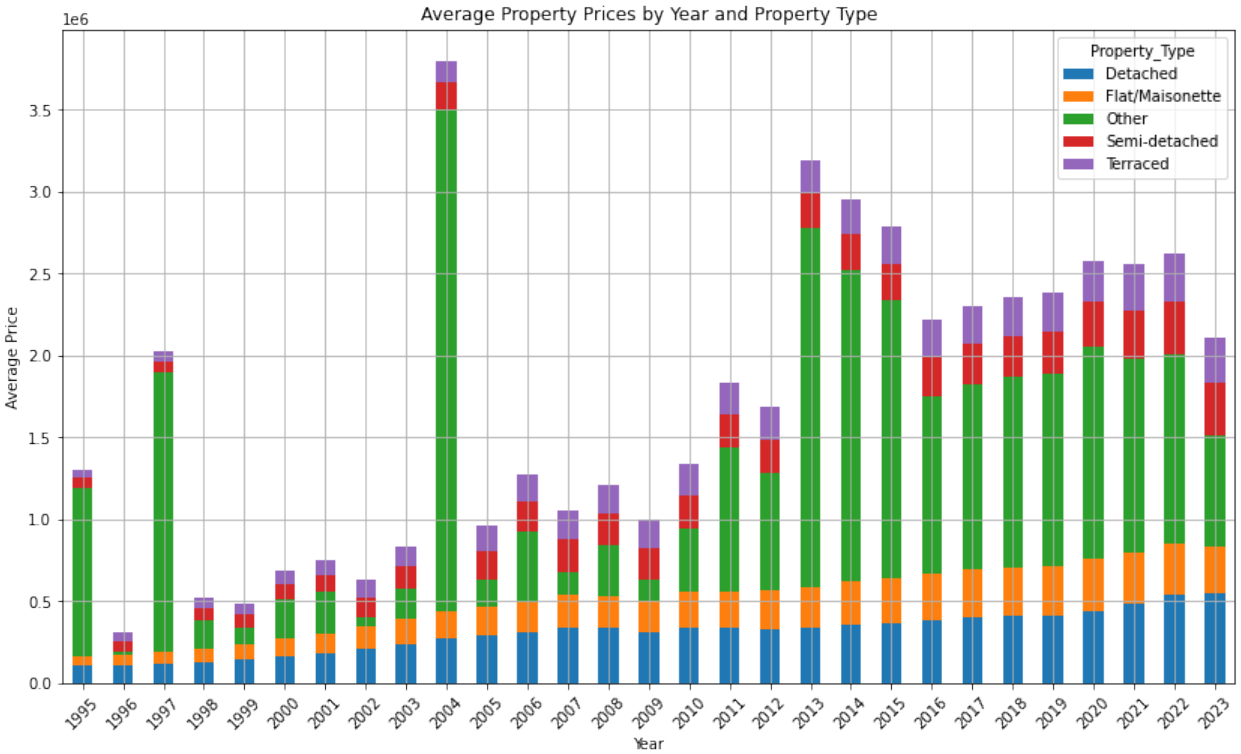
# Plot the correlation matrix
plt.figure(figsize=(14, 10))
sns.heatmap(corr_matrix, annot=True, cmap='coolwarm', fmt='.2f')
plt.title('Correlation Matrix')
plt.show()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 28230258 entries, 0 to 28230257
Data columns (total 21 columns):
 #   Column                          Dtype
---  ------                          -----
 0   Transaction_unique_identifier  object
```

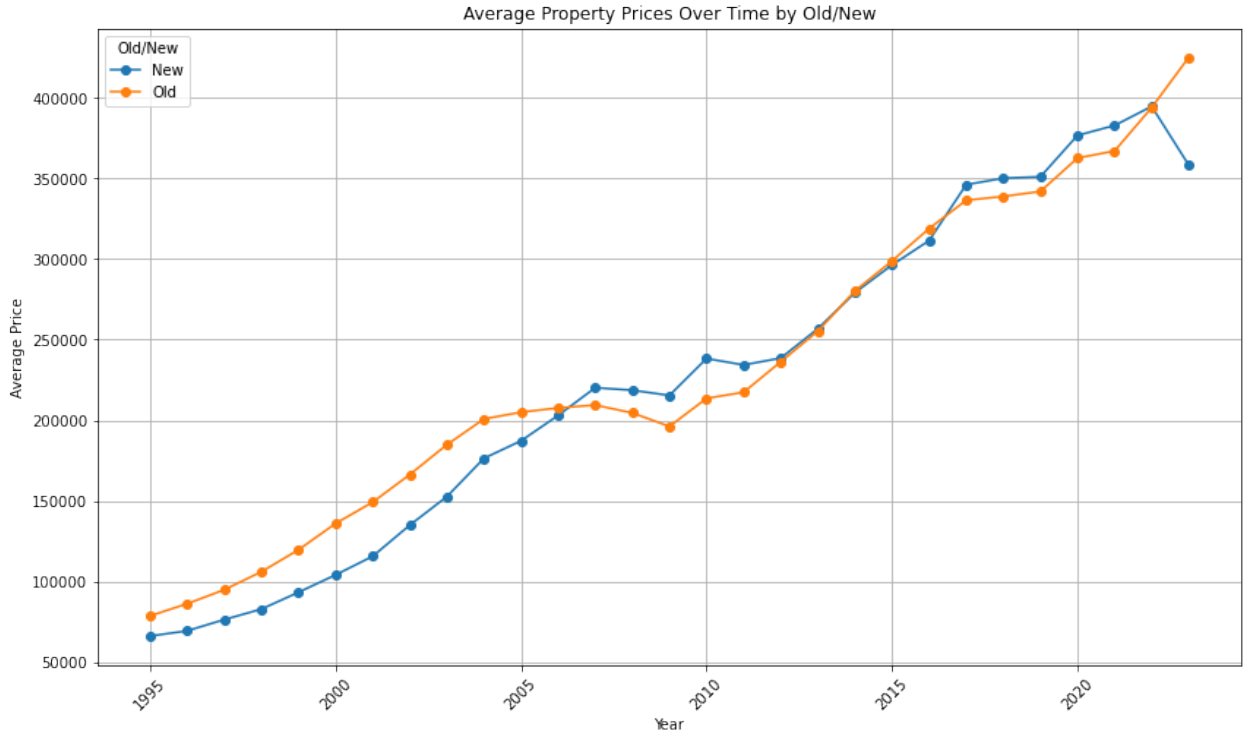
```
 1   Price                           int64
 2   Date_of_Transfer                datetime64[ns]
 3   Postcode                        object
 4   Property_Type                   object
 5   Old/New                         object
 6   Duration                        object
 7   PAON                            object
 8   SAON                            object
 9   Street                          object
 10  Locality                        object
 11  Town/City                       object
 12  District                        object
 13  County                          object
 14  Transaction_type                object
 15  Record_status                   object
 16  Date                            object
 17  Day                             int64
 18  Month                           int64
 19  Year                            int32
 20  Region                          object
dtypes: datetime64[ns](1), int32(1), int64(3), object(16)
memory usage: 4.3+ GB
```



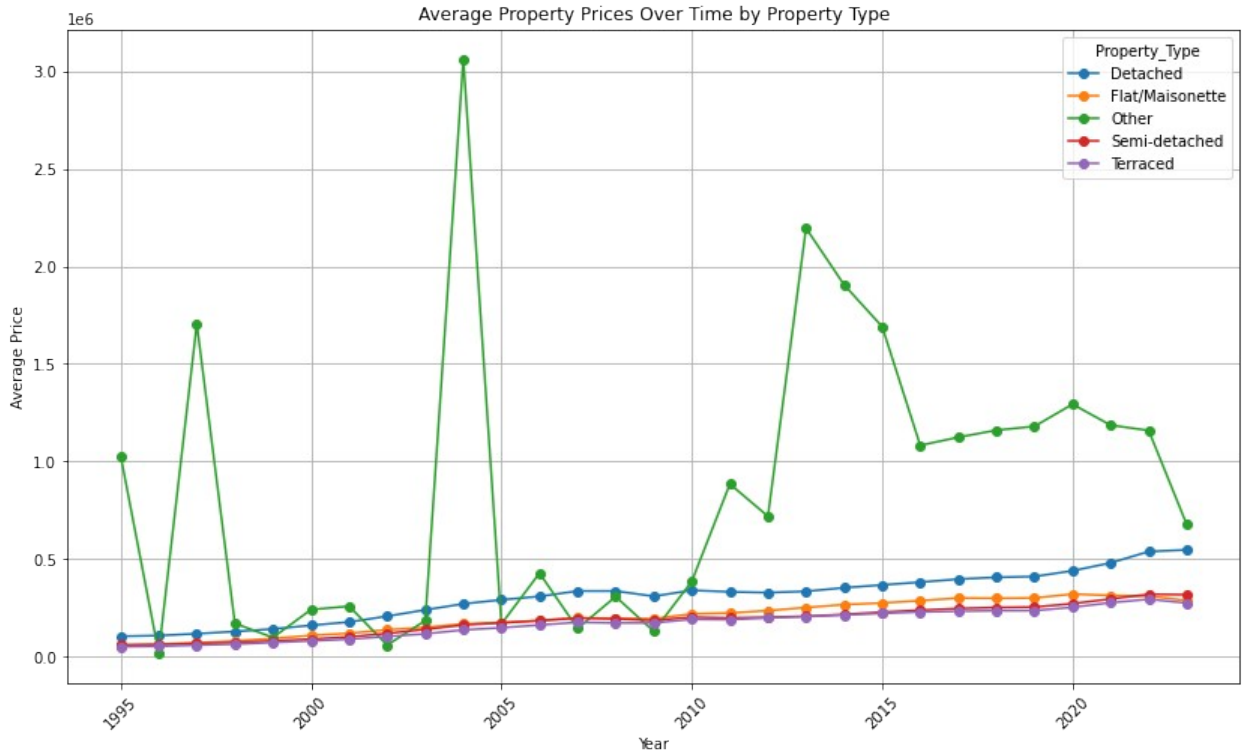

```
# Stacked bar chart for average prices by property type
if 'Property_Type' in df.columns:
    df_grouped = df.groupby(['Year', 'Property_Type'])
['Price'].mean().unstack().fillna(0)
    df_grouped.plot(kind='bar', stacked=True, figsize=(14, 8))
    plt.title('Average Property Prices by Year and Property Type')
    plt.xlabel('Year')
    plt.ylabel('Average Price')
    plt.grid(True)
    plt.xticks(rotation=45)
    plt.show()
else:
    print("Column 'property_type' does not exist in the DataFrame.")
```




```
# Line chart for average prices by old/new property
if 'Old/New' in df.columns:
    df_grouped = df.groupby(['Year', 'Old/New'])
['Price'].mean().unstack().fillna(0)
    df_grouped.plot(kind='line', figsize=(14, 8), marker='o')
    plt.title('Average Property Prices Over Time by Old/New')
    plt.xlabel('Year')
    plt.ylabel('Average Price')
    plt.grid(True)
    plt.xticks(rotation=45)
    plt.show()
else:
    print("Column 'Old/New' does not exist in the DataFrame.")
```




```
# Line chart for average prices by property type
if 'Property_Type' in df.columns:
    df_grouped = df.groupby(['Year', 'Property_Type'])
['Price'].mean().unstack().fillna(0)
    df_grouped.plot(kind='line', figsize=(14, 8), marker='o')
    plt.title('Average Property Prices Over Time by Property Type')
    plt.xlabel('Year')
    plt.ylabel('Average Price')
    plt.grid(True)
    plt.xticks(rotation=45)
    plt.show()
else:
    print("Column 'Property_Type' does not exist in the DataFrame.")
```




```
import pandas as pd
import plotly.graph_objects as go

# Aggregate data for the Sankey diagram
alluvial_data = df.groupby(['Property_Type',
'Old/New']).size().reset_index(name='count')

# Data for Sankey diagram
labels = list(df['Property_Type'].unique()) +
list(df['Old/New'].unique())
source = [labels.index(pt) for pt in alluvial_data['Property_Type']]
target = [labels.index(on) for on in alluvial_data['Old/New']]

# Create Sankey diagram
fig = go.Figure(data=[go.Sankey(
    node=dict(pad=15, thickness=20, line=dict(color="black",
width=0.5), label=labels),
    link=dict(source=source, target=target,
value=alluvial_data['count'])
)])

fig.update_layout(title_text="Sankey Diagram of Property Types and
Old/New Status", font_size=10)
fig.show()
```


```
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```

```
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```


```
import plotly.express as px

# Data for radial bar chart
property_type_counts =
df['Property_Type'].value_counts().reset_index()
property_type_counts.columns = ['Property_Type', 'count']

# Create the radial bar chart
fig = px.bar_polar(property_type_counts, r='count',
theta='Property_Type', color='Property_Type',
                   title='Radial Bar Chart of Property Types')

# Update layout to set background color and font
fig.update_layout(
```

```
    polar=dict(
        bgcolor="white"
    ),
    font=dict(
        color="black"
    ),
    paper_bgcolor="white",
    plot_bgcolor="lightgrey"
)

fig.show()
```

```
C:\Users\ddiol\anaconda3\lib\site-packages\plotly\express\
_core.py:2065: 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.
```


```
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```


```
import plotly.express as px

# Prepare data for the treemap
df['Price'] = df['Price'].astype(float)  # Ensure price is float for
summing
grouped_df = df.groupby(['Old/New', 'Property_Type'])
['Price'].sum().reset_index()

# Create a treemap
fig = px.treemap(grouped_df,
                 path=['Old/New', 'Property_Type'],
                 values='Price',
                 color='Price',
                 color_continuous_scale='RdBu',
                 title='Treemap of Property Prices by Old/New and
Property Type')

# Update layout for better appearance
```

```
fig.update_layout(
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    margin=dict(t=50, l=25, r=25, b=25),
    paper_bgcolor='white',
    plot_bgcolor='white'
)

# Show the plot
fig.show()
```


```
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```
import plotly.express as px

# Prepare data for the sunburst chart
df['Price'] = df['Price'].astype(float)  # Ensure price is float for
summing
grouped_df = df.groupby(['Old/New', 'Property_Type'])
['Price'].sum().reset_index()

# Create a sunburst chart, which can also be displayed as a multilevel
donut chart
fig = px.sunburst(grouped_df,
                  path=['Old/New', 'Property_Type'],
                  values='Price',
                  color='Price',
                  color_continuous_scale='RdBu',
                  title='Multilevel Donut Chart of Property Prices by
Old/New and Property Type')

# Update layout for better appearance
fig.update_layout(
    title_font=dict(size=20, family='Arial, sans-serif'),
    margin=dict(t=50, l=25, r=25, b=25),
    paper_bgcolor='white',
    plot_bgcolor='white'
)
```

```
# Show the plot
fig.show()
```


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

# Line chart for average prices by property type
if 'Property_Type' in df.columns:
    df_grouped = df.groupby(['Year', 'Property_Type'])
['Price'].mean().unstack().fillna(0)

    fig = go.Figure()

    # Plot all property types except 'Other'
    for column in df_grouped.columns:
        if column != 'Other':
            fig.add_trace(go.Scatter(
                x=df_grouped.index,
                y=df_grouped[column],
                mode='lines+markers',
                name=column,
                hovertemplate=f'{column}: {{y:.2f}}<extra></extra>'
            ))

    # Plot 'Other' on the secondary y-axis
    if 'Other' in df_grouped.columns:
        fig.add_trace(go.Scatter(
            x=df_grouped.index,
            y=df_grouped['Other'],
            mode='lines+markers',
            name='Other',
            line=dict(dash='dash', width=1, color='grey'),
            hovertemplate='Other: {y:.2f}<extra></extra>',
            yaxis='y2'
        ))

    # Update layout
```

```
    fig.update_layout(
        title='Average Property Prices Over Time by Property Type',
        xaxis=dict(
            title='Year',
            rangeslider=dict(visible=True),
            title_font=dict(size=12, family='Arial, sans-serif'),
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        yaxis=dict(
            title='Average Price (Primary)',
            title_font=dict(size=12, family='Arial, sans-serif'),
        ),
        yaxis2=dict(
            title='Average Price (Other)',
            overlaying='y',
            side='right',
            title_font=dict(size=12, family='Arial, sans-serif'),
        ),
        legend=dict(
            x=0.01, y=0.99,
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            borderwidth=1,
            font=dict(size=10, family='Arial, sans-serif')
        ),
        hovermode='x unified',
        plot_bgcolor='white',
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    )

    # Add zoom and pan functionality
    fig.update_layout(
        xaxis=dict(
            rangeslider=dict(visible=True),
            type='linear'
        ),
        yaxis=dict(
            fixedrange=False
        ),
        yaxis2=dict(
            fixedrange=False
        )
    )

    # Update range slider layout to have a label above it
    fig.update_layout(
        xaxis=dict(
            title='Use slider below to zoom in/out:',
            title_standoff=20,
            rangeslider=dict(visible=True),
```

```
            type='linear'
        )
    )

    fig.show()
else:
    print("Column 'Property_Type' does not exist in the DataFrame.")
```


```
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```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error, r2_score

# Load the dataset
df = pd.read_csv('Housing_Uk.csv')

# Data preprocessing
df['Date_of_Transfer'] = pd.to_datetime(df['Date_of_Transfer'])
df['Year'] = df['Date_of_Transfer'].dt.year
df['Month'] = df['Date_of_Transfer'].dt.month
df['Day'] = df['Date_of_Transfer'].dt.day

# Convert categorical columns to dummy variables
df = pd.get_dummies(df, columns=['Property_Type', 'Region'],
drop_first=True)

# Define features and target
features = ['Year', 'Month', 'Day'] + [col for col in df.columns if
'Property_Type' in col or 'Region' in col]
X = df[features]
y = df['Price']

# Train-test split
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

# Train the model
rf = RandomForestRegressor(n_estimators=100, random_state=42)
```

```
rf.fit(X_train, y_train)

# Predictions
y_pred = rf.predict(X_test)

# Evaluate the model
mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

print(f'Mean Squared Error: {mse}')
print(f'R^2 Score: {r2}')
```