retail-case-study

August 28, 2024

0.1 P1-RETAIL CASE STUDY

1. Merge the datasets Customers, Product Hierarchy and Transactions as Customer_Final. Ensure to keep all customers who have done transactions with us and select the join type accordingly.

[32]:
```
import pandas as pd

# Loading the datasets
customers = pd.read_csv("Customer.csv")
transactions = pd.read_csv("prod_cat_info.csv")
product_hierarchy = pd.read_csv("Transactions.csv")
```

[44]:
```
#Renaming the column as join operations need to be performed.
product_hierarchy = product_hierarchy.rename(columns={'cust_id': 'customer_Id'})
transactions=transactions.rename(columns={'prod_sub_cat_code':␣
 ↪'prod_subcat_code'})
```

[38]:
```
customers
```

[38]:
```
      customer_Id         DOB Gender  city_code
0          268408  02-01-1970      M        4.0
1          269696  07-01-1970      F        8.0
2          268159  08-01-1970      F        8.0
3          270181  10-01-1970      F        2.0
4          268073  11-01-1970      M        1.0
…             …           …     …          …
5642       274474  19-12-1992      M        2.0
5643       267666  24-12-1992      M        6.0
5644       270476  25-12-1992      F        3.0
5645       269626  27-12-1992      F        5.0
5646       274308  29-12-1992      F        5.0

[5647 rows x 4 columns]
```

[57]:
```
transactions
```

```
[57]:     prod_cat_code          prod_cat  prod_subcat_code          prod_subcat
      0               1          Clothing                 4                 Mens
      1               1          Clothing                 1                Women
      2               1          Clothing                 3                 Kids
      3               2          Footwear                 1                 Mens
      4               2          Footwear                 3                Women
      5               2          Footwear                 4                 Kids
      6               3       Electronics                 4              Mobiles
      7               3       Electronics                 5            Computers
      8               3       Electronics                 8  Personal Appliances
      9               3       Electronics                 9              Cameras
      10              3       Electronics                10      Audio and video
      11              4              Bags                 1                 Mens
      12              4              Bags                 4                Women
      13              5             Books                 7              Fiction
      14              5             Books                12             Academic
      15              5             Books                10          Non-Fiction
      16              5             Books                11             Children
      17              5             Books                 3               Comics
      18              5             Books                 6                  DIY
      19              6  Home and kitchen                 2           Furnishing
      20              6  Home and kitchen                10              Kitchen
      21              6  Home and kitchen                11                 Bath
      22              6  Home and kitchen                12                Tools
```

```
[56]: product_hierarchy
```

```
[56]:        transaction_id  customer_Id   tran_date  prod_subcat_code  \
      0         80712190438       270351  28-02-2014                 1
      1         29258453508       270384  27-02-2014                 5
      2         51750724947       273420  24-02-2014                 6
      3         93274880719       271509  24-02-2014                11
      4         51750724947       273420  23-02-2014                 6
      …                   …            …           …               …
      23048     94340757522       274550  25-01-2011                12
      23049     89780862956       270022  25-01-2011                 4
      23050     85115299378       271020  25-01-2011                 2
      23051     72870271171       270911  25-01-2011                11
      23052     77960931771       271961  25-01-2011                11

             prod_cat_code  Qty  Rate      Tax  total_amt Store_type
      0                  1   -5  -772  405.300  -4265.300     e-Shop
      1                  3   -5 -1497  785.925  -8270.925     e-Shop
      2                  5   -2  -791  166.110  -1748.110   TeleShop
      3                  6   -3 -1363  429.345  -4518.345     e-Shop
      4                  5   -2  -791  166.110  -1748.110   TeleShop
      …                  …  …    …        …          …          …
```

```
23048             5   1  1264  132.720   1396.720     e-Shop
23049             1   1   677   71.085    748.085     e-Shop
23050             6   4  1052  441.840   4649.840        MBR
23051             5   3  1142  359.730   3785.730   TeleShop
23052             5   1   447   46.935    493.935   TeleShop

[23053 rows x 10 columns]
```

[66]:
```
# Merge the datasets and adjust the column names.
customer_final = (customers
                  .merge(product_hierarchy, on='customer_Id', how='inner')
                  .merge(transactions, on='prod_subcat_code', how='inner'))

customer_final = customer_final.drop('prod_cat_code_y', axis=1)
customer_final=customer_final.rename(columns={'prod_cat_code_x':␣
 ↪'prod_cat_code'})
customer_final
```

[66]:
```
       customer_Id         DOB Gender  city_code  transaction_id   tran_date  \
0           268408  02-01-1970      M        4.0     87243835584  13-01-2014
1           275152  16-01-1970      M        4.0     73109425404  25-03-2011
2           275034  18-01-1970      F        4.0     64777271023  23-05-2011
3           270829  22-01-1970      F        8.0     87174343938   9/12/2013
4           267657  29-01-1970      F        7.0     76242744953  23-05-2013
…              …          …    …      …              …           …
57161       272141  02-12-1992      F       10.0     79059585885  25-10-2012
57162       269719  04-12-1992      F        8.0     70553332101  23-11-2013
57163       275051  04-12-1992      M        5.0     77933614379  18-05-2013
57164       270695  05-12-1992      F        6.0      2300510157  20-11-2012
57165       270476  25-12-1992      F        3.0     85475160771    9/8/2011

       prod_subcat_code  prod_cat_code  Qty  Rate      Tax  total_amt  \
0                     7              5    5   187   98.175   1033.175
1                     7              5    2   464   97.440   1025.440
2                     7              5    2   197   41.370    435.370
3                     7              5    4  1141  479.220   5043.220
4                     7              5    4  1020  428.400   4508.400
…                   …             …  …   …      …        …
57161                 5              3    2  1354  284.340   2992.340
57162                 5              3    2   623  130.830   1376.830
57163                 5              3    5  1095  574.875   6049.875
57164                 5              3    3   906  285.390   3003.390
57165                 5              3    5  1354  710.850   7480.850

           Store_type     prod_cat prod_subcat
0            TeleShop        Books     Fiction
1              e-Shop        Books     Fiction
```

```
2      Flagship store        Books     Fiction
3              e-Shop        Books     Fiction
4              e-Shop        Books     Fiction
…                 …           …          …
57161          e-Shop  Electronics   Computers
57162  Flagship store  Electronics   Computers
57163          e-Shop  Electronics   Computers
57164        TeleShop  Electronics   Computers
57165  Flagship store  Electronics   Computers

[57166 rows x 15 columns]
```

2. Prepare a summary report for the merged data set.

A.Get the column names and their corresponding data types

[67]:
```
print(customer_final.dtypes)
```

```
customer_Id           int64
DOB                  object
Gender               object
city_code           float64
transaction_id        int64
tran_date            object
prod_subcat_code      int64
prod_cat_code         int64
Qty                   int64
Rate                  int64
Tax                 float64
total_amt           float64
Store_type           object
prod_cat             object
prod_subcat          object
dtype: object
```

B.Top/Bottom 10 observations

[68]:
```
print(customer_final.head(10))
print(customer_final.tail(10))
```

```
   customer_Id         DOB Gender  city_code  transaction_id   tran_date  \
0       268408  02-01-1970      M        4.0     87243835584  13-01-2014
1       275152  16-01-1970      M        4.0     73109425404  25-03-2011
2       275034  18-01-1970      F        4.0     64777271023  23-05-2011
3       270829  22-01-1970      F        8.0     87174343938   9/12/2013
4       267657  29-01-1970      F        7.0     76242744953  23-05-2013
5       274630  01-02-1970      M        4.0     78357345891   11/4/2012
6       273541  01-02-1970      M        4.0     23916816961    9/2/2013
7       269008  13-02-1970      F        6.0     35560569829    9/3/2013
```

```
8       269008  13-02-1970      F        6.0     94033312891  26-04-2012
9       267199  14-02-1970    NaN        2.0     56749259881   11/1/2012

   prod_subcat_code  prod_cat_code  Qty  Rate      Tax  total_amt  \
0                 7              5    5   187   98.175   1033.175
1                 7              5    2   464   97.440   1025.440
2                 7              5    2   197   41.370    435.370
3                 7              5    4  1141  479.220   5043.220
4                 7              5    4  1020  428.400   4508.400
5                 7              5    1   646   67.830    713.830
6                 7              5    4   410  172.200   1812.200
7                 7              5    1  1441  151.305   1592.305
8                 7              5    5   746  391.650   4121.650
9                 7              5    4  1049  440.580   4636.580

       Store_type prod_cat prod_subcat
0        TeleShop    Books     Fiction
1          e-Shop    Books     Fiction
2  Flagship store    Books     Fiction
3          e-Shop    Books     Fiction
4          e-Shop    Books     Fiction
5        TeleShop    Books     Fiction
6          e-Shop    Books     Fiction
7          e-Shop    Books     Fiction
8             MBR    Books     Fiction
9             MBR    Books     Fiction
       customer_Id         DOB Gender  city_code  transaction_id   tran_date  \
57156       273899  07-10-1992      F        5.0     28966519600  31-12-2011
57157       269241  09-10-1992      F        4.0     99372261440   6/10/2013
57158       270484  14-10-1992      F        1.0     49410470654  13-11-2013
57159       266825  21-11-1992      F        8.0      8969181661  27-12-2013
57160       267094  24-11-1992      M        9.0     12905992307  26-01-2014
57161       272141  02-12-1992      F       10.0     79059585885  25-10-2012
57162       269719  04-12-1992      F        8.0     70553332101  23-11-2013
57163       275051  04-12-1992      M        5.0     77933614379  18-05-2013
57164       270695  05-12-1992      F        6.0      2300510157  20-11-2012
57165       270476  25-12-1992      F        3.0     85475160771    9/8/2011

       prod_subcat_code  prod_cat_code  Qty  Rate      Tax  total_amt  \
57156                 5              3    1   308   32.340    340.340
57157                 5              3    3   511  160.965   1693.965
57158                 5              3    2   825  173.250   1823.250
57159                 5              3    4   109   45.780    481.780
57160                 5              3    1  1449  152.145   1601.145
57161                 5              3    2  1354  284.340   2992.340
57162                 5              3    2   623  130.830   1376.830
57163                 5              3    5  1095  574.875   6049.875
57164                 5              3    3   906  285.390   3003.390
```

```
57165                 5              3    5  1354  710.850   7480.850

           Store_type     prod_cat prod_subcat
57156          e-Shop  Electronics   Computers
57157          e-Shop  Electronics   Computers
57158          e-Shop  Electronics   Computers
57159             MBR  Electronics   Computers
57160          e-Shop  Electronics   Computers
57161          e-Shop  Electronics   Computers
57162  Flagship store  Electronics   Computers
57163          e-Shop  Electronics   Computers
57164        TeleShop  Electronics   Computers
57165  Flagship store  Electronics   Computers
```

"Five-number summary" for continuous variables (min, Q1, median, Q3 and max)

```
[69]: print(customer_final.describe())
```

```
         customer_Id     city_code  transaction_id  prod_subcat_code  \
count   57166.000000  57151.000000    5.716600e+04      57166.000000
mean   271015.375101      5.496457    5.017556e+10          5.613949
std      2426.954106      2.865186    2.896442e+10          3.701183
min    266783.000000      1.000000    3.268991e+06          1.000000
25%    268931.000000      3.000000    2.527880e+10          3.000000
50%    270982.000000      5.000000    5.019132e+10          4.000000
75%    273096.000000      8.000000    7.551116e+10         10.000000
max    275265.000000     10.000000    9.998755e+10         12.000000

       prod_cat_code           Qty          Rate           Tax     total_amt
count   57166.000000  57166.000000  57166.000000  57166.000000  57166.000000
mean        3.462425      2.429766    635.022653    248.967409   2102.084532
std         1.710811      2.273219    623.390431    187.344788   2516.597510
min         1.000000     -5.000000  -1499.000000      7.350000  -8270.925000
25%         2.000000      1.000000    312.000000     98.490000    764.660000
50%         3.000000      3.000000    709.000000    199.342500   1759.160000
75%         5.000000      4.000000   1109.000000    364.980000   3553.680000
max         6.000000      5.000000   1500.000000    787.500000   8287.500000
```

D.Frequency tables for all the categorical variables

```
[70]: for col in customer_final.select_dtypes(include='object').columns:
          print(customer_final[col].value_counts())
```

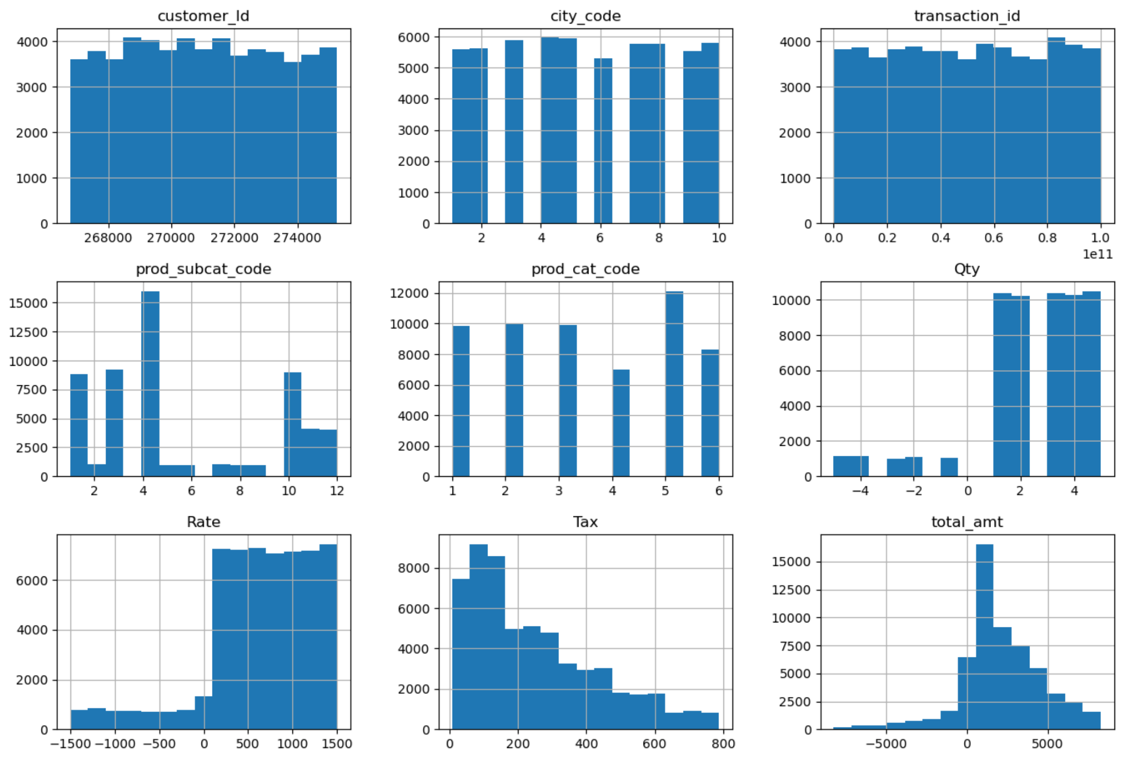
```
DOB
17-09-1982    79
27-12-1988    75
25-02-1974    73
20-03-1972    68
21-07-1988    64
```

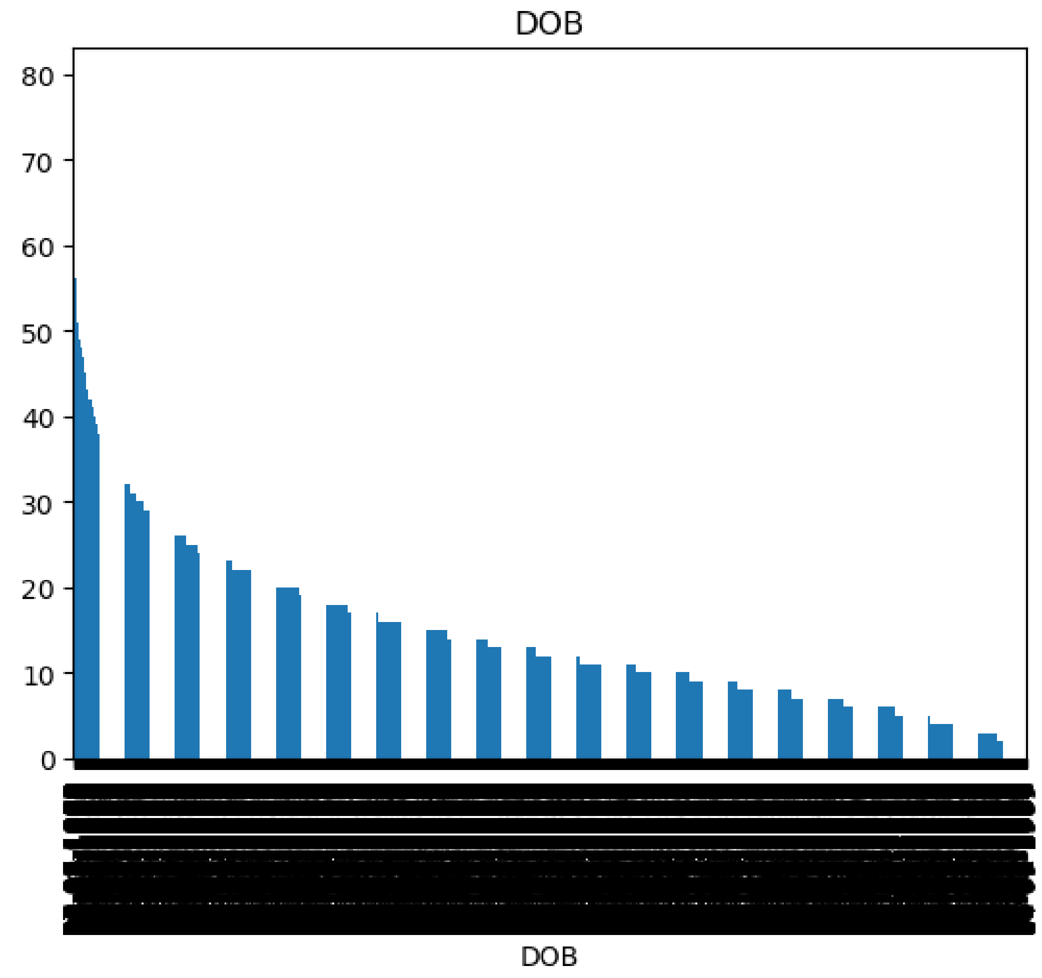
```
              ..
27-01-1988     1
14-09-1989     1
09-07-1990     1
01-01-1991     1
06-02-1989     1
Name: count, Length: 3987, dtype: int64
Gender
M    29191
F    27953
Name: count, dtype: int64
tran_date
25-11-2012    90
13-07-2011    89
7/10/2011     86
23-10-2011    85
4/1/2013      85
              ..
28-02-2014     3
24-02-2014     3
23-02-2014     2
21-02-2014     1
27-02-2014     1
Name: count, Length: 1129, dtype: int64
Store_type
e-Shop            23087
MBR               11644
Flagship store    11324
TeleShop          11111
Name: count, dtype: int64
prod_cat
Books               12179
Clothing            10019
Footwear            10019
Electronics          9910
Home and kitchen     8087
Bags                 6952
Name: count, dtype: int64
prod_subcat
Women                   10019
Mens                     9902
Kids                     7069
Mobiles                  4002
Comics                   3067
Audio and video          2993
Non-Fiction              2993
Kitchen                  2993
Children                 2058
```

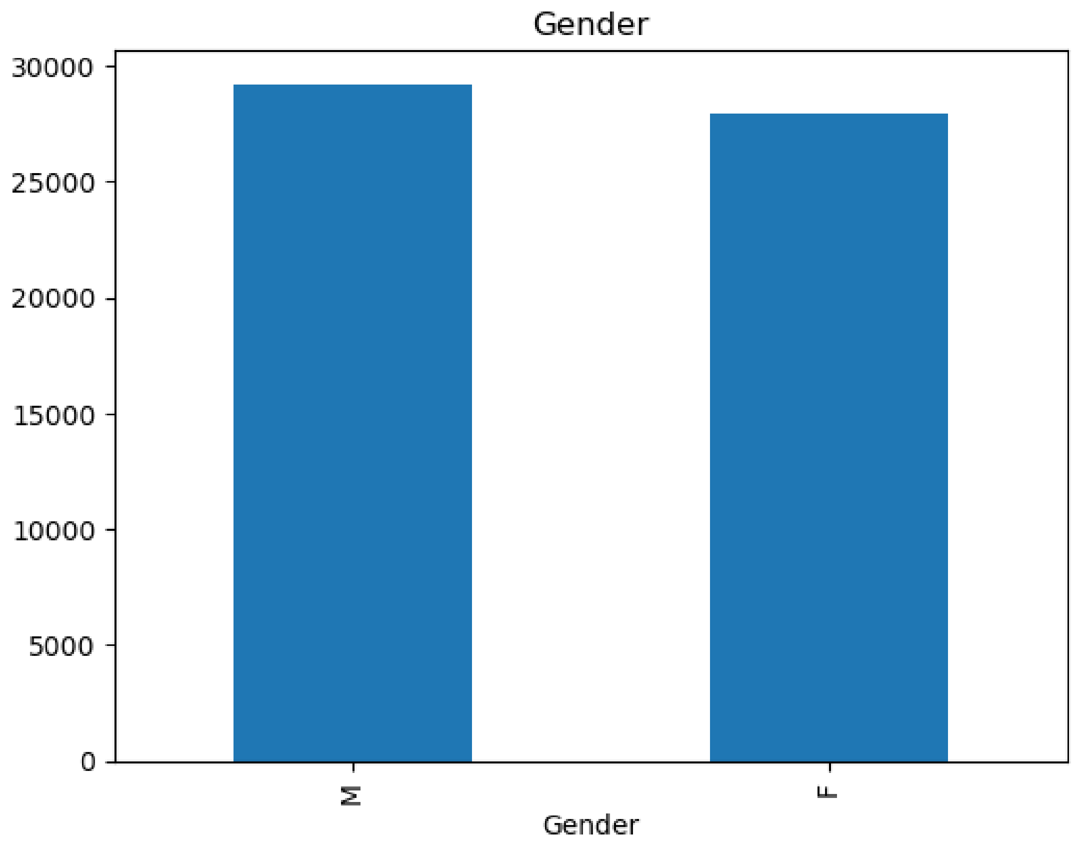
```
Bath                    2058
Academic                2029
Tools                   2029
Fiction                 1043
Furnishing              1007
DIY                      989
Cameras                  985
Personal Appliances      972
Computers                958
Name: count, dtype: int64
```

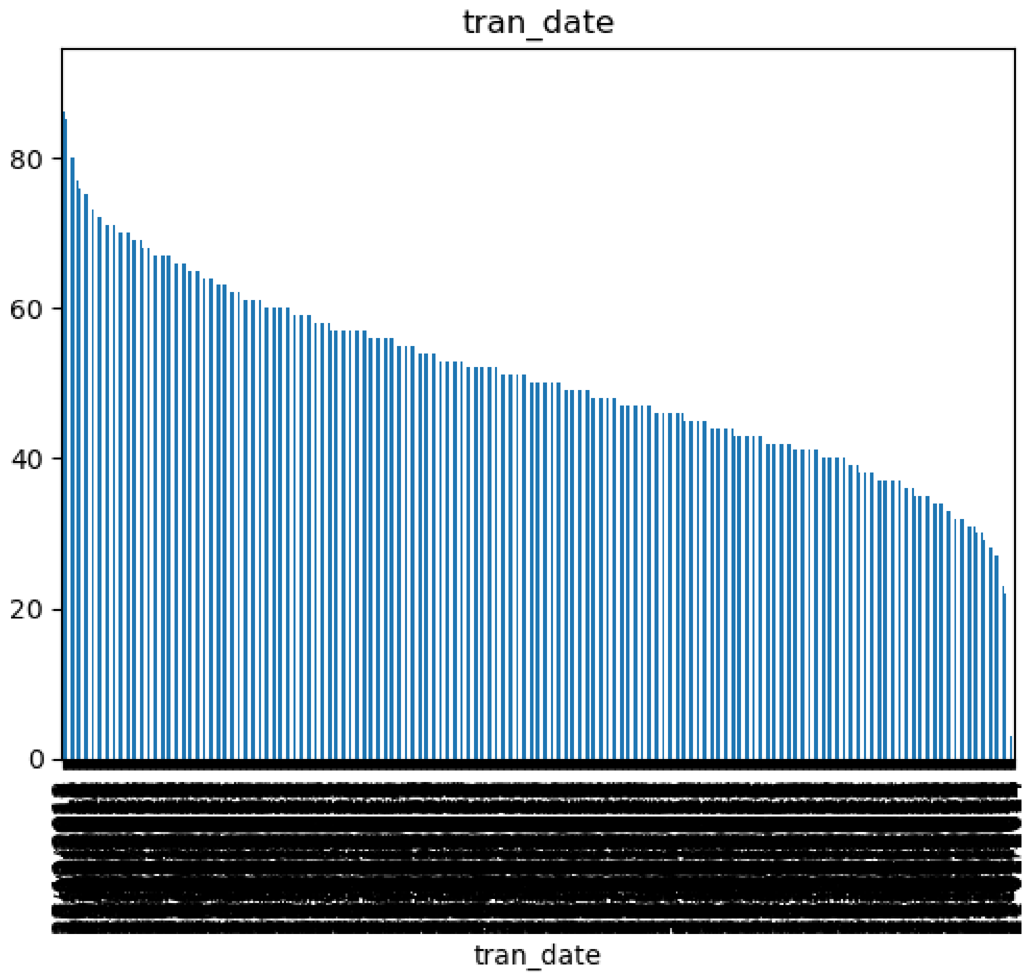
3.Generate histograms for all continuous variables and frequency bars for categorical variables.

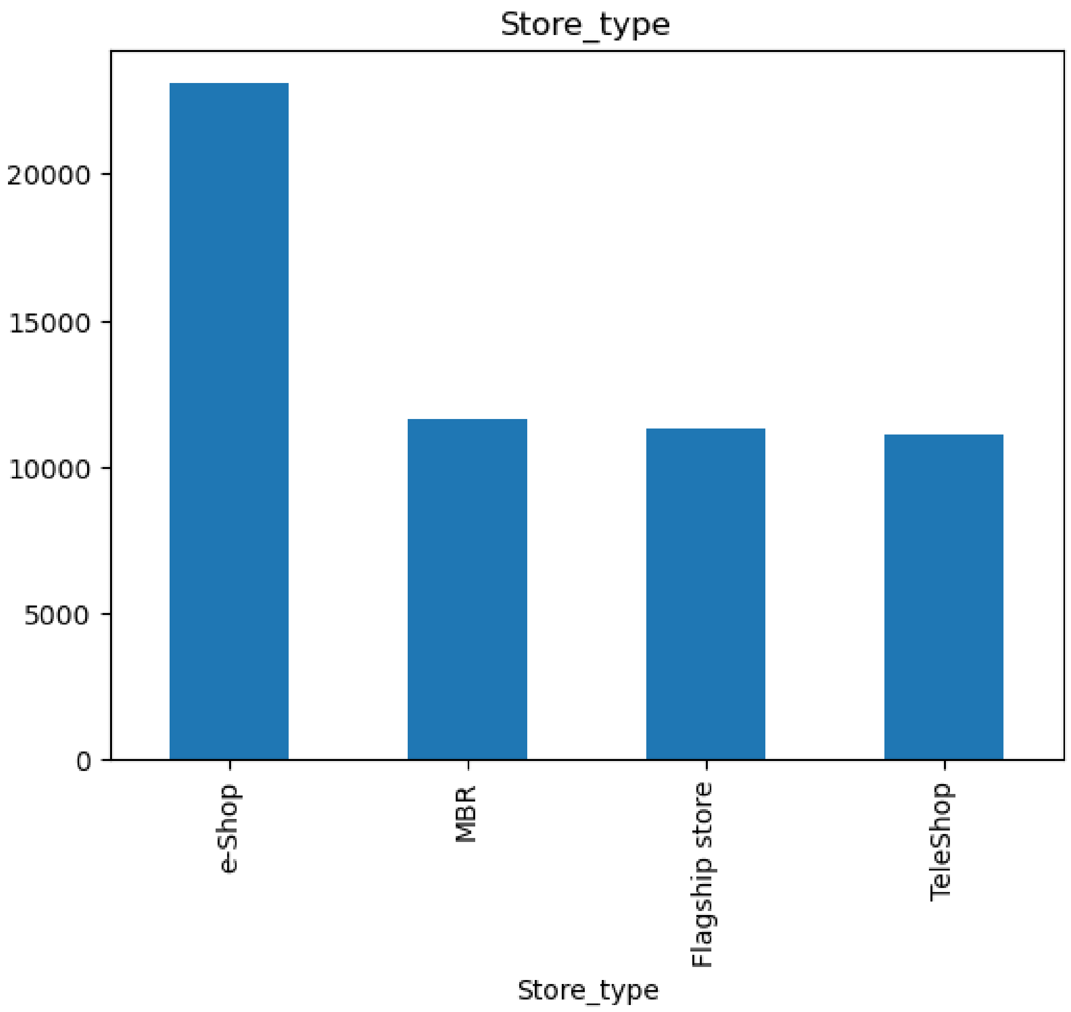
[72]:
```python
import matplotlib.pyplot as plt

# Let's see Histograms for continuous variables
customer_final.hist(bins=15, figsize=(15, 10))
plt.show()

# And now the frequency bars for categorical variables
for col in customer_final.select_dtypes(include='object').columns:
    customer_final[col].value_counts().plot(kind='bar')
    plt.title(col)
    plt.show()
```

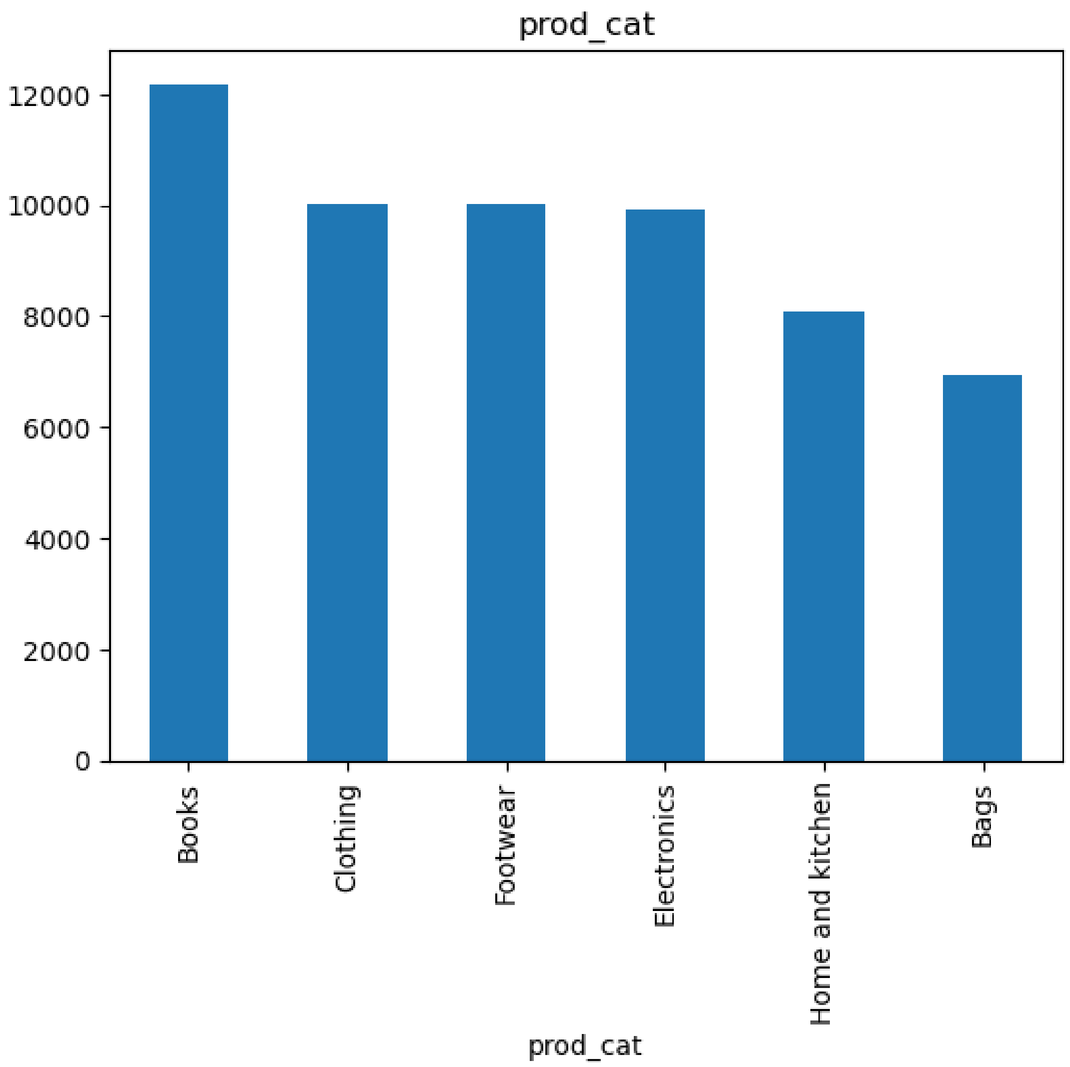


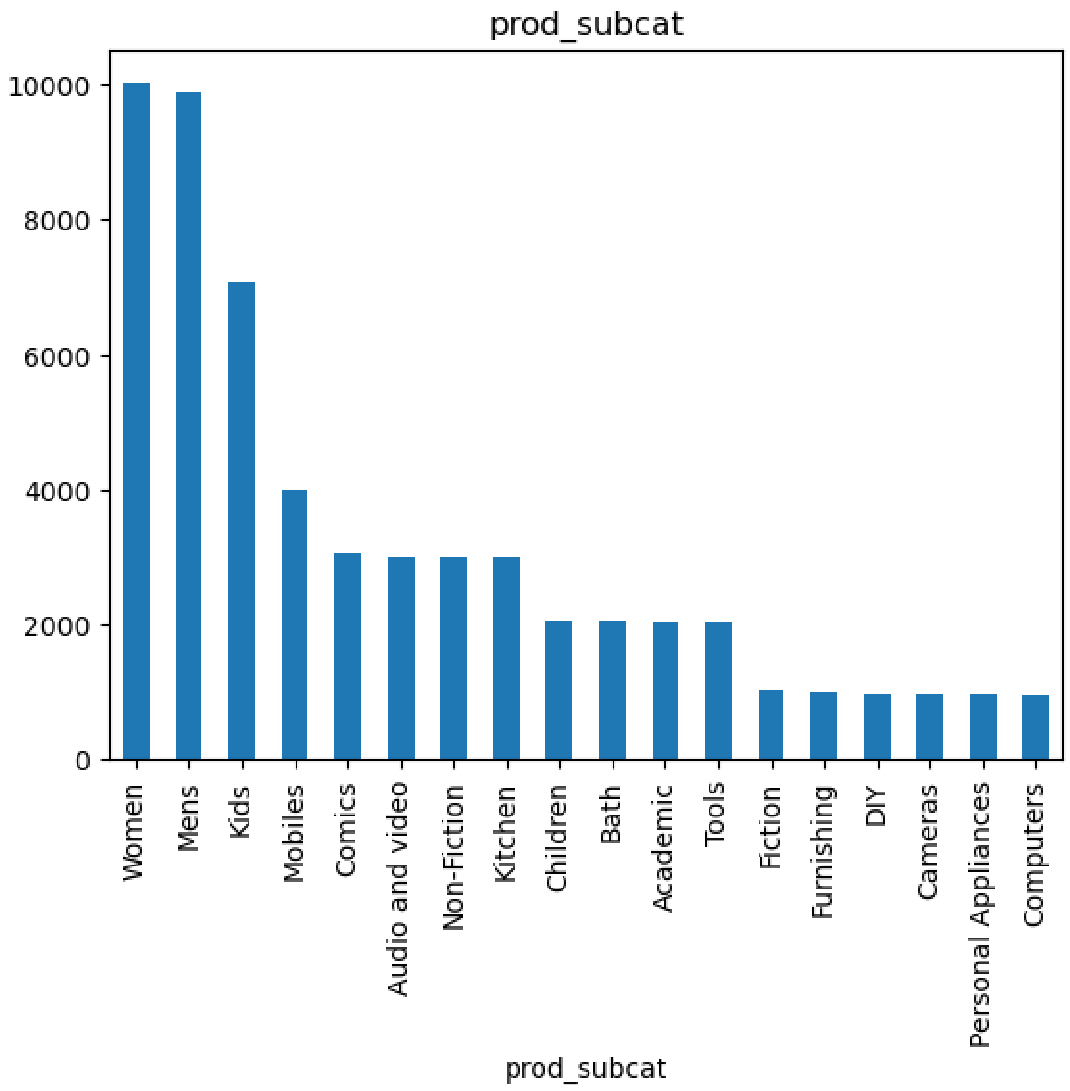

DOB
80
70
60
50
40
30
20
10
0
DOB


Gender
30000
25000
20000
15000
10000
5000
0
M
F
Gender


tran_date
80
60
40
20
0
tran_date


Store_type
20000
15000
10000
5000
0
e-Shop
MBR
Flagship store
TeleShop
Store_type


prod_cat
12000
10000
8000
6000
4000
2000
0
Books
Clothing
Footwear
Electronics
Home and kitchen
Bags
prod_cat



4.Calculate the following information using the merged dataset :

A.Time period of the available transaction data

[73]:
```
print(customer_final['tran_date'].min(), customer_final['tran_date'].max())
```

```
1/1/2012 9/9/2013
```

B.Count of transactions where the total amount of transaction was negative

[74]:
```
print(customer_final[customer_final['total_amt'] < 0].shape[0])
```

```
5430
```

5.Analyze which product categories are more popular among females vs male customers.

```
[75]: popularity_by_gender = customer_final.groupby(['Gender',␣
       ↪'prod_cat'])['transaction_id'].count().unstack().fillna(0)

      print(popularity_by_gender)
```

```
prod_cat  Bags  Books  Clothing  Electronics  Footwear  Home and kitchen
Gender
F         3363   6004      4916         4795      4916              3959
M         3586   6169      5099         5113      5099              4125
```

6.Which City code has the maximum customers and what was the percentage of customers from that city?

```
[78]: city_counts = customer_final['city_code'].value_counts()
      max_city_code = city_counts.idxmax()
      percentage = round((city_counts.max() / city_counts.sum()) * 100,2)

      print("City Code with Highest Count:", max_city_code)
      print("Percentage of Total:", percentage)
```

```
City Code with Highest Count: 4.0
Percentage of Total: 10.43
```

7.Which store type sells the maximum products by value and by quantity?

```
[82]: max_value_store = customer_final.groupby('Store_type')['total_amt'].sum().
       ↪idxmax()
      max_quantity_store = customer_final.groupby('Store_type')['Qty'].sum().idxmax()
      print("Store type with maximum products by value: ",max_value_store)
      print("Store type with maximum products by quantity: ", max_quantity_store)
```

```
Store type with maximum products by value:  e-Shop
Store type with maximum products by quantity:  e-Shop
```

8.What was the total amount earned from the "Electronics" and "Clothing" categories from Flagship Stores?

```
[87]: total_amount = customer_final[(customer_final['prod_cat'].isin(['Electronics',␣
       ↪'Clothing'])) &
                                    (customer_final['Store_type'] == 'Flagship␣
       ↪store')]['total_amt'].sum()
      print(total_amount)
```

```
8526843.0
```

9.What was the total amount earned from "Male" customers under the "Electronics" category?

```
[120]: total_amount_male_electronics =round(customer_final[(customer_final['Gender']␣
        ↪== 'M') &
```

```
                                          (customer_final['prod_cat'] ==␣
↪'Electronics')]['total_amt'].sum(),2)

print("Total amount earned from Electronics category for Male is: ",␣
↪total_amount_male_electronics)
```

```
Total amount earned from Electronics category for Male is:  6468856.75
```

10.How many customers have more than 10 unique transactions, after removing all transactions which have any negative amounts?

[94]:
```
customer_transactions = customer_final[customer_final['total_amt'] > 0].
↪groupby('customer_Id')['transaction_id'].nunique()
customers_with_10_plus = customer_transactions[customer_transactions > 10].
↪count()\

print("Customers with more than 10 unique transactions:␣
↪",customers_with_10_plus)
```

```
Customers with more than 10 unique transactions:  6
```

11.For all customers aged between 25 - 35, find out:

A.What was the total amount spent for “Electronics” and “Books” product categories?

[113]:
```
import pandas as pd
from datetime import datetime


# First lets Convert DOB and tran_date columns to datetime format
customer_final['DOB'] = pd.to_datetime(customer_final['DOB'])
customer_final['tran_date'] = pd.to_datetime(customer_final['tran_date'])

# Now lets Calculate age from DOB using python function:

def calculate_age(dob, tran_date):
    age = tran_date.year - dob.year - ((tran_date.month, tran_date.day) < (dob.
↪month, dob.day))
    return age

customer_final['Age'] = customer_final.apply(lambda row:␣
↪calculate_age(row['DOB'], row['tran_date']), axis=1)

# Lastly lets Filter for age between 25 and 35 and product categories␣
↪Electronics or Books
filtered_data = customer_final[(customer_final['Age'].between(25, 35)) &
                                (customer_final['prod_cat'].isin(['Electronics',␣
↪'Books']))]
```

```
total_amount_25_35 = filtered_data['total_amt'].sum()

print(total_amount_25_35)
```

```
13526881.81
```

B.What was the total amount spent by these customers between 1st Jan, 2014 to 1st Mar, 2014?

[119]:
```
total_amount_date_range = round(
    customer_final[
        (customer_final['Age'].between(25, 35)) &
        (customer_final['tran_date'].between('2014-01-01', '2014-03-01'))
    ]['total_amt'].sum(), 2
)

print("Total amount spent by customers between 1st Jan,2014 to 1St March,2014␣
 ↪is: ",total_amount_date_range)
```

```
Total amount spent by customers between 1st Jan,2014 to 1St March,2014 is:
1431508.72
```