Web Scraping and Model Development for the Stockholm housing market dataset

Business Problem

To analyze how reduction in interest rates influences property prices and migration patterns in Stockholm's housing market

Objective

To build a Polynomial Regression model to predict prices and investigate the relationship between
property types, interest rates and housing transitions.

Data Collection

1. Web Scraping the Housing Market Website: www.Booli.se
2. Downloading Monetary Policy report : https://www.riksbank.se/

Data Set Description

```
Sold Price    : Final price at which the house was sold in Swedish
krona(SEK)(kr)
```

```
Street Address: Specific location of the sold house
Sold_date     : Date at which the property sale is legally finalized
Area Name     : Descriptive location area name
Object Type   : Categorical variable which represents the different type
of houses
                (e.g., Apartment, Rowhouse, Villa etc)
Date          : Interest Rate published date by the Riskbank
Interest Rate : Rate of interest on the specified date
```

1. Web Scraping

In [1]:
```
#Importing the necessary modules
import requests
import json
import pandas as pd
from bs4 import BeautifulSoup
import time
from datetime import datetime
```

Scraping rowhouse, semi-detached house URLs has been done seperately to avoid overwhelming the server
and time-out error

In [2]:
```
# Defining base URLs for each object type
base_urls = {
    'Lägenhet': 'https://www.booli.se/sok/slutpriser?areaIds=1&objectType=Lägenhet&
    'Villa': 'https://www.booli.se/sok/slutpriser?areaIds=1&objectType=Villa&sort=s
    }
```

In [3]:
```
# Initialize a dictionary to store lists for each property type
results = {
    'Lägenhet': [],
    'Villa': []
    }

# Set maximum pages to scrape
max_pages = 300

# Loop through each property type
for object_type, base_url in [('Lägenhet', base_urls['Lägenhet']),
                              ('Villa', base_urls['Villa'])]:


    print(f"Scraping {object_type}")

    # Pagination for scraping multiple desired pages
    for page_number in range(1, max_pages + 1):
        url = base_url.format(page_number)
        response = requests.get(url)

        if response.status_code == 200:
            print(f"Scraping page {page_number} for {object_type}")
```

```
            #Parsing the HTML content using BeautifulSoup
            soup = BeautifulSoup(response.content, 'html.parser')

            #Inspect the scriptid from HTML structure to retrieve data as there is
            script_tag = soup.find('script', id='__NEXT_DATA__')
            json_data = json.loads(script_tag.string)
            apollo_state = json_data['props']['pageProps']['__APOLLO_STATE__']

            # Check for sold properties
            data_found = False
            for key in apollo_state.keys():
                if key.startswith('SoldProperty:'):
                    data_found = True
                    property_data = apollo_state[key]

                    # Only collect data if the object type matches
                    if property_data.get('objectType') == object_type:

                        sold_price = property_data.get('soldPrice', {}).get('format

                        street_address = property_data.get('streetAddress', 'N/A')

                        # Handle living_area extraction safely based on faced chall
                        living_area_data = property_data.get('livingArea', None)

                        if living_area_data is not None:
                            living_area = living_area_data.get('formatted', 'N/A')
                        else:
                            living_area = 'N/A'

                        object_type = property_data.get('objectType', 'N/A')

                        area_name = property_data.get('descriptiveAreaName', 'N/A')

                        sold_date = property_data.get('soldDate', 'N/A')



                        # Append data to the appropriate list
                        results[object_type].append({
                            'Sold Price': sold_price,
                            'Street Address': street_address,
                            'Living Area': living_area,
                            'Object Type': object_type,
                            'Area Name': area_name,
                            'Sold Date': sold_date,
                        })

            # In case, if no data was found on the page, break the loop
            if not data_found:
                print(f"No more data found for {object_type} on page {page_number}.
                break
        else:
            print(f"Failed to retrieve data from page {page_number} for {object_typ
            break
```

```
        # Delay to avoid rate limiting or overwhelming the server (included based o
        time.sleep(2)

# Convert results to DataFrames and save as CSV for data consistency
for object_type, data in results.items():
    df = pd.DataFrame(data)
    df.to_csv(f'{object_type.lower()}.csv', index=False)
```

```
Scraping Lägenhet
Scraping page 1 for Lägenhet
Scraping page 2 for Lägenhet
Scraping page 3 for Lägenhet
Scraping page 4 for Lägenhet
Scraping page 5 for Lägenhet
Scraping page 6 for Lägenhet
Scraping page 7 for Lägenhet
Scraping page 8 for Lägenhet
Scraping page 9 for Lägenhet
Scraping page 10 for Lägenhet
Scraping page 11 for Lägenhet
Scraping page 12 for Lägenhet
Scraping page 13 for Lägenhet
Scraping page 14 for Lägenhet
Scraping page 15 for Lägenhet
Scraping page 16 for Lägenhet
Scraping page 17 for Lägenhet
Scraping page 18 for Lägenhet
Scraping page 19 for Lägenhet
Scraping page 20 for Lägenhet
Scraping page 21 for Lägenhet
Scraping page 22 for Lägenhet
Scraping page 23 for Lägenhet
Scraping page 24 for Lägenhet
Scraping page 25 for Lägenhet
Scraping page 26 for Lägenhet
Scraping page 27 for Lägenhet
Scraping page 28 for Lägenhet
Scraping page 29 for Lägenhet
Scraping page 30 for Lägenhet
Scraping page 31 for Lägenhet
Scraping page 32 for Lägenhet
Scraping page 33 for Lägenhet
Scraping page 34 for Lägenhet
Scraping page 35 for Lägenhet
Scraping page 36 for Lägenhet
Scraping page 37 for Lägenhet
Scraping page 38 for Lägenhet
Scraping page 39 for Lägenhet
Scraping page 40 for Lägenhet
Scraping page 41 for Lägenhet
Scraping page 42 for Lägenhet
Scraping page 43 for Lägenhet
Scraping page 44 for Lägenhet
Scraping page 45 for Lägenhet
Scraping page 46 for Lägenhet
Scraping page 47 for Lägenhet
Scraping page 48 for Lägenhet
Scraping page 49 for Lägenhet
Scraping page 50 for Lägenhet
Scraping page 51 for Lägenhet
Scraping page 52 for Lägenhet
Scraping page 53 for Lägenhet
Scraping page 54 for Lägenhet
Scraping page 55 for Lägenhet
```

```
Scraping page 56 for Lägenhet
Scraping page 57 for Lägenhet
Scraping page 58 for Lägenhet
Scraping page 59 for Lägenhet
Scraping page 60 for Lägenhet
Scraping page 61 for Lägenhet
Scraping page 62 for Lägenhet
Scraping page 63 for Lägenhet
Scraping page 64 for Lägenhet
Scraping page 65 for Lägenhet
Scraping page 66 for Lägenhet
Scraping page 67 for Lägenhet
Scraping page 68 for Lägenhet
Scraping page 69 for Lägenhet
Scraping page 70 for Lägenhet
Scraping page 71 for Lägenhet
Scraping page 72 for Lägenhet
Scraping page 73 for Lägenhet
Scraping page 74 for Lägenhet
Scraping page 75 for Lägenhet
Scraping page 76 for Lägenhet
Scraping page 77 for Lägenhet
Scraping page 78 for Lägenhet
Scraping page 79 for Lägenhet
Scraping page 80 for Lägenhet
Scraping page 81 for Lägenhet
Scraping page 82 for Lägenhet
Scraping page 83 for Lägenhet
Scraping page 84 for Lägenhet
Scraping page 85 for Lägenhet
Scraping page 86 for Lägenhet
Scraping page 87 for Lägenhet
Scraping page 88 for Lägenhet
Scraping page 89 for Lägenhet
Scraping page 90 for Lägenhet
Scraping page 91 for Lägenhet
Scraping page 92 for Lägenhet
Scraping page 93 for Lägenhet
Scraping page 94 for Lägenhet
Scraping page 95 for Lägenhet
Scraping page 96 for Lägenhet
Scraping page 97 for Lägenhet
Scraping page 98 for Lägenhet
Scraping page 99 for Lägenhet
Scraping page 100 for Lägenhet
Scraping page 101 for Lägenhet
Scraping page 102 for Lägenhet
Scraping page 103 for Lägenhet
Scraping page 104 for Lägenhet
Scraping page 105 for Lägenhet
Scraping page 106 for Lägenhet
Scraping page 107 for Lägenhet
Scraping page 108 for Lägenhet
Scraping page 109 for Lägenhet
Scraping page 110 for Lägenhet
Scraping page 111 for Lägenhet
```

```
Scraping page 112 for Lägenhet
Scraping page 113 for Lägenhet
Scraping page 114 for Lägenhet
Scraping page 115 for Lägenhet
Scraping page 116 for Lägenhet
Scraping page 117 for Lägenhet
Scraping page 118 for Lägenhet
Scraping page 119 for Lägenhet
Scraping page 120 for Lägenhet
Scraping page 121 for Lägenhet
Scraping page 122 for Lägenhet
Scraping page 123 for Lägenhet
Scraping page 124 for Lägenhet
Scraping page 125 for Lägenhet
Scraping page 126 for Lägenhet
Scraping page 127 for Lägenhet
Scraping page 128 for Lägenhet
Scraping page 129 for Lägenhet
Scraping page 130 for Lägenhet
Scraping page 131 for Lägenhet
Scraping page 132 for Lägenhet
Scraping page 133 for Lägenhet
Scraping page 134 for Lägenhet
Scraping page 135 for Lägenhet
Scraping page 136 for Lägenhet
Scraping page 137 for Lägenhet
Scraping page 138 for Lägenhet
Scraping page 139 for Lägenhet
Scraping page 140 for Lägenhet
Scraping page 141 for Lägenhet
Scraping page 142 for Lägenhet
Scraping page 143 for Lägenhet
Scraping page 144 for Lägenhet
Scraping page 145 for Lägenhet
Scraping page 146 for Lägenhet
Scraping page 147 for Lägenhet
Scraping page 148 for Lägenhet
Scraping page 149 for Lägenhet
Scraping page 150 for Lägenhet
Scraping page 151 for Lägenhet
Scraping page 152 for Lägenhet
Scraping page 153 for Lägenhet
Scraping page 154 for Lägenhet
Scraping page 155 for Lägenhet
Scraping page 156 for Lägenhet
Scraping page 157 for Lägenhet
Scraping page 158 for Lägenhet
Scraping page 159 for Lägenhet
Scraping page 160 for Lägenhet
Scraping page 161 for Lägenhet
Scraping page 162 for Lägenhet
Scraping page 163 for Lägenhet
Scraping page 164 for Lägenhet
Scraping page 165 for Lägenhet
Scraping page 166 for Lägenhet
Scraping page 167 for Lägenhet
```

```
Scraping page 168 for Lägenhet
Scraping page 169 for Lägenhet
Scraping page 170 for Lägenhet
Scraping page 171 for Lägenhet
Scraping page 172 for Lägenhet
Scraping page 173 for Lägenhet
Scraping page 174 for Lägenhet
Scraping page 175 for Lägenhet
Scraping page 176 for Lägenhet
Scraping page 177 for Lägenhet
Scraping page 178 for Lägenhet
Scraping page 179 for Lägenhet
Scraping page 180 for Lägenhet
Scraping page 181 for Lägenhet
Scraping page 182 for Lägenhet
Scraping page 183 for Lägenhet
Scraping page 184 for Lägenhet
Scraping page 185 for Lägenhet
Scraping page 186 for Lägenhet
Scraping page 187 for Lägenhet
Scraping page 188 for Lägenhet
Scraping page 189 for Lägenhet
Scraping page 190 for Lägenhet
Scraping page 191 for Lägenhet
Scraping page 192 for Lägenhet
Scraping page 193 for Lägenhet
Scraping page 194 for Lägenhet
Scraping page 195 for Lägenhet
Scraping page 196 for Lägenhet
Scraping page 197 for Lägenhet
Scraping page 198 for Lägenhet
Scraping page 199 for Lägenhet
Scraping page 200 for Lägenhet
Scraping page 201 for Lägenhet
Scraping page 202 for Lägenhet
Scraping page 203 for Lägenhet
Scraping page 204 for Lägenhet
Scraping page 205 for Lägenhet
Scraping page 206 for Lägenhet
Scraping page 207 for Lägenhet
Scraping page 208 for Lägenhet
Scraping page 209 for Lägenhet
Scraping page 210 for Lägenhet
Scraping page 211 for Lägenhet
Scraping page 212 for Lägenhet
Scraping page 213 for Lägenhet
Scraping page 214 for Lägenhet
Scraping page 215 for Lägenhet
Scraping page 216 for Lägenhet
Scraping page 217 for Lägenhet
Scraping page 218 for Lägenhet
Scraping page 219 for Lägenhet
Scraping page 220 for Lägenhet
Scraping page 221 for Lägenhet
Scraping page 222 for Lägenhet
Scraping page 223 for Lägenhet
```

```
Scraping page 224 for Lägenhet
Scraping page 225 for Lägenhet
Scraping page 226 for Lägenhet
Scraping page 227 for Lägenhet
Scraping page 228 for Lägenhet
Scraping page 229 for Lägenhet
Scraping page 230 for Lägenhet
Scraping page 231 for Lägenhet
Scraping page 232 for Lägenhet
Scraping page 233 for Lägenhet
Scraping page 234 for Lägenhet
Scraping page 235 for Lägenhet
Scraping page 236 for Lägenhet
Scraping page 237 for Lägenhet
Scraping page 238 for Lägenhet
Scraping page 239 for Lägenhet
Scraping page 240 for Lägenhet
Scraping page 241 for Lägenhet
Scraping page 242 for Lägenhet
Scraping page 243 for Lägenhet
Scraping page 244 for Lägenhet
Scraping page 245 for Lägenhet
Scraping page 246 for Lägenhet
Scraping page 247 for Lägenhet
Scraping page 248 for Lägenhet
Scraping page 249 for Lägenhet
Scraping page 250 for Lägenhet
Scraping page 251 for Lägenhet
Scraping page 252 for Lägenhet
Scraping page 253 for Lägenhet
Scraping page 254 for Lägenhet
Scraping page 255 for Lägenhet
Scraping page 256 for Lägenhet
Scraping page 257 for Lägenhet
Scraping page 258 for Lägenhet
Scraping page 259 for Lägenhet
Scraping page 260 for Lägenhet
Scraping page 261 for Lägenhet
Scraping page 262 for Lägenhet
Scraping page 263 for Lägenhet
Scraping page 264 for Lägenhet
Scraping page 265 for Lägenhet
Scraping page 266 for Lägenhet
Scraping page 267 for Lägenhet
Scraping page 268 for Lägenhet
Scraping page 269 for Lägenhet
Scraping page 270 for Lägenhet
Scraping page 271 for Lägenhet
Scraping page 272 for Lägenhet
Scraping page 273 for Lägenhet
Scraping page 274 for Lägenhet
Scraping page 275 for Lägenhet
Scraping page 276 for Lägenhet
Scraping page 277 for Lägenhet
Scraping page 278 for Lägenhet
Scraping page 279 for Lägenhet
```

```
Scraping page 280 for Lägenhet
Scraping page 281 for Lägenhet
Scraping page 282 for Lägenhet
Scraping page 283 for Lägenhet
Scraping page 284 for Lägenhet
Scraping page 285 for Lägenhet
Scraping page 286 for Lägenhet
Scraping page 287 for Lägenhet
Scraping page 288 for Lägenhet
Scraping page 289 for Lägenhet
Scraping page 290 for Lägenhet
Scraping page 291 for Lägenhet
Scraping page 292 for Lägenhet
Scraping page 293 for Lägenhet
Scraping page 294 for Lägenhet
Scraping page 295 for Lägenhet
Scraping page 296 for Lägenhet
Scraping page 297 for Lägenhet
Scraping page 298 for Lägenhet
Scraping page 299 for Lägenhet
Scraping page 300 for Lägenhet
Scraping Villa
Scraping page 1 for Villa
Scraping page 2 for Villa
Scraping page 3 for Villa
Scraping page 4 for Villa
Scraping page 5 for Villa
Scraping page 6 for Villa
Scraping page 7 for Villa
Scraping page 8 for Villa
Scraping page 9 for Villa
Scraping page 10 for Villa
Scraping page 11 for Villa
Scraping page 12 for Villa
Scraping page 13 for Villa
Scraping page 14 for Villa
Scraping page 15 for Villa
Scraping page 16 for Villa
Scraping page 17 for Villa
Scraping page 18 for Villa
Scraping page 19 for Villa
Scraping page 20 for Villa
Scraping page 21 for Villa
Scraping page 22 for Villa
Scraping page 23 for Villa
Scraping page 24 for Villa
Scraping page 25 for Villa
Scraping page 26 for Villa
Scraping page 27 for Villa
Scraping page 28 for Villa
Scraping page 29 for Villa
Scraping page 30 for Villa
Scraping page 31 for Villa
Scraping page 32 for Villa
Scraping page 33 for Villa
Scraping page 34 for Villa
```

```
Scraping page 35 for Villa
Scraping page 36 for Villa
Scraping page 37 for Villa
Scraping page 38 for Villa
Scraping page 39 for Villa
Scraping page 40 for Villa
Scraping page 41 for Villa
Scraping page 42 for Villa
Scraping page 43 for Villa
Scraping page 44 for Villa
Scraping page 45 for Villa
Scraping page 46 for Villa
Scraping page 47 for Villa
Scraping page 48 for Villa
Scraping page 49 for Villa
Scraping page 50 for Villa
Scraping page 51 for Villa
Scraping page 52 for Villa
Scraping page 53 for Villa
Scraping page 54 for Villa
Scraping page 55 for Villa
Scraping page 56 for Villa
Scraping page 57 for Villa
Scraping page 58 for Villa
Scraping page 59 for Villa
Scraping page 60 for Villa
Scraping page 61 for Villa
Scraping page 62 for Villa
Scraping page 63 for Villa
Scraping page 64 for Villa
Scraping page 65 for Villa
Scraping page 66 for Villa
Scraping page 67 for Villa
Scraping page 68 for Villa
Scraping page 69 for Villa
Scraping page 70 for Villa
Scraping page 71 for Villa
Scraping page 72 for Villa
Scraping page 73 for Villa
Scraping page 74 for Villa
Scraping page 75 for Villa
Scraping page 76 for Villa
Scraping page 77 for Villa
Scraping page 78 for Villa
Scraping page 79 for Villa
Scraping page 80 for Villa
Scraping page 81 for Villa
Scraping page 82 for Villa
Scraping page 83 for Villa
Scraping page 84 for Villa
Scraping page 85 for Villa
Scraping page 86 for Villa
Scraping page 87 for Villa
Scraping page 88 for Villa
Scraping page 89 for Villa
Scraping page 90 for Villa
```

```
Scraping page 91 for Villa
Scraping page 92 for Villa
Scraping page 93 for Villa
Scraping page 94 for Villa
Scraping page 95 for Villa
Scraping page 96 for Villa
Scraping page 97 for Villa
Scraping page 98 for Villa
Scraping page 99 for Villa
Scraping page 100 for Villa
Scraping page 101 for Villa
Scraping page 102 for Villa
Scraping page 103 for Villa
Scraping page 104 for Villa
Scraping page 105 for Villa
Scraping page 106 for Villa
Scraping page 107 for Villa
Scraping page 108 for Villa
Scraping page 109 for Villa
Scraping page 110 for Villa
Scraping page 111 for Villa
Scraping page 112 for Villa
Scraping page 113 for Villa
Scraping page 114 for Villa
Scraping page 115 for Villa
Scraping page 116 for Villa
Scraping page 117 for Villa
Scraping page 118 for Villa
Scraping page 119 for Villa
Scraping page 120 for Villa
Scraping page 121 for Villa
Scraping page 122 for Villa
Scraping page 123 for Villa
Scraping page 124 for Villa
Scraping page 125 for Villa
Scraping page 126 for Villa
Scraping page 127 for Villa
Scraping page 128 for Villa
Scraping page 129 for Villa
Scraping page 130 for Villa
Scraping page 131 for Villa
Scraping page 132 for Villa
Scraping page 133 for Villa
Scraping page 134 for Villa
Scraping page 135 for Villa
Scraping page 136 for Villa
Scraping page 137 for Villa
Scraping page 138 for Villa
Scraping page 139 for Villa
Scraping page 140 for Villa
Scraping page 141 for Villa
Scraping page 142 for Villa
Scraping page 143 for Villa
Scraping page 144 for Villa
Scraping page 145 for Villa
Scraping page 146 for Villa
```

```
Scraping page 147 for Villa
Scraping page 148 for Villa
Scraping page 149 for Villa
Scraping page 150 for Villa
Scraping page 151 for Villa
Scraping page 152 for Villa
Scraping page 153 for Villa
Scraping page 154 for Villa
Scraping page 155 for Villa
Scraping page 156 for Villa
Scraping page 157 for Villa
Scraping page 158 for Villa
Scraping page 159 for Villa
Scraping page 160 for Villa
Scraping page 161 for Villa
Scraping page 162 for Villa
Scraping page 163 for Villa
Scraping page 164 for Villa
Scraping page 165 for Villa
Scraping page 166 for Villa
Scraping page 167 for Villa
Scraping page 168 for Villa
Scraping page 169 for Villa
Scraping page 170 for Villa
Scraping page 171 for Villa
Scraping page 172 for Villa
Scraping page 173 for Villa
Scraping page 174 for Villa
Scraping page 175 for Villa
Scraping page 176 for Villa
Scraping page 177 for Villa
Scraping page 178 for Villa
Scraping page 179 for Villa
Scraping page 180 for Villa
Scraping page 181 for Villa
Scraping page 182 for Villa
Scraping page 183 for Villa
Scraping page 184 for Villa
Scraping page 185 for Villa
Scraping page 186 for Villa
Scraping page 187 for Villa
Scraping page 188 for Villa
Scraping page 189 for Villa
Scraping page 190 for Villa
Scraping page 191 for Villa
Scraping page 192 for Villa
Scraping page 193 for Villa
Scraping page 194 for Villa
Scraping page 195 for Villa
Scraping page 196 for Villa
Scraping page 197 for Villa
Scraping page 198 for Villa
Scraping page 199 for Villa
Scraping page 200 for Villa
Scraping page 201 for Villa
Scraping page 202 for Villa
```

```
Scraping page 203 for Villa
Scraping page 204 for Villa
Scraping page 205 for Villa
Scraping page 206 for Villa
Scraping page 207 for Villa
Scraping page 208 for Villa
Scraping page 209 for Villa
Scraping page 210 for Villa
Scraping page 211 for Villa
Scraping page 212 for Villa
Scraping page 213 for Villa
Scraping page 214 for Villa
Scraping page 215 for Villa
Scraping page 216 for Villa
Scraping page 217 for Villa
Scraping page 218 for Villa
Scraping page 219 for Villa
Scraping page 220 for Villa
Scraping page 221 for Villa
Scraping page 222 for Villa
Scraping page 223 for Villa
Scraping page 224 for Villa
Scraping page 225 for Villa
Scraping page 226 for Villa
Scraping page 227 for Villa
Scraping page 228 for Villa
Scraping page 229 for Villa
Scraping page 230 for Villa
Scraping page 231 for Villa
Scraping page 232 for Villa
Scraping page 233 for Villa
Scraping page 234 for Villa
Scraping page 235 for Villa
Scraping page 236 for Villa
Scraping page 237 for Villa
Scraping page 238 for Villa
Scraping page 239 for Villa
Scraping page 240 for Villa
Scraping page 241 for Villa
Scraping page 242 for Villa
Scraping page 243 for Villa
Scraping page 244 for Villa
Scraping page 245 for Villa
Scraping page 246 for Villa
Scraping page 247 for Villa
Scraping page 248 for Villa
Scraping page 249 for Villa
Scraping page 250 for Villa
Scraping page 251 for Villa
Scraping page 252 for Villa
Scraping page 253 for Villa
Scraping page 254 for Villa
Scraping page 255 for Villa
Scraping page 256 for Villa
Scraping page 257 for Villa
Scraping page 258 for Villa
```

```
Scraping page 259 for Villa
Scraping page 260 for Villa
Scraping page 261 for Villa
Scraping page 262 for Villa
Scraping page 263 for Villa
Scraping page 264 for Villa
Scraping page 265 for Villa
Scraping page 266 for Villa
Scraping page 267 for Villa
Scraping page 268 for Villa
Scraping page 269 for Villa
Scraping page 270 for Villa
Scraping page 271 for Villa
Scraping page 272 for Villa
Scraping page 273 for Villa
Scraping page 274 for Villa
Scraping page 275 for Villa
Scraping page 276 for Villa
Scraping page 277 for Villa
Scraping page 278 for Villa
Scraping page 279 for Villa
Scraping page 280 for Villa
Scraping page 281 for Villa
Scraping page 282 for Villa
Scraping page 283 for Villa
Scraping page 284 for Villa
Scraping page 285 for Villa
Scraping page 286 for Villa
Scraping page 287 for Villa
Scraping page 288 for Villa
Scraping page 289 for Villa
Scraping page 290 for Villa
Scraping page 291 for Villa
Scraping page 292 for Villa
Scraping page 293 for Villa
Scraping page 294 for Villa
Scraping page 295 for Villa
Scraping page 296 for Villa
Scraping page 297 for Villa
Scraping page 298 for Villa
Scraping page 299 for Villa
Scraping page 300 for Villa
```

In [4]:
```
# Read the individual CSV files
df_rowhouse = pd.read_csv('kedjehus_parhus_radhus.csv')
df_apartment = pd.read_csv('lägenhet.csv')
df_villa = pd.read_csv('villa.csv')
```

2. Monetary Policy rapport data

In [5]:
```
interest_rate_df = pd.read_excel('styrrantan-effektiv.xlsx')
```

In [6]:
```
interest_rate_df
```

Out[6]:

	Date	Interest Rate	Year	Month
0	2006-01-26	1.75	2006	1
1	2006-03-02	2.00	2006	3
2	2006-05-03	2.00	2006	5
3	2006-06-22	2.25	2006	6
4	2006-09-07	2.50	2006	9
...	...	...	...	...
112	2024-07-03	3.75	2024	7
113	2024-08-21	3.50	2024	8
114	2024-10-02	3.25	2024	10
115	2024-11-13	2.75	2024	11
116	2025-01-08	2.50	2025	1

117 rows × 4 columns

Data Cleaning and Data Preprocessing

In [7]:
```
print(df_rowhouse.head())
print(df_apartment.head())
print(df_villa.head())
```

```
     Sold Price         Street Address Living Area Object Type  \
0  6 755 000 kr      Långseleringen 58      112 m²      Radhus
1  4 200 000 kr      Kvickrotsgränd 98      119 m²      Radhus
2  5 825 000 kr      Skrattmåsvägen 40      115 m²      Radhus
3  4 150 000 kr       Valborgsstigen 4      118 m²      Radhus
4  5 200 000 kr  Mickelsbergsvägen 144      107 m²    Kedjehus

                 Area Name   Sold Date
0                  Råcksta  2025-01-23
1  Hässelby Norra Villastad  2025-01-23
2                 Fagersjö  2025-01-22
3                   Nälsta  2025-01-22
4    Hägersten-Liljeholmen  2025-01-21
     Sold Price          Street Address Living Area Object Type  \
0  4 130 000 kr        Åkeshovsvägen 36       85 m²    Lägenhet
1  4 050 000 kr  Blommensbergsvägen 188       58 m²    Lägenhet
2  4 900 000 kr           Banérgatan 50       42 m²    Lägenhet
3  3 100 000 kr        Sicklingsvägen 5       56 m²    Lägenhet
4  4 600 000 kr          Strandliden 49       73 m²    Lägenhet

                Area Name   Sold Date
0                Åkeslund  2025-01-24
1                Aspudden  2025-01-24
2               Östermalm  2025-01-24
3  Farsta Stadsdelsområde  2025-01-24
4          Hässelby Strand  2025-01-24
      Sold Price      Street Address Living Area Object Type        Area Name  \
0  11 650 000 kr  Sköldingevägen 40A      172 m²       Villa             Örby
1   7 550 000 kr     Vinstavägen 29A      140 m²       Villa           Spånga
2  37 500 000 kr     Äppelbovägen 12      235 m²       Villa           Bromma
3  10 050 000 kr      Timrågatan 108      169 m²       Villa  Vällingbyhöjden
4   7 500 000 kr     Attundavägen 33      157 m²       Villa     Bromma Kyrka

    Sold Date
0  2025-01-24
1  2025-01-23
2  2025-01-22
3  2025-01-22
4  2025-01-18
```

In [8]:
```
df_rowhouse.isnull().any()
```

Out[8]:
```
Sold Price        False
Street Address    False
Living Area        True
Object Type       False
Area Name         False
Sold Date         False
dtype: bool
```

In [9]:
```
df_apartment.isnull().any()
```

Out[9]:
```
Sold Price        False
Street Address    False
Living Area        True
Object Type       False
Area Name         False
Sold Date         False
dtype: bool
```

In [10]:
```
df_villa.isnull().any()
```

Out[10]:
```
Sold Price        False
Street Address    False
Living Area        True
Object Type       False
Area Name         False
Sold Date         False
dtype: bool
```

In [11]:
```
#Merging it into a single dataframe
df_merged = pd.concat([df_rowhouse, df_apartment,df_villa],ignore_index = True)
```

In [12]:
```
# Converting sold_date into datetime
df_merged['Sold Date'] = pd.to_datetime(df_merged['Sold Date'])

# Initializing start_date and end_date
start_date = pd.to_datetime('2010-01-01')
end_date = pd.to_datetime('2025-1-8')
```

In [13]:
```
# Extracting 'year' and 'month' as a seperate column from the merged dataset
df_merged['Year'] = pd.DatetimeIndex(df_merged['Sold Date']).year
df_merged['Month'] = pd.DatetimeIndex(df_merged['Sold Date']).month
```

In [14]:
```
# Filtering the dataset based on specific dates
real_estate_df = df_merged[(df_merged['Sold Date'] >= start_date) &
                           (df_merged['Sold Date'] <= end_date)]
```

In [15]:
```
real_estate_df.head()
```

Out[15]:

	Sold Price	Street Address	Living Area	Object Type	Area Name	Sold Date	Year	Month
241	12 000 000 kr	Martebogatan 32	174 m²	Parhus	Beckomberga	2024-10-25	2024	10
242	7 750 000 kr	Sten Bergmans väg 25	113 m²	Radhus	Hammarbyhöjden	2024-10-25	2024	10
243	8 395 000 kr	Nävekvarnsvägen 5A	NaN	Parhus	Örby	2024-10-25	2024	10
244	8 170 000 kr	Sköntorpsvägen 68	123 m²	Radhus	Årsta	2024-10-25	2024	10
245	5 490 000 kr	Lyckselevägen 85	90 m²	Radhus	Vällingby Centrum	2024-10-25	2024	10

In [16]:
```
# Merging interest rate column from the df to the existing df based on year and mon
real_estate_df = real_estate_df.merge(interest_rate_df[['Year','Month','Interest Ra
```

In [17]:
```
real_estate_df.columns
```

Out[17]:
```
Index(['Sold Price', 'Street Address', 'Living Area', 'Object Type',
       'Area Name', 'Sold Date', 'Year', 'Month', 'Interest Rate'],
      dtype='object')
```

In [18]:
```
real_estate_df.shape
```

Out[18]:
```
(22801, 9)
```

In [19]:
```
real_estate_df['Interest Rate'].isnull().sum()
```

Out[19]:
```
11237
```

In [20]:
```
real_estate_df.head()
```

Out[20]:

	Sold Price	Street Address	Living Area	Object Type	Area Name	Sold Date	Year	Month	Inte
0	12 000 000 kr	Martebogatan 32	174 m²	Parhus	Beckomberga	2024-10-25	2024	10	
1	7 750 000 kr	Sten Bergmans väg 25	113 m²	Radhus	Hammarbyhöjden	2024-10-25	2024	10	
2	8 395 000 kr	Nävekvarnsvägen 5A	NaN	Parhus	Örby	2024-10-25	2024	10	
3	8 170 000 kr	Sköntorpsvägen 68	123 m²	Radhus	Årsta	2024-10-25	2024	10	
4	5 490 000 kr	Lyckselevägen 85	90 m²	Radhus	Vällingby Centrum	2024-10-25	2024	10	

In [21]:
```
real_estate_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 22801 entries, 0 to 22800
Data columns (total 9 columns):
 #   Column          Non-Null Count  Dtype         
---  ------          --------------  -----         
 0   Sold Price      22801 non-null  object        
 1   Street Address  22801 non-null  object        
 2   Living Area     22743 non-null  object        
 3   Object Type     22801 non-null  object        
 4   Area Name       22801 non-null  object        
 5   Sold Date       22801 non-null  datetime64[ns]
 6   Year            22801 non-null  int64         
 7   Month           22801 non-null  int64         
 8   Interest Rate   11564 non-null  float64       
dtypes: datetime64[ns](1), float64(1), int64(2), object(5)
memory usage: 1.7+ MB
```

In [22]:
```
real_estate_df.describe()
```

Out[22]:

	Year	Month	Interest Rate
count	22801.000000	22801.000000	11564.000000
mean	2021.212666	7.233060	1.576358
std	2.617668	3.051542	1.814287
min	2016.000000	1.000000	-0.500000
25%	2019.000000	5.000000	-0.250000
50%	2022.000000	8.000000	0.750000
75%	2024.000000	10.000000	3.500000
max	2024.000000	12.000000	4.000000

In [23]:
```
real_estate_df['Object Type'].value_counts()
```

Out[23]:
```
Villa       10503
Lägenhet     6097
Radhus       4749
Kedjehus      888
Parhus        563
Gård            1
Name: Object Type, dtype: int64
```

Handling missing values

In [24]:
```
real_estate_df['Interest Rate'] = real_estate_df['Interest Rate'].fillna(method = '
```

In [25]:
```
real_estate_df['Interest Rate'].isnull().any()
```

Out[25]:
```
False
```

In [26]:
```
# Remove non-numeric characters like comma,sq.m from the column 'Living Area'
real_estate_df['Living Area'] = real_estate_df['Living Area'].str.replace(r'[^\d]',
```

In [27]:
```
# convert it into numeric therby handling NaN values
real_estate_df['Living Area'] = pd.to_numeric(real_estate_df['Living Area'], errors
```

In [28]:
```
# grouping based on object type before filling missing values for the column living
real_estate_df['Living Area'] = real_estate_df.groupby('Object Type')['Living Area'
```

Removing Outlier

In [29]:
```
real_estate_df = real_estate_df[real_estate_df['Object Type'] != 'Gård']
```

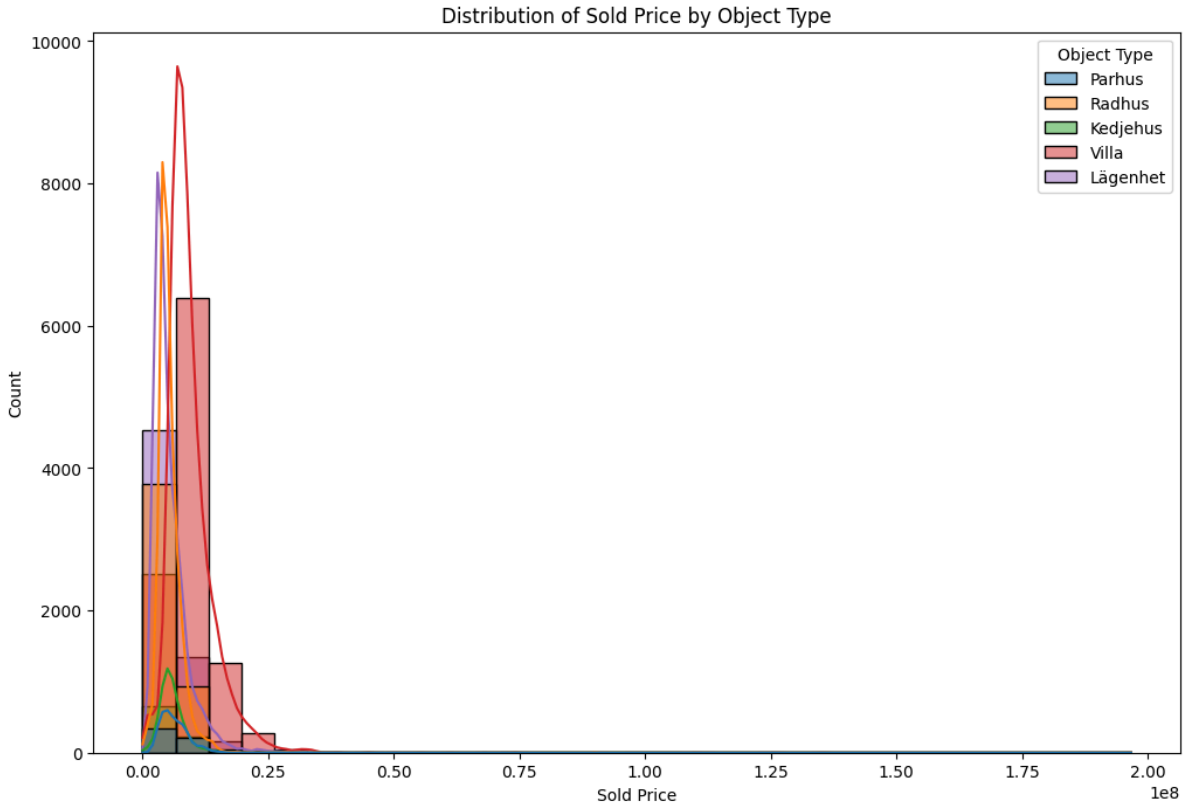
Removing inconsistent dataformat

In [30]:
```
# Remove non-numeric characters like comma, kr from 'Sold Price' and convert it to
real_estate_df['Sold Price'] = real_estate_df['Sold Price'].str.replace(r'[^\d]',''
# Verify the result
print(real_estate_df['Sold Price'].head())
```

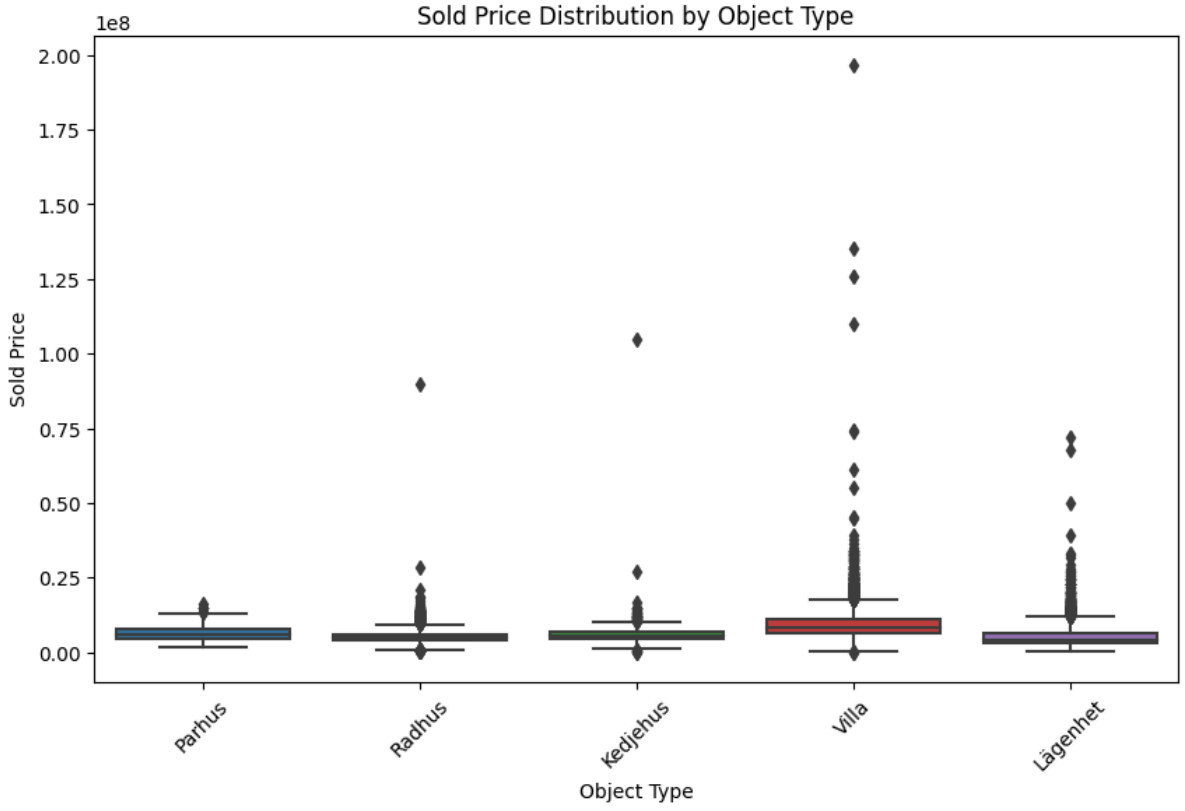
```
0    12000000
1     7750000
2     8395000
3     8170000
4     5490000
Name: Sold Price, dtype: int32
```

Exploratory Data Analysis

In [31]:
```
#Distribution of Sold Price by Object Type
import seaborn as sns
import matplotlib.pyplot as plt

plt.figure(figsize=(12,8))
sns.histplot(data=real_estate_df, x='Sold Price', hue='Object Type', bins=30, kde=T
plt.title('Distribution of Sold Price by Object Type')
plt.show()
```

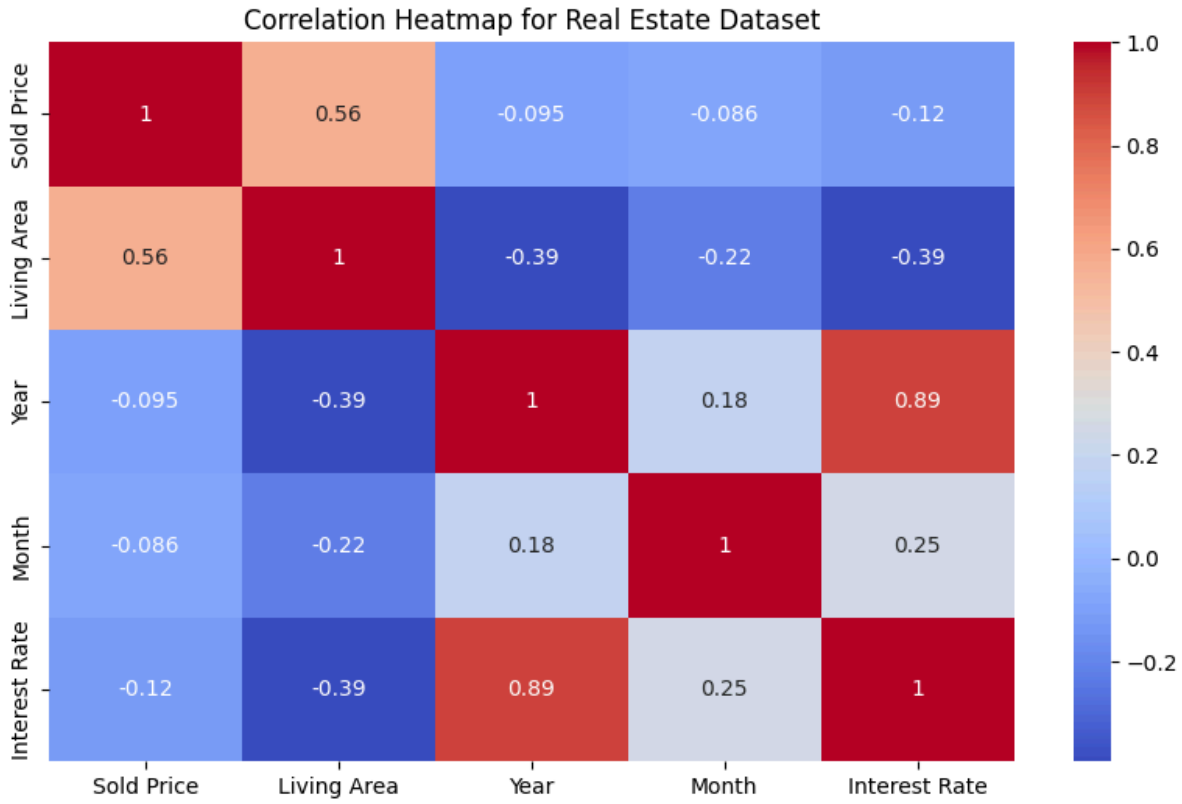


In [32]:
```
# to understand IQR, min and max value of sold price for each object type
plt.figure(figsize=(10,6))
sns.boxplot(data=real_estate_df, x='Object Type', y='Sold Price')
plt.title('Sold Price Distribution by Object Type')
plt.xticks(rotation=45)
plt.show()
```

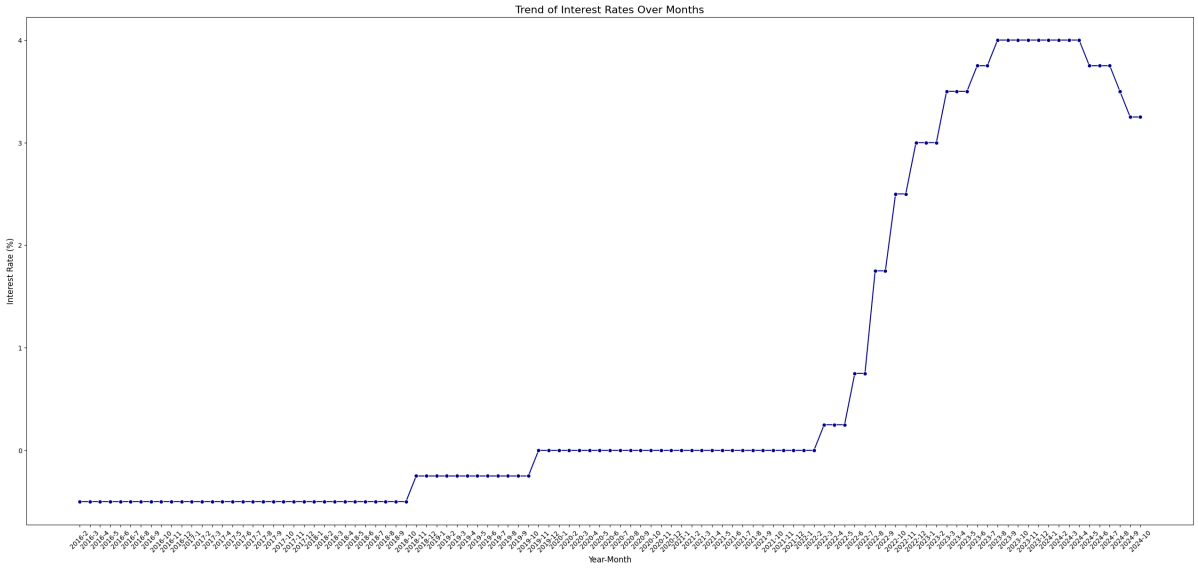


In [33]:
```
# to understand the relationship between numerical variables
plt.figure(figsize = (10,6))
sns.heatmap(real_estate_df.corr(), annot = True, cmap = 'coolwarm')
plt.title('Correlation Heatmap for Real Estate Dataset')
plt.show()
```

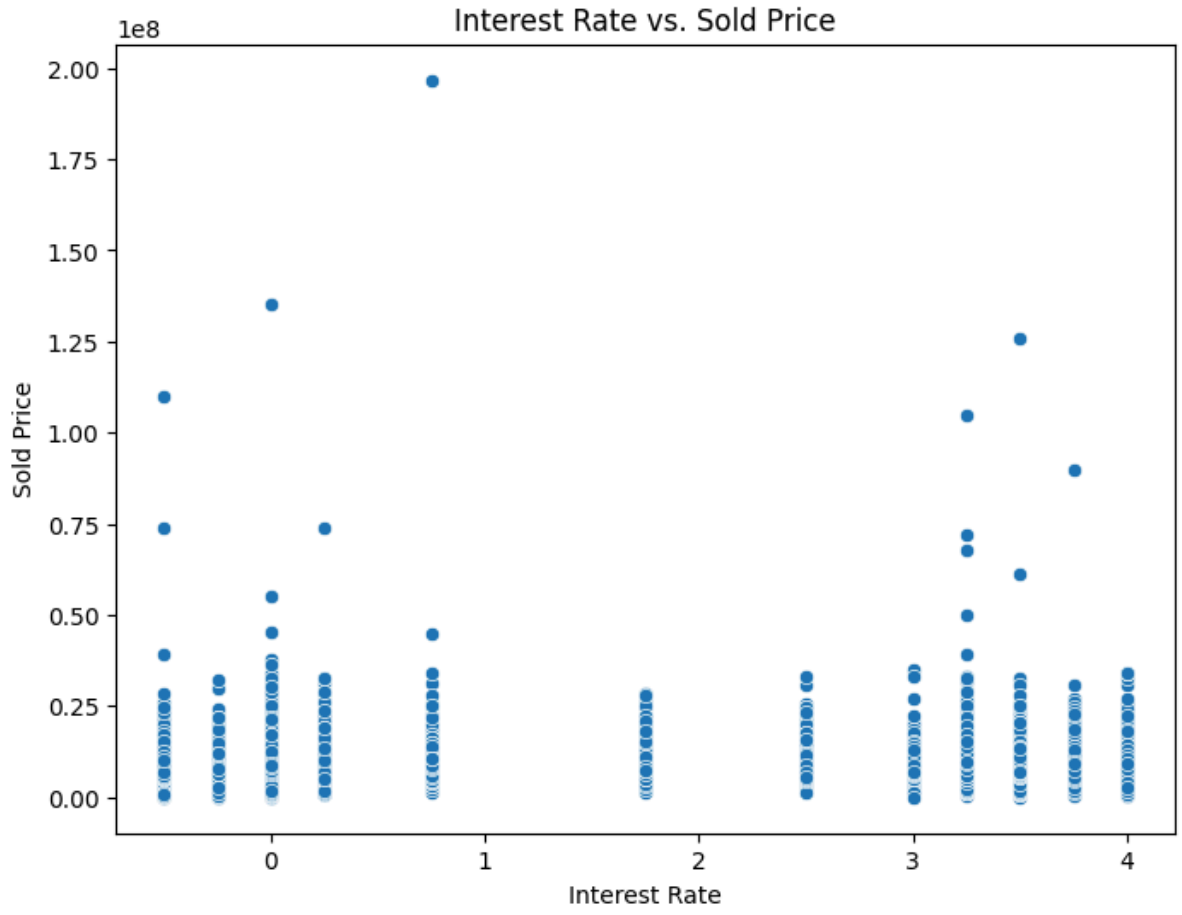
```
C:\Users\nklmy\AppData\Local\Temp\ipykernel_5000\1080443470.py:3: FutureWarning: T
he default value of numeric_only in DataFrame.corr is deprecated. In a future vers
ion, it will default to False. Select only valid columns or specify the value of n
umeric_only to silence this warning.
  sns.heatmap(real_estate_df.corr(), annot = True, cmap = 'coolwarm')
```



In [34]:
```
# Create a 'Year-Month' column to represent it in the plot
real_estate_df['Year-Month'] = real_estate_df['Year'].astype(str) + '-' + real_esta

# Sort by 'Year-Month' to ensure proper order
real_estate_df = real_estate_df.sort_values(by=['Year', 'Month'])

# Plotting the interest rate trend over months
plt.figure(figsize=(32,14))
sns.lineplot(data=real_estate_df, x='Year-Month', y='Interest Rate', color = 'darkb

# Customize the plot
plt.title('Trend of Interest Rates Over Months', fontsize=16)
plt.xlabel('Year-Month', fontsize=12)
plt.ylabel('Interest Rate (%)', fontsize=12)
plt.xticks(rotation=45)
plt.show()
```

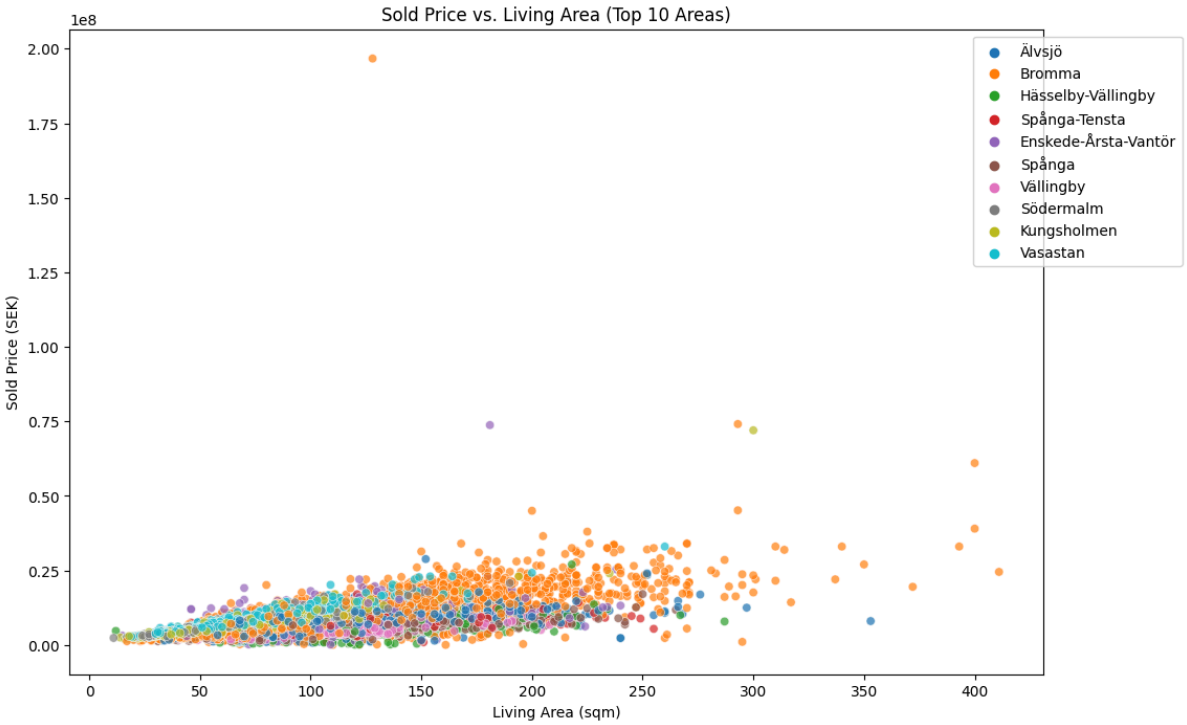


In [35]:
```
# Scatter plot: Interest Rate vs. Sold Price
plt.figure(figsize=(8,6))
sns.scatterplot(x=real_estate_df['Interest Rate'], y=real_estate_df['Sold Price'])
plt.title('Interest Rate vs. Sold Price')
plt.show()
```



In [36]:
```
# Extracting top 10 areas by count (regardless of the property type,total count mat
top_areas = real_estate_df['Area Name'].value_counts().nlargest(10).index
filtered_df = real_estate_df[real_estate_df['Area Name'].isin(top_areas)]
```

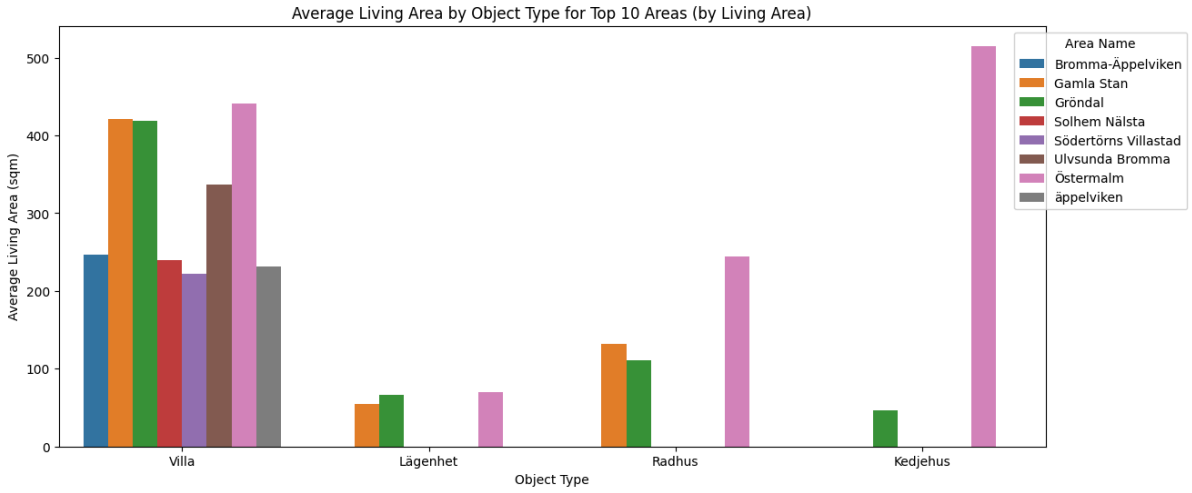
```
# Plot
plt.figure(figsize=(12,8))
sns.scatterplot(data=filtered_df, x='Living Area', y='Sold Price', hue='Area Name',
plt.title('Sold Price vs. Living Area (Top 10 Areas)')
plt.ylabel('Sold Price (SEK)')
plt.xlabel('Living Area (sqm)')
plt.legend(loc='upper right', bbox_to_anchor=(1.15, 1))
plt.show()
```

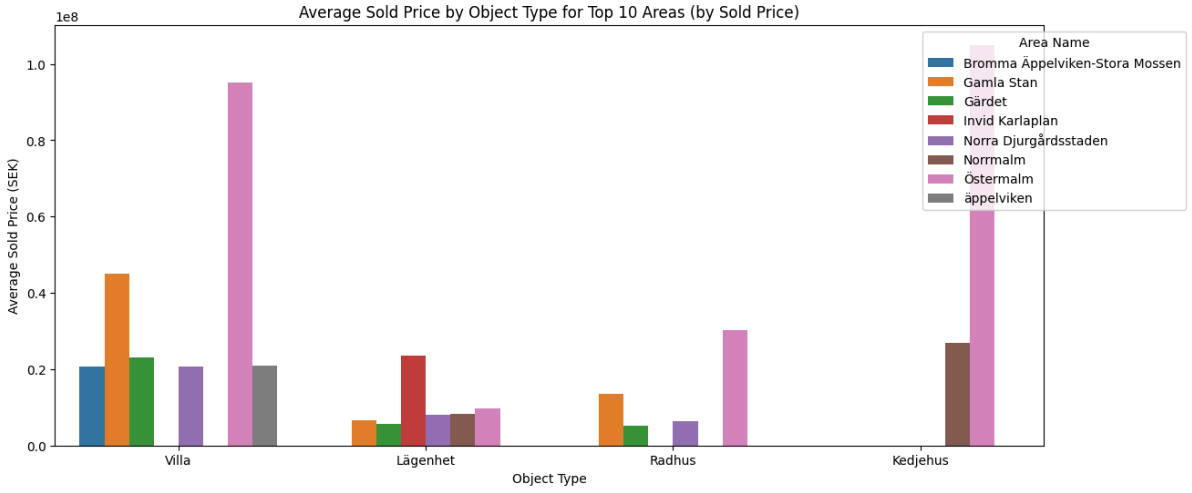


In [37]:
```
# Calculate average Living Area and Sold Price by Area and Object Type
area_stats = real_estate_df.groupby(['Area Name', 'Object Type']).agg(
    avg_living_area=('Living Area', 'mean'),
    avg_sold_price=('Sold Price', 'mean')
).reset_index()

# Get top 10 areas by average Living Area
top_areas_living_area = area_stats.nlargest(10, 'avg_living_area')['Area Name']
# Get top 10 areas by average Sold Price
top_areas_sold_price = area_stats.nlargest(10, 'avg_sold_price')['Area Name']
```

In [38]:
```
# Plot Average Living Area and Sold Price Across Object Types for Top 10 Areas
import seaborn as sns
import matplotlib.pyplot as plt

# Filter data for top 10 areas by Living Area and Sold Price
filtered_living_area = area_stats[area_stats['Area Name'].isin(top_areas_living_are
filtered_sold_price = area_stats[area_stats['Area Name'].isin(top_areas_sold_price)

# Plot for Average Living Area
plt.figure(figsize=(14, 6))
sns.barplot(
    data=filtered_living_area,
    x='Object Type',
```

```
    y='avg_living_area',
    hue='Area Name',
    palette='tab10'
)
plt.title('Average Living Area by Object Type for Top 10 Areas (by Living Area)')
plt.ylabel('Average Living Area (sqm)')
plt.xlabel('Object Type')
plt.legend(title='Area Name', loc='upper right', bbox_to_anchor=(1.15, 1))
plt.show()

# Plot for Average Sold Price
plt.figure(figsize=(14, 6))
sns.barplot(
    data=filtered_sold_price,
    x='Object Type',
    y='avg_sold_price',
    hue='Area Name',
    palette='tab10'
)
plt.title('Average Sold Price by Object Type for Top 10 Areas (by Sold Price)')
plt.ylabel('Average Sold Price (SEK)')
plt.xlabel('Object Type')
plt.legend(title='Area Name', loc='upper right', bbox_to_anchor=(1.15, 1))
plt.show()
```





Encoding Categorical Variable

In [39]:
```
real_estate_df = pd.get_dummies(real_estate_df, columns = ['Object Type'], drop_fir
```

In [40]:
```
real_estate_df
```

Out[40]:

	Sold Price	Street Address	Living Area	Area Name	Sold Date	Year	Month	Interest Rate	Yea Mont
22734	6950000	Humlestigen 5	118.0	Älvsjö	2016-02-29	2016	2	-0.50	2016
22735	7360000	Timrågatan 31	160.0	Vällingbyhöjden	2016-02-29	2016	2	-0.50	2016
22736	12800000	Virvelvindsvägen 58	106.0	Bromma	2016-02-29	2016	2	-0.50	2016
22737	6900000	Kålgårdsvägen 30	64.0	Enskede Gård	2016-02-29	2016	2	-0.50	2016
22738	6900000	Brändövägen 43	202.0	Hässelby-Vällingby	2016-02-29	2016	2	-0.50	2016
...	...	...	...	...	...	...	...	...	...
12750	17000000	Ensittarvägen 17	146.0	Essingeöarna	2024-10-01	2024	10	3.25	2024 1
12751	8000000	Doktor Abrahams väg 46	85.0	Bromma Kyrka	2024-10-01	2024	10	3.25	2024 1
12752	9200000	Bollstavägen 2	101.0	Stureby	2024-10-01	2024	10	3.25	2024 1
12753	9925000	Mälarhöjdsvägen 69	95.0	Hägersten-Liljeholmen	2024-10-01	2024	10	3.25	2024 1
12754	15250000	Tussmötevägen 223	140.0	Enskede-Årsta-Vantör	2024-10-01	2024	10	3.25	2024 1

22800 rows × 13 columns

Feature Scaling

In [41]:
```
import numpy as np
```

In [42]:
```
real_estate_df['Sold Price Log'] = np.log(real_estate_df['Sold Price'])
```

Model Development

1. Train-Test data split

In [61]:
```
# importing the necessary library
from sklearn.model_selection import train_test_split

X = real_estate_df.drop(columns = ['Sold Price','Street Address','Area Name','Sold
y = real_estate_df['Sold Price']

# spliting the dataset into training and test data
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size = 0.3, random_st
```

2. Training the Model

In [62]:
```
# training the multiple linear regression model on the training data set'
from sklearn.preprocessing import PolynomialFeatures
from sklearn.linear_model import LinearRegression
pol_reg = PolynomialFeatures(degree=4)

# Transforming the features
X_pol = pol_reg.fit_transform(X_train)

# Fitting the Linear Regression model
lin_reg_of_poly = LinearRegression()
lin_reg_of_poly.fit(X_pol, y_train)

# Transforming the test data
X_test_pol = pol_reg.transform(X_test)
```

3. Model Prediction

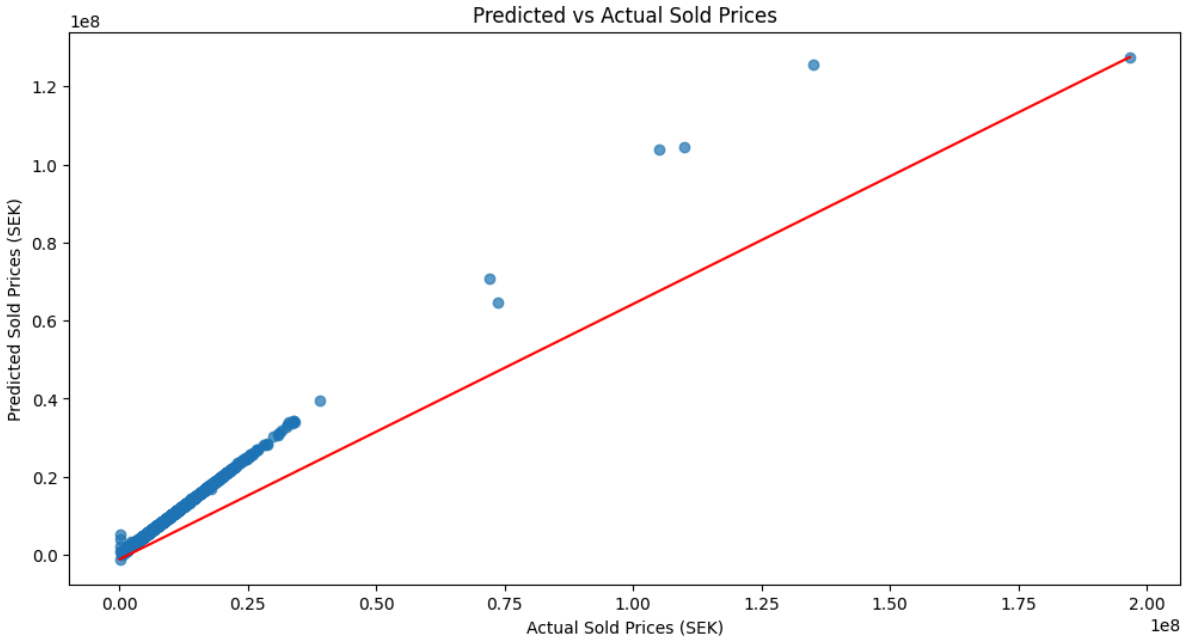
In [63]:
```
# Making predictions on the transformed test data
y_pred = lin_reg_of_poly.predict(X_test_pol)
```

4. Model Evaluation

In [64]:
```
# Mean Squared Error and R-squared for model evaluation
from sklearn.metrics import mean_squared_error, r2_score

mse = mean_squared_error(y_test, y_pred)
r2 = r2_score(y_test, y_pred)

# Calculate Root Mean Squared Error (RMSE)
rmse = np.sqrt(mse)

print(f'Root Mean Squared Error: {rmse:.2f} SEK')

print(f'R-squared: {r2}')
```

```
Root Mean Squared Error: 860193.63 SEK
R-squared: 0.973746235485654
```

In [65]:
```
# Plotting predicted vs actual values
plt.figure(figsize=(12, 6))
plt.scatter(y_test, y_pred, alpha=0.7)
plt.plot([y_test.min(), y_test.max()], [y_pred.min(), y_pred.max()], color='red')
plt.title('Predicted vs Actual Sold Prices')
plt.xlabel('Actual Sold Prices (SEK)')
plt.ylabel('Predicted Sold Prices (SEK)')
plt.show()
```



5. Saving the model

In [66]:
```
# Save the model to a file
import joblib
joblib.dump(lin_reg_of_poly, 'stockholm_property_price_model.pkl')
```

Out[66]:
```
['stockholm_property_price_model.pkl']
```