Statistical Data Analysis

In [189…

```
import requests
import pandas as pd

data = requests.get(
    'https://raw.githubusercontent.com/rfordatascience/tidytuesday/master/data/202

with open('dataset.csv', 'w', encoding="utf-8") as f:#'w' means opens for recordin
    f.write(data)
data = pd.read_csv('dataset.csv', sep=',')
# It shows how many rows and columns the dataset has.
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3694 entries, 0 to 3693
Data columns (total 14 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Unnamed: 0         3694 non-null   int64  
 1   item_id            3694 non-null   int64  
 2   name               3694 non-null   object 
 3   category           3694 non-null   object 
 4   price              3694 non-null   float64
 5   old_price          3694 non-null   object 
 6   sellable_online    3694 non-null   bool   
 7   link               3694 non-null   object 
 8   other_colors       3694 non-null   object 
 9   short_description  3694 non-null   object 
 10  designer           3694 non-null   object 
 11  depth              2231 non-null   float64
 12  height             2706 non-null   float64
 13  width              3105 non-null   float64
dtypes: bool(1), float64(4), int64(2), object(7)
memory usage: 378.9+ KB
```

In [190…

```
import sqlite3
conn = sqlite3.connect('sql_step_project.db', check_same_thread=False, )
cursor = conn.cursor()

def delete_table():
    cursor.execute("DROP TABLE IF EXISTS all_data")
delete_table()

columns = ','.join(['"' + col + '"' + ' ' + 'TEXT' for col in data.columns])

def creationandfilingDB():
    cursor.execute(f"""CREATE TABLE IF NOT EXISTS all_data ({columns})""")

    for x in data.values:
        cursor.execute("""INSERT INTO all_data VALUES(?,?,?,?,?,?,?,?,?,?,?,?,?,?)
        conn.commit()

# Creating and Populating a Database
creationandfilingDB()
```

Category

In [191…

```
# a query to select the category column.
cursor.execute("""SELECT category
                FROM all_data_without_duplicate""")
exer1= cursor.fetchall()
exer1=pd.DataFrame(exer1,columns=['category'])
# Descriptive statistics of the category dataset
print(exer1.describe())
```

```
                          category
count                         2962
unique                          17
top     Bookcases & shelving units
freq                           548
```

In [193…

```
# The number of products in each category
count_category = exer1['category'].value_counts()
# Sorting in descending order
count_category = count_category.sort_values(ascending=False)
print(count_category)
```

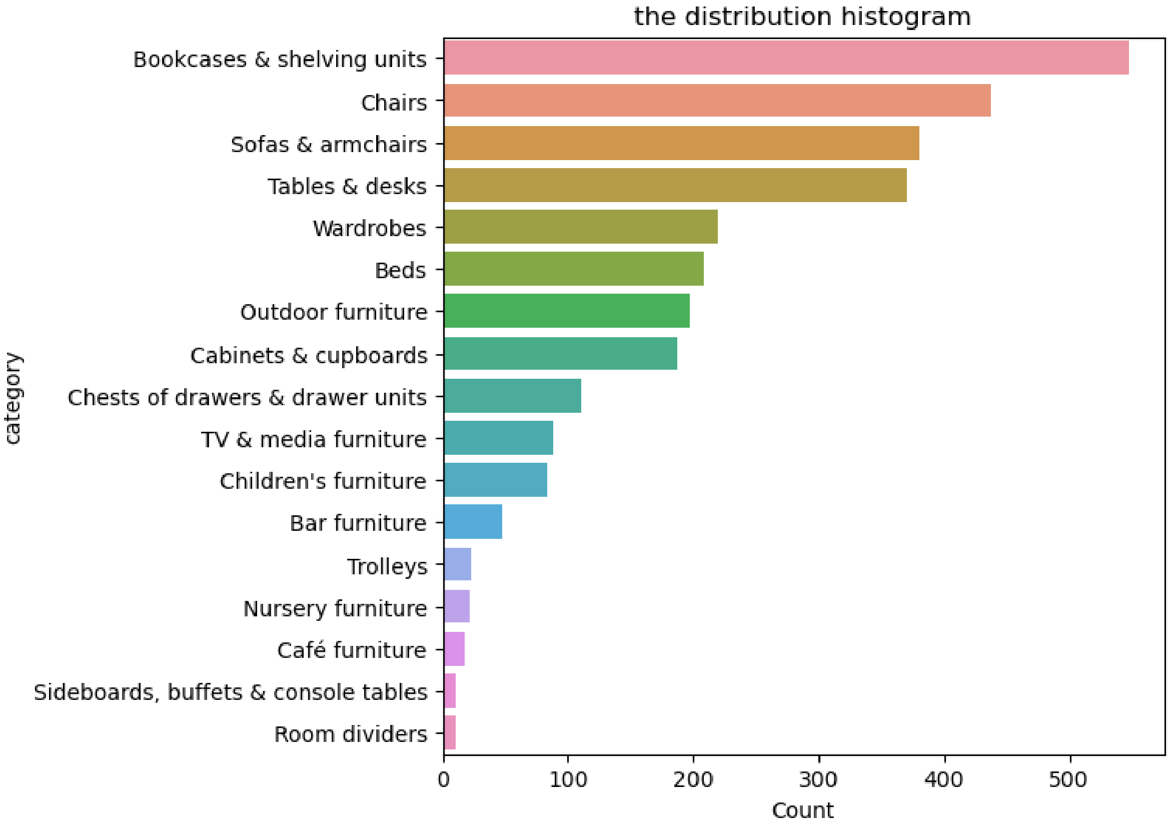
```
Bookcases & shelving units           548
Chairs                               438
Sofas & armchairs                    380
Tables & desks                       370
Wardrobes                            220
Beds                                 208
Outdoor furniture                    197
Cabinets & cupboards                 187
Chests of drawers & drawer units     111
TV & media furniture                  89
Children's furniture                  84
Bar furniture                         47
Trolleys                              23
Nursery furniture                     22
Café furniture                        18
Sideboards, buffets & console tables  10
Room dividers                         10
Name: category, dtype: int64
```

In [194…

```
#Constructing a histogram for the category.
import matplotlib.pyplot as plt
import seaborn as sns
fig,ax=plt.subplots(figsize=(6,6))
sns.barplot(x=count_category.values,y=count_category.index)
ax.set_ylabel('category')
ax.set_xlabel('Count')
ax.set_title('the distribution histogram')
```

Out[194]:

```
Text(0.5, 1.0, 'the distribution histogram')
```



Price

In [195…

```
# A query to select the price column
cursor.execute("""SELECT price
                FROM all_data_without_duplicate""")
exer2= cursor.fetchall()
exer2=pd.DataFrame(exer2,columns=['price'])
exer2['price'] = exer2['price'].astype(float)
# Descriptive statistics of the price dataset
print(exer2.describe().round(2))
```

```
         price
count  2962.00
mean   1108.72
std    1393.58
min       3.00
25%     200.00
50%     570.00
75%    1475.00
max    9585.00
```

In [196…

```
# Let's find the mode for the price.
from statistics import mode

mode = mode(exer2['price'])
print('mode ',mode)
```

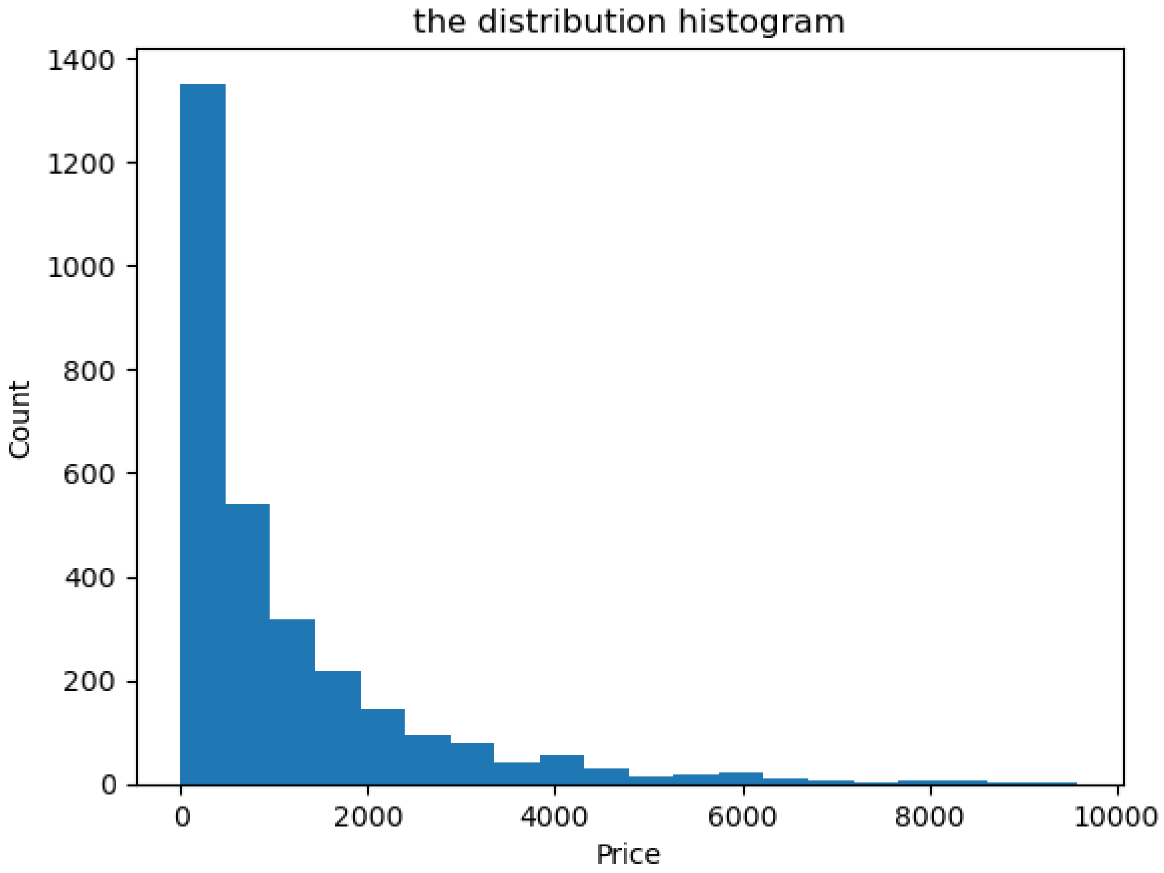
```
mode  395.0
```

In [197…

```
fig,ax=plt.subplots()
ax.hist(exer2['price'], bins=20)
ax.set_xlabel('Price')
ax.set_ylabel('Count')
ax.set_title('the distribution histogram')
```

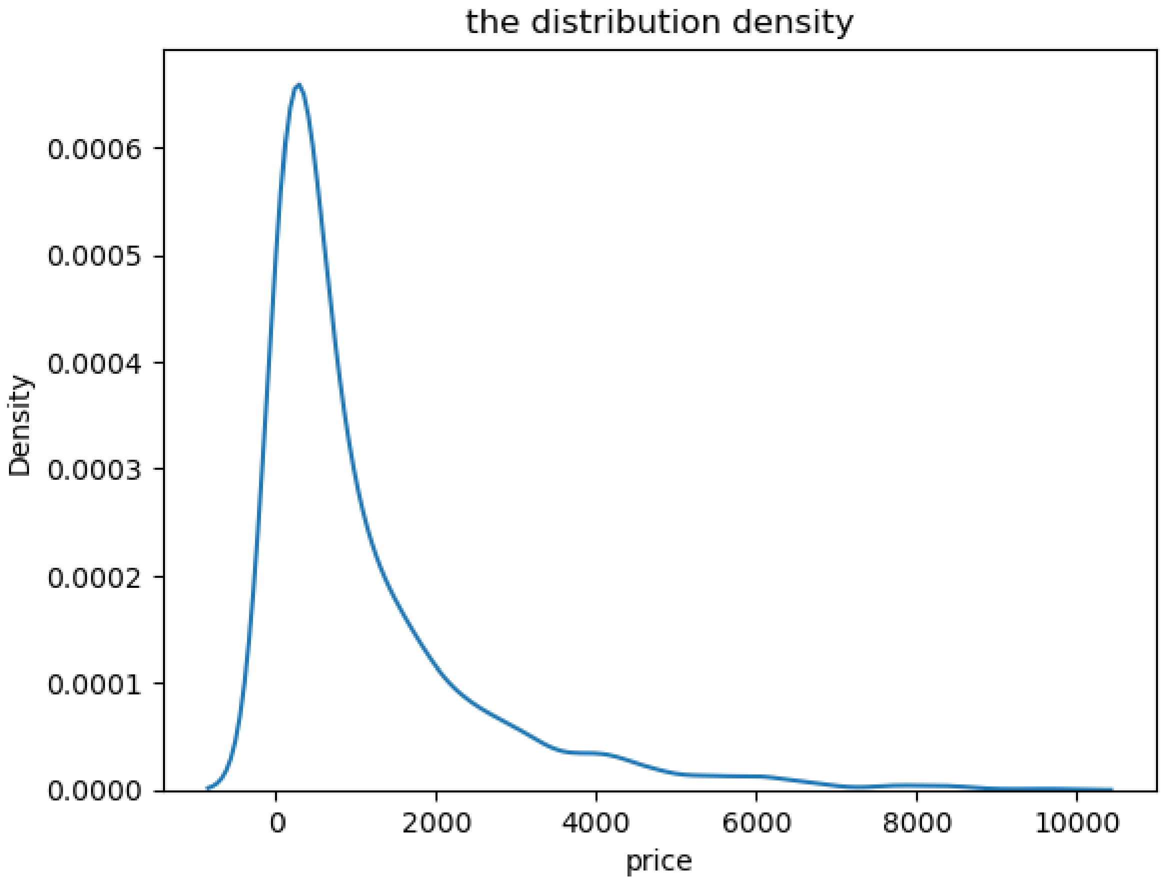
Out[197]:

```
Text(0.5, 1.0, 'the distribution histogram')
```



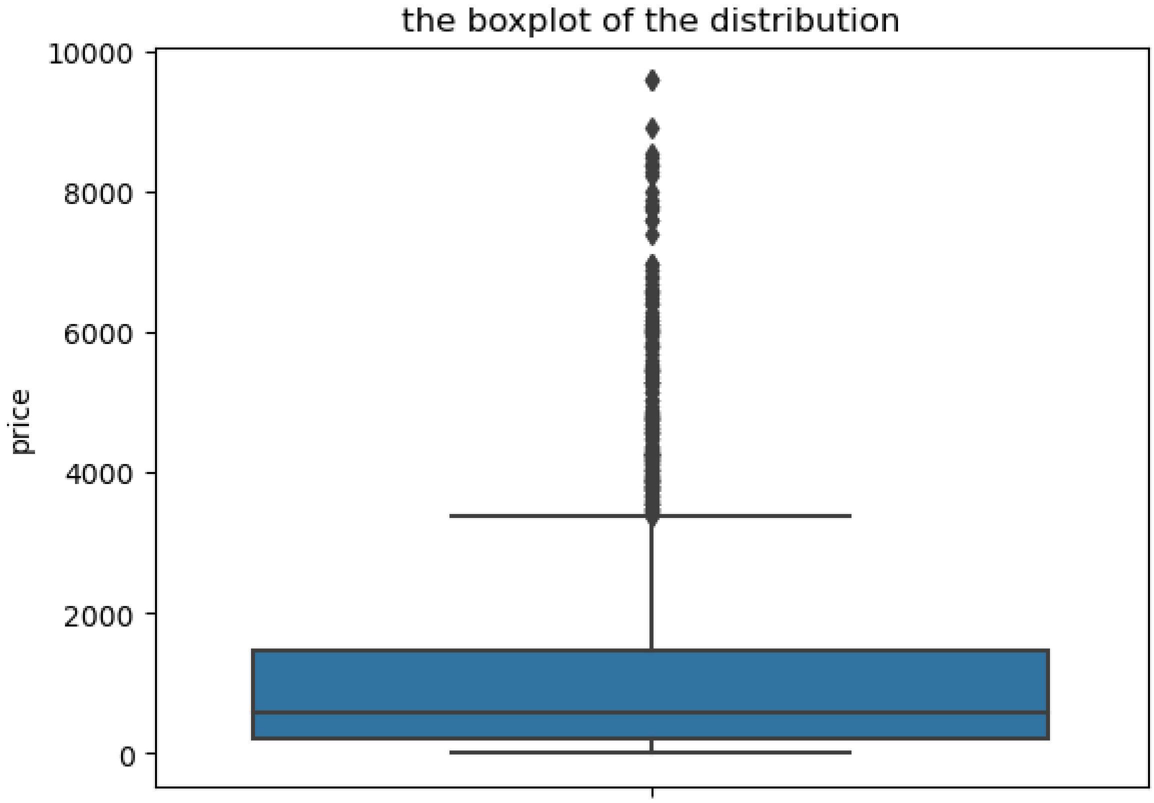
In [198…

```
#A density plot of the price data
fig,ax=plt.subplots()
sns.kdeplot(exer2['price'])
ax.set_title('the distribution density')
plt.show()
```



In [199…

```
#building boxplot price
fig,ax=plt.subplots()
sns.boxplot(y ='price', data=exer2)
ax.set_title('the boxplot of the distribution')
plt.show()
```



Designer

In [200…

```
# A query to select designer column
cursor.execute("""SELECT designer
                FROM all_data_without_duplicate
                WHERE designer!=''""")
exer1_1= cursor.fetchall()
exer1_1=pd.DataFrame(exer1_1,columns=['designer'])
# Descriptive statistics of the category dataset
print(exer1_1.describe())
```

```
              designer
count             2860
unique             279
top     IKEA of Sweden
freq               683
```

In [201…

```
# The number of products by designer
count_designer = exer1_1['designer'].value_counts()
count_designer
```

Out[201]:

```
IKEA of Sweden                                       683
Ehlén Johansson                                      136
Francis Cayouette                                    131
Ola Wihlborg                                         128
Jon Karlsson                                         106
                                                    ...
E Thomasson/P Süssmann                                 1
Ehlén Johansson/K Hagberg/M Hagberg/IKEA of Sweden     1
Ola Wihlborg/Ehlén Johansson/IKEA of Sweden            1
Mia Lagerman/IKEA of Sweden/Wiebke Braasch             1
K Hagberg/M Hagberg/Francis Cayouette                  1
Name: designer, Length: 279, dtype: int64
```

In [202…

```
# Designers that appear only once in the data
min_value = count_designer.min()
min_indices = count_designer[count_designer == min_value].index
print(min_indices)
```

```
Index(['Johanna Jelinek', 'IKEA of Sweden/Virgil Abloh',
       'IKEA of Sweden/K Hagberg/M Hagberg/Ehlén Johansson',
       'Monika Mulder/IKEA of Sweden',
       'Johanna Asshoff/IKEA of Sweden/Gustav Carlberg',
       'Francis Cayouette/Nike Karlsson',
       'David Wahl/IKEA of Sweden/John/Jonas/Petrus/Paul/Caroline',
       'Ola Wihlborg/Synnöve Mork/IKEA of Sweden',
       'IKEA of Sweden/Anna Efverlund', 'Magnus Elebäck',
       ...
       'Francis Cayouette/Jomi Evers', 'Mia Lagerman/Ehlén Johansson',
       'K Hagberg/M Hagberg/John/Jonas/Petrus/Paul/Caroline',
       'Studio Copenhagen/Mia Lagerman', 'IKEA of Sweden/Nike Karlsson',
       'E Thomasson/P Süssmann',
       'Ehlén Johansson/K Hagberg/M Hagberg/IKEA of Sweden',
       'Ola Wihlborg/Ehlén Johansson/IKEA of Sweden',
       'Mia Lagerman/IKEA of Sweden/Wiebke Braasch',
       'K Hagberg/M Hagberg/Francis Cayouette'],
      dtype='object', length=113)
```

In [203…

```
# The number of designers that appear only once in the data
num_min_designers = (count_designer == min_value).sum()
print(num_min_designers)
```

```
113
```

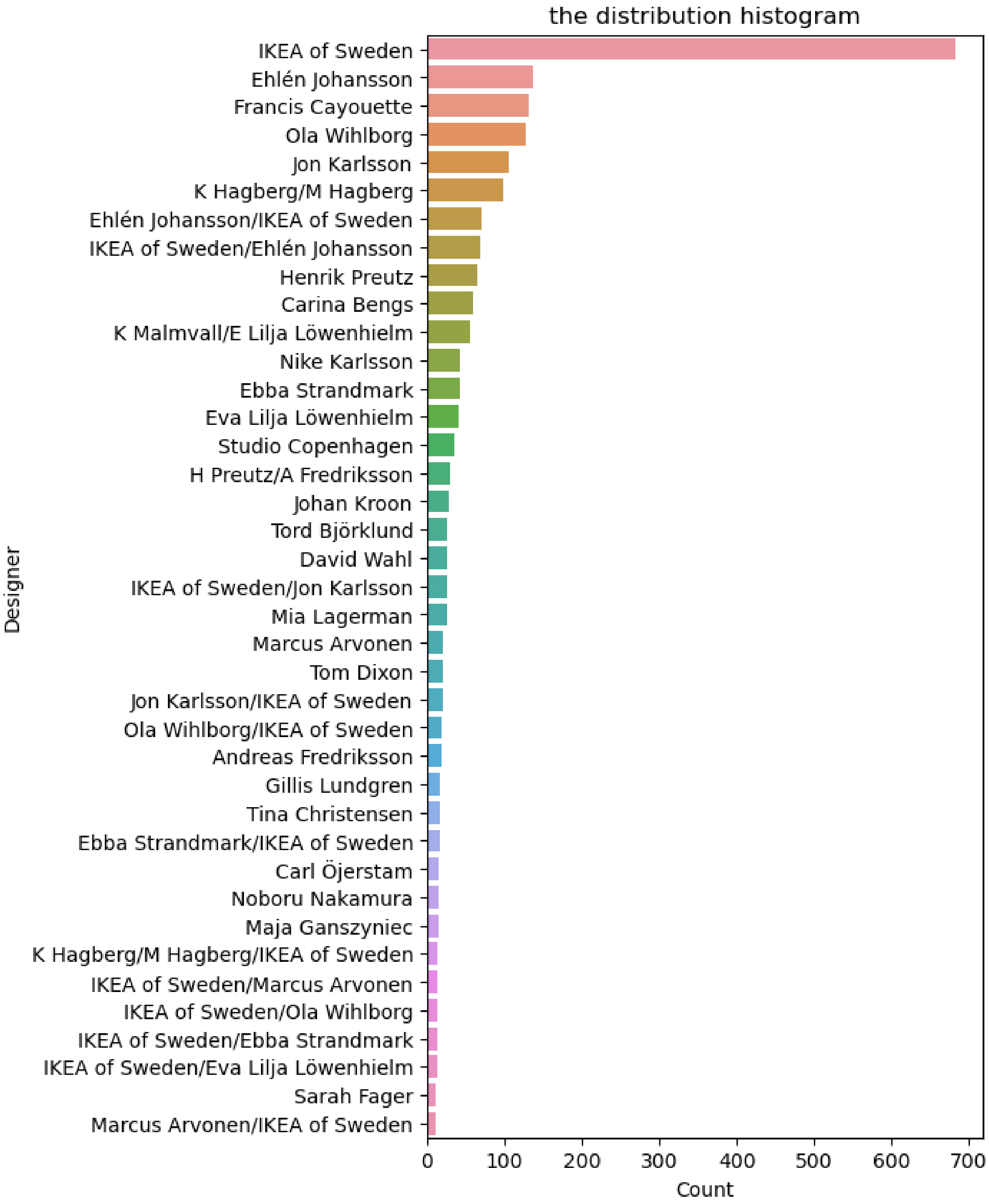
In [204…

```
# Sorting in descending order
count_designer = count_designer[count_designer.values>10].sort_values(ascending=Fa
print(count_designer)
```

```
IKEA of Sweden                         683
Ehlén Johansson                        136
Francis Cayouette                      131
Ola Wihlborg                           128
Jon Karlsson                           106
K Hagberg/M Hagberg                     98
Ehlén Johansson/IKEA of Sweden          70
IKEA of Sweden/Ehlén Johansson          68
Henrik Preutz                           64
Carina Bengs                            60
K Malmvall/E Lilja Löwenhielm           55
Nike Karlsson                           43
Ebba Strandmark                         42
Eva Lilja Löwenhielm                    41
Studio Copenhagen                       35
H Preutz/A Fredriksson                  30
Johan Kroon                             27
Tord Björklund                          26
David Wahl                              26
IKEA of Sweden/Jon Karlsson             25
Mia Lagerman                            25
Marcus Arvonen                          21
Tom Dixon                               21
Jon Karlsson/IKEA of Sweden             21
Ola Wihlborg/IKEA of Sweden             19
Andreas Fredriksson                     18
Gillis Lundgren                         17
Tina Christensen                        17
Ebba Strandmark/IKEA of Sweden          16
Carl Öjerstam                           14
Noboru Nakamura                         14
Maja Ganszyniec                         14
K Hagberg/M Hagberg/IKEA of Sweden      13
IKEA of Sweden/Marcus Arvonen           13
IKEA of Sweden/Ola Wihlborg             12
IKEA of Sweden/Ebba Strandmark          12
IKEA of Sweden/Eva Lilja Löwenhielm     12
Sarah Fager                             11
Marcus Arvonen/IKEA of Sweden           11
Name: designer, dtype: int64
```

In [205…

```
#Constructing a histogram for the designer column
fig,ax=plt.subplots(figsize=(5,10))
sns.barplot(x=count_designer.values,y=count_designer.index)
ax.set_ylabel('Designer')
ax.set_xlabel('Count')
ax.set_title('the distribution histogram')
plt.show()
```



Old price

In [206…

```
# A query to select the old_price column
cursor.execute("""SELECT old_price
                FROM all_data_without_duplicate
                WHERE old_price!='0'""")
exer2_1= cursor.fetchall()
exer2_1=pd.DataFrame(exer2_1,columns=['old_price'])
exer2_1['old_price'] = exer2_1['old_price'].astype(float)
print(exer2_1)
# Descriptive statistics of the "old_price" dataset
print(exer2_1.describe().round(2))
```

```
     old_price
0        250.0
1       3250.0
2         30.0
3         30.0
4         12.5
..         ...
569      360.0
570      885.0
571     2270.0
572      855.0
573      380.0

[574 rows x 1 columns]
       old_price
count     574.00
mean     1633.06
std      1814.51
min         2.50
25%       400.00
50%       995.00
75%      2172.50
max      9985.00
```

In [207…

```python
# Let's find the mode for the old_price.
from statistics import mode

mode = mode(exer2_1['old_price'])
print('mode ',mode)
```

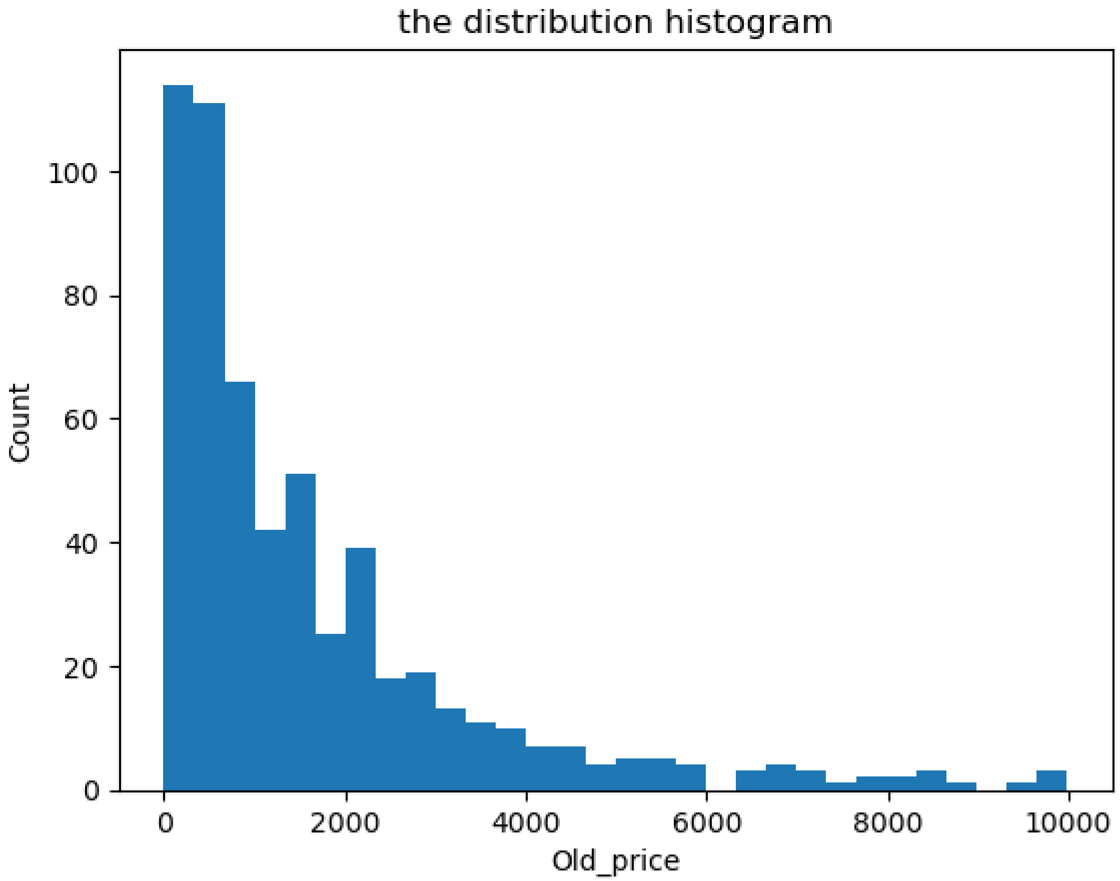
```
mode  595.0
```

In [208…

```python
# Constructing a distribution histogram old_price
fig,ax=plt.subplots()
ax.hist(exer2_1['old_price'], bins=30)
ax.set_xlabel('Old_price')
ax.set_ylabel('Count')
ax.set_title('the distribution histogram')
```

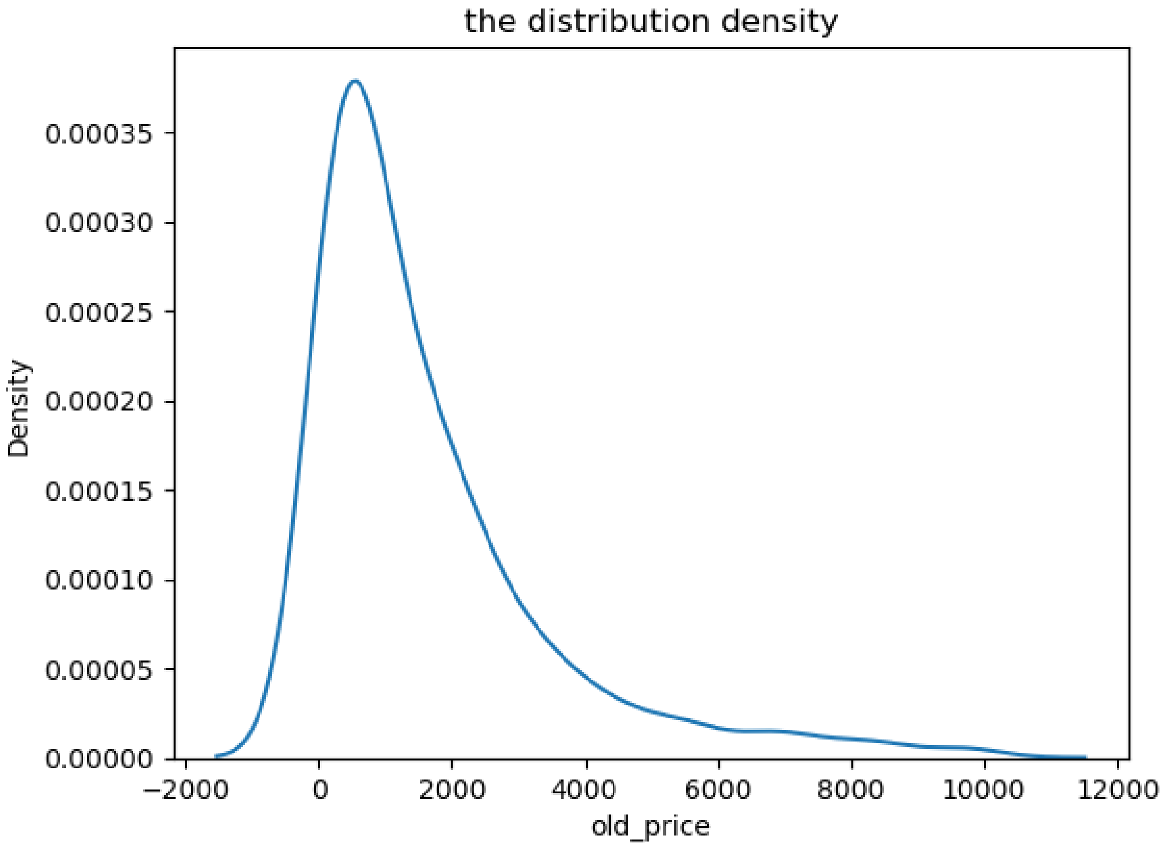
Out[208]:

```
Text(0.5, 1.0, 'the distribution histogram')
```



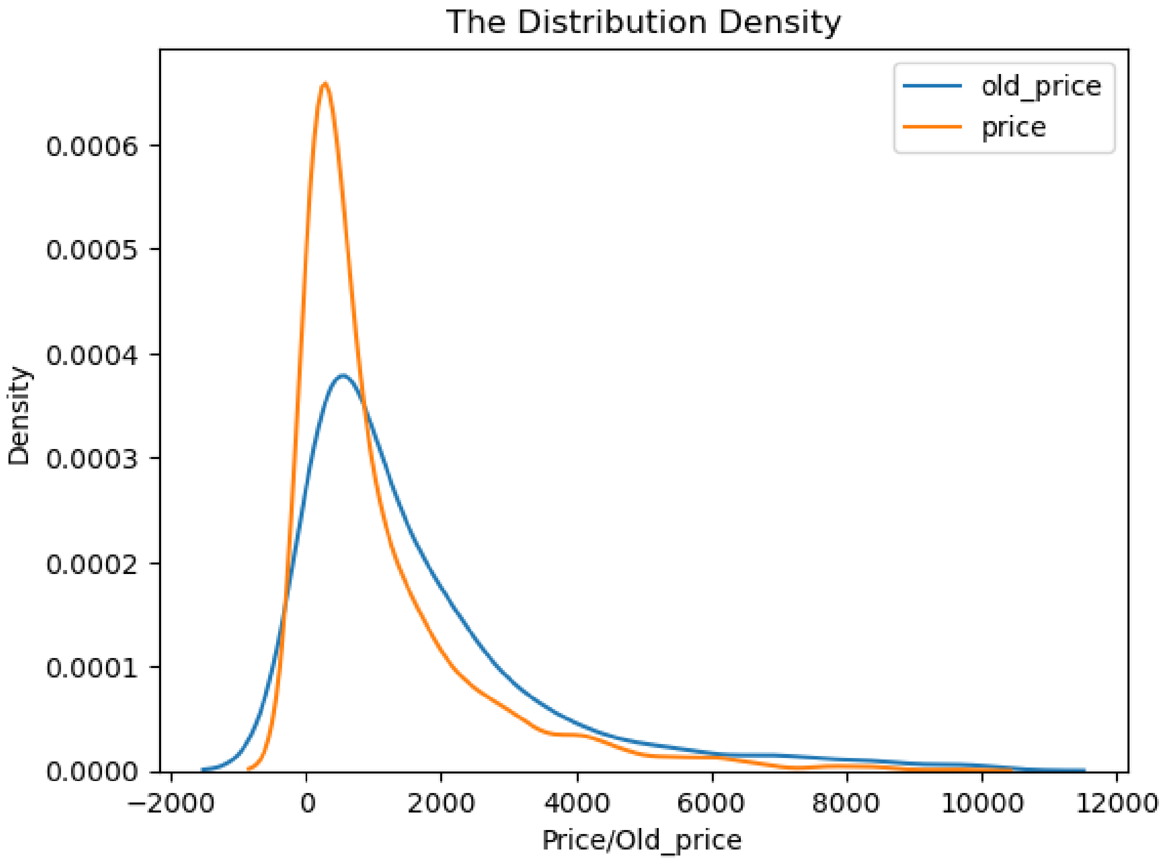
In [209…

```
# Density plot old_price
fig,ax=plt.subplots()
sns.kdeplot(exer2_1['old_price'])
ax.set_title('the distribution density')
plt.show()
```



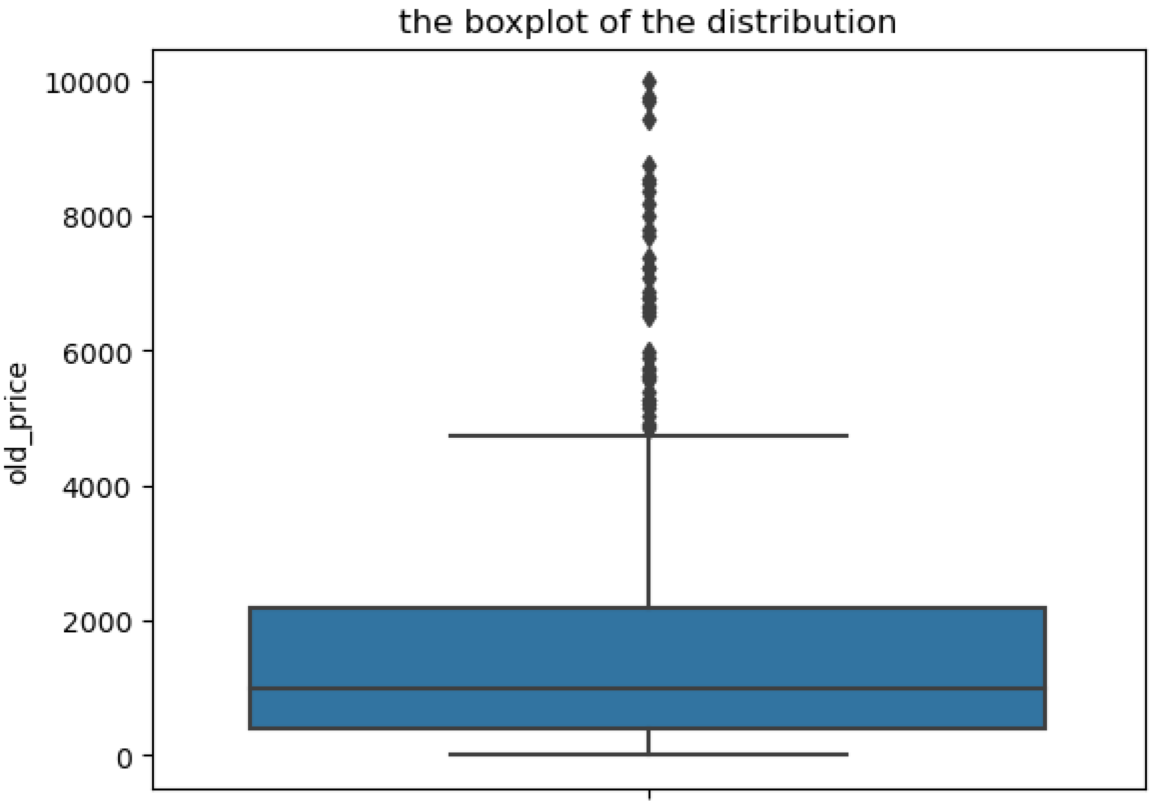
In [210…

```
import matplotlib.pyplot as plt
import seaborn as sns

fig, ax = plt.subplots()
sns.kdeplot(exer2_1['old_price'], label='old_price')
sns.kdeplot(exer2['price'], label='price')
ax.set_title('The Distribution Density')
ax.legend()
ax.set_xlabel('Price/Old_price')
plt.show()
```



In [211…

```
#Constructing boxplot old_price
fig,ax=plt.subplots()
sns.boxplot(y ='old_price', data=exer2_1)
ax.set_title('the boxplot of the distribution')
plt.show()
```



Depth, height, width

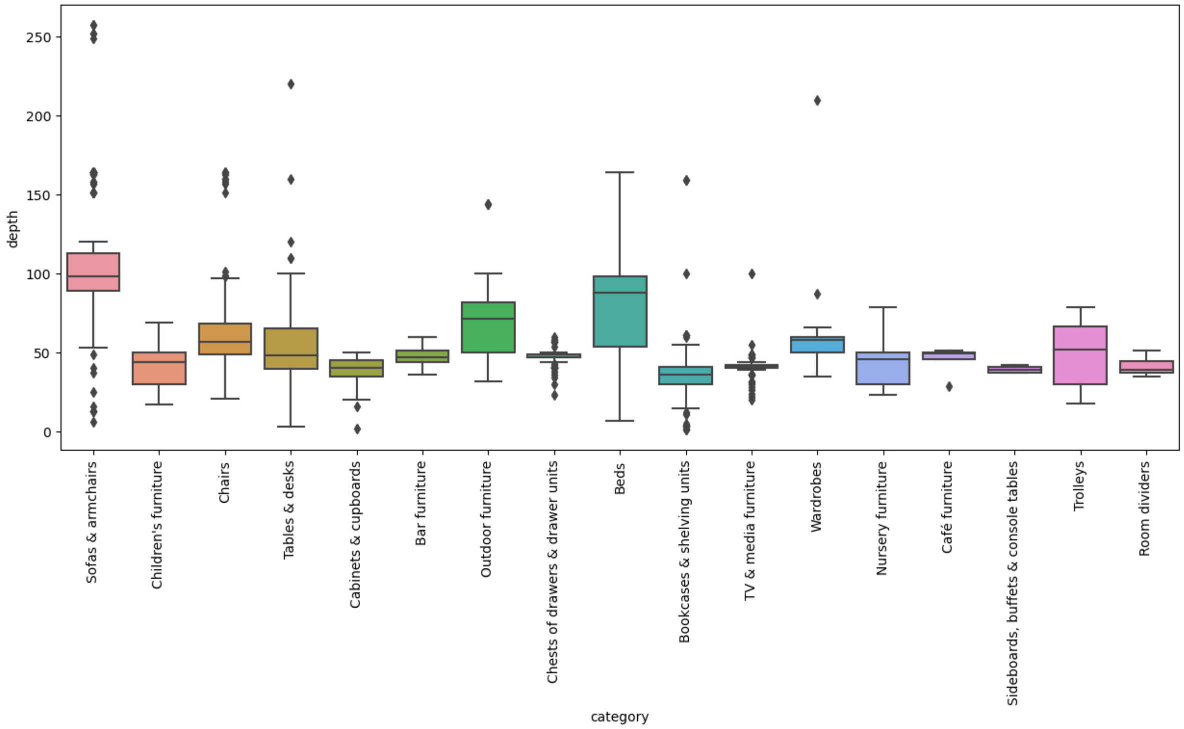
In [212…

```
import numpy
# A query to select  category, depth, height, width,price columns
cursor.execute("""SELECT category, price, depth, height, width
                FROM all_data_without_duplicate""")
exer3_1= cursor.fetchall()
exer3_1=pd.DataFrame(exer3_1,columns=['category','price','depth', 'height', 'width

print(exer3_1)

exer3_1['depth'] = exer3_1['depth'].fillna(value=numpy.nan).astype(float)
exer3_1['height'] = exer3_1['height'].fillna(value=numpy.nan).astype(float)
exer3_1['width'] = exer3_1['width'].fillna(value=numpy.nan).astype(float)
exer3_1['price'] = exer3_1['price'].astype(float)
print(exer3_1.info())
```

```
                      category  price depth height  width
0             Sofas & armchairs  150.0  None    7.0   60.0
1          Children's furniture  275.0  44.0   94.0   99.0
2                        Chairs   99.0  47.0   76.0   45.0
3                Tables & desks   75.0  70.0   70.0   42.0
4          Cabinets & cupboards  295.0  37.0  163.0   43.0
...                         ...    ...   ...    ...    ...
2957          Outdoor furniture  619.0  None   None   None
2958  Bookcases & shelving units  609.0  36.0   None  202.0
2959  Bookcases & shelving units  296.0  41.0  197.0   86.0
2960             Tables & desks  385.0  None   73.0   60.0
2961             Tables & desks  265.0  None   74.0   60.0

[2962 rows x 5 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2962 entries, 0 to 2961
Data columns (total 5 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   category  2962 non-null   object 
 1   price     2962 non-null   float64
 2   depth     1844 non-null   float64
 3   height    2236 non-null   float64
 4   width     2520 non-null   float64
dtypes: float64(4), object(1)
memory usage: 115.8+ KB
None
```

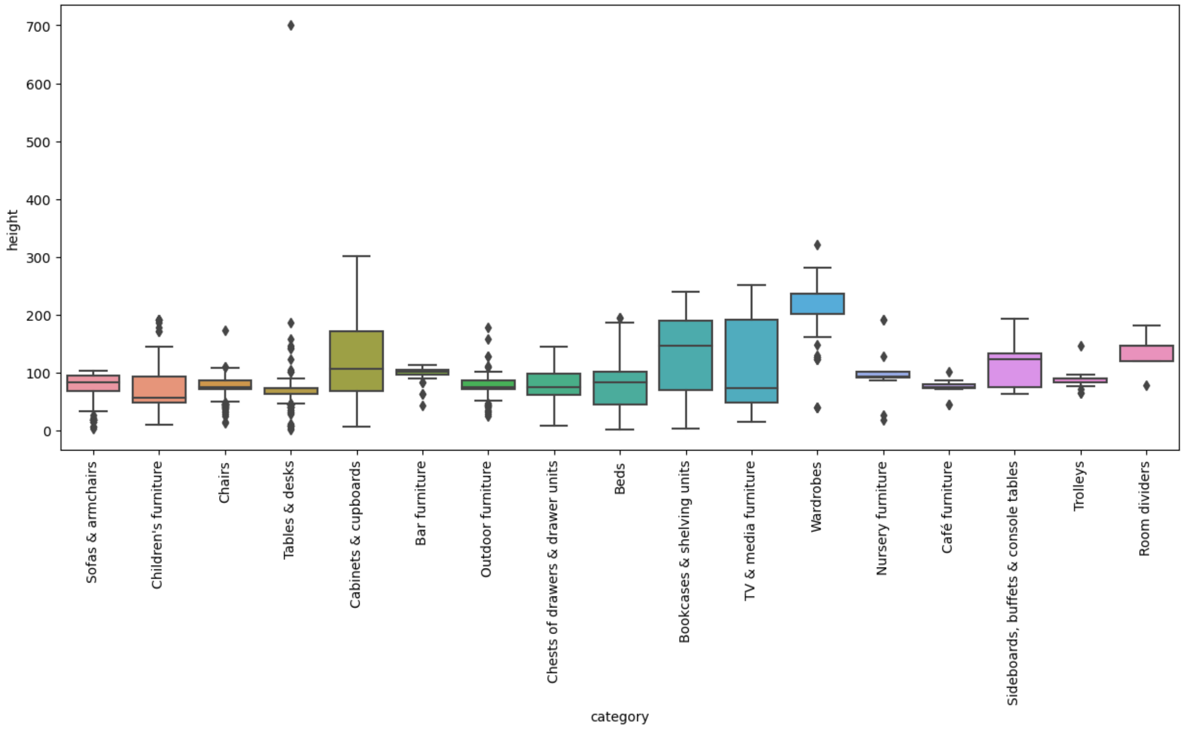
In [213…

```python
#Constructing a boxplot of depth by category
plt.subplots(figsize=(15,6))
sns.boxplot(x='category',y ='depth', data=exer3_1)
plt.xticks(rotation=90)
plt.show()
```



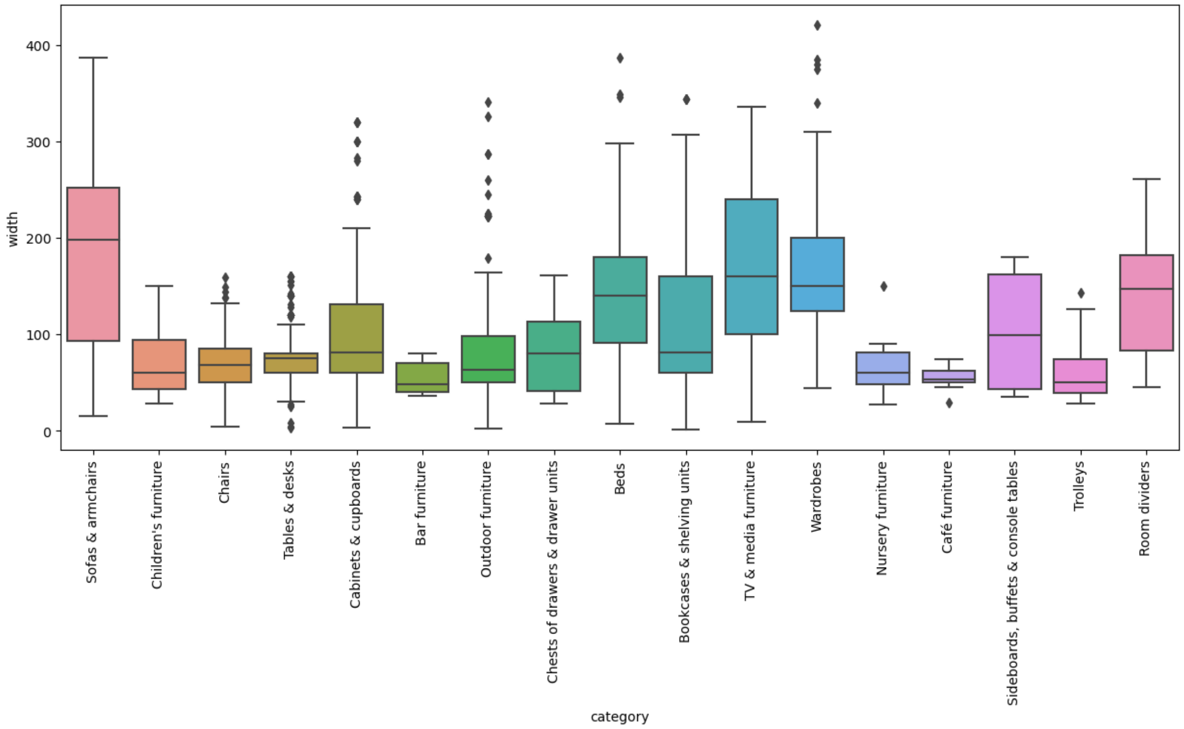
In [214…

```python
#Constructing a boxplot of height by category
plt.subplots(figsize=(15,6))
sns.boxplot(x='category',y ='height', data=exer3_1)
plt.xticks(rotation=90)
plt.show()
```



In [215…

```
#Constructing a boxplot of width by category
plt.subplots(figsize=(15,6))
sns.boxplot(x='category',y ='width', data=exer3_1)
plt.xticks(rotation=90)
plt.show()
```



In [216…

```
# Finding the averages
avg_parametr = exer3_1.groupby('category').agg(mean_depth=('depth', lambda x: x.me
                                               mean_height=('height', lambda x: x.
                                              mean_width=('width', lambda x: x.mea
                                              median_depth=('depth', lambda x: x.m
                                               median_height=('height', lambda x: 
                                              median_width=('width', lambda x: x.m
avg_parametr = avg_parametr.round(2)
```

In [217…

```
#Finding the volume
avg_parametr['volume'] = avg_parametr.apply(lambda row: row.mean_depth * row.mean_
avg_parametr['volume'] = avg_parametr.groupby('category')['volume'].prod()
avg_parametr['price'] = exer3_1.groupby('category')['price'].mean()
avg_parametr.round(2)
```

Out[217]:

	mean_depth	mean_height	mean_width	median_depth	median_height	median_widt
category						
Bar furniture	46.93	97.57	52.95	47.0	102.0	48.0
Beds	81.73	82.85	141.98	88.0	84.0	140.0
Bookcases & shelving units	36.92	131.10	106.56	36.0	147.0	81.0
Cabinets & cupboards	39.12	118.20	103.85	40.0	107.0	81.0
Café furniture	46.80	74.81	55.40	49.5	75.5	53.0
Chairs	62.48	75.15	68.05	56.5	75.5	68.0
Chests of drawers & drawer units	46.81	79.72	80.68	47.0	75.0	80.0
Children's furniture	41.97	78.26	68.16	44.0	56.5	60.0
Nursery furniture	46.53	98.94	65.18	46.0	93.0	60.0
Outdoor furniture	69.36	77.25	91.42	71.5	75.0	63.0
Room dividers	41.14	134.80	149.89	39.0	147.0	147.0
Sideboards, buffets & console tables	39.14	113.70	105.20	39.0	123.0	99.0
Sofas & armchairs	108.14	77.08	188.32	98.0	83.0	198.5
TV & media furniture	40.91	110.49	164.94	41.0	74.0	160.0
Tables & desks	55.00	70.15	74.23	48.0	74.0	75.0
Trolleys	49.75	87.73	61.13	52.0	90.0	50.0
Wardrobes	56.19	219.60	168.02	58.0	236.0	150.0

In [218…

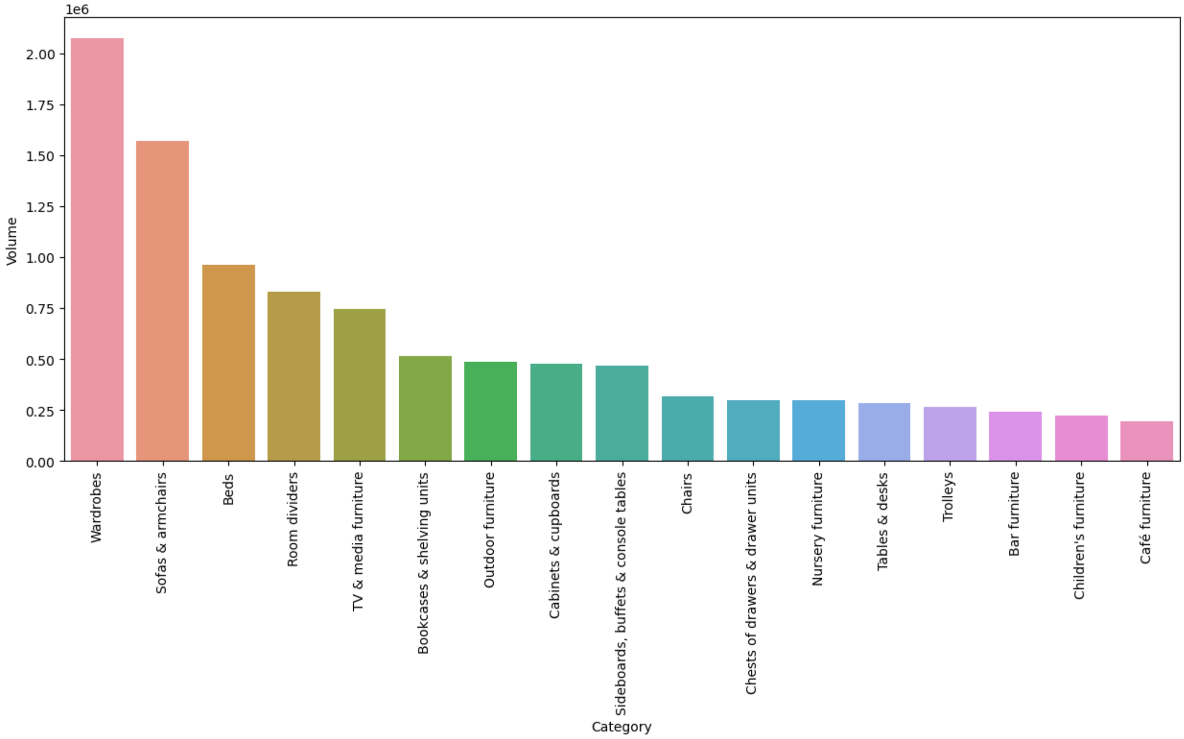
```
avg_parametr = avg_parametr.sort_values(by='volume', ascending=False)
avg_parametr.round(2)
```

Out[218]:

	mean_depth	mean_height	mean_width	median_depth	median_height	median_width
category						
Wardrobes	56.19	219.60	168.02	58.0	236.0	150.0
Sofas & armchairs	108.14	77.08	188.32	98.0	83.0	198.5
Beds	81.73	82.85	141.98	88.0	84.0	140.0
Room dividers	41.14	134.80	149.89	39.0	147.0	147.0
TV & media furniture	40.91	110.49	164.94	41.0	74.0	160.0
Bookcases & shelving units	36.92	131.10	106.56	36.0	147.0	81.0
Outdoor furniture	69.36	77.25	91.42	71.5	75.0	63.0
Cabinets & cupboards	39.12	118.20	103.85	40.0	107.0	81.0
Sideboards, buffets & console tables	39.14	113.70	105.20	39.0	123.0	99.0
Chairs	62.48	75.15	68.05	56.5	75.5	68.0
Chests of drawers & drawer units	46.81	79.72	80.68	47.0	75.0	80.0
Nursery furniture	46.53	98.94	65.18	46.0	93.0	60.0
Tables & desks	55.00	70.15	74.23	48.0	74.0	75.0
Trolleys	49.75	87.73	61.13	52.0	90.0	50.0
Bar furniture	46.93	97.57	52.95	47.0	102.0	48.0
Children's furniture	41.97	78.26	68.16	44.0	56.5	60.0
Café furniture	46.80	74.81	55.40	49.5	75.5	53.0

In [219…

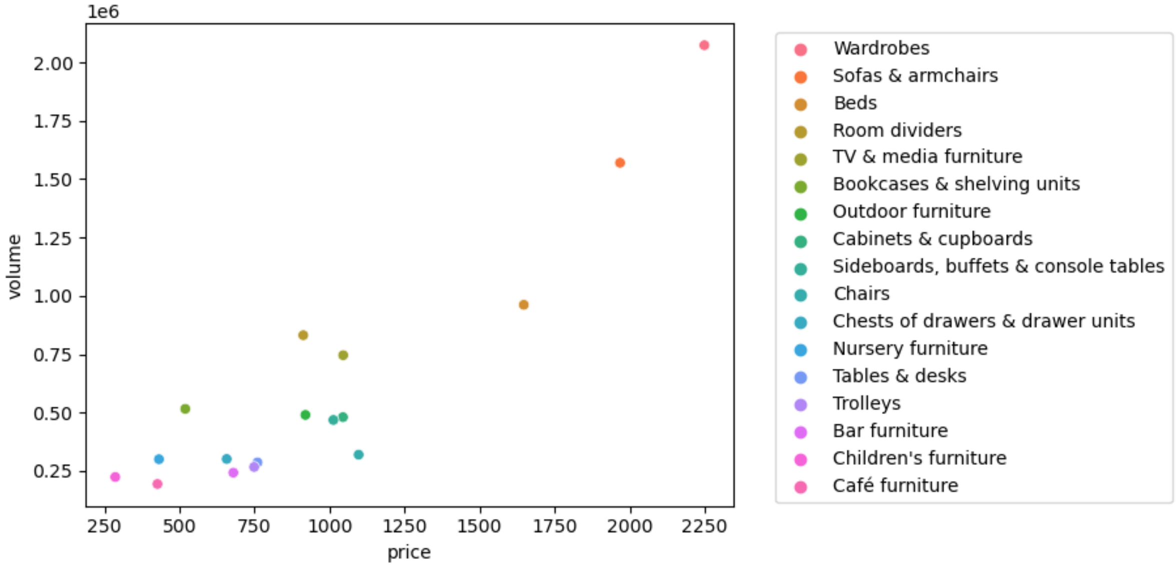
```
#Constructing barplot volume by category
plt.subplots(figsize=(15,6))
sns.barplot(x=avg_parametr.index, y=avg_parametr["volume"])
plt.xticks(rotation=90)
plt.xlabel("Category")
plt.ylabel("Volume")
plt.show()
```



Price vs depth, height, width

In [220…

```
#Constructing scatterplot price and volume
sns.scatterplot(x='price',y ='volume', hue='category', data=avg_parametr)
plt.legend(bbox_to_anchor=(1.05, 1), loc='upper left')
plt.show()
```



In [221…

```
corr = avg_parametr[['price', 'volume']].corr().iloc[0, 1]
corr
```

Out[221]:

```
0.911674744557904
```

Missing depth

In [222…

```
# a query to select columns item_id, category, and depth where depth is Null
cursor.execute("""SELECT item_id, category, depth
                FROM all_data_without_duplicate
                WHERE depth IS NULL""")
exer4= cursor.fetchall()
exer4=pd.DataFrame(exer4,columns=['item_id','category','depth'])
print(exer4)
# exer4['depth'] = exer4['depth'].fillna(value=numpy.nan).astype(float)
print(exer4.info())
```

```
       item_id             category depth
0     10052362     Sofas & armchairs  None
1     10135659                Chairs  None
2     10141170                Chairs  None
3     10150094                Chairs  None
4     10192013  Children's furniture  None
...        ...                   ...   ...
1113  99323925         Bar furniture  None
1114  99331384        Tables & desks  None
1115  99335985     Outdoor furniture  None
1116  99930961        Tables & desks  None
1117  99932615        Tables & desks  None

[1118 rows x 3 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1118 entries, 0 to 1117
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   item_id   1118 non-null   object
 1   category  1118 non-null   object
 2   depth     0 non-null      object
dtypes: object(3)
memory usage: 26.3+ KB
None
```

In [223…

```
# Replacing empty values with means.
exer4.loc[exer4['category']=="Children's furniture", 'depth'] = avg_parametr.loc[a
exer4.loc[exer4['category']=="Bar furniture", 'depth'] = avg_parametr.loc[avg_paran
exer4.loc[exer4['category']=="Outdoor furniture", 'depth'] = avg_parametr.loc[avg_
exer4.loc[exer4['category']=="Trolleys", 'depth'] = avg_parametr.loc[avg_parametr.
```

In [224…

```
# Replacing empty values with medians
exer4.loc[exer4['category']=="Sofas & armchairs", 'depth'] = avg_parametr.loc[avg_
exer4.loc[exer4['category']=="Cabinets & cupboards", 'depth'] = avg_parametr.loc[a
exer4.loc[exer4['category']=="Chairs", 'depth'] = avg_parametr.loc[avg_parametr.in
exer4.loc[exer4['category']=="Tables & desks", 'depth'] = avg_parametr.loc[avg_para
exer4.loc[exer4['category']=="Chests of drawers & drawer units", 'depth'] = avg_pa
exer4.loc[exer4['category']=="Beds", 'depth'] = avg_parametr.loc[avg_parametr.inde
exer4.loc[exer4['category']=="Bookcases & shelving units", 'depth'] = avg_parametr
exer4.loc[exer4['category']=="TV & media furniture", 'depth'] = avg_parametr.loc[a
exer4.loc[exer4['category']=="Wardrobes", 'depth'] = avg_parametr.loc[avg_parametr
exer4.loc[exer4['category']=="Nursery furniture", 'depth'] = avg_parametr.loc[avg_
exer4.loc[exer4['category']=="Café furniture", 'depth'] = avg_parametr.loc[avg_para
exer4.loc[exer4['category']=="Sideboards, buffets & console tables", 'depth'] = av
exer4.loc[exer4['category']=="Room dividers", 'depth'] = avg_parametr.loc[avg_paran
```

In [225…

```
exer4=exer4.sort_values(by='depth', ascending=False)
print(exer4)
exer4.info()
```

```
      item_id                  category depth
0    10052362          Sofas & armchairs  98.0
564  50363970          Sofas & armchairs  98.0
919  80425212          Sofas & armchairs  98.0
827  79217921          Sofas & armchairs  98.0
576  50418053          Sofas & armchairs  98.0
..        ...                        ...   ...
289  30323367  Bookcases & shelving units  36.0
981  90226797  Bookcases & shelving units  36.0
290  30323598  Bookcases & shelving units  36.0
291  30333286  Bookcases & shelving units  36.0
559  50347503  Bookcases & shelving units  36.0

[1118 rows x 3 columns]
<class 'pandas.core.frame.DataFrame'>
Int64Index: 1118 entries, 0 to 559
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   item_id   1118 non-null   object
 1   category  1118 non-null   object
 2   depth     1118 non-null   object
dtypes: object(3)
memory usage: 34.9+ KB
```

In [226…

```
# Let's write the filled values of the depth column into the table named NEW_data.
conn = sqlite3.connect('sql_step_project.db')
conn.execute('BEGIN TRANSACTION')
for index, row in exer4.iterrows():
    item_id=row['item_id']
    category = row['category']
    depth = row['depth']
    conn.execute('UPDATE NEW_data SET depth_new = ? WHERE item_id = ? AND category
conn.commit()
```

Missing height

In [227…

```
# A query to select columns item_id, category, and height where height is Null
cursor.execute("""SELECT item_id, category, height
                FROM all_data_without_duplicate
                WHERE height IS NULL""")
exer4_1= cursor.fetchall()
exer4_1=pd.DataFrame(exer4_1,columns=['item_id','category','height'])
print(exer4_1)
# exer4['depth'] = exer4['depth'].fillna(value=numpy.nan).astype(float)
print(exer4_1.info())
```

```
      item_id                    category height
0    10135659                      Chairs   None
1    10141170                      Chairs   None
2    10150094                      Chairs   None
3    10192013        Children's furniture   None
4      102065                        Beds   None
..        ...                         ...    ...
721  99305158                      Chairs   None
722  99305177                      Chairs   None
723  99331384              Tables & desks   None
724  99335985           Outdoor furniture   None
725  99902661  Bookcases & shelving units   None

[726 rows x 3 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 726 entries, 0 to 725
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   item_id   726 non-null    object
 1   category  726 non-null    object
 2   height    0 non-null      object
dtypes: object(3)
memory usage: 17.1+ KB
None
```

In [228…

```python
# Replacing empty values with means
exer4_1.loc[exer4_1['category']=="Cabinets & cupboards", 'height'] = avg_parametr.
exer4_1.loc[exer4_1['category']=="Chests of drawers & drawer units", 'height'] = a
exer4_1.loc[exer4_1['category']=="Bookcases & shelving units", 'height'] = avg_par
```

In [229…

```python
# Replacing empty values with medians
exer4_1.loc[exer4_1['category']=="Children's furniture", 'height'] = avg_parametr.
exer4_1.loc[exer4_1['category']=="Bar furniture", 'height'] = avg_parametr.loc[avg_
exer4_1.loc[exer4_1['category']=="Outdoor furniture", 'height'] = avg_parametr.loc
exer4_1.loc[exer4_1['category']=="Trolleys", 'height'] = avg_parametr.loc[avg_para
exer4_1.loc[exer4_1['category']=="Sofas & armchairs", 'height'] = avg_parametr.loc
exer4_1.loc[exer4_1['category']=="Chairs", 'height'] = avg_parametr.loc[avg_parame
exer4_1.loc[exer4_1['category']=="Tables & desks", 'height'] = avg_parametr.loc[av
exer4_1.loc[exer4_1['category']=="Beds", 'height'] = avg_parametr.loc[avg_parametr
exer4_1.loc[exer4_1['category']=="TV & media furniture", 'height'] = avg_parametr.
exer4_1.loc[exer4_1['category']=="Wardrobes", 'height'] = avg_parametr.loc[avg_par
exer4_1.loc[exer4_1['category']=="Nursery furniture", 'height'] = avg_parametr.loc
exer4_1.loc[exer4_1['category']=="Café furniture", 'height'] = avg_parametr.loc[av
exer4_1.loc[exer4_1['category']=="Sideboards, buffets & console tables", 'height']
exer4_1.loc[exer4_1['category']=="Room dividers", 'height'] = avg_parametr.loc[avg_
```

In [230…

```python
# Let's write the filled values of the height column into the table named NEW_data
conn = sqlite3.connect('sql_step_project.db')
conn.execute('BEGIN TRANSACTION')
for index, row in exer4_1.iterrows():
    item_id=row['item_id']
    category = row['category']
    height = row['height']
    conn.execute('UPDATE NEW_data SET height_new = ? WHERE item_id = ? AND category
conn.commit()
```

Missing width

In [231…
```
# A query to select columns item_id, category, and width where width is Null
cursor.execute("""SELECT item_id, category, width
                FROM all_data_without_duplicate
                WHERE width IS NULL""")
exer4_2= cursor.fetchall()
exer4_2=pd.DataFrame(exer4_2,columns=['item_id','category','width'])
print(exer4_2)
# exer4['depth'] = exer4['depth'].fillna(value=numpy.nan).astype(float)
print(exer4_2.info())
```

```
      item_id                    category width
0    10141170                      Chairs  None
1    10150094                      Chairs  None
2    10192013        Children's furniture  None
3      102065                        Beds  None
4    10209202                      Chairs  None
..        ...                         ...   ...
437  99239620           Sofas & armchairs  None
438  99275241                        Beds  None
439  99278956           Sofas & armchairs  None
440  99297634  Bookcases & shelving units  None
441  99335985           Outdoor furniture  None

[442 rows x 3 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 442 entries, 0 to 441
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   item_id   442 non-null    object
 1   category  442 non-null    object
 2   width     0 non-null      object
dtypes: object(3)
memory usage: 10.5+ KB
None
```

In [232…
```
# Replacing empty values with means.
exer4_2.loc[exer4_2['category']=="Beds", 'width'] = avg_parametr.loc[avg_parametr.
exer4_2.loc[exer4_2['category']=="Chairs", 'width'] = avg_parametr.loc[avg_parametr
exer4_2.loc[exer4_2['category']=="TV & media furniture", 'width'] = avg_parametr.l
```

In [233…
```
# Replacing empty values with medians
exer4_2.loc[exer4_2['category']=="Cabinets & cupboards", 'width'] = avg_parametr.l
exer4_2.loc[exer4_2['category']=="Chests of drawers & drawer units", 'width'] = av
exer4_2.loc[exer4_2['category']=="Bookcases & shelving units", 'width'] = avg_para
exer4_2.loc[exer4_2['category']=="Children's furniture", 'width'] = avg_parametr.l
exer4_2.loc[exer4_2['category']=="Bar furniture", 'width'] = avg_parametr.loc[avg_
exer4_2.loc[exer4_2['category']=="Outdoor furniture", 'width'] = avg_parametr.loc[
exer4_2.loc[exer4_2['category']=="Trolleys", 'width'] = avg_parametr.loc[avg_param
exer4_2.loc[exer4_2['category']=="Sofas & armchairs", 'width'] = avg_parametr.loc[
exer4_2.loc[exer4_2['category']=="Tables & desks", 'width'] = avg_parametr.loc[avg_
exer4_2.loc[exer4_2['category']=="Wardrobes", 'width'] = avg_parametr.loc[avg_para
exer4_2.loc[exer4_2['category']=="Nursery furniture", 'width'] = avg_parametr.loc[
exer4_2.loc[exer4_2['category']=="Café furniture", 'width'] = avg_parametr.loc[avg_
exer4_2.loc[exer4_2['category']=="Sideboards, buffets & console tables", 'width']
exer4_2.loc[exer4_2['category']=="Room dividers", 'width'] = avg_parametr.loc[avg_
```

In [234…
```
# Let's write the filled values of the width column into the table named NEW_data
conn = sqlite3.connect('sql_step_project.db')
conn.execute('BEGIN TRANSACTION')
for index, row in exer4_2.iterrows():
    item_id=row['item_id']
    category = row['category']
    width = row['width']
    conn.execute('UPDATE NEW_data SET width_new = ? WHERE item_id = ? AND category
conn.commit()
```

Category vs price

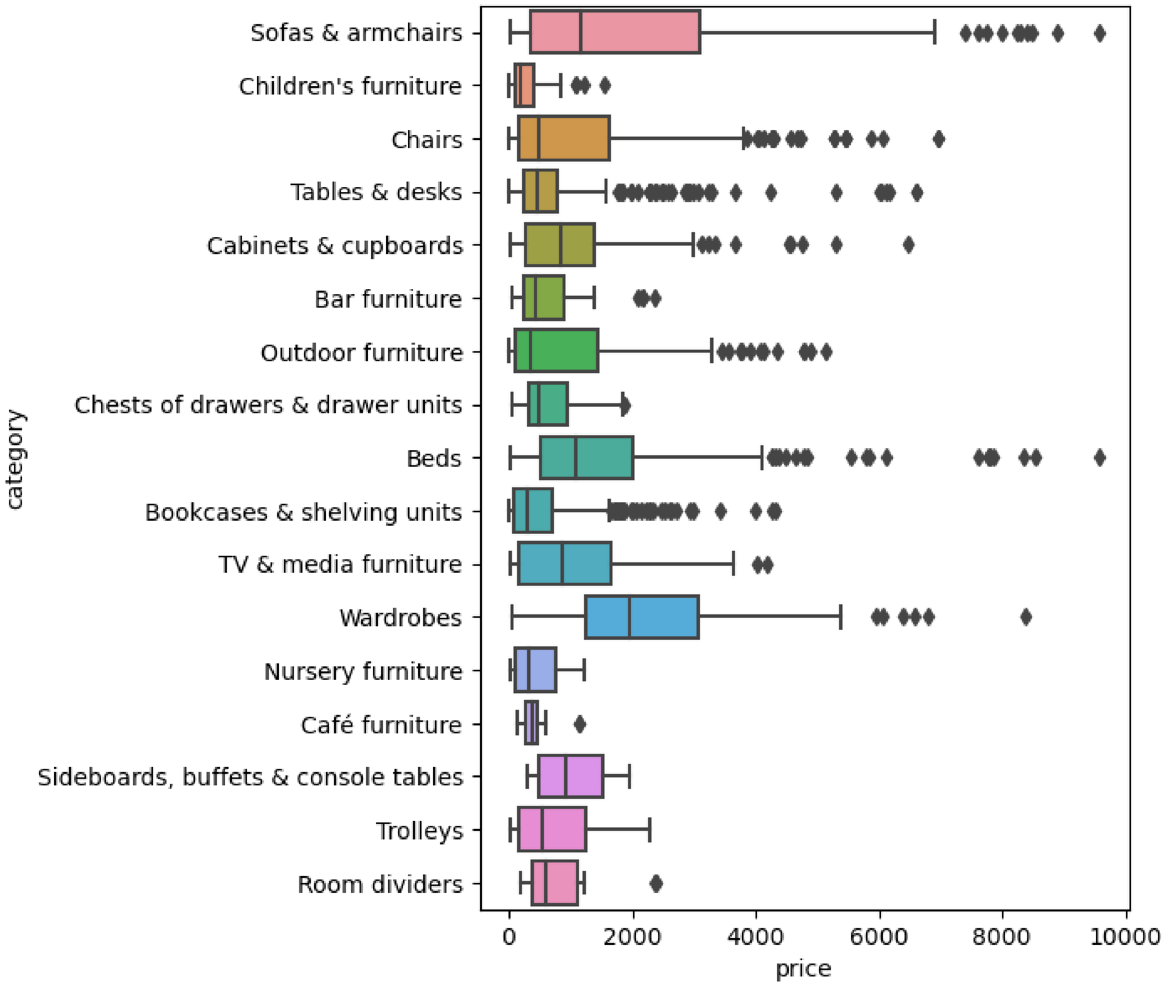
In [235…

```
# Query for selecting columns category and price
cursor.execute("""SELECT category, price
                FROM all_data_without_duplicate""")
exer3= cursor.fetchall()
exer3=pd.DataFrame(exer3,columns=['category','price'])
exer3['price'] = exer3['price'].astype(float)
print(exer3.info())
# Description of the price column by category
print(exer3.groupby(['category'])['price'].mean().round(2))
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2962 entries, 0 to 2961
Data columns (total 2 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   category  2962 non-null   object 
 1   price     2962 non-null   float64
dtypes: float64(1), object(1)
memory usage: 46.4+ KB
None
category
Bar furniture                        679.55
Beds                                1647.43
Bookcases & shelving units           519.42
Cabinets & cupboards                1044.82
Café furniture                       426.72
Chairs                              1097.12
Chests of drawers & drawer units     657.49
Children's furniture                 286.18
Nursery furniture                    431.77
Outdoor furniture                    919.76
Room dividers                        912.60
Sideboards, buffets & console tables    1013.00
Sofas & armchairs                   1968.16
TV & media furniture                1045.65
Tables & desks                       760.13
Trolleys                             748.87
Wardrobes                           2249.02
Name: price, dtype: float64
```

In [236…

```
#побудова boxplot price за category
plt.subplots(figsize=(5,7))
sns.boxplot(x='price',y ='category', data=exer3)
plt.show()
```



Category vs designer

In [237…

```
# Query for selecting columns category,COUNT_empty_value where designer has empty
cursor.execute("""SELECT category , COUNT(designer) AS COUNT_empty_value
                   FROM all_data_without_duplicate
                  WHERE designer=''
                  GROUP BY category
                  ORDER BY COUNT_empty_value DESC""")
exer6= cursor.fetchall()
exer6=pd.DataFrame(exer6,columns=['category','COUNT_empty_value'])
print(exer6)
print(exer6.info())
# кількість пусмих комірок
print(exer6['COUNT_empty_value'].sum())
```

```
                         category  COUNT_empty_value
0        Bookcases & shelving units                 26
1                            Chairs                 23
2                  Sofas & armchairs                20
3                     Tables & desks                14
4               Cabinets & cupboards                 5
5                              Beds                  5
6               Children's furniture                 4
7               TV & media furniture                 3
8                  Outdoor furniture                 1
9  Chests of drawers & drawer units                  1
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 2 columns):
 #   Column             Non-Null Count  Dtype 
---  ------             --------------  ----- 
 0   category           10 non-null     object
 1   COUNT_empty_value  10 non-null     int64 
dtypes: int64(1), object(1)
memory usage: 288.0+ bytes
None
102
```

In [238…

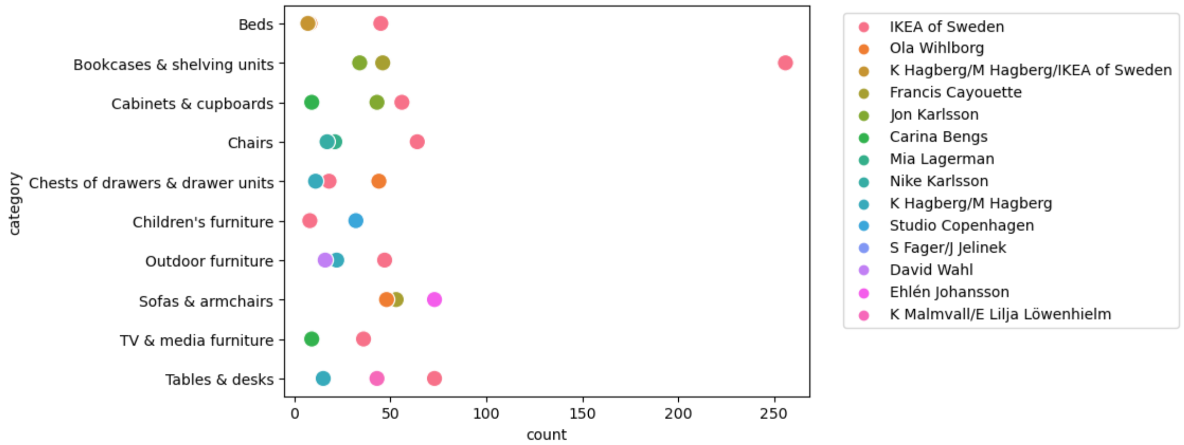
```
# Query for selecting columns category, designer for categories that have empty va
cursor.execute("""SELECT category, designer, coun
                FROM designer_for_empty_3""")
exer6_1= cursor.fetchall()
exer6_1=pd.DataFrame(exer6_1,columns=['category','designer','count'])
print(exer6_1)
print(exer6_1.info())
```

```
                            category                            designer  \
0                               Beds                      IKEA of Sweden
1                               Beds                        Ola Wihlborg
2                               Beds  K Hagberg/M Hagberg/IKEA of Sweden
3         Bookcases & shelving units                      IKEA of Sweden
4         Bookcases & shelving units                   Francis Cayouette
5         Bookcases & shelving units                        Jon Karlsson
6               Cabinets & cupboards                      IKEA of Sweden
7               Cabinets & cupboards                        Jon Karlsson
8               Cabinets & cupboards                        Carina Bengs
9                             Chairs                      IKEA of Sweden
10                            Chairs                        Mia Lagerman
11                            Chairs                       Nike Karlsson
12  Chests of drawers & drawer units                        Ola Wihlborg
13  Chests of drawers & drawer units                      IKEA of Sweden
14  Chests of drawers & drawer units                 K Hagberg/M Hagberg
15              Children's furniture                   Studio Copenhagen
16              Children's furniture                   S Fager/J Jelinek
17              Children's furniture                      IKEA of Sweden
18                 Outdoor furniture                      IKEA of Sweden
19                 Outdoor furniture                 K Hagberg/M Hagberg
20                 Outdoor furniture                          David Wahl
21                 Sofas & armchairs                     Ehlén Johansson
22                 Sofas & armchairs                   Francis Cayouette
23                 Sofas & armchairs                        Ola Wihlborg
24              TV & media furniture                      IKEA of Sweden
25              TV & media furniture                 K Hagberg/M Hagberg
26              TV & media furniture                        Carina Bengs
27                    Tables & desks                      IKEA of Sweden
28                    Tables & desks       K Malmvall/E Lilja Löwenhielm
29                    Tables & desks                 K Hagberg/M Hagberg

    count
0      45
1       8
2       7
3     256
4      46
5      34
6      56
7      43
8       9
9      64
10     21
11     17
12     44
13     18
14     11
15     32
16      8
17      8
18     47
19     22
20     16
21     73
22     53
23     48
24     36
25      9
26      9
27     73
28     43
29     15
<class 'pandas.core.frame.DataFrame'>
```

```
RangeIndex: 30 entries, 0 to 29
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   category  30 non-null     object
 1   designer  30 non-null     object
 2   count     30 non-null     int64 
dtypes: int64(1), object(2)
memory usage: 848.0+ bytes
None
```

In [239…

```
# Graph of the distribution of designer by category
sns.scatterplot(x='count',y ='category', hue='designer',data=exer6_1, s=125)
plt.legend(bbox_to_anchor=(1.05, 1), loc='upper left')
plt.show()
```



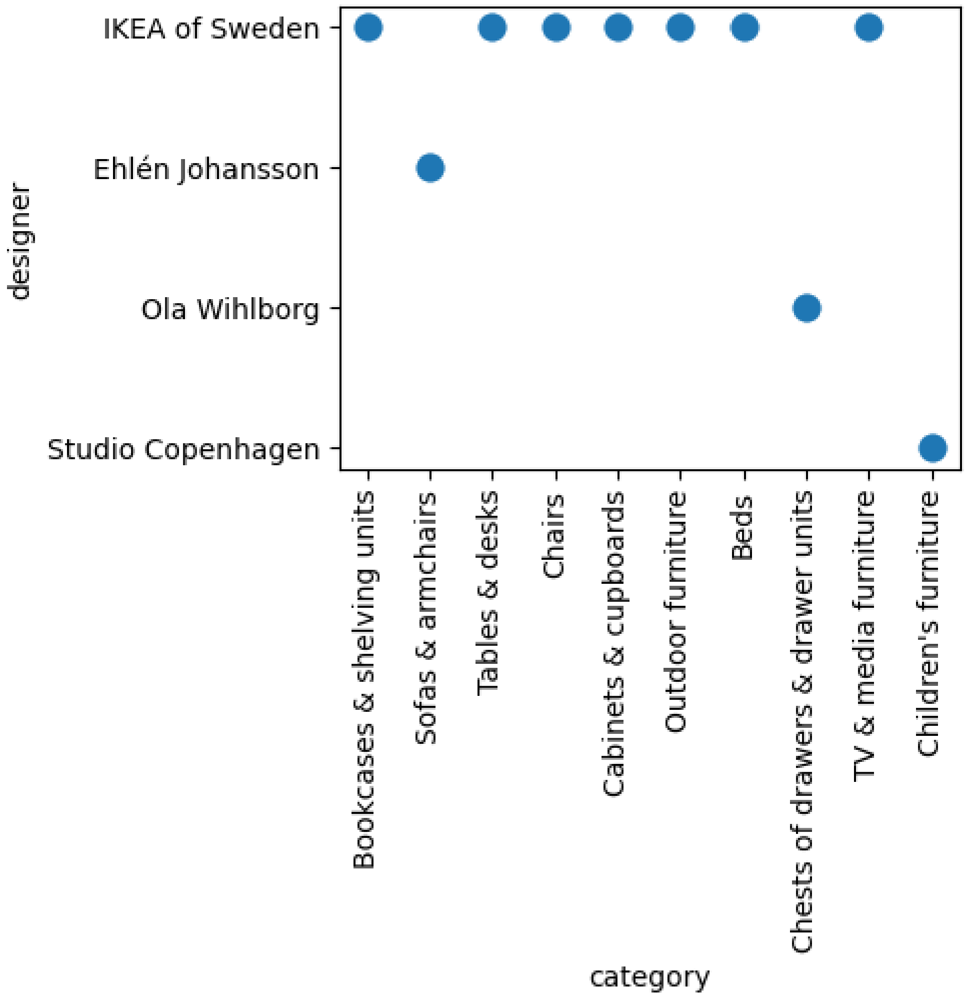
In [240…

```
# запит вибору стовпчика max  кількість (designer який найчастіше зустрічається),
# також стовпчики category, designer
cursor.execute("""SELECT category, designer, max
                FROM designer_for_empty""")
exer6_2= cursor.fetchall()
exer6_2=pd.DataFrame(exer6_2,columns=['category','designer','max'])
print(exer6_2)
print(exer6_2.info())
```

```
                           category           designer  max
0        Bookcases & shelving units     IKEA of Sweden  256
1                 Sofas & armchairs    Ehlén Johansson   73
2                    Tables & desks     IKEA of Sweden   73
3                            Chairs     IKEA of Sweden   64
4              Cabinets & cupboards     IKEA of Sweden   56
5                 Outdoor furniture     IKEA of Sweden   47
6                              Beds     IKEA of Sweden   45
7  Chests of drawers & drawer units       Ola Wihlborg   44
8              TV & media furniture     IKEA of Sweden   36
9              Children's furniture  Studio Copenhagen   32
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   category  10 non-null     object
 1   designer  10 non-null     object
 2   max       10 non-null     int64 
dtypes: int64(1), object(2)
memory usage: 368.0+ bytes
None
```

In [241…

```
# Graph of the distribution of designer by category
plt.subplots(figsize=(4,3))
sns.scatterplot(x='category',y ='designer',data=exer6_2, s=125)
plt.xticks(rotation=90)
plt.show()
```



Missing designer

In [242…

```
# Query for selecting columns item_id, category, designer, where designer values ar
cursor.execute("""SELECT item_id, category , designer
                   FROM all_data_without_duplicate
                   WHERE designer=''
                  """)
exer6_3= cursor.fetchall()
exer6_3=pd.DataFrame(exer6_3,columns=['item_id', 'category' , 'designer'])
print(exer6_3.sort_values(by='designer', ascending=True))
print(exer6_3.info())
```

```
      item_id                     category designer
0    10294511        TV & media furniture         
73   70443626  Bookcases & shelving units         
72   70441566  Bookcases & shelving units         
71   70428904  Bookcases & shelving units         
70   70299879  Bookcases & shelving units         
..        ...                         ...      ...
29   30428915        Cabinets & cupboards         
28   30428901        Cabinets & cupboards         
27   30415625              Tables & desks         
37     385069                      Chairs         
101  99239620          Sofas & armchairs         

[102 rows x 3 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 102 entries, 0 to 101
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   item_id   102 non-null    object
 1   category  102 non-null    object
 2   designer  102 non-null    object
dtypes: object(3)
memory usage: 2.5+ KB
None
```

In [243…

```python
# Filling in missing values of designer with the most frequently occurring designer
for index, row in exer6_3.iterrows():
    category = row['category']
    designer = exer6_2.loc[exer6_2['category'] == category, 'designer'].iloc[0]
    exer6_3.at[index, 'designer'] = designer
```

In [244…

```python
exer6_3.sort_values(by='designer', ascending=True)
```

Out[244]:

	item_id	category	designer
101	99239620	Sofas & armchairs	Ehlén Johansson
30	30433790	Sofas & armchairs	Ehlén Johansson
77	79239635	Sofas & armchairs	Ehlén Johansson
36	382594	Sofas & armchairs	Ehlén Johansson
81	80382608	Sofas & armchairs	Ehlén Johansson
...	...	...	...
87	80433486	Chests of drawers & drawer units	Ola Wihlborg
46	40466285	Children's furniture	Studio Copenhagen
33	30466281	Children's furniture	Studio Copenhagen
58	50466275	Children's furniture	Studio Copenhagen
56	50422494	Children's furniture	Studio Copenhagen

102 rows × 3 columns

In [245…

```python
# Let's write the filled values of the designer column to the table named NEW_data
conn = sqlite3.connect('sql_step_project.db')
conn.execute('BEGIN TRANSACTION')
for index, row in exer6_3.iterrows():
    item_id=row['item_id']
    category = row['category']
    designer = row['designer']
    conn.execute('UPDATE NEW_data SET designer_new = ? WHERE item_id = ? AND catego
conn.commit()
```

Designer vs price

In [246…

```
# Query for selecting columns category,designer, and price
cursor.execute("""SELECT category, designer, price
                FROM all_data_without_duplicate
                WHERE designer!=''""")
exer7= cursor.fetchall()
exer7=pd.DataFrame(exer7,columns=['category','designer','price'])
exer7['price'] = exer7['price'].astype(float)
print(exer7.info())
# Description of the price column by category
print(exer7.groupby(['designer'])['price'].mean().round(2))
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2860 entries, 0 to 2859
Data columns (total 3 columns):
 #   Column    Non-Null Count  Dtype  
---  ------    --------------  -----  
 0   category  2860 non-null   object 
 1   designer  2860 non-null   object 
 2   price     2860 non-null   float64
dtypes: float64(1), object(2)
memory usage: 67.2+ KB
None
designer
A Fredriksson/J Hultqvist/W Chong     406.50
A Huldén/S Dahlman                     55.00
Andreas Fredriksson                  1383.61
Anna Efverlund                        525.00
Anna Palleschitz                      822.50
                                      ...   
Tom Dixon/IKEA of Sweden             2395.00
Tord Björklund                        528.08
Tord Björklund/IKEA of Sweden        3253.00
Virgil Abloh                          501.60
Wiebke Braasch                        410.00
Name: price, Length: 279, dtype: float64
```

ANOVA test for the dependence of price on two factors, category and designer.

In [248…

```
# Mean price value for each designer within each category
mean_des_in_categor=exer7.groupby(['category','designer'])['price'].mean().round(2
print(mean_des_in_categor)
```

```
category       designer
Bar furniture  Carina Bengs                                     370.00
               Ehlén Johansson                                 1149.89
               Francis Cayouette                               1121.67
               Henrik Preutz                                     69.00
               IKEA of Sweden                                   257.50
                                                                 ...
Wardrobes      L Hilland/J Karlsson                             945.00
               Ola Wihlborg                                     648.67
               Ola Wihlborg/Ehlén Johansson/IKEA of Sweden     3935.00
               Ola Wihlborg/IKEA of Sweden                     1397.95
               T Winkel/T Jacobsen                             1270.00
Name: price, Length: 558, dtype: float64
```

In [78]:

```python
import statsmodels.api as sm
from statsmodels.formula.api import ols

# We define the formula for the model
formula = 'price ~ C(category) + C(designer) + C(category):C(designer)'

# We create the model and calculate the ANOVA
model = ols(formula, data=exer7).fit()
table = sm.stats.anova_lm(model, typ=2)

# We display the results of ANOVA
print(table)
```

```
C:\anaconda3\lib\site-packages\statsmodels\base\model.py:1871: ValueWarning: covar
iance of constraints does not have full rank. The number of constraints is 16, but
rank is 2
  warnings.warn('covariance of constraints does not have full '
C:\anaconda3\lib\site-packages\statsmodels\base\model.py:1871: ValueWarning: covar
iance of constraints does not have full rank. The number of constraints is 278, bu
t rank is 25
  warnings.warn('covariance of constraints does not have full '
```

```
                                sum_sq      df             F         PR(>F)
C(category)              -1.459431e+01    16.0 -9.353310e-07   1.000000e+00
C(designer)              -6.537808e+09   278.0 -2.411510e+01   1.000000e+00
C(category):C(designer)   2.232818e+10  4448.0  5.147428e+00  1.266065e-168
Residual                  2.244935e+09  2302.0           NaN            NaN
```

```
C:\anaconda3\lib\site-packages\statsmodels\base\model.py:1871: ValueWarning: covar
iance of constraints does not have full rank. The number of constraints is 4448, b
ut rank is 537
  warnings.warn('covariance of constraints does not have full '
```

The result displays the sum of squares, degrees of freedom, F-statistic, and p-value for three sources of variation: category, designer, and the interaction between category and designer (category: designer). The null hypothesis for the ANOVA test is that all group means are equal.

The p-value for the interaction effect (category: designer) is very small (1.266065e-168), indicating a significant influence of the interaction between category and designer on price. In other words, the impact of the designer on price depends on the category, and vice versa.

The p-values for the main effects of category and designer are both 1, implying that there is no significant difference in price among categories or designers after controlling for other factors. However, this result should be interpreted cautiously, as the significant interaction effect suggests that the relationship between price, category, and designer is more complex than simple mean comparisons.

In summary, the ANOVA test reveals a significant interaction effect between category and designer on price, while there is no significant main effect of category or designer on price.

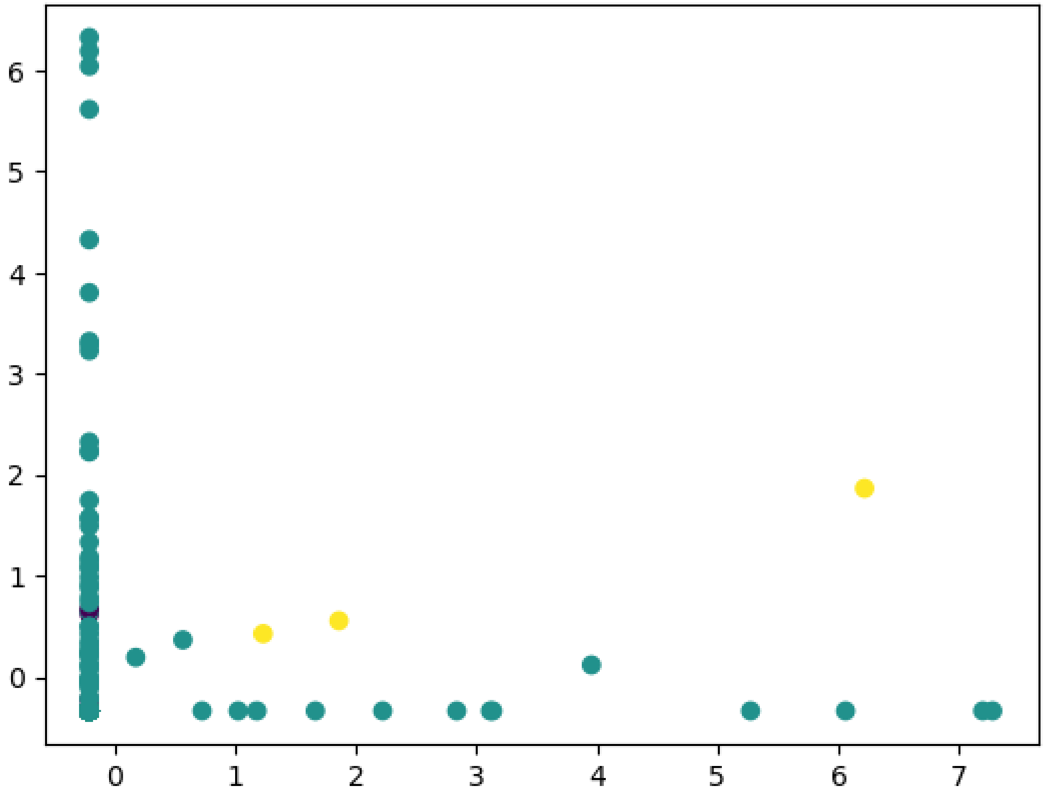
In [249…

```
grouped_data=exer7
```

In [250…

```
# Clusters of designer dependencies within groups
from sklearn.cluster import KMeans
from sklearn.preprocessing import StandardScaler

# Creation of the feature matrix
features = pd.pivot_table(grouped_data, values='price', index=['designer'], column

# Data standardization
scaler = StandardScaler()
features_std = scaler.fit_transform(features)

# Clustering using the K-means method
kmeans = KMeans(n_clusters=3, random_state=42)
kmeans.fit(features_std)
labels = kmeans.predict(features_std)

# Visualization of clustering results
plt.scatter(features_std[:, 0], features_std[:, 1], c=labels, cmap='viridis')
plt.show()
```

```
C:\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:870: FutureWarning: The
default value of `n_init` will change from 10 to 'auto' in 1.4. Set the value of `
n_init` explicitly to suppress the warning
  warnings.warn(
C:\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:1382: UserWarning: KMean
s is known to have a memory leak on Windows with MKL, when there are less chunks t
han available threads. You can avoid it by setting the environment variable OMP_NU
M_THREADS=2.
  warnings.warn(
```



The plot visualizes how different designers are distributed in a two-dimensional space based on their characteristics (in our example, the average price of items in different categories). Each point on the plot corresponds to a single designer. Designers that are located close to each other have similar characteristics. Therefore, the plot can help identify groups of similar designers who might share common attributes in their work. Each color on this plot corresponds to a distinct cluster. Clustering identifies groups of similar objects and assigns them a common color. As a result, the colors indicate which designers belong to the same group based on their work across different categories.

Price vs old price

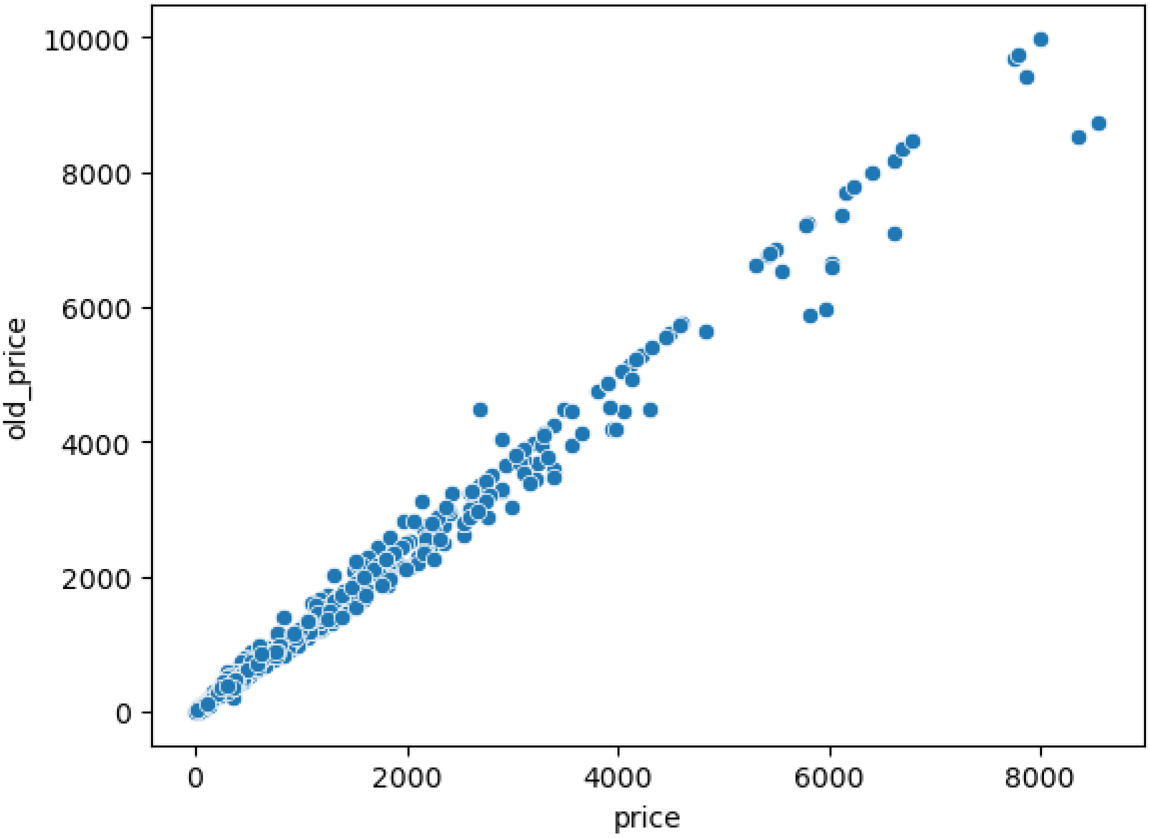
In [251...

```
# Query to select columns category, price, and old_price
cursor.execute("""SELECT item_id,category, price, old_price
                FROM all_data_without_duplicate""")
exer5= cursor.fetchall()
exer5=pd.DataFrame(exer5,columns=['item_id','category','price','old_price'])
print(exer5)
exer5['old_price'] = exer5['old_price'].astype(float)
exer5['price'] = exer5['price'].astype(float)
print(exer5.info())
```

```
       item_id                   category  price old_price
0     10052362          Sofas & armchairs  150.0       250
1     10091453       Children's furniture  275.0         0
2     10115067                     Chairs   99.0         0
3     10118971             Tables & desks   75.0         0
4     10119206       Cabinets & cupboards  295.0         0
...        ...                        ...    ...       ...
2957  99335985          Outdoor furniture  619.0       855
2958  99902661  Bookcases & shelving units  609.0         0
2959  99903788  Bookcases & shelving units  296.0       380
2960  99930961             Tables & desks  385.0         0
2961  99932615             Tables & desks  265.0         0

[2962 rows x 4 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2962 entries, 0 to 2961
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   item_id    2962 non-null   object 
 1   category   2962 non-null   object 
 2   price      2962 non-null   float64
 3   old_price  2962 non-null   float64
dtypes: float64(2), object(2)
memory usage: 92.7+ KB
None
```

In [252...

```
exer5_1=exer5[exer5['old_price']!=0]
exer5_2=exer5[exer5['old_price']==0]
#creating scatterplot price за old_price
sns.scatterplot(x='price',y ='old_price', data=exer5_1)
plt.show()
```

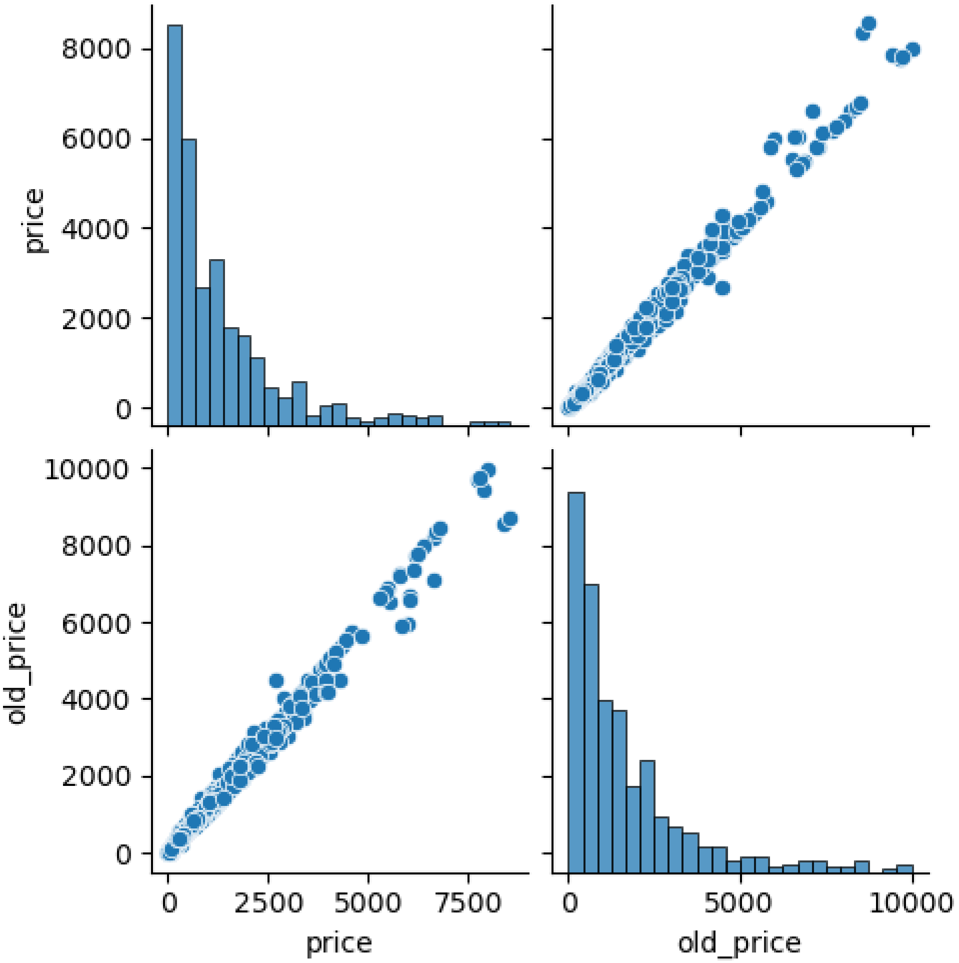


In [253…

```
sns.pairplot(exer5_1)
```

Out[253]:

```
<seaborn.axisgrid.PairGrid at 0x215b61268f0>
```



In [254…

```
corr = exer5_1.corr()
corr
```

```
C:\Users\user\AppData\Local\Temp\ipykernel_4156\4266957897.py:1: FutureWarning: Th
e default value of numeric_only in DataFrame.corr is deprecated. In a future versi
on, it will default to False. Select only valid columns or specify the value of nu
meric_only to silence this warning.
  corr = exer5_1.corr()
```

Out[254]:

	price	old_price
price	1.000000	0.993705
old_price	0.993705	1.000000

In [255…

```
import numpy as np
from scipy.stats import pearsonr

 # Calculation of Pearson's correlation coefficient and p-value (for testing stati
correlation_coefficient, p_value = pearsonr(exer5_1['old_price'], exer5_1['price']

print("correlation coefficient:", correlation_coefficient)
print("p-value:", p_value)

 # Calculation of Pearson's correlation coefficient and p-value (for testing stati
if p_value < 0.05:  #підходящий рівень значущості
    print("Statistically significant dependency")
else:
    print("The dependency is not statistically significant")
```

```
correlation coefficient: 0.9937052030377374
p-value: 0.0
Statistically significant dependency
```

Missing old price

In [256…

```
#Separately storing the data from 'old_price' that are not equal to and equal to 0
X=exer5_1['price'].values.reshape(-1, 1)
y=exer5_1['old_price']

#Splitting the data into training and testing sets
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test=train_test_split(X,y,random_state=42)
```

In [257…

```
# Building a linear regression model
from sklearn.linear_model import LinearRegression
model = LinearRegression()
model.fit(X_train,y_train)
```

Out[257]:

```
▾ LinearRegression
LinearRegression()
```

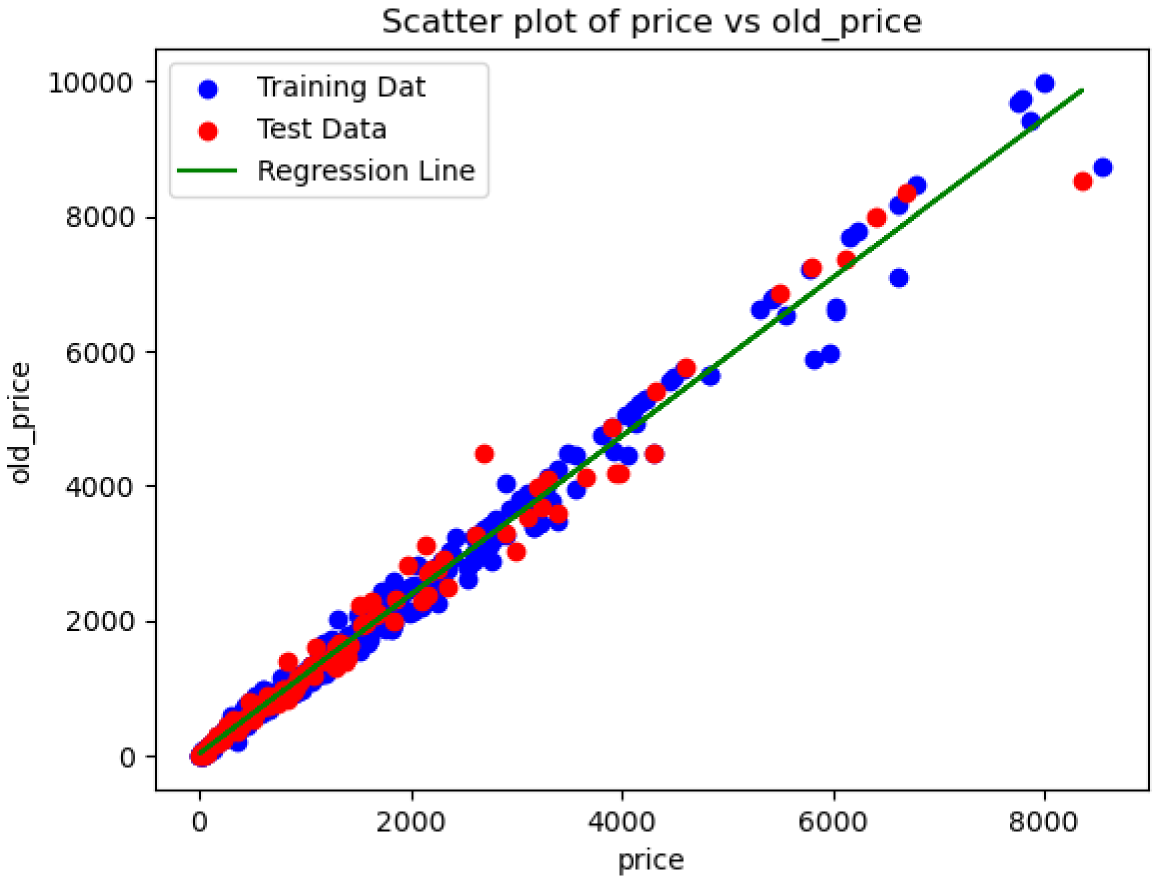
In [258…

```
#Testing the model
y_pred=model.predict(X_test)
```

In [259…

```
# Graphical representation of the model
import matplotlib.pyplot as plt
```

```
plt.scatter(X_train, y_train, color='blue', label='Training Dat')
plt.scatter(X_test, y_test, color='red', label='Test Data')

# Line of best fit for the test data
plt.plot(X_test, y_pred, color='green', label='Regression Line')

# Add axis labels and title
plt.xlabel('price')
plt.ylabel('old_price')
plt.title('Scatter plot of price vs old_price')

# Add legend
plt.legend()

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



In [260…

```
# Model validation
from sklearn.metrics import r2_score
r2_score(y_test, y_pred)
```

Out[260]:

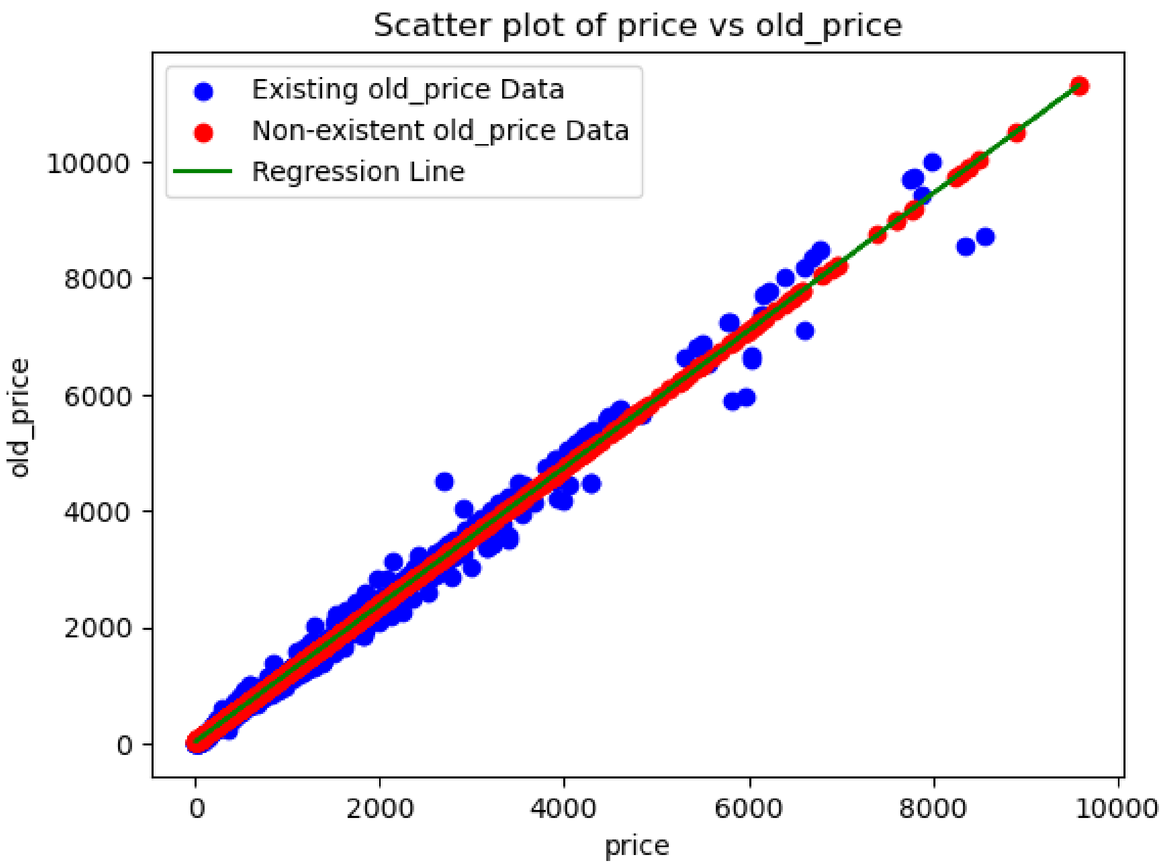
```
0.98331845721843
```

If the coefficient of determination (R-squared) is close to 1, then there may be a linear relationship between the two variables.

In [261…

```
plot_x=exer5_2['price'].values.reshape(-1, 1)
plot_y=model.predict(plot_x)

plt.scatter(X, y, color='blue', label='Existing old_price Data')
plt.scatter(plot_x, plot_y, color='red', label='Non-existent old_price Data')

# Line of best fit for the test data
plt.plot(plot_x, plot_y, color='green', label='Regression Line')
```

```
# Add axis labels and title
plt.xlabel('price')
plt.ylabel('old_price')
plt.title('Scatter plot of price vs old_price')

# Add legend
plt.legend()

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



In [262...

```
plot_y=model.predict(plot_x)
plot_y
```

Out[262]:

```
array([350.04409999, 142.74841553, 114.4808222 , ..., 743.43477392,
       479.60390278, 338.26593611])
```

In [263...

```
# Let's record the predicted values into the dataframe exer5
exer5.loc[exer5['old_price'] == 0.0, 'old_price'] = plot_y.reshape(-1, 1)
```

In [264...

```
print(exer5.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2962 entries, 0 to 2961
Data columns (total 4 columns):
 #   Column     Non-Null Count  Dtype  
---  ------     --------------  -----  
 0   item_id    2962 non-null   object 
 1   category   2962 non-null   object 
 2   price      2962 non-null   float64
 3   old_price  2962 non-null   float64
dtypes: float64(2), object(2)
memory usage: 92.7+ KB
None
```

In [265…

```
# Let's record the predicted values of the old_price column into the NEW_data table
conn = sqlite3.connect('sql_step_project.db')
conn.execute('BEGIN TRANSACTION')
for index, row in exer5.iterrows():
    item_id=row['item_id']
    category = row['category']
    old_price = row['old_price']
    conn.execute('UPDATE NEW_data SET old_price_predict = ? WHERE item_id = ? AND c
                 (old_price, item_id, category))
conn.commit()
```

Price prediction model

In [266…

```
# The column selection query necessary for creating the model
cursor.execute("""SELECT name,category, price, old_price_predict,designer_new, dept
                FROM NEW_data""")
exer8= cursor.fetchall()
exer8=pd.DataFrame(exer8,columns=['name','category', 'price', 'old_price_predict',
                                  'height_new', 'width_new'])
print(exer8.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2962 entries, 0 to 2961
Data columns (total 8 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   name               2962 non-null   object 
 1   category           2962 non-null   object 
 2   price              2962 non-null   float64
 3   old_price_predict  2962 non-null   float64
 4   designer_new       2962 non-null   object 
 5   depth_new          2962 non-null   float64
 6   height_new         2962 non-null   float64
 7   width_new          2962 non-null   float64
dtypes: float64(5), object(3)
memory usage: 185.2+ KB
None
```

In [267…

```
# Selection of data for model creation
X=exer8[['category','old_price_predict', 'depth_new','height_new', 'width_new']]
y=exer8['price']
```

In [268…

```
# Splitting the data into training and testing sets
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test=train_test_split(X,y,random_state=42)
```

In [269…

```
# Creation of a prediction model based on DecisionTreeRegressor
from sklearn.compose import ColumnTransformer
from sklearn.impute import SimpleImputer
from sklearn.tree import DecisionTreeRegressor
from sklearn.pipeline import Pipeline
from sklearn.metrics import mean_squared_error
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import OneHotEncoder
numeric_transformer = Pipeline(steps=[
        ('scaler', StandardScaler())])
categorical_transformer = Pipeline(steps=[
       ('onehot', OneHotEncoder())])
```

```
column_preprocessing = ColumnTransformer(transformers=[
    ('numeric', numeric_transformer,['old_price_predict', 'depth_new','height_new'
    ('categorical', categorical_transformer,['category'])])
clf = Pipeline(steps=[
    ('preprocessing', column_preprocessing),
    ('clf', DecisionTreeRegressor())])
```

In [272…

```
# Validation and tuning of the best strategy (max_depth)
from sklearn.model_selection import GridSearchCV
gridsearch=GridSearchCV(estimator=clf,
                        param_grid = {'clf__max_depth': [None,1,2,3,4,5,6,7,8,9,10
gridsearch.fit(X_train, y_train)
print(gridsearch.best_params_)
print(gridsearch.best_score_)
clf.fit(X_train, y_train)
mean_squared_error(y_test,clf.predict(X_test))
```

```
{'clf__max_depth': 6}
0.994384451222454
```

Out[272]:

```
7138.919038981761
```

In [273…

```
# Creating a prediction model based on the DecisionTreeRegressor with the best str
numeric_transformer = Pipeline(steps=[
        ('scaler', StandardScaler())])
categorical_transformer = Pipeline(steps=[
       ('onehot', OneHotEncoder())])
column_preprocessing = ColumnTransformer(transformers=[
    ('numeric', numeric_transformer,['old_price_predict', 'depth_new','height_new'
    ('categorical', categorical_transformer,['category'])])
clf = Pipeline(steps=[
    ('preprocessing', column_preprocessing),
    ('clf', DecisionTreeRegressor(max_depth=6))])
```

In [275…

```
# Cross-validation
from sklearn.model_selection import cross_val_score
scores = cross_val_score(clf, X, y, cv=5)
print(scores)
print(scores.mean())
clf.fit(X_train,y_train)
mean_squared_error(y_test,clf.predict(X_test))
```

```
[0.99647932 0.99627524 0.99716491 0.99369414 0.99588228]
0.9958991791333176
```

Out[275]:

```
6251.934538140453
```

In [276…

```
# Creating a prediction model based on KNeighborsRegressor
from sklearn.compose import ColumnTransformer
from sklearn.impute import SimpleImputer
from sklearn.neighbors import KNeighborsRegressor
from sklearn.pipeline import Pipeline
from sklearn.metrics import mean_squared_error
from sklearn.preprocessing import StandardScaler
from sklearn.preprocessing import OneHotEncoder
numeric_transformer = Pipeline(steps=[
        ('scaler', StandardScaler())])
categorical_transformer = Pipeline(steps=[
       ('onehot', OneHotEncoder())])
column_preprocessing = ColumnTransformer(transformers=[
    ('numeric', numeric_transformer,['old_price_predict', 'depth_new','height_new'
    ('categorical', categorical_transformer,['category'])])
model = Pipeline(steps=[
    ('preprocessing', column_preprocessing),
    ('reg', KNeighborsRegressor())])
```

In [277…

```
# Validation and tuning of the best strategy
# Find the best value of "k"
from sklearn.metrics import accuracy_score
for k in range(1, 21):
    numeric_transformer = Pipeline(steps=[('scaler', StandardScaler())])
    categorical_transformer = Pipeline(steps=[('onehot', OneHotEncoder())])
    column_preprocessing = ColumnTransformer(transformers=[
    ('numeric', numeric_transformer,['old_price_predict', 'depth_new','height_new'
    ('categorical', categorical_transformer,['category'])])
    model = Pipeline(steps=[
    ('preprocessing', column_preprocessing),
    ('reg', KNeighborsRegressor(n_neighbors=k))])
    model.fit(X_train, y_train)
    y_pred = model.predict(X_test)
    msr = mean_squared_error(y_test,model.predict(X_test))
    print("k:", k, "mean_squared_error:", msr)
```

```
k: 1 mean_squared_error: 48750.41018893388
k: 2 mean_squared_error: 44375.346403508775
k: 3 mean_squared_error: 47030.87008846904
k: 4 mean_squared_error: 50628.564908906876
k: 5 mean_squared_error: 51694.094146828604
k: 6 mean_squared_error: 56406.44885252661
k: 7 mean_squared_error: 60971.743863229494
k: 8 mean_squared_error: 64782.11966683536
k: 9 mean_squared_error: 67683.93469652288
k: 10 mean_squared_error: 68932.15776788123
k: 11 mean_squared_error: 72747.71078562585
k: 12 mean_squared_error: 74327.66305967911
k: 13 mean_squared_error: 77093.87382195817
k: 14 mean_squared_error: 79961.02144482083
k: 15 mean_squared_error: 80640.75020266905
k: 16 mean_squared_error: 82403.86288477352
k: 17 mean_squared_error: 84698.86116591719
k: 18 mean_squared_error: 87979.8723264774
k: 19 mean_squared_error: 89546.41890781716
k: 20 mean_squared_error: 92571.42932260458
```

In [278…

```
# Creating a prediction model based on KNeighborsRegressor with the best strategy,
numeric_transformer = Pipeline(steps=[
        ('scaler', StandardScaler())])
categorical_transformer = Pipeline(steps=[
       ('onehot', OneHotEncoder())])
column_preprocessing = ColumnTransformer(transformers=[
    ('numeric', numeric_transformer,['old_price_predict', 'depth_new','height_new'
    ('categorical', categorical_transformer,['category'])])
model = Pipeline(steps=[
    ('preprocessing', column_preprocessing),
    ('reg', KNeighborsRegressor(n_neighbors=2))])
```

In [279…

```
# Cross-validation
from sklearn.model_selection import cross_val_score
scores = cross_val_score(model, X, y, cv=5)
print(scores)
print(scores.mean())
model.fit(X_train,y_train)
mean_squared_error(y_test,model.predict(X_test))
```

```
[0.963896   0.97760414 0.97834686 0.97331423 0.97305154]
0.9732425530314609
```

Out[279]:

```
44375.346403508775
```

Приклад передбачення

In [281…

```python
# Data for prediction
new_data = pd.DataFrame({
    'category': ['Chairs'],
    'old_price_predict': [320],
    'depth_new': [50],
    'height_new': [80],
    'width_new': [40]
})
# Prediction using the DecisionTreeRegressor model
Price_new=clf.predict(new_data)
Price_new.round(1)
```

Out[281]:

```
array([238.6])
```

In [282…

```python
# Prediction using the KNeighborsRegressor model
Price_new_1=model.predict(new_data)
Price_new_1.round(1)
```

Out[282]:

```
array([198.5])
```