Final Project - Grocery store sales analysis-Copy1

August 27, 2024

[1]:
```
pip install --upgrade pandas numpy openpyxl
pip install --upgrade numpy statsmodels
```

```
Requirement already up-to-date: pandas in ./opt/anaconda3/lib/python3.8/site-
packages (2.0.3)
Requirement already up-to-date: numpy in ./opt/anaconda3/lib/python3.8/site-
packages (1.24.4)
Requirement already up-to-date: openpyxl in ./opt/anaconda3/lib/python3.8/site-
packages (3.1.5)
Requirement already satisfied, skipping upgrade: tzdata>=2022.1 in
./opt/anaconda3/lib/python3.8/site-packages (from pandas) (2023.4)
Requirement already satisfied, skipping upgrade: python-dateutil>=2.8.2 in
./opt/anaconda3/lib/python3.8/site-packages (from pandas) (2.9.0.post0)
Requirement already satisfied, skipping upgrade: pytz>=2020.1 in
./opt/anaconda3/lib/python3.8/site-packages (from pandas) (2020.1)
Requirement already satisfied, skipping upgrade: et-xmlfile in
./opt/anaconda3/lib/python3.8/site-packages (from openpyxl) (1.0.1)
Requirement already satisfied, skipping upgrade: six>=1.5 in
./opt/anaconda3/lib/python3.8/site-packages (from python-
dateutil>=2.8.2->pandas) (1.15.0)
Note: you may need to restart the kernel to use updated packages.
```

[1]:
```
import math
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import random
import re
import scipy
from scipy.stats import norm
from scipy import stats as st
import seaborn as sns
import statsmodels.api as sm
```

1 Preliminary data analysis

[2]:
```
path_to_file = 'Grocery Database.xlsx'
df = pd.read_excel(path_to_file)
```

Data shape overview

[18]:
```
df.shape
print(f'The set contains {df.shape[0]} rows and {df.shape[1]} columns.')
```

```
The set contains 50447 rows and 32 columns.
```

Let us review the data types in the dataset

[19]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 50447 entries, 0 to 50446
Data columns (total 32 columns):
 #   Column               Non-Null Count  Dtype
---  ------               --------------  -----
 0   Receipt Number       50447 non-null  object
 1   Date                 50447 non-null  datetime64[ns]
 2   Year                 50447 non-null  int64
 3   Month                50447 non-null  int64
 4   Time                 50447 non-null  object
 5   Mobile Number        50447 non-null  int64
 6   Membership ID        50447 non-null  object
 7   Loyalty Card Points  50447 non-null  int64
 8   Age                  50447 non-null  int64
 9   Gender               50447 non-null  object
 10  City                 50447 non-null  object
 11  Country              50447 non-null  object
 12  Category             50447 non-null  object
 13  Sub_Category         50447 non-null  object
 14  Items                50447 non-null  object
 15  Brand                50447 non-null  object
 16  Description          50447 non-null  object
 17  Price                50447 non-null  float64
 18  QTY                  50447 non-null  int64
 19  DISC                 50447 non-null  float64
 20  Amount               50447 non-null  float64
 21  Net Bill Amount      50447 non-null  float64
 22  GST                  50447 non-null  float64
 23  Gross Bill Amount    50447 non-null  float64
 24  Payment Mode         50447 non-null  object
 25  Bank Name            50447 non-null  object
 26  % Profit Margin      50447 non-null  float64
 27  % Operating Cost     50447 non-null  float64
```

```
 28   % Product Cost       50447 non-null   float64
 29   Profit Margin        50447 non-null   float64
 30   Operating Cost       50447 non-null   float64
 31   Product Cost         50447 non-null   float64
dtypes: datetime64[ns](1), float64(12), int64(6), object(13)
memory usage: 12.3+ MB
```

Let us check whether the data set has missing values

[20]:
```
df.isna().sum()
```

[20]:
```
Receipt Number        0
Date                  0
Year                  0
Month                 0
Time                  0
Mobile Number         0
Membership ID         0
Loyalty Card Points   0
Age                   0
Gender                0
City                  0
Country               0
Category              0
Sub_Category          0
Items                 0
Brand                 0
Description           0
Price                 0
QTY                   0
DISC                  0
Amount                0
Net Bill Amount       0
GST                   0
Gross Bill Amount     0
Payment Mode          0
Bank Name             0
% Profit Margin       0
% Operating Cost      0
% Product Cost        0
Profit Margin         0
Operating Cost        0
Product Cost          0
dtype: int64
```

There are no missing values in the data set.

2 Main part of data analysis

1: What is the most common way of payment among costumers?

[21]:
```
df['Payment Mode'].value_counts()
```

[21]:
```
Payment Mode
Card      17149
Wallet    16867
Cash      16431
Name: count, dtype: int64
```

Conclusion: We can see that the most popular way of payment among customesr is card.

Business idea: One can develop a mobile app that allows customers to make contactless payments. This could include features like order-ahead and curbside pickup, creating a convenient and safe shopping experience.

2: What are the most commonly purchased product categories?

[22]:
```
df.rename(columns = {'Receipt Number':'Receipt_Number'}, inplace = True)
df.groupby(['Category']).Receipt_Number.count()
```

[22]:
```
Category
Bakery & Breakfast           6770
Beauty                       5205
Beverages                    2208
Choco, Snacks, Sweets        3019
Dairy, Chilled & Eggs        3381
Frozen                       6393
Fruit & Vegetable            4370
Health                       1008
Household                    1881
Kitchen & Dining             2552
Meat & Seafood               2149
Mother & Baby                2064
Party Supplies               1836
Pet Care                     3465
Rice & Cooking Essentials    2432
Wines, Beers & Spirits       1714
Name: Receipt_Number, dtype: int64
```

Conclusion: One sees that the "Bakery and breakfast" is the most purchuased category.

Business ideas: 1. Gourmet Breakfast Delivery Service: Create a business that specializes in delivering gourmet breakfast options to people's homes or offices.

2.Healthy Breakfast Subscription Box: Develop a subscription box service that delivers healthy breakfast options to subscribers each month. Include items like granola, yogurt, whole-grain muffins, and fresh fruits.

3: What is the average price for the categories?

[15]:
```
df.groupby(['Category']).Price.mean()
```

[15]:
```
Category
Bakery & Breakfast             5.222038
Beauty                        10.063051
Beverages                      8.297360
Choco, Snacks, Sweets          5.770414
Dairy, Chilled & Eggs          6.900683
Frozen                         7.692615
Fruit & Vegetable              5.570590
Health                        13.693046
Household                      8.855045
Kitchen & Dining               3.753100
Meat & Seafood                11.947627
Mother & Baby                 11.869695
Party Supplies                 4.641950
Pet Care                       6.976049
Rice & Cooking Essentials      3.507113
Wines, Beers & Spirits        13.282456
Name: Price, dtype: float64
```

Conclusion: The highest price is in the "Health" category.

Business idea: Beauty Tech: Invest in beauty technology, such as AI-powered skincare analysis or virtual makeup try-on apps. You could provide these services to consumers, helping them find the right products for their skin type and tone.

4: What are the top-selling products in terms of quantity sold or revenue generated?

[25]:
```
df.rename(columns = {'Profit Margin':'Profit_Margin'}, inplace = True)
df.groupby('Items').Amount.mean().idxmax()
```

[25]:
```
'Bollinger Pink platted moscato rose'
```

5: What is the top-selling product category in terms of quantity sold or revenue generated?

[26]:
```
df.groupby('Sub_Category').Amount.mean().idxmax()
```

[26]:
```
'Champagne & Spakling Wine'
```

Conclusion (4,5): One can see that Bollinger Pink platted moscato rose is the product that generstes the highest revenue. Also, one can see that Champagne & Sparkling Wine is the top-selling producct category.

Business ideas: 1.Wine Subscription Service: Launch a subscription service specializing in premium rosé wines, including Bollinger Pink platted moscato Rosé.

2.Wine Tasting Tours: If you're located in a wine-producing region, consider offering wine tasting tours that focus on rosé wines, including a tasting of Bollinger Pink Platted Moscato Rosé. Create unique and immersive experiences by partnering with local wineries for tours and tastings.

6: Who buy more in the "Frozen" category: men or women?

[29]:
```
gender_counts = df[df['Category'] == 'Frozen']['Gender'].value_counts()
print(gender_counts)
```

```
Gender
Female    5401
Male       992
Name: count, dtype: int64
```

Conclusion: There less of male customers in the "Frozen" category.

Business idea: Product Placement and Store Layout: Adjust the store layout to prominently display frozen food items that are popular among men. Placing these products in areas that men frequently visit can increase their visibility and encourage more purchases.

7: At which category do we have the most expensive purchase?

[47]:
```
df.groupby('Membership ID').Price.mean().idxmax()
df.loc[df['Membership ID'] == 'MIDSG0094'].Category
```

[47]:
```
32676    Mother & Baby
Name: Category, dtype: object
```

Conclusion: We have the most expensive purchase in the category: "Mother & Baby".

Business idea: Baby Shower Planning Services: Offer event planning services for baby showers, gender reveal parties, and other related celebrations. Create memorable experiences for expectant parents and their friends and family.

8: At what city customers have the highest average bill?

[76]:
```
df.groupby('City').Amount.mean()
```

[76]:
```
City
Bedok           11.054826
Jakarta         11.310233
Kuala Lumpur    11.262599
Manila          10.822900
Woodlands       11.732765
Name: Amount, dtype: float64
```

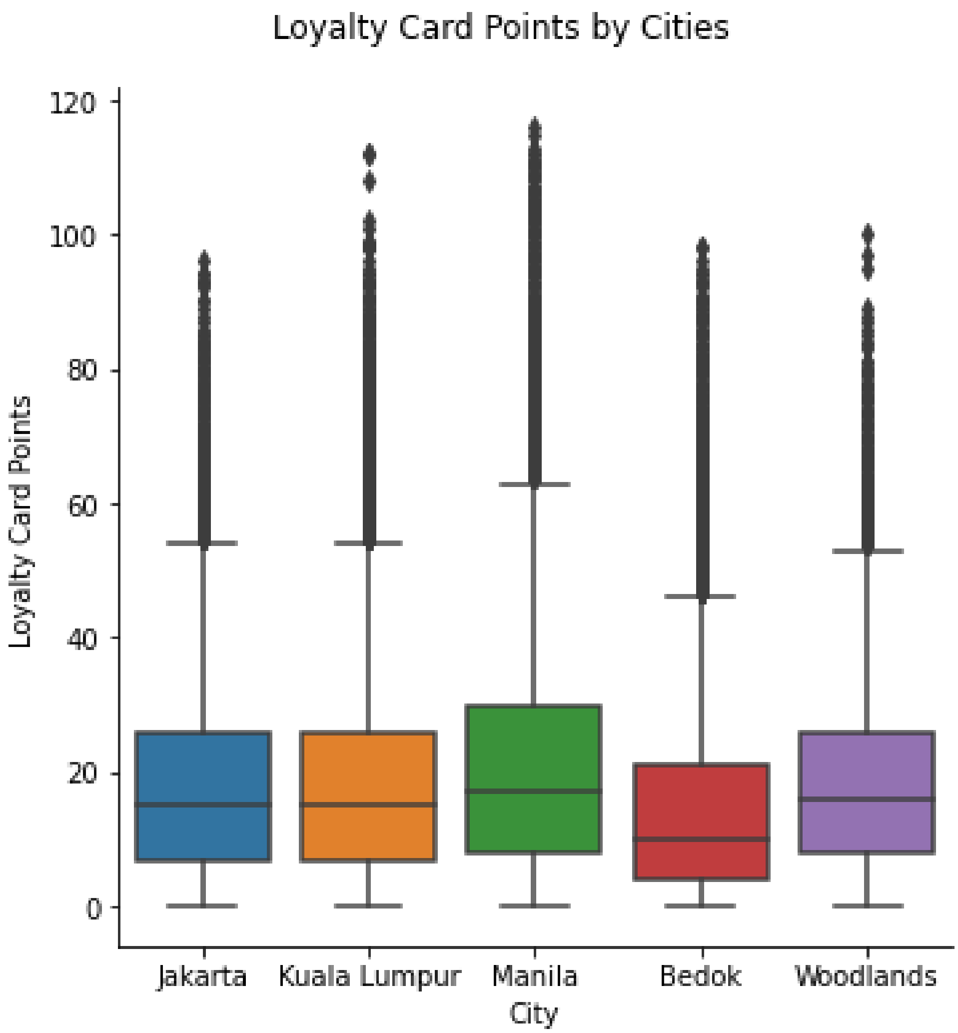
Conclusion: In Woodlands customers have the highest average bill.

Business idea: Exclusive Cooking Classes: Organize exclusive cooking classes and workshops that teach customers how to prepare gourmet meals using premium ingredients. Collaborate with renowned chefs or culinary experts to provide a unique and educational experience. Offer classes in-person and online to reach a wider audience.

10: At what city people have the lowest level of loyalty card points?

[19]:
```
plot = sns.catplot(data = df, x="City", y="Loyalty Card Points", kind="box")
plot.fig.suptitle("Loyalty Card Points by Cities", y=1.05)
plot
```

[19]: <seaborn.axisgrid.FacetGrid at 0x7fbf63af4580>



Conclusion: In Bedock people have the lowest level of loyalty card points.

Business idea: Loyalty Point Boost Program: Create a loyalty point boosting program specifically for Bedeck grocery stores.

Let us create a pivot table

[9]:
```python
age_pivot = df.pivot_table(index='Age', columns='City', values='Amount',aggfunc␣
↪= 'sum')
age_pivot.head()
```

[9]:

City	Bedok	Jakarta	Kuala Lumpur	Manila	Woodlands
Age					
15	2784.5174	2793.6930	1979.3798	2684.6992	1231.9019
16	3723.5775	1839.1363	4214.1807	3890.7314	2529.8478
17	3601.8660	2530.0170	5495.0694	4463.0577	1619.7760
18	4770.9461	3918.6245	4049.1765	3696.5842	2151.6184
19	2830.9589	4447.4399	8208.4761	2224.9030	860.2747

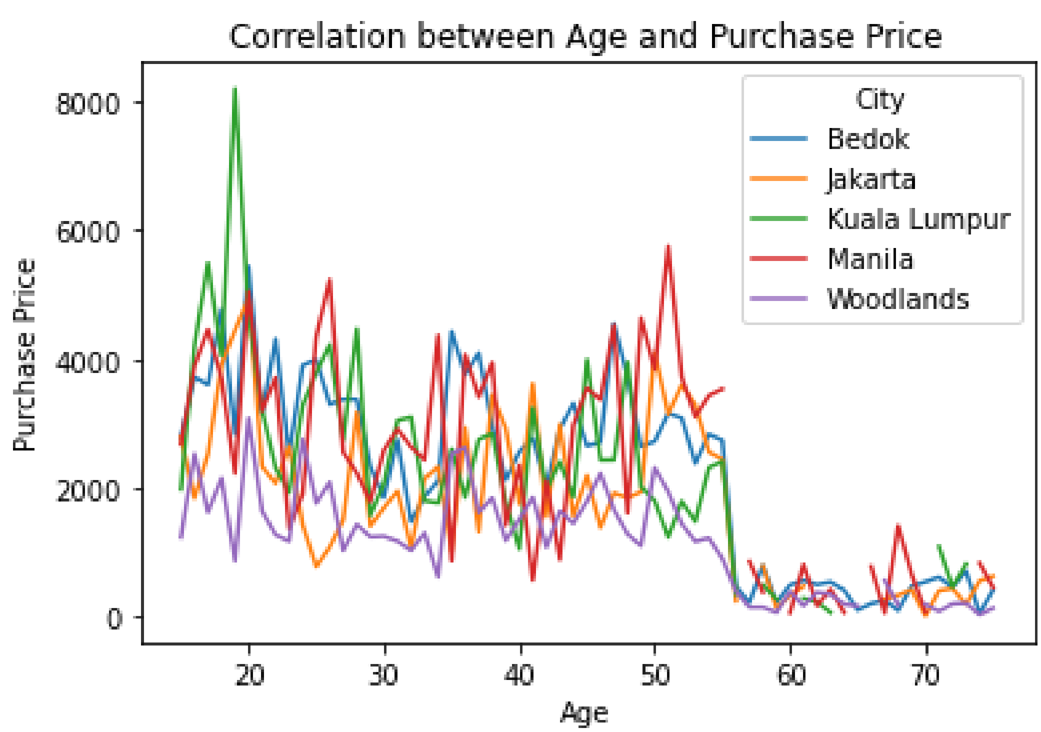
11: What is the corelation between age and purchase price for every city?

[16]:
```python
ap = age_pivot.plot()

ap.set_xlabel("Age")
ap.set_ylabel("Purchase Price")


ap.set_title("Correlation between Age and Purchase Price")
```

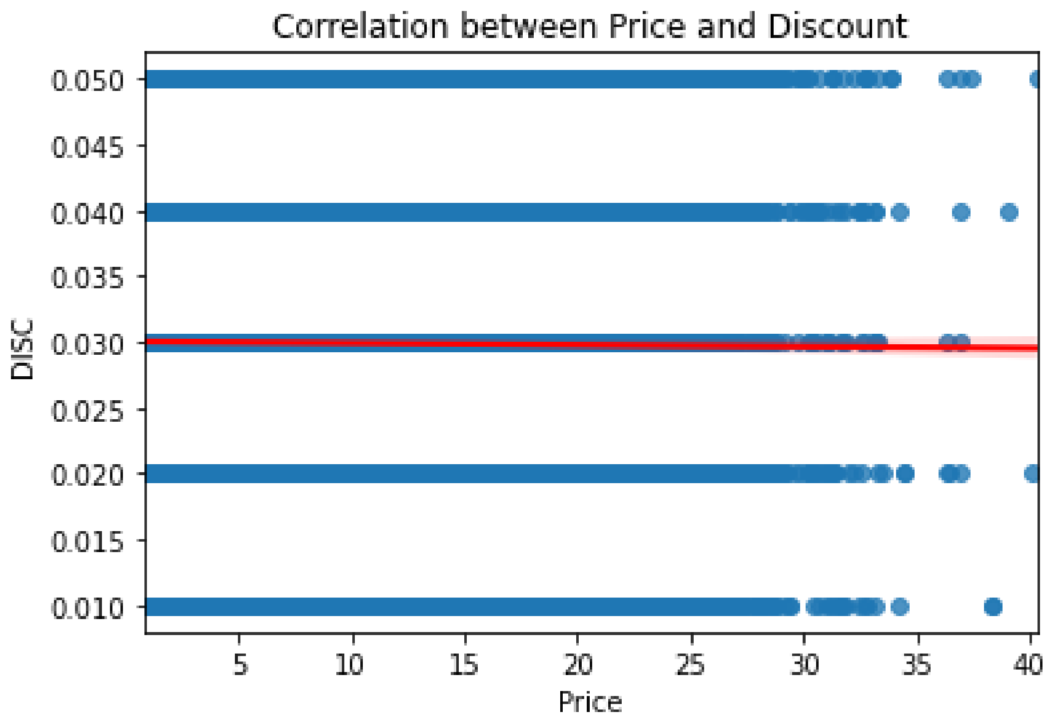
[16]: Text(0.5, 1.0, 'Correlation between Age and Purchase Price')



Conclusion: one sees that in Kuala Lumpur people around 20 make the most expensive purchases. That look suspicious and takes needs some additional reserch to be done.

13: Is there any correlation between Price and Discount?

[25]:
```
sns.regplot(
    data = df,
    x = 'Price', y='DISC', line_kws = {'color': 'red'}
);
plt.title("Correlation between Price and Discount")
plt.show()
```



Conclusion: There is a direct correlation between Price and Discount. No outliers.

Let us create another pivot table

[34]:
```
gender_pivot = df.pivot_table(index='Gender', columns='City',␣
 ↪values='Amount',aggfunc = 'sum')
gender_pivot.head()
```

[34]:

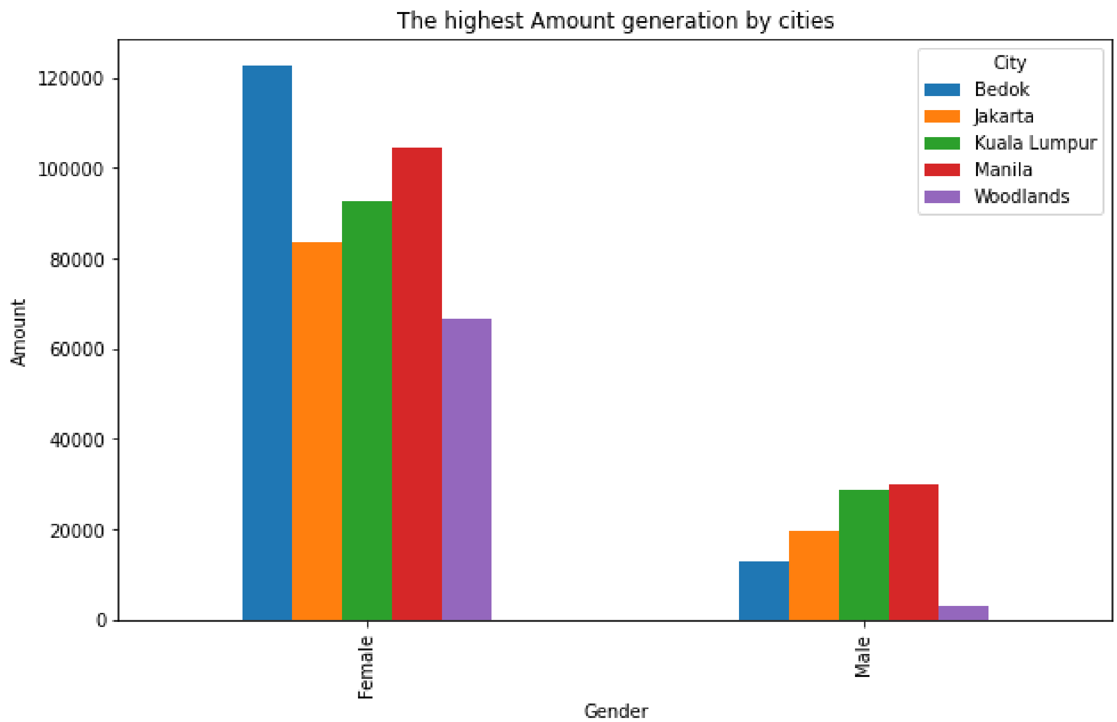
City	Bedok	Jakarta	Kuala Lumpur	Manila	Woodlands
Gender					
Female	122601.1731	83361.1450	92527.7172	104309.6095	66404.0654
Male	13063.6490	19652.4567	28691.6373	29677.8889	3100.8349

14: At what city do female customers generate the highest Amount?

[35]:
```
ax = gender_pivot.plot.bar(figsize=(10,6));
ax.set_title("The highest Amount generation by cities")
ax.set_ylabel("Amount")
ax.show()
```

```
---------------------------------------------------------------------------
AttributeError                            Traceback (most recent call last)
<ipython-input-35-1a481d89051c> in <module>
      2 ax.set_title("The highest Amount generation by cities")
      3 ax.set_ylabel("Amount")
----> 4 ax.show()

AttributeError: 'AxesSubplot' object has no attribute 'show'
```



Conclusion: in Bedok female customers generate the highest Amount

Business ideas: 1.Inventory and Stocking: If female customers in Bedok prefer specific products, the business can optimize its inventory and stocking decisions. It can ensure that the products favored by this demographic are well-stocked and readily available.

2.Feedback and Surveys: To gain deeper insights into why female customers in Bedok are spending more, the business can conduct surveys or gather feedback. This information can help refine strategies and offerings.

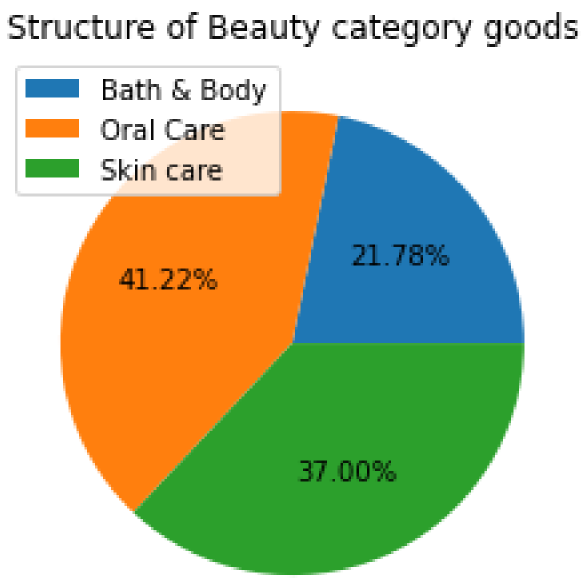
15: What are the average pre-tax checks for each subcategory in the beauty and care

category? Let's create a pie chart and review the structure

[7]:
```
beaty_net_bill = df[df['Category'] == 'Beauty'].groupby('Sub_Category')['Net␣
↪Bill Amount'].sum()
beaty_net_bill
```

[7]:
```
Sub_Category
Bath & Body      84351.7905
Oral Care       159649.8545
skin care       143328.2248
Name: Net Bill Amount, dtype: float64
```

[9]:
```
plt.pie(beaty_net_bill, autopct = '%1.2f%%')
plt.title('Structure of Beauty category goods')
plt.legend(labels = ['Bath & Body', 'Oral Care', 'Skin care']);
```



Conclusion: The oral care goods have the highest pre-tax checks.