# assignment-2

September 16, 2024

## 1 Problem 1: scraping houses prices

[17]:
```
import glob
import math
import re
from datetime import datetime

import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
from bs4 import BeautifulSoup
```

### 1.0.1 Sold date

This is the HTML structure of the sold date element:

```
<span class="hcl-label hcl-label--state hcl-label--sold-at">
    Såld 9 oktober 2023
</span>
```

The following function extracts the sold date from the list item:

[18]:
```
swedish_to_english_months = {
        'januari': 'January', 'februari': 'February', 'mars': 'March',
        'april': 'April', 'maj': 'May', 'juni': 'June',
        'juli': 'July', 'augusti': 'August', 'september': 'September',
        'oktober': 'October', 'november': 'November', 'december': 'December'
}


def extract_sold_date(li):
        sold_date_element = li.find("span", class_="hcl-label hcl-label--state␣
 ↪hcl-label--sold-at")
        if sold_date_element is not None:
                sold_date = (
                        sold_date_element.text
                        .replace("Såld ", "")
                        .strip()
```

```
                )
                for swedish_month, english_month in swedish_to_english_months.
↪items():
                        sold_date = sold_date.replace(swedish_month,␣
↪english_month)
                sold_date = datetime.strptime(sold_date, '%d %B %Y')
                return sold_date
        return None
```

### 1.0.2 Address

This is the HTML structure of the address element:

```
<h2 class="sold-property-listing__heading qa-selling-price-title hcl-card__title">
  Skårby station 350
</h2>
```

The following function extracts the address from the list item:

[19]:
```
def extract_address(li):
        address_element = li.find("h2", class_="sold-property-listing__heading␣
↪qa-selling-price-title hcl-card__title")
        if address_element is not None:
                address = (
                        address_element.text
                        .strip()
                )
                return address
        return None
```

### 1.0.3 Location of the estate

This is the HTML structure of the location element:

```
<div class="sold-property-listing__location">
  <div>
    <span class="property-icon property-icon--result">...</span>
    Kareby,
    Kungälvs kommun
  </div>
</div>
```

The following function extracts the location from the list item:

[20]:
```
def extract_location(li):
        location_element = li.find("div",␣
↪class_="sold-property-listing__location").div
        if location_element is not None:
                location_element.find("span").decompose()
                location = re.sub(
```

```
                        r'\n\s+',
                        " ",
                        location_element.text.strip(),
                )
                return location
        return None
```

### 1.0.4 Area of the house & number of rooms

This is the HTML structure of the info element:

```
<div class="sold-property-listing__subheading sold-property-listing__area">
    143
    <span class="listing-card__attribute--normal-weight">
        + 25 m²
    </span>
     
    7 rum
</div>
```

or

```
<div class="sold-property-listing__subheading sold-property-listing__area">
    123 m²
     
    6 rum
</div>
```

The following function extracts the area of the house and the number of rooms from the list item:

[21]:
```
def extract_info(li):
        info_element = li.find("div", class_="sold-property-listing__subheading␣
 ↪sold-property-listing__area")
        if info_element is not None:
                if info_element.find("span") is not None:
                        biarea = float(
                                info_element
                                .find("span").text
                                .replace("\u00a0", "")
                                .replace("m²", "")
                                .replace("+ ", "")
                                .replace(",", ".")
                                .strip()
                        )
                        info_element.find("span").decompose()
                else:
                        biarea = None
                values = (
                        info_element.text
```

```
                        .replace("\u00a0m²", "")
                        .replace("\u00a0rum", "")
                        .split("\u00a0")
                )
                values = [
                        float(v.replace(",", ".").strip())
                        for v in values
                        if re.match(
                                r'^-?\d+(?:\.\d+)?$',
                                v.replace(",", ".").strip()
                        ) is not None
                ]
                boarea, rooms = (values + [None, None])[:2]
                rooms = int(rooms) if rooms is not None else None

                if boarea is not None and biarea is not None:
                        total_area = boarea + biarea
                else:
                        total_area = None

                return boarea, biarea, rooms, total_area
        return None, None, None, None
```

### 1.0.5 Area of the plot

This is the HTML structure of the plot area element:

```
<div class="sold-property-listing__land-area">
    2 963 m² tomt
</div>
```

The following function extracts the plot area from the list item:

[22]:
```
def extract_plot_area(li):
        plot_element = li.find("div", class_="sold-property-listing__land-area")
        if plot_element is not None:
                plot_area = float(
                        plot_element.text
                        .replace("\u00a0", "")
                        .replace("m² tomt", "")
                        .replace(",", ".")
                        .strip()
                )
                return plot_area
        return None
```

### 1.0.6 Closing price

This is the HTML structure of the price element:

```
<span class="hcl-text hcl-text--medium">
    Slutpris 4 395 000 kr
</span>
```

The following function extracts the closing price from the list item:

[23]:
```
def extract_price(li):
        price_element = li.find("span", class_="hcl-text hcl-text--medium")
        if price_element is not None:
                price = float(
                        price_element.text
                        .replace("\u00a0", "")
                        .replace("Slutpris ", "")
                        .replace("kr", "")
                        .replace(",", ".")
                        .strip()
                )
                return price
        return None
```

### 1.0.7 Processing a list element

The following function processes a list element and extracts all the required information:

[24]:
```
def process_list_element(li):
        sold_date = extract_sold_date(li)
        address = extract_address(li)
        location = extract_location(li)
        boarea, biarea, rooms, total_area = extract_info(li)
        plot_area = extract_plot_area(li)
        price = extract_price(li)
        return {
                "sold_date": sold_date,
                "address": address,
                "location": location,
                "boarea": boarea,
                "biarea": biarea,
                "total_area": total_area,
                "room_number": rooms,
                "plot_area": plot_area,
                "closing_price": price,
        }
```

### 1.0.8 Processing all the pages

The following code processes all the pages and extracts the required information:

[25]:
```
data_list = []
file_pattern = "data/kungalv_slutpris_page_*.html"
```

```
for file_name in glob.glob(file_pattern):
        with open(file_name, "r") as f:
                content = f.read()
                soup = BeautifulSoup(content, "html.parser")
                print("Processing", file_name, "...")
                data_list.extend(map(
                        process_list_element,
                        soup.find_all("li", class_="sold-results__normal-hit")
                ))
```

```
Processing data/kungalv_slutpris_page_27.html …
Processing data/kungalv_slutpris_page_31.html …
Processing data/kungalv_slutpris_page_11.html …
Processing data/kungalv_slutpris_page_07.html …
Processing data/kungalv_slutpris_page_06.html …
Processing data/kungalv_slutpris_page_10.html …
Processing data/kungalv_slutpris_page_30.html …
Processing data/kungalv_slutpris_page_26.html …
Processing data/kungalv_slutpris_page_40.html …
Processing data/kungalv_slutpris_page_17.html …
Processing data/kungalv_slutpris_page_01.html …
Processing data/kungalv_slutpris_page_21.html …
Processing data/kungalv_slutpris_page_37.html …
Processing data/kungalv_slutpris_page_36.html …
Processing data/kungalv_slutpris_page_20.html …
Processing data/kungalv_slutpris_page_16.html …
Processing data/kungalv_slutpris_page_39.html …
Processing data/kungalv_slutpris_page_03.html …
Processing data/kungalv_slutpris_page_15.html …
Processing data/kungalv_slutpris_page_35.html …
Processing data/kungalv_slutpris_page_23.html …
Processing data/kungalv_slutpris_page_19.html …
Processing data/kungalv_slutpris_page_18.html …
Processing data/kungalv_slutpris_page_22.html …
Processing data/kungalv_slutpris_page_34.html …
Processing data/kungalv_slutpris_page_14.html …
Processing data/kungalv_slutpris_page_02.html …
Processing data/kungalv_slutpris_page_38.html …
Processing data/kungalv_slutpris_page_33.html …
Processing data/kungalv_slutpris_page_25.html …
Processing data/kungalv_slutpris_page_09.html …
Processing data/kungalv_slutpris_page_29.html …
Processing data/kungalv_slutpris_page_05.html …
Processing data/kungalv_slutpris_page_13.html …
Processing data/kungalv_slutpris_page_12.html …
Processing data/kungalv_slutpris_page_04.html …
Processing data/kungalv_slutpris_page_28.html …
Processing data/kungalv_slutpris_page_08.html …
```

```
Processing data/kungalv_slutpris_page_24.html …
Processing data/kungalv_slutpris_page_32.html …
```

### 1.0.9 Saving the data

The following code saves the extracted data to a CSV file:

[26]:
```
df = pd.DataFrame(data_list)
df["sold_date"] = pd.to_datetime(df["sold_date"])

df.to_csv("data/housing_data.csv", index=False)
```

# 2 Problem 2: Analyzing 2022 house sales

### 2.0.1 Filtering only the 2022 sales

The following code filters the pandas DataFrame to only include the sales from 2022:

[27]:
```
df = df[df["sold_date"].dt.year == 2022]
df.describe()
```

[27]:

| | sold_date | boarea | biarea | total_area | \ |
|---|---|---|---|---|---|
| count | 190 | 190.000000 | 93.000000 | 93.000000 | |
| mean | 2022-06-14 22:36:37.894736896 | 121.326316 | 53.849462 | 181.204301 | |
| min | 2022-01-07 00:00:00 | 4.000000 | 2.000000 | 65.000000 | |
| 25% | 2022-03-30 00:00:00 | 97.250000 | 21.000000 | 140.000000 | |
| 50% | 2022-06-07 00:00:00 | 120.000000 | 48.000000 | 174.000000 | |
| 75% | 2022-08-31 18:00:00 | 144.750000 | 75.000000 | 211.000000 | |
| max | 2022-12-27 00:00:00 | 325.000000 | 174.000000 | 406.000000 | |
| std | NaN | 45.168454 | 37.700175 | 62.483660 | |

| | room_number | plot_area | closing_price |
|---|---|---|---|
| count | 178.000000 | 184.000000 | 1.900000e+02 |
| mean | 4.943820 | 1806.826087 | 5.076153e+06 |
| min | 2.000000 | 127.000000 | 1.650000e+06 |
| 25% | 4.000000 | 600.750000 | 4.012500e+06 |
| 50% | 5.000000 | 1118.500000 | 5.000000e+06 |
| 75% | 6.000000 | 1718.500000 | 5.795000e+06 |
| max | 10.000000 | 47500.000000 | 1.050000e+07 |
| std | 1.413091 | 4108.109618 | 1.557399e+06 |

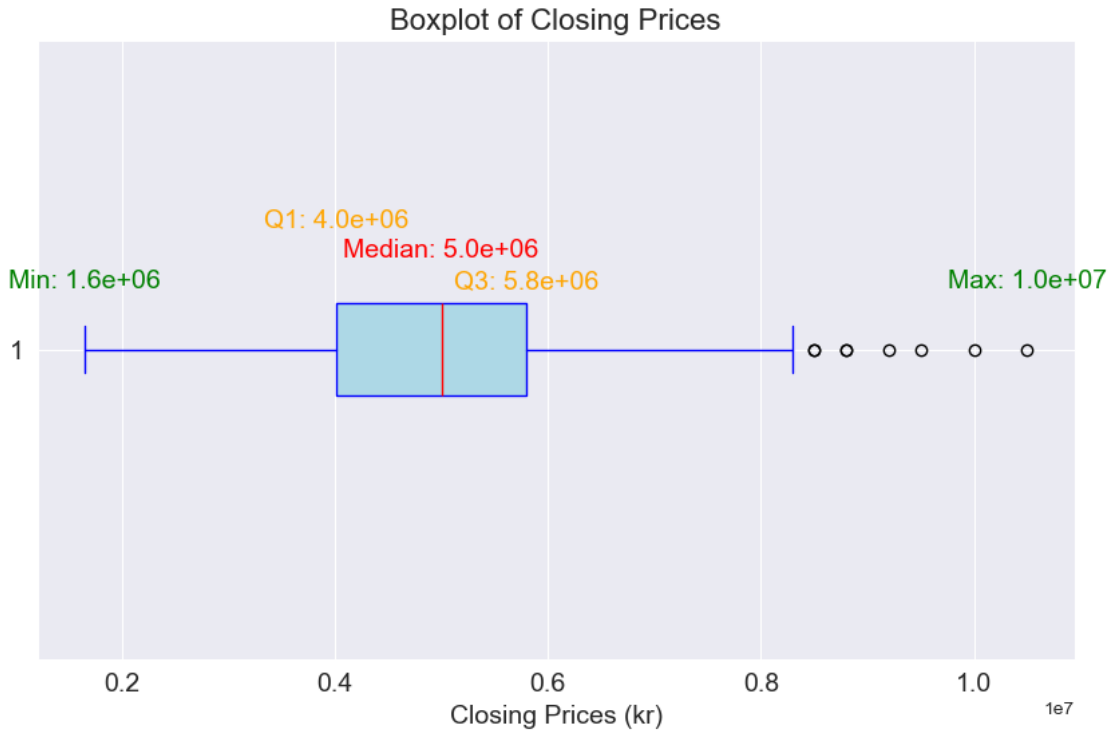
### 2.0.2 Plotting the distribution of the closing prices

The following code extracts the closing prices and plots the distribution using a boxplot and a histogram.

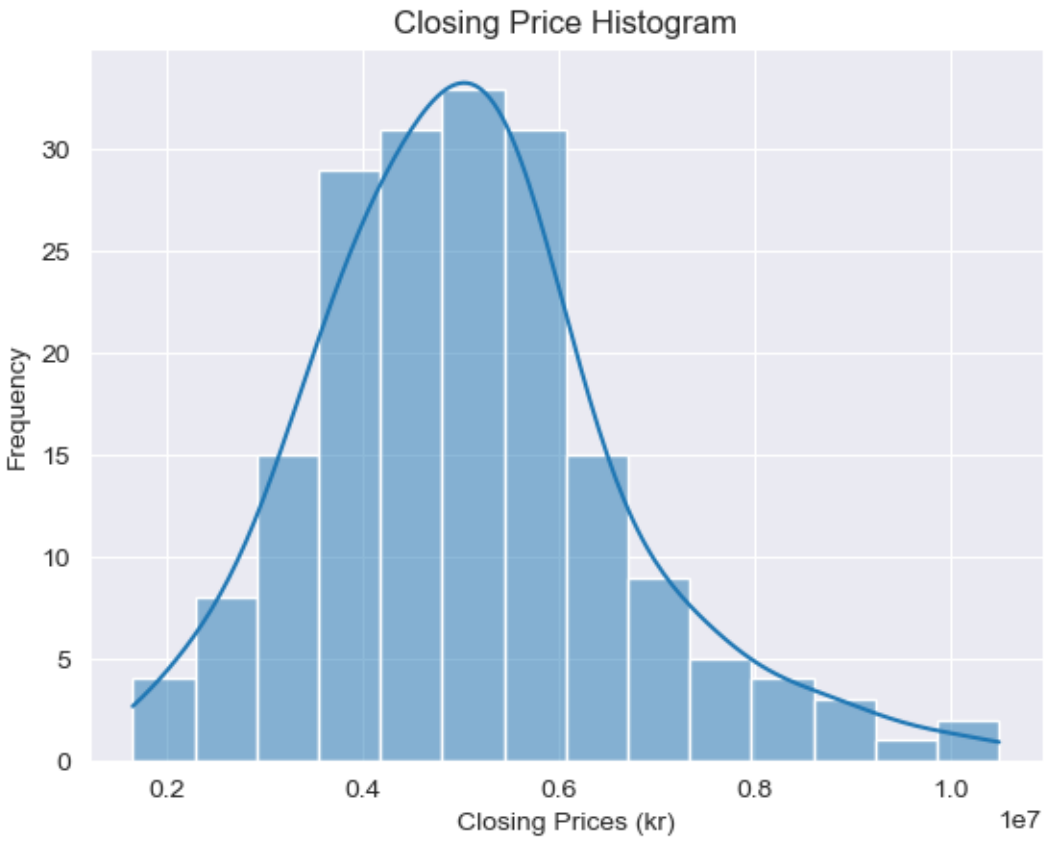
For the histogram, the number of bins is calculated using the square root rule.

[28]:
```
closing_price_list = df["closing_price"].dropna().tolist()
```

[29]:
```
plt.figure(figsize=(10, 6))
boxplot = plt.boxplot(
        closing_price_list,
        vert=False,
        patch_artist=True,
        boxprops=dict(facecolor='lightblue', color='blue'),
        whiskerprops=dict(color='blue'),
        capprops=dict(color='blue'),
        medianprops=dict(color='red'),
)

# Calculate the five-number summary
minimum = np.min(closing_price_list)
maximum = np.max(closing_price_list)
median = np.median(closing_price_list)
q1 = np.percentile(closing_price_list, 25)
q3 = np.percentile(closing_price_list, 75)

# Annotate the five-number summary values
plt.text(minimum, 1.1, f'Min: {minimum:.1e}', horizontalalignment='center',␣
 ↪color='green', fontsize = 14)
plt.text(q1, 1.2, f'Q1: {q1:.1e}', horizontalalignment='center',␣
 ↪color='orange', fontsize = 14)
plt.text(median, 1.15, f'Median: {median:.1e}', horizontalalignment='center',␣
 ↪color='red', fontsize = 14)
plt.text(q3, 1.1, f'Q3: {q3:.1e}', horizontalalignment='center',␣
 ↪color='orange', fontsize = 14)
plt.text(maximum, 1.1, f'Max: {maximum:.1e}', horizontalalignment='center',␣
 ↪color='green', fontsize = 14)

plt.tick_params(axis='both', which='major', labelsize=14)
plt.ticklabel_format(style='sci', axis='x', scilimits=(0, 0))
plt.title("Boxplot of Closing Prices", fontsize = 16)
plt.xlabel("Closing Prices (kr)", fontsize = 14)

plt.savefig("closing_prices_boxplot.png")
```



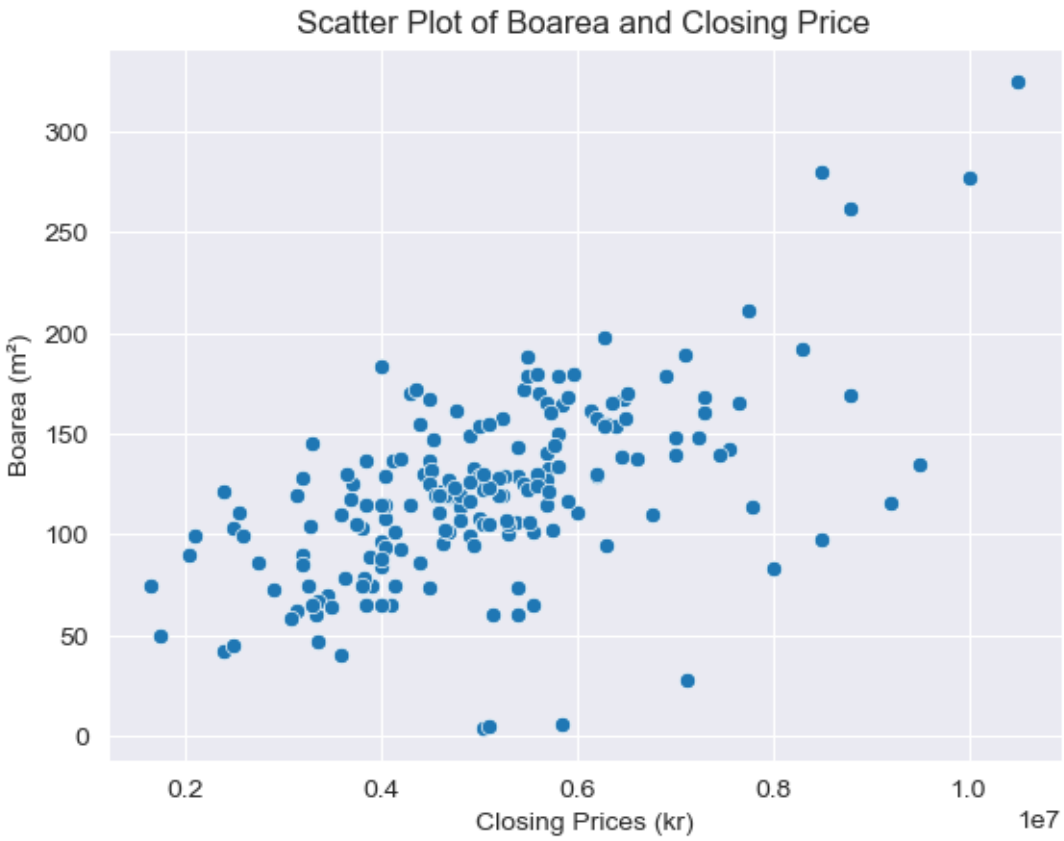

[30]:
```
sns.histplot(closing_price_list, kde=True, bins=math.
 ↪ceil(len(closing_price_list) ** 0.5))
plt.title("Closing Price Histogram")
plt.xlabel("Closing Prices (kr)")
plt.ylabel("Frequency")

plt.savefig("closing_prices_histogram.png")
```



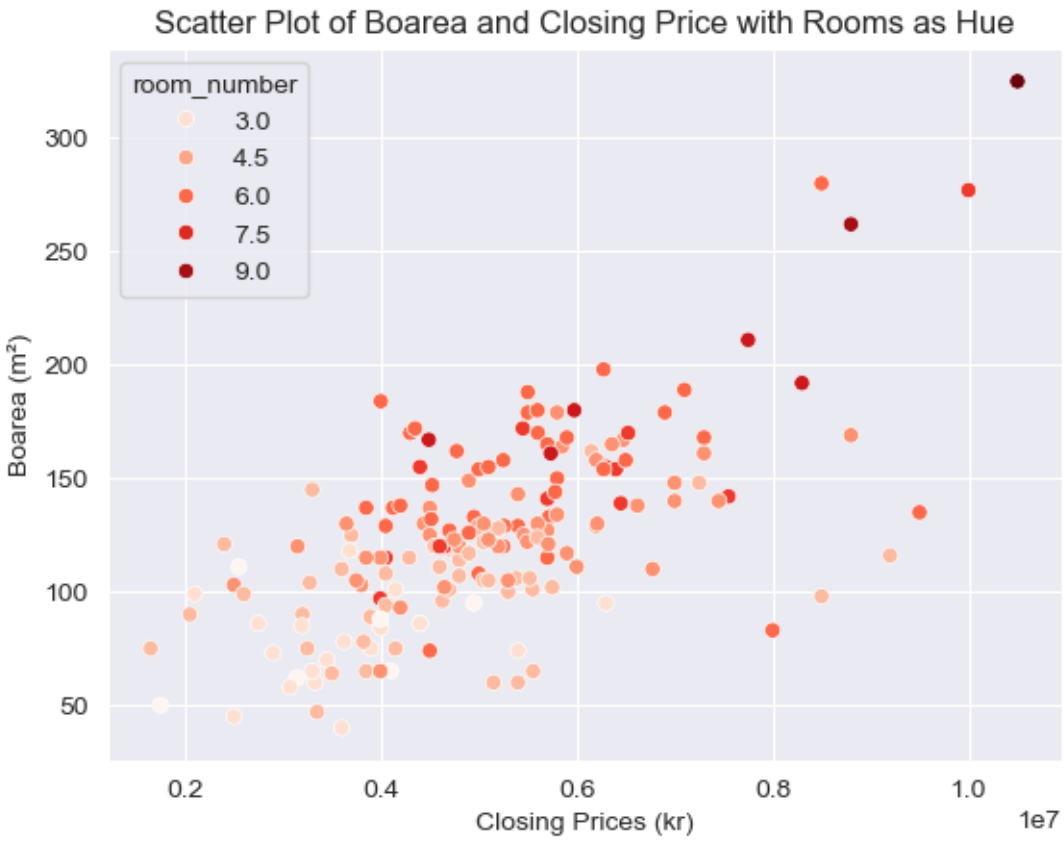

### 2.0.3 Plotting the relationship between the closing prices, living area and the number of rooms

The following code plots the relationship between the three variables using a scatter plot, first without the number of rooms and then with the number of rooms as a hue:

[31]:
```
sns.scatterplot(x="closing_price", y="boarea", data=df)
plt.title("Scatter Plot of Boarea and Closing Price")
plt.xlabel("Closing Prices (kr)")
plt.ylabel("Boarea (m\u00B2)")

plt.savefig("closing_prices_boarea_scatter.png")
```




[33]:
```
sns.scatterplot(x="closing_price", y="boarea", hue="rooms", data=df,␣
↪palette="Reds")
plt.title("Scatter Plot of Boarea and Closing Price with Rooms as Hue")
plt.xlabel("Closing Prices (kr)")
plt.ylabel("Boarea (m\u00B2)")

plt.savefig("closing_prices_boarea_rooms_scatter.png")
```


Scatter Plot of Boarea and Closing Price with Rooms as Hue
room_number
3.0
4.5
6.0
7.5
9.0
Boarea (m²)
300
250
200
150
100
50
0.2
0.4
0.6
0.8
1.0
1e7
Closing Prices (kr)