Use e-commerce data to analyze and classify customer behavior and implement precision marketing

edit by David Yang 02/15/2023

1. Data preparation

import module

In [83]:
```
import pandas as pd
import matplotlib.pyplot as plt
from datetime import datetime
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

import data，path is './工作/data.csv'，Encoding format is 'utf-8'

In [91]:
```
missing_values = ['-','na','none','null','']
test_data = pd.read_csv('E:/风变/数据分析实训营/all_data.csv',na_values = missing_values, encoding = 'utf-8')
test_data.head()
```

Out[91]:

	订单号	顾客ID	订单时间	付款金额	商品ID	商品描述
0	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56	18.12	87285b34884572647811a353c7ac498a	housewares
1	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56	2.00	87285b34884572647811a353c7ac498a	housewares
2	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56	18.59	87285b34884572647811a353c7ac498a	housewares
3	128e10d95713541c87cd1a2e48201934	a20e8105f23924cd00833fd87daa0831	2017-08-15 18:29	37.77	87285b34884572647811a353c7ac498a	housewares

	订单号	顾客ID	订单时间	付款金额	商品ID	商品描述
4	0e7e841ddf8f8f2de2bad69267ecfbcf	26c7ac168e1433912a51b924fbd34d34	2017-08-02 18:24	37.77	87285b34884572647811a353c7ac498a	housewares

In [92]:
```
test_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 115878 entries, 0 to 115877
Data columns (total 6 columns):
 #   Column  Non-Null Count   Dtype
---  ------  --------------   -----
 0   订单号     115878 non-null  object
 1   顾客ID    115878 non-null  object
 2   订单时间    115878 non-null  object
 3   付款金额    115878 non-null  float64
 4   商品ID    115878 non-null  object
 5   商品描述    115878 non-null  object
dtypes: float64(1), object(5)
memory usage: 5.3+ MB
```

Data Cleansing

In [93]:
```
missing_value = ['-','na','none','null','inf']
```

In [94]:
```
test_data.isnull().sum()
```

Out[94]:
```
订单号     0
顾客ID    0
订单时间    0
付款金额    0
商品ID    0
商品描述    0
dtype: int64
```

In [95]:
```
test_data[test_data.duplicated()].tail()
```

Out[95]:

	订单号	顾客ID	订单时间	付款金额	商品ID	商
115714	5020a3db49225f967490d76021c7d13a	5a8b3e70cb6bfdbc353bcb5ae2b4d4eb	2018-01-28 23:36	188.45	3fdb534dccf5bc9ab0406944b913787d	diapers_and_h
115715	5020a3db49225f967490d76021c7d13a	5a8b3e70cb6bfdbc353bcb5ae2b4d4eb	2018-01-28 23:36	188.45	3fdb534dccf5bc9ab0406944b913787d	diapers_and_h
115716	5020a3db49225f967490d76021c7d13a	5a8b3e70cb6bfdbc353bcb5ae2b4d4eb	2018-01-28 23:36	188.45	3fdb534dccf5bc9ab0406944b913787d	diapers_and_h
115737	b144e2ac9863ed27bc59dbe4dd2f8773	49bc0bacf1f213a2d30e240c648ccb01	2017-12-06 14:04	99.70	f83fd2b539bc73678c65be8d418be8c1	diapers_and_h
115781	161f105f25baba98c7604aad9b99d9a6	b9dd6c551bfe1ea46e2ca722708df61d	2018-03-14 12:26	170.60	7515ab3fc02c8f43b07e9451497fb13e	books_im

In [96]:

```
test_data1 = test_data.drop_duplicates().reset_index(drop=True)
test_data1[test_data1.duplicated()]
```

Out[96]:

订单号	顾客ID	订单时间	付款金额	商品ID	商品描述

In [97]:

```
test_data1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 104839 entries, 0 to 104838
Data columns (total 6 columns):
 #   Column  Non-Null Count   Dtype  
---  ------  --------------   -----  
 0   订单号     104839 non-null  object 
 1   顾客ID    104839 non-null  object 
 2   订单时间    104839 non-null  object 
 3   付款金额    104839 non-null  float64
 4   商品ID    104839 non-null  object 
 5   商品描述    104839 non-null  object 
```

```
dtypes: float64(1), object(5)
memory usage: 4.8+ MB
```

In [98]:
```
test_data1.tail()
```

Out[98]:

	订单号	顾客ID	订单时间	付款金额	商品ID	
104834	0b82d0616f1ad8da15cf967b984b4004	986632b40c38f4240caf8608cb01d40d	2018-08-03 21:35	33.69	4a24717893a6c8f3cfcf9843b8987d15	arts_and_craft
104835	2ef4a11b6e24fdfbb43b92cb5f95edff	ee1cfdc92e449920e25d3ca4ab4da4f6	2018-07-23 18:35	84.63	9c313adb4b38a55b092f53f83f78be9e	arts_and_craft
104836	2ef4a11b6e24fdfbb43b92cb5f95edff	ee1cfdc92e449920e25d3ca4ab4da4f6	2018-07-23 18:35	84.63	eacb104882d39ffb53140b1d1860a7c3	arts_and_craft
104837	2c4ada2e75c2ad41dd93cebb5df5f023	363d3a9b2ec5c5426608688ca033292d	2017-01-26 11:09	209.06	6c7a0a349ad11817745e3ad58abd5c79	security_and
104838	bede3503afed051733eeb4a84d1adcc5	919570a26efbd068d6a0f66d5c5072a3	2017-09-17 16:51	115.45	8db75af9aed3315374db44d7860e25da	security_and

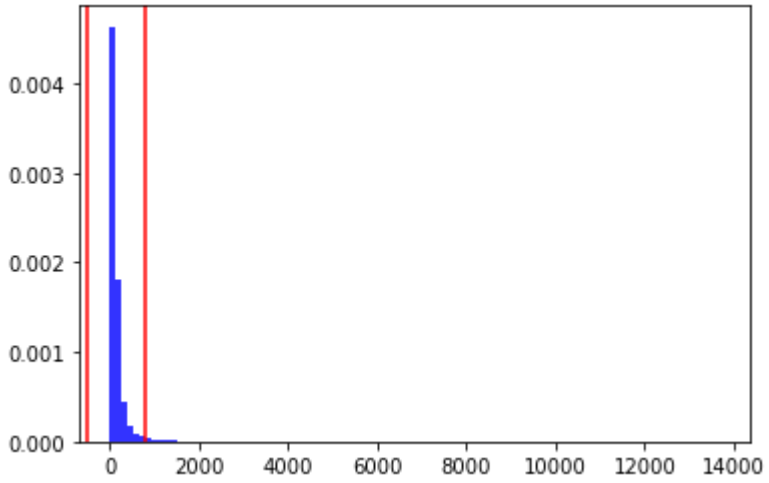
In [99]:
```
test_data1['付款金额'].describe()
```

Out[99]:
```
count    104839.000000
mean        158.264636
std         218.993424
min           0.000000
25%          58.370000
50%         102.850000
75%         177.320000
max       13664.080000
Name: 付款金额, dtype: float64
```

use 3*6 method to remove outlier

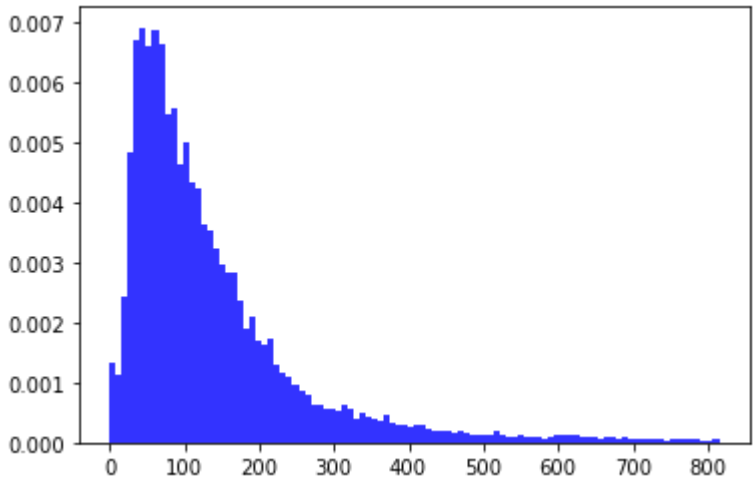
In [100…

```
plt.hist(test_data1['付款金额'],100,density=True,facecolor='b',alpha=0.8)
m = test_data1['付款金额'].mean()
std = test_data1['付款金额'].std()
plt.axvline(x=m+3*std,color='r')
plt.axvline(x=m-3*std,color='r')
plt.show()
```



In [101…

```
price_sorted = sorted(test_data1["付款金额"])
threshhold = m+3*std
price_normal = []
price_outlier = []

for price in price_sorted:
    if price<threshhold:
        price_normal.append(price)
    else:
        price_outlier.append(price)

plt.hist(price_normal,100,density=True,facecolor='b',alpha=0.8)
plt.show()
```



In [102…

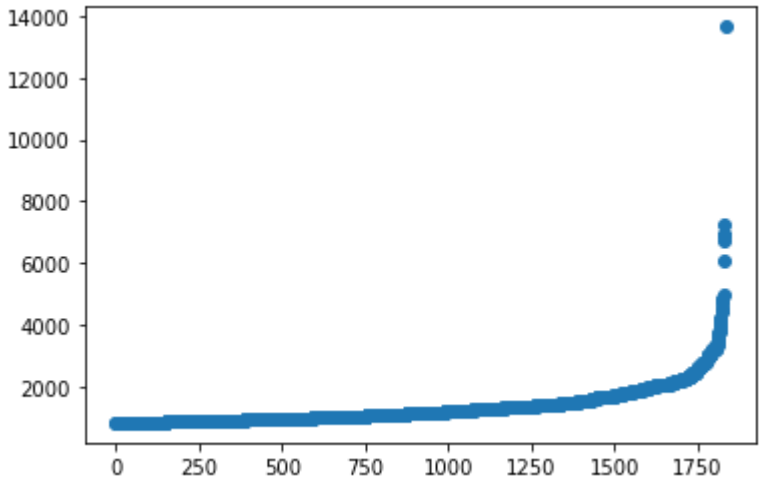
```
len(price_outlier)
```

Out[102…

```
1833
```

In [103…

```
plt.scatter(range(len(price_outlier)),price_outlier)
plt.show()
```



In [104…

```
test_data2 = test_data1[test_data1["付款金额"]<m+3*std].reset_index(drop=True)
```

In [105…

```
test_data2.describe()
```

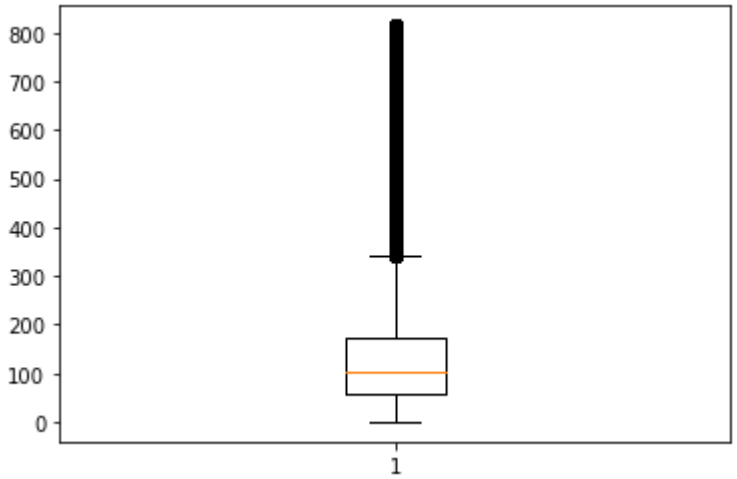
Out[105…

	付款金额
count	103006.000000
mean	137.298398
std	122.271094
min	0.000000
25%	57.770000
50%	100.940000
75%	171.780000
max	814.960000

use 1.5*IQR to analyze based on the 3*6 method to remove outlier

In [106…

```
plt.boxplot(test_data2["付款金额"])
plt.show()
```



In [107…

```
Q1 = test_data2["付款金额"].quantile(0.25)
Q3 = test_data2["付款金额"].quantile(0.75)
```

```
IQR = Q3-Q1
IQR
```

Out[107…

```
114.00999999999999
```

In [108…

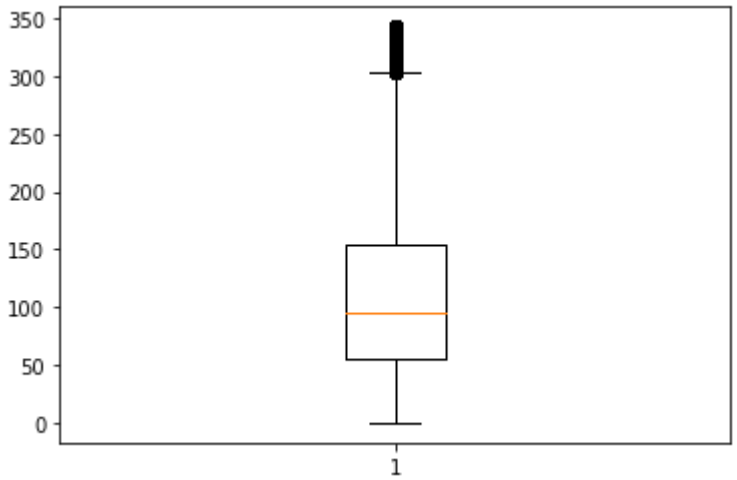
```
test_data2_normal = test_data2[(test_data2["付款金额"]>Q1-1.5*IQR) & (test_data2["付款金额"]<Q3+1.5*IQR)]
test_data2_normal.describe()
```

Out[108…

	付款金额
count	96204.000000
mean	112.228934
std	73.282026
min	0.000000
25%	55.240000
50%	94.520000
75%	154.200000
max	342.690000

In [109…

```
plt.boxplot(test_data2_normal["付款金额"])
plt.show()
```



In [110…

```
test_data2_normal.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 96204 entries, 0 to 103005
Data columns (total 6 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   订单号     96204 non-null  object
 1   顾客ID    96204 non-null  object
 2   订单时间    96204 non-null  object
 3   付款金额    96204 non-null  float64
 4   商品ID    96204 non-null  object
 5   商品描述    96204 non-null  object
dtypes: float64(1), object(5)
memory usage: 5.1+ MB
```

In [111…

```
test_data2_normal.head()
```

Out[111…

	订单号	顾客ID	订单时间	付款金额	商品ID	商品描述
0	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56	18.12	87285b34884572647811a353c7ac498a	housewares
1	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56	2.00	87285b34884572647811a353c7ac498a	housewares

	订单号	顾客ID	订单时间	付款金额	商品ID	商品描述
2	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56	18.59	87285b34884572647811a353c7ac498a	housewares
3	128e10d95713541c87cd1a2e48201934	a20e8105f23924cd00833fd87daa0831	2017-08-15 18:29	37.77	87285b34884572647811a353c7ac498a	housewares
4	0e7e841ddf8f8f2de2bad69267ecfbcf	26c7ac168e1433912a51b924fbd34d34	2017-08-02 18:24	37.77	87285b34884572647811a353c7ac498a	housewares

data wrangling

In [112…

```
test_data2_normal['订单时间'] = test_data2_normal['订单时间'].astype('datetime64')
test_data2_normal.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 96204 entries, 0 to 103005
Data columns (total 6 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   订单号     96204 non-null  object
 1   顾客ID    96204 non-null  object
 2   订单时间    96204 non-null  datetime64[ns]
 3   付款金额    96204 non-null  float64
 4   商品ID    96204 non-null  object
 5   商品描述    96204 non-null  object
dtypes: datetime64[ns](1), float64(1), object(4)
memory usage: 5.1+ MB
```

In [113…

```
test_data2_normal['year'] = test_data2_normal['订单时间'].dt.year
test_data2_normal['month'] = test_data2_normal['订单时间'].dt.month
test_data2_normal['day'] = test_data2_normal['订单时间'].dt.day
```

In [114…

```
test_data2_normal.head()
```

Out[114...

	订单号	顾客ID	订单时间	付款金额	商品ID	商品描述	year
0	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	18.12	87285b34884572647811a353c7ac498a	housewares	2017
1	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	2.00	87285b34884572647811a353c7ac498a	housewares	2017
2	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	18.59	87285b34884572647811a353c7ac498a	housewares	2017
3	128e10d95713541c87cd1a2e48201934	a20e8105f23924cd00833fd87daa0831	2017-08-15 18:29:00	37.77	87285b34884572647811a353c7ac498a	housewares	2017
4	0e7e841ddf8f8f2de2bad69267ecfbcf	26c7ac168e1433912a51b924fbd34d34	2017-08-02 18:24:00	37.77	87285b34884572647811a353c7ac498a	housewares	2017

In [115...

```
test_data2_normal.to_csv('E:/风变/数据分析实训营/cleansing_data.csv',encoding = 'utf-8-sig',index = False)
```

2. Data analyze

In [116...

```
df = pd.read_csv('E:/风变/数据分析实训营/cleansing_data.csv')
df.columns = ['order_id','cust_id','order_time','order_payment','pro_id','pro_describe','year','month','day']
df.head()
```

Out[116...

	order_id	cust_id	order_time	order_payment	pro_id	pro_d
0	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	18.12	87285b34884572647811a353c7ac498a	hou
1	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	2.00	87285b34884572647811a353c7ac498a	hou
2	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-	18.59	87285b34884572647811a353c7ac498a	hou

	order_id	cust_id	order_time	order_payment	pro_id	pro_c
			02 10:56:00			
3	128e10d95713541c87cd1a2e48201934	a20e8105f23924cd00833fd87daa0831	2017-08-15 18:29:00	37.77	87285b34884572647811a353c7ac498a	hou
4	0e7e841ddf8f8f2de2bad69267ecfbcf	26c7ac168e1433912a51b924fbd34d34	2017-08-02 18:24:00	37.77	87285b34884572647811a353c7ac498a	hou

increase weekday

In [117…

```
df['weekday'] = pd.to_datetime(df['order_time']).dt.weekday
df.head()
```

Out[117…

	order_id	cust_id	order_time	order_payment	pro_id	pro_c
0	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	18.12	87285b34884572647811a353c7ac498a	hou
1	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	2.00	87285b34884572647811a353c7ac498a	hou
2	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	18.59	87285b34884572647811a353c7ac498a	hou
3	128e10d95713541c87cd1a2e48201934	a20e8105f23924cd00833fd87daa0831	2017-08-15 18:29:00	37.77	87285b34884572647811a353c7ac498a	hou
4	0e7e841ddf8f8f2de2bad69267ecfbcf	26c7ac168e1433912a51b924fbd34d34	2017-08-02 18:24:00	37.77	87285b34884572647811a353c7ac498a	hou

remove the data in 2016

In [118…

```
df.groupby('year')['year'].value_counts()
```

Out[118…

```
year  year
2016  2016      304
2017  2017    43687
2018  2018    52213
Name: year, dtype: int64
```

In [119…

```
df = df[(df['year']==2017) | (df['year']==2018)]
df.groupby('year')['year'].value_counts()
```

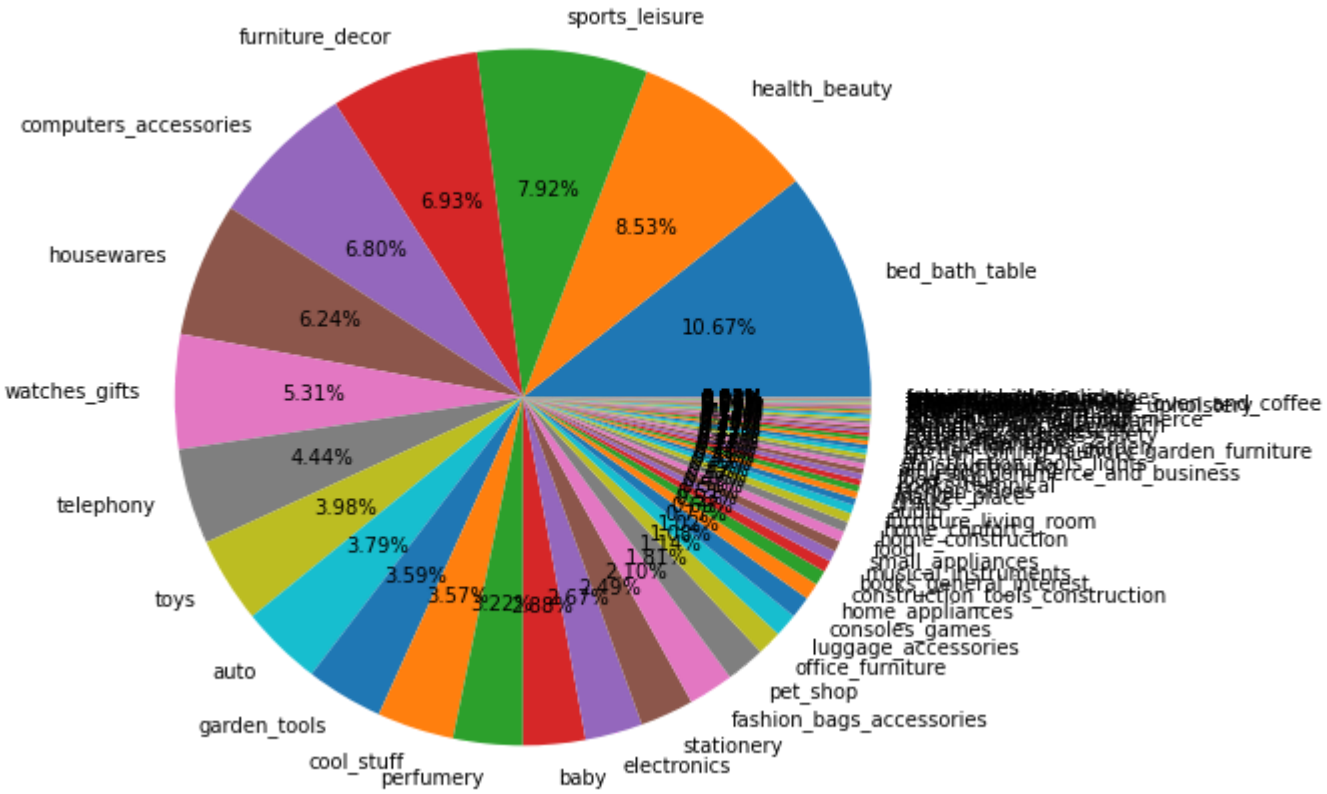
Out[119…

```
year  year
2017  2017    43687
2018  2018    52213
Name: year, dtype: int64
```

draw a Pie of product deacribe

In [120…

```
ratio_describe = df['pro_describe'].value_counts() / df['pro_describe'].value_counts().sum()
ratio_describe.plot(kind='pie', autopct='%.2f%%',figsize=(8,8),label='')
plt.show()
```



analyze the sales in different year

In [121…

```
plt.rcParams['figure.figsize'] = 10,6
df.groupby(['year','month'])['order_payment'].sum()
```

Out[121…

```
year  month
2017  1         80203.60
      2        182304.65
      3        280771.10
      4        256491.77
      5        389725.59
      6        339110.83
      7        435607.42
      8        464427.76
      9        459472.04
      10       502989.91
      11       817452.04
      12       620276.42
2018  1        788700.86
      2        716850.69
      3        786641.68
      4        778140.09
      5        764595.04
      6        698249.14
      7        691996.42
      8        706881.42
      9           166.46
Name: order_payment, dtype: float64
```

In [122…

```
year_month_sales_sum = df.groupby(['year','month'])['order_payment'].sum().unstack(level=0)
year_month_sales_sum
```

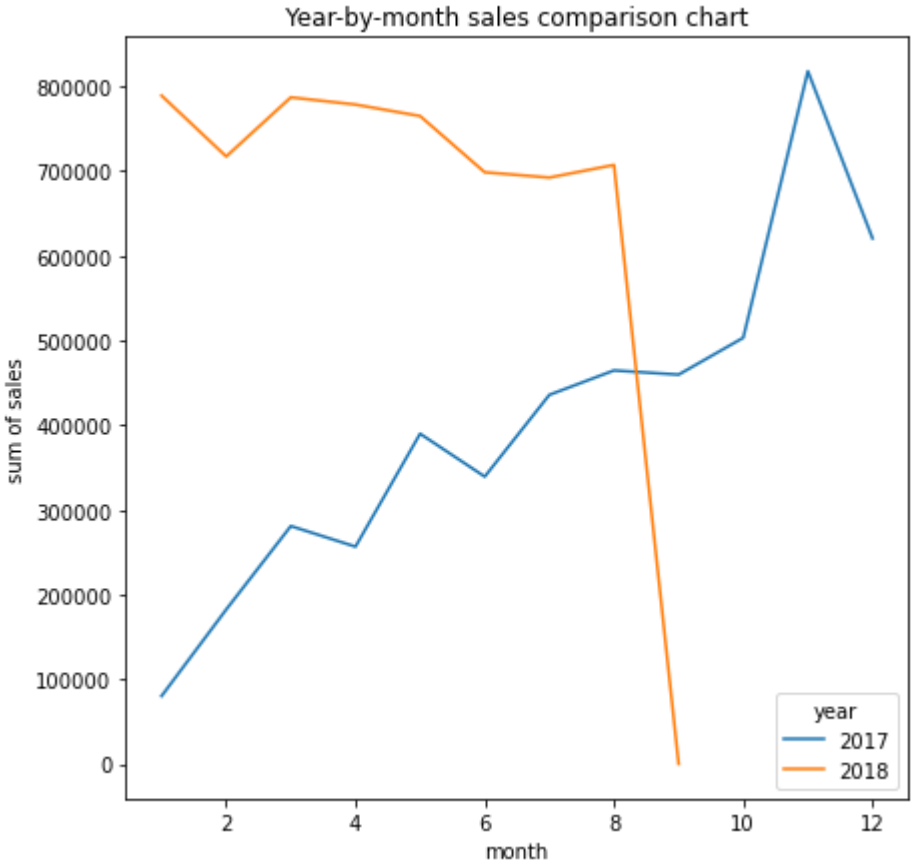
Out[122…

year	2017	2018
month		
1	80203.60	788700.86
2	182304.65	716850.69
3	280771.10	786641.68
4	256491.77	778140.09

year	2017	2018
month		
5	389725.59	764595.04
6	339110.83	698249.14
7	435607.42	691996.42
8	464427.76	706881.42
9	459472.04	166.46
10	502989.91	NaN
11	817452.04	NaN
12	620276.42	NaN

In [123…

```
year_month_sales_sum.plot(kind='line',figsize=(7,7))
plt.xlabel('month')
plt.ylabel('sum of sales')
plt.title('Year-by-month sales comparison chart')
plt.show()
```



use seaborn to draw the means of weekday

In [124…

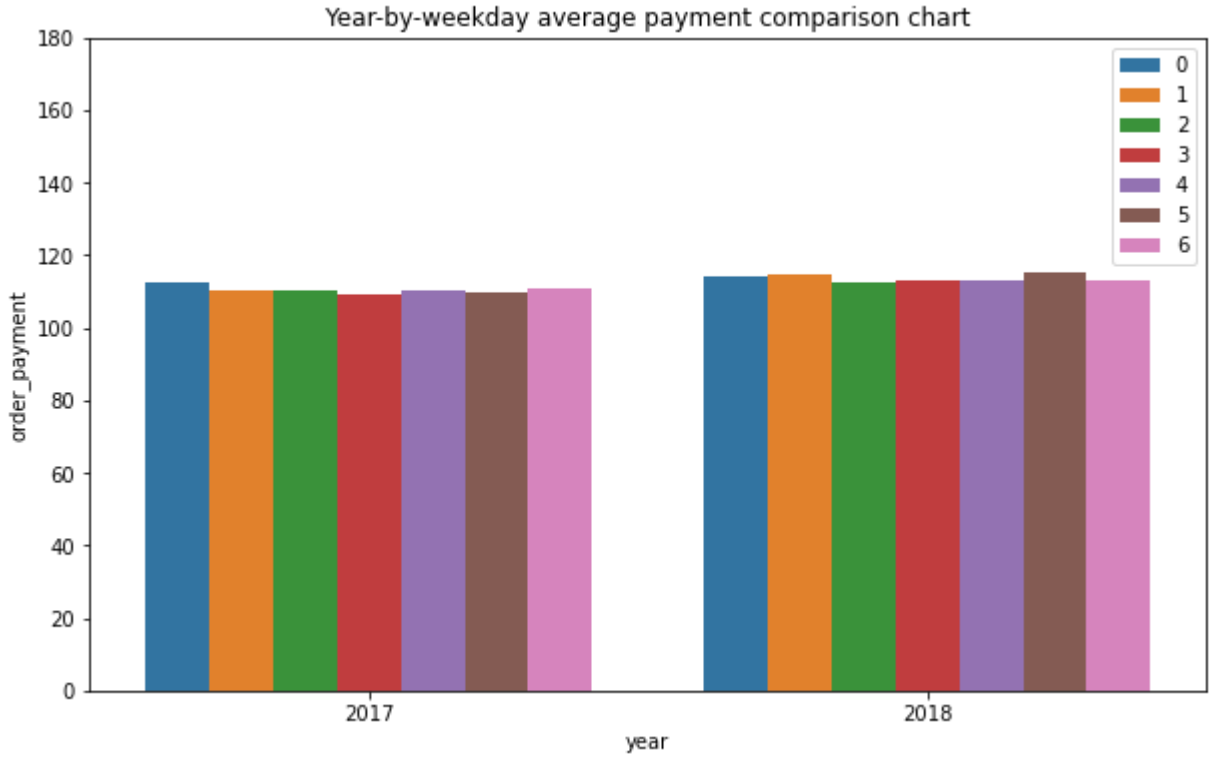
```
import seaborn as sns
```

In [125…

```
# to compare the average payment of every weekday in different year
# use hue to class and ci to remove the error interval
sns.barplot(x='year',y='order_payment', data=df, hue='weekday', ci=None)
# extend axis Y
plt.ylim(0,180)
# set the legend
plt.legend(loc='upper right')
plt.title('Year-by-weekday average payment comparison chart')
```

Out[125…

```
Text(0.5, 1.0, 'Year-by-weekday average payment comparison chart')
```



use seaborn to analyze total customers and total payment in every month of 2017

In [127…

```
# To compare total of customers in every month, need to combine the same cust_id in the same month
# after group the data in 2017 by month and cust_id, use agg to get the sum of order_payment and mean of year.
# mean of year just for the chart
df_2017 = df[df['year']== 2017].groupby(['month','cust_id']).agg({'order_payment':'sum', 'year':'mean'})
df_month_customer_2017 = df_2017.reset_index()
df_month_customer_2017.tail()
```

Out[127…

	month	cust_id	order_payment	year
40268	12	ffdb7e488ea7c83b9c1258ee2d3776fa	85.23	2017.0
40269	12	ffdd933fe636d97903e7a4758faa8c6a	63.60	2017.0
40270	12	ffe509f377a33554f5a677dcd83e669e	211.82	2017.0
40271	12	fff675a0d5924b9162b4a1bf410466cd	75.07	2017.0
40272	12	fff89c8ed4fcf69a823c1d149e429a0b	44.10	2017.0

In [128…

```
# continue to group the data by month and count the total of cumtomer every month
customer_payment_2017 = df_month_customer_2017.groupby('month').agg({'cust_id':'count','order_payment':'sum','year':'mean
customer_payment_2017
```

Out[128…

	month	cust_id	order_payment	year
0	1	684	80203.60	2017.0
1	2	1541	182304.65	2017.0
2	3	2375	280771.10	2017.0
3	4	2123	256491.77	2017.0
4	5	3288	389725.59	2017.0
5	6	2929	339110.83	2017.0
6	7	3642	435607.42	2017.0
7	8	3902	464427.76	2017.0
8	9	3813	459472.04	2017.0
9	10	4126	502989.91	2017.0
10	11	6757	817452.04	2017.0
11	12	5093	620276.42	2017.0

In [129…

```
customer_payment_2017 = customer_payment_2017.rename(columns={'cust_id':'total_cust','order_payment':'total_payment'})
customer_payment_2017
```

Out[129…

	month	total_cust	total_payment	year
0	1	684	80203.60	2017.0
1	2	1541	182304.65	2017.0
2	3	2375	280771.10	2017.0
3	4	2123	256491.77	2017.0
4	5	3288	389725.59	2017.0

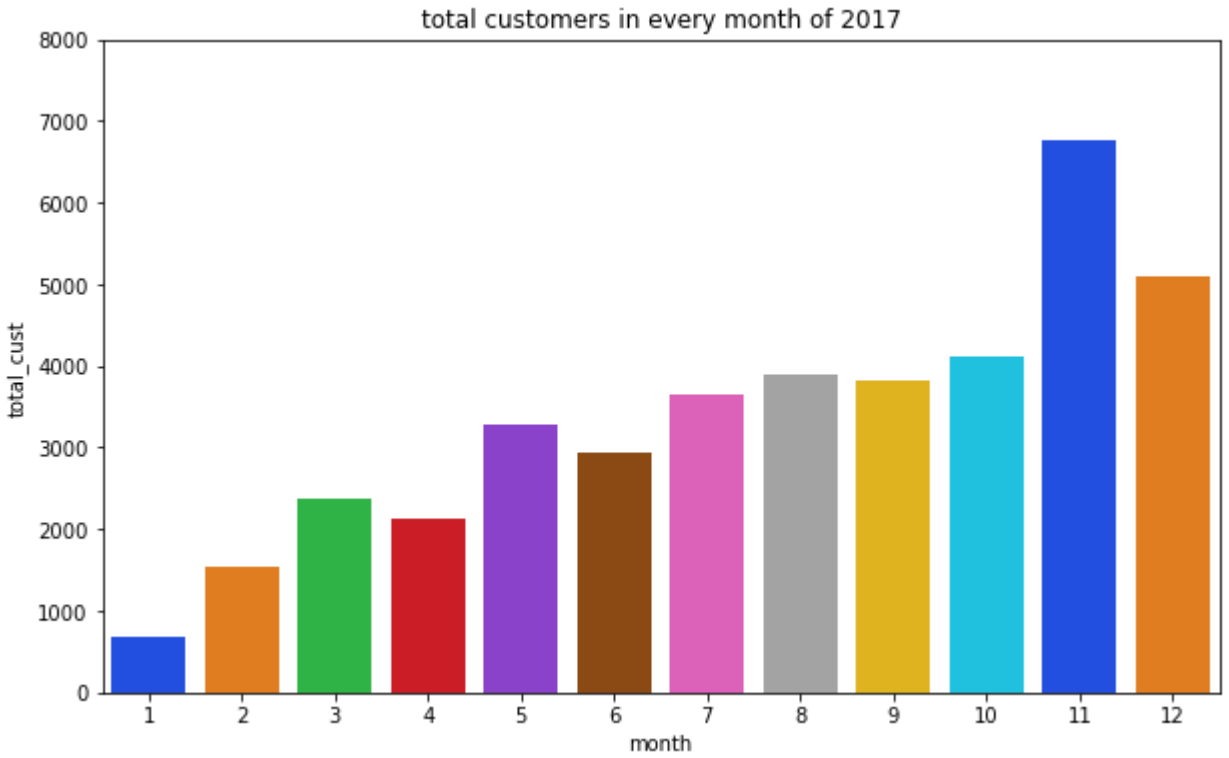
	month	total_cust	total_payment	year
5	6	2929	339110.83	2017.0
6	7	3642	435607.42	2017.0
7	8	3902	464427.76	2017.0
8	9	3813	459472.04	2017.0
9	10	4126	502989.91	2017.0
10	11	6757	817452.04	2017.0
11	12	5093	620276.42	2017.0

In [130…

```
sns.barplot(x='month',y='total_cust', data=customer_payment_2017, palette='bright')
# extend axis Y
plt.ylim(0,8000)
plt.title('total customers in every month of 2017')
```

Out[130…

```
Text(0.5, 1.0, 'total customers in every month of 2017')
```

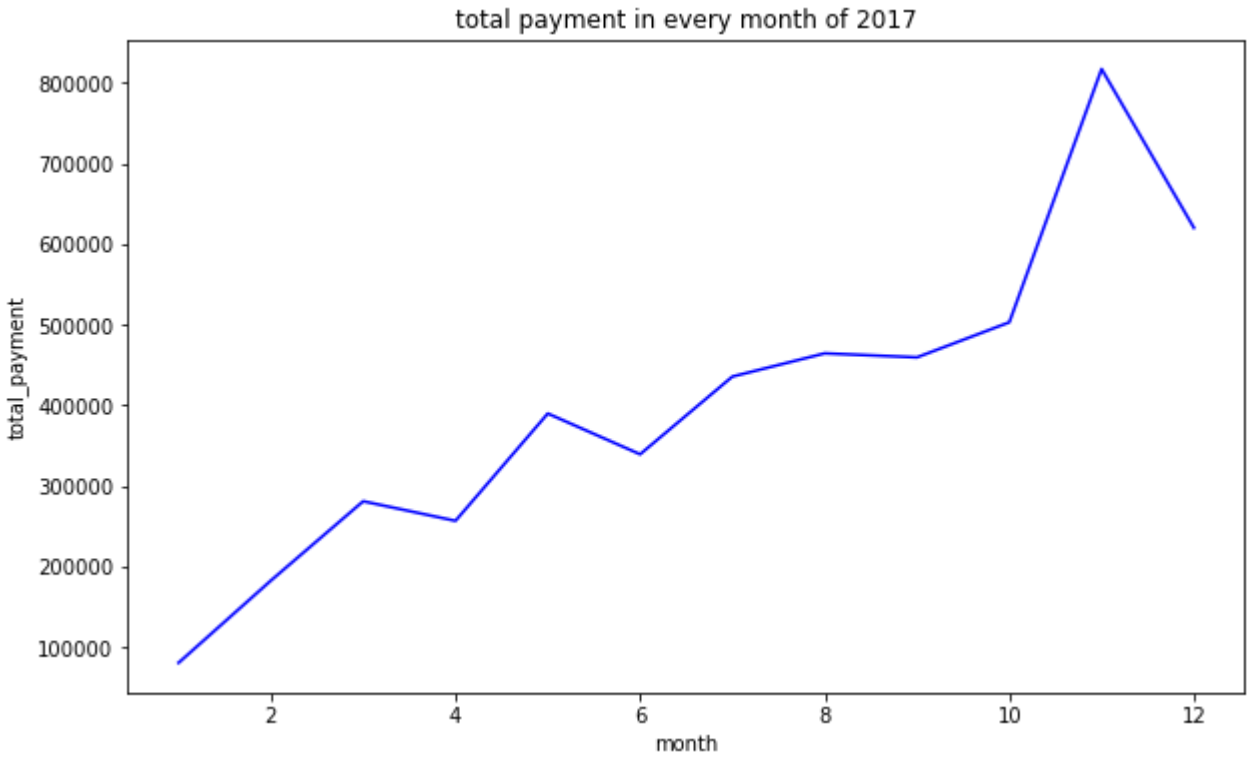


In [131…

```
sns.lineplot(x='month',y='total_payment', data=customer_payment_2017, color='blue')
plt.title('total payment in every month of 2017')
```

Out[131…

```
Text(0.5, 1.0, 'total payment in every month of 2017')
```



In [132…

```
df.to_csv('E:/风变/数据分析实训营/analyze_data_1.csv',encoding = 'utf-8-sig',index = False)
```

In [133…

```
import pandas as pd
import matplotlib.pyplot as plt
from datetime import datetime
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

In [134…

```
df = pd.read_csv('E:/风变/数据分析实训营/analyze_data_1.csv',encoding = 'utf-8')
```

In [135…

```
df.info()
```

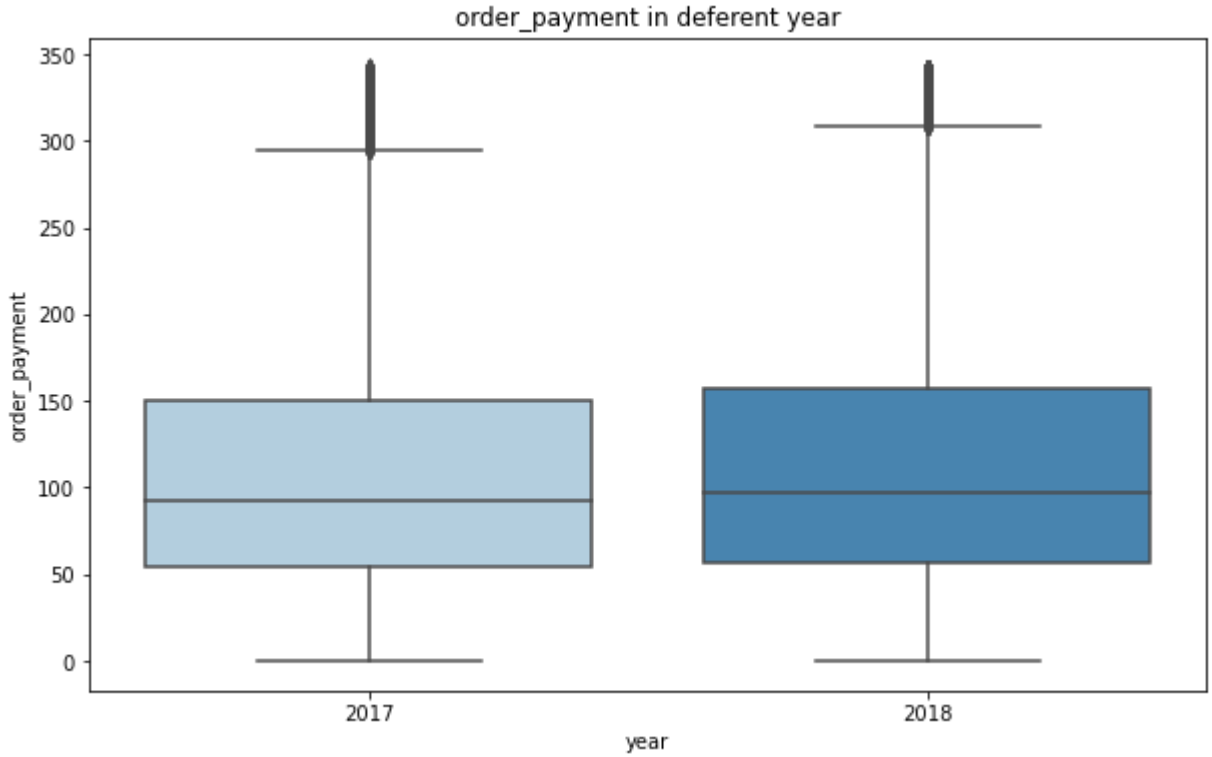
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 95900 entries, 0 to 95899
```

```
Data columns (total 10 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   order_id       95900 non-null  object 
 1   cust_id        95900 non-null  object 
 2   order_time     95900 non-null  object 
 3   order_payment  95900 non-null  float64
 4   pro_id         95900 non-null  object 
 5   pro_describe   95900 non-null  object 
 6   year           95900 non-null  int64  
 7   month          95900 non-null  int64  
 8   day            95900 non-null  int64  
 9   weekday        95900 non-null  int64  
dtypes: float64(1), int64(4), object(5)
memory usage: 7.3+ MB
```

use seaborn to analyze order_payment in deferent year

In [136…

```
sns.boxplot(x='year',y='order_payment',data=df,palette='Blues')
plt.title('order_payment in deferent year')
plt.show()
```



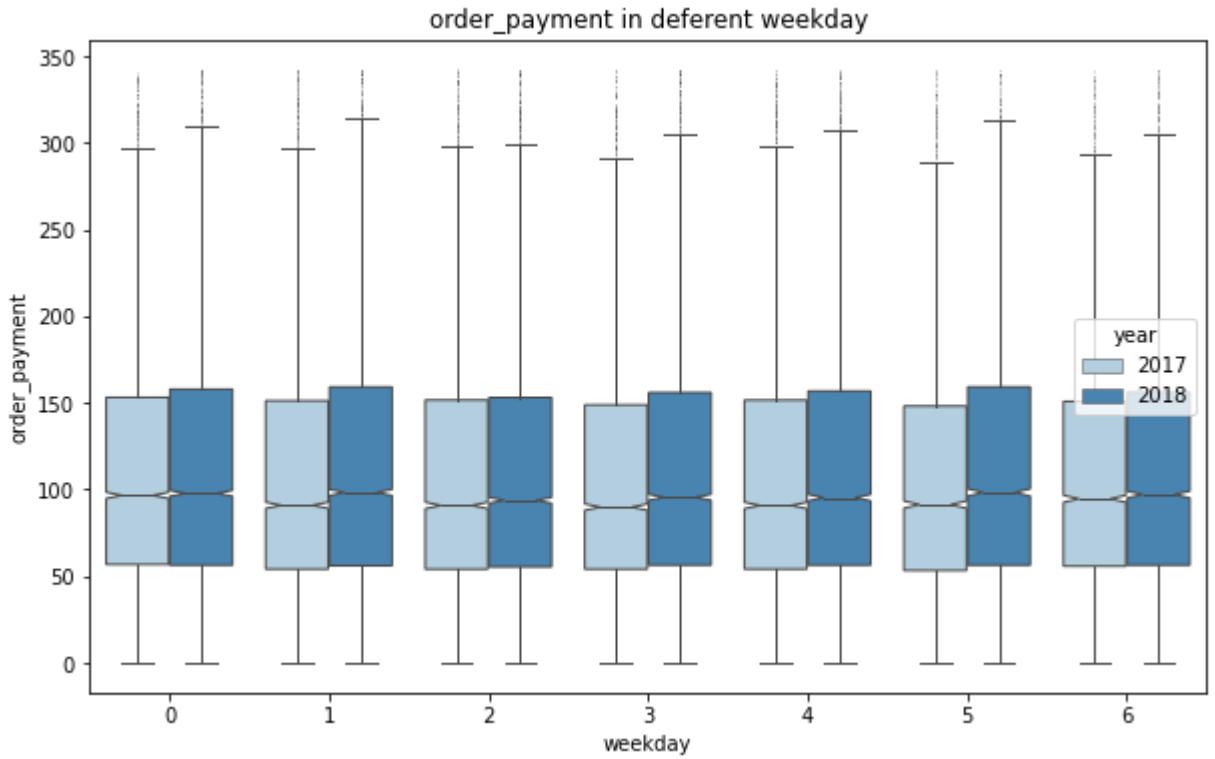
use seaborn to analyze order_payment in diferent weekday

In [137…

```
sns.boxplot(x='weekday',y='order_payment', hue='year',linewidth=1,fliersize=0.05,whis=1.5,notch=True,data=df,palette='Blu
plt.title('order_payment in deferent weekday')
plt.show
```

Out[137…

```
<function matplotlib.pyplot.show(close=None, block=None)>
```



use seaborn to analyze year-by-month total of the customer

In [138…

```
# get the different customer of each month
df_month_customerid = df.groupby(['year','month','cust_id'])['order_payment'].sum().reset_index()
df_month_customerid
```

Out[138…

	year	month	cust_id	order_payment
0	2017	1	0040b00970e2139e8c43b647c0da5305	41.93
1	2017	1	0051337a96842850e1ec728dd158f4b3	237.99
2	2017	1	007b7f04a35e02745c23ea706492ca20	77.06
3	2017	1	00f3b3a7cd0b6566435090c7fbda03a2	57.51
4	2017	1	01a0d45a369a4356ac4652584652109a	45.86
…	…	…	…	…

	year	month	cust_id	order_payment
89222	2018	8	ffb3857a7f2f2945434d57e00d0a97a7	131.38
89223	2018	8	ffb5eaca500a57b7dd52256fcfc82e12	93.63
89224	2018	8	ffe1eab23bff108bf37c973b05d4e9ba	98.65
89225	2018	8	fff212062d600f2e1d53f3c5d4a25138	65.44
89226	2018	9	4b7decb9b58e2569548b8b4c8e20e8d7	166.46

89227 rows × 4 columns

In [139…

```
df_month_customer_all = df_month_customerid.groupby(['year','month'])['cust_id'].count().reset_index().rename(columns={'c
df_month_customer_all
```

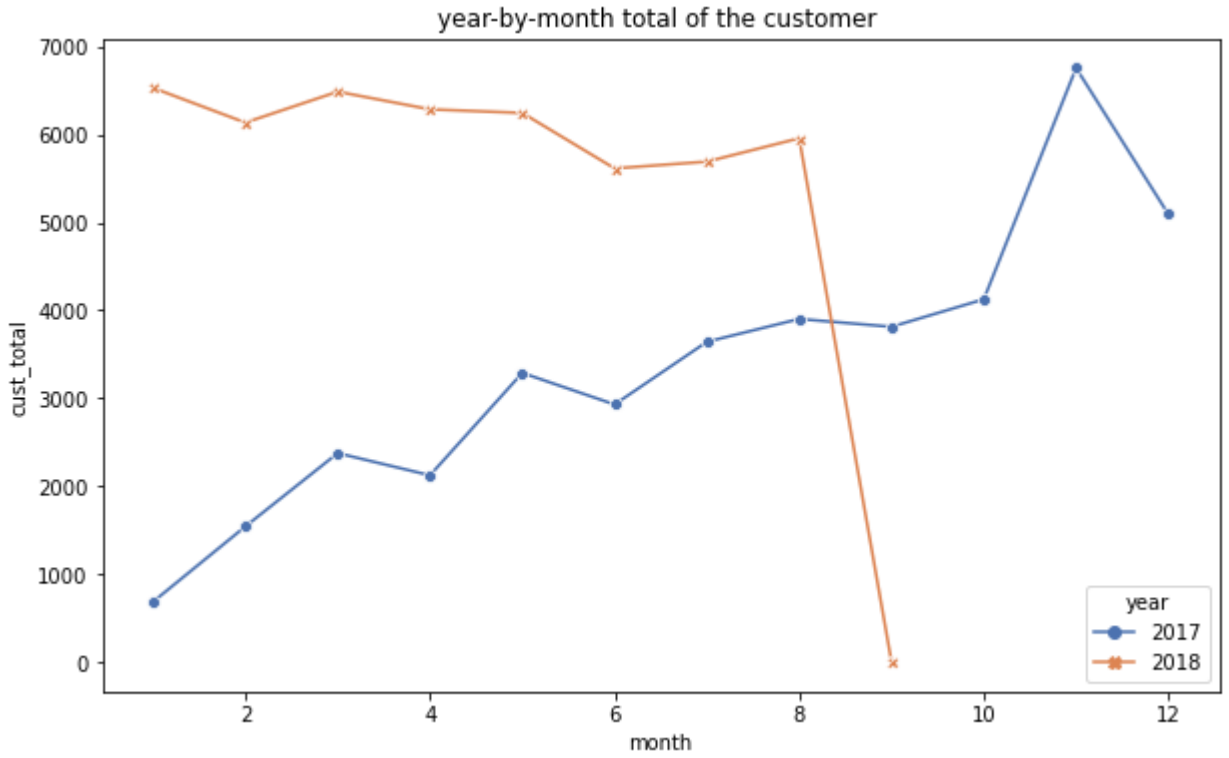
Out[139…

	year	month	cust_total
0	2017	1	684
1	2017	2	1541
2	2017	3	2375
3	2017	4	2123
4	2017	5	3288
5	2017	6	2929
6	2017	7	3642
7	2017	8	3902
8	2017	9	3813
9	2017	10	4126
10	2017	11	6757
11	2017	12	5093
12	2018	1	6531
13	2018	2	6136
14	2018	3	6488

	year	month	cust_total
15	2018	4	6287
16	2018	5	6246
17	2018	6	5615
18	2018	7	5692
19	2018	8	5958
20	2018	9	1

In [140…

```
sns.lineplot(x='month',y='cust_total',data=df_month_customer_all,hue='year',style='year',markers=True,dashes=False,palett
plt.title('year-by-month total of the customer ')
plt.show()
```



use seaborn to analyze the distribution of customer according to the order\'s number

In [141…

```
# sum the order number of different customer
df_diff_customer_order = df.groupby('cust_id')['order_id'].count().reset_index().rename(columns={'order_id':'order_total'
df_diff_customer_order
```

Out[141…

	cust_id	order_total
0	00012a2ce6f8dcda20d059ce98491703	1
1	000161a058600d5901f007fab4c27140	1
2	0001fd6190edaaf884bcaf3d49edf079	1
3	0002414f95344307404f0ace7a26f1d5	1
4	000379cdec625522490c315e70c7a9fb	1
...	...	...
89222	fffcb937e9dd47a13f05ecb8290f4d3e	1
89223	fffecc9f79fd8c764f843e9951b11341	3
89224	fffeda5b6d849fbd39689bb92087f431	1
89225	ffff42319e9b2d713724ae527742af25	1
89226	ffffa3172527f765de70084a7e53aae8	1

89227 rows × 2 columns

In [142…

```
# sum the total of customer
customer_total = len(df_diff_customer_order)
# get the total of customers with different order number
df_customer_diff_order = df_diff_customer_order.groupby('order_total')['cust_id'].count()
# get the retio of customers with different order number
ratio_cust__diff_order = (df_customer_diff_order / customer_total*100).round(2).to_frame().reset_index().rename(columns={
ratio_cust__diff_order
```

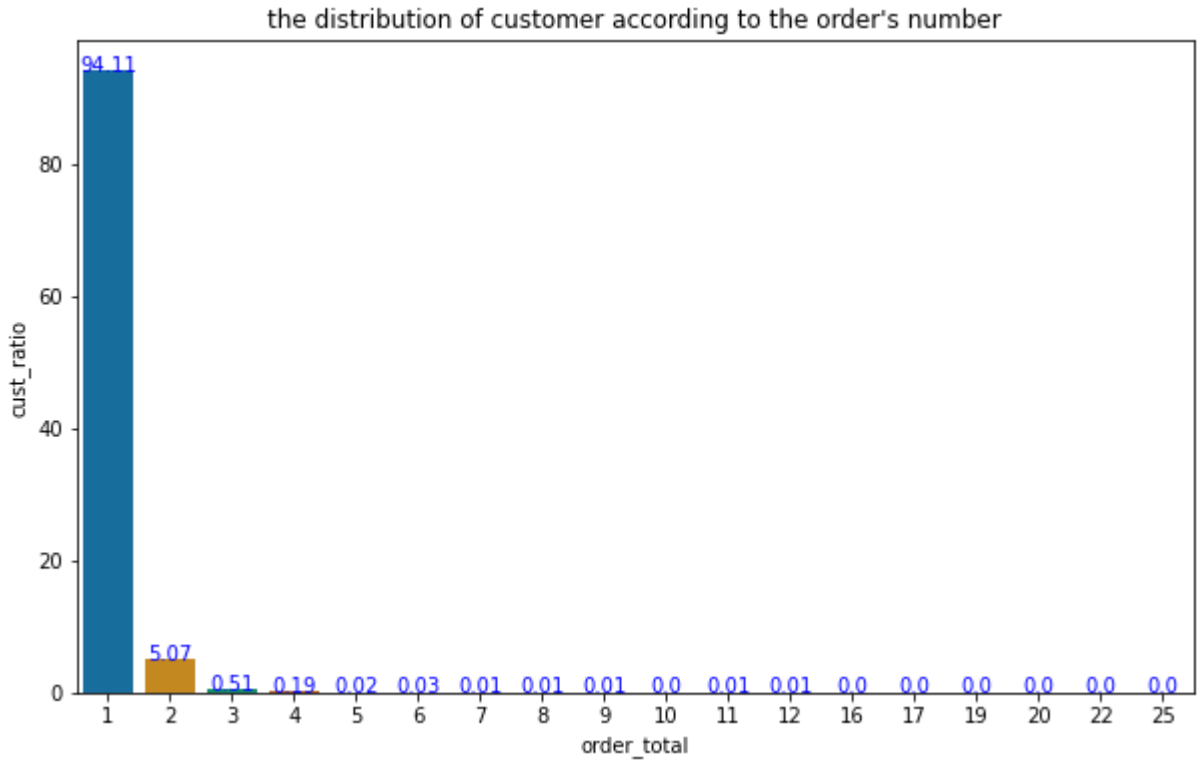
Out[142…

	order_total	cust_ratio
0	1	94.11
1	2	5.07

	order_total	cust_ratio
2	3	0.51
3	4	0.19
4	5	0.02
5	6	0.03
6	7	0.01
7	8	0.01
8	9	0.01
9	10	0.00
10	11	0.01
11	12	0.01
12	16	0.00
13	17	0.00
14	19	0.00
15	20	0.00
16	22	0.00
17	25	0.00

In [143…

```
# draw the bar chart
g = sns.barplot(x='order_total',y='cust_ratio',data=ratio_cust__diff_order,palette='colorblind')
# add the tags for every bar
for index,row in ratio_cust__diff_order.iterrows():
    g.text(row.name,row['cust_ratio'],round(row['cust_ratio'],2),color='blue',ha='center')

plt.xlabel('order_total')
plt.ylabel('cust_ratio')
plt.title('the distribution of customer according to the order\'s number')
plt.show()
```



3. RFM analyze

In [65]:
```
import pandas as pd
import matplotlib.pyplot as plt
from datetime import datetime
import seaborn as sns
import warnings
warnings.filterwarnings('ignore')
```

In [66]:
```
df = pd.read_csv('E:/风变/数据分析实训营/analyze_data_1.csv',encoding = 'utf-8')
```

In [67]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 95900 entries, 0 to 95899
```

```
Data columns (total 10 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   order_id       95900 non-null  object
 1   cust_id        95900 non-null  object
 2   order_time     95900 non-null  object
 3   order_payment  95900 non-null  float64
 4   pro_id         95900 non-null  object
 5   pro_describe   95900 non-null  object
 6   year           95900 non-null  int64
 7   month          95900 non-null  int64
 8   day            95900 non-null  int64
 9   weekday        95900 non-null  int64
dtypes: float64(1), int64(4), object(5)
memory usage: 7.3+ MB
```

In [68]:

```
df['order_time'] = df['order_time'].astype('datetime64')
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 95900 entries, 0 to 95899
Data columns (total 10 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   order_id       95900 non-null  object
 1   cust_id        95900 non-null  object
 2   order_time     95900 non-null  datetime64[ns]
 3   order_payment  95900 non-null  float64
 4   pro_id         95900 non-null  object
 5   pro_describe   95900 non-null  object
 6   year           95900 non-null  int64
 7   month          95900 non-null  int64
 8   day            95900 non-null  int64
 9   weekday        95900 non-null  int64
dtypes: datetime64[ns](1), float64(1), int64(4), object(4)
memory usage: 7.3+ MB
```

get value of Recency, Frequency, and Monetary

In [69]:

```
max(df['order_time'] )
```

Out[69]:

```
Timestamp('2018-09-03 09:06:00')
```

In [70]:
```
today = '2019-01-01 00:00:00'
df['interval'] = (pd.to_datetime(today)-pd.to_datetime(df['order_time'])).dt.days
df.head()
```

Out[70]:

	order_id	cust_id	order_time	order_payment	pro_id	pro_c
0	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	18.12	87285b34884572647811a353c7ac498a	hou
1	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	2.00	87285b34884572647811a353c7ac498a	hou
2	e481f51cbdc54678b7cc49136f2d6af7	9ef432eb6251297304e76186b10a928d	2017-10-02 10:56:00	18.59	87285b34884572647811a353c7ac498a	hou
3	128e10d95713541c87cd1a2e48201934	a20e8105f23924cd00833fd87daa0831	2017-08-15 18:29:00	37.77	87285b34884572647811a353c7ac498a	hou
4	0e7e841ddf8f8f2de2bad69267ecfbcf	26c7ac168e1433912a51b924fbd34d34	2017-08-02 18:24:00	37.77	87285b34884572647811a353c7ac498a	hou

In [71]:
```
# get values of R, F, and M
rfm_data = df.groupby('cust_id').agg({'interval':'min','order_payment':'sum','order_id':'count'}).reset_index()

rfm_data = rfm_data.rename(columns={'interval':'min_interval','order_payment':'total_pay','order_id':'times'})

rfm_data
```

Out[71]:

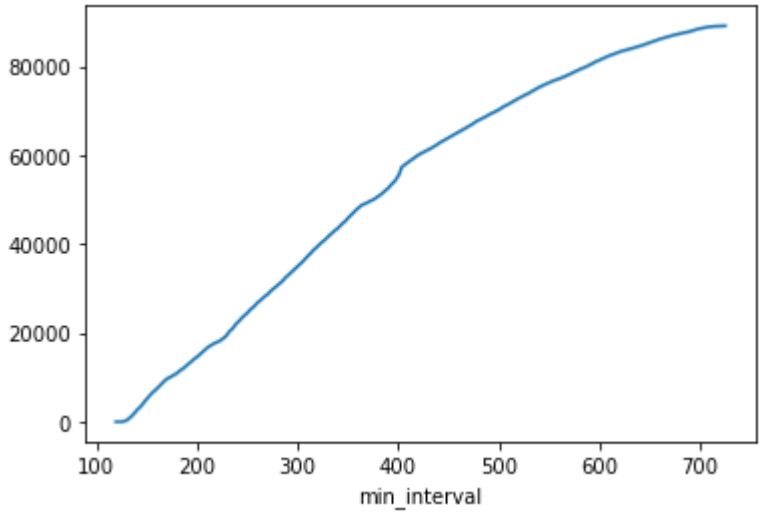
	cust_id	min_interval	total_pay	times
0	00012a2ce6f8dcda20d059ce98491703	412	114.74	1
1	000161a058600d5901f007fab4c27140	533	67.41	1
2	0001fd6190edaaf884bcaf3d49edf079	671	195.42	1
3	0002414f95344307404f0ace7a26f1d5	502	179.35	1
4	000379cdec625522490c315e70c7a9fb	273	107.01	1
...	...	...	...	...
89222	fffcb937e9dd47a13f05ecb8290f4d3e	289	91.91	1

	cust_id	min_interval	total_pay	times
89223	fffecc9f79fd8c764f843e9951b11341	277	81.36	3
89224	fffeda5b6d849fbd39689bb92087f431	223	63.13	1
89225	ffff42319e9b2d713724ae527742af25	201	214.13	1
89226	ffffa3172527f765de70084a7e53aae8	485	45.50	1

89227 rows × 4 columns

get threshold of Recency, Frequency, and Monetary

In [72]:
```
x_r = rfm_data['min_interval'].sort_values()
y_r = rfm_data.index
sns.lineplot(x=x_r,y=y_r,data=rfm_data)
plt.show()
```

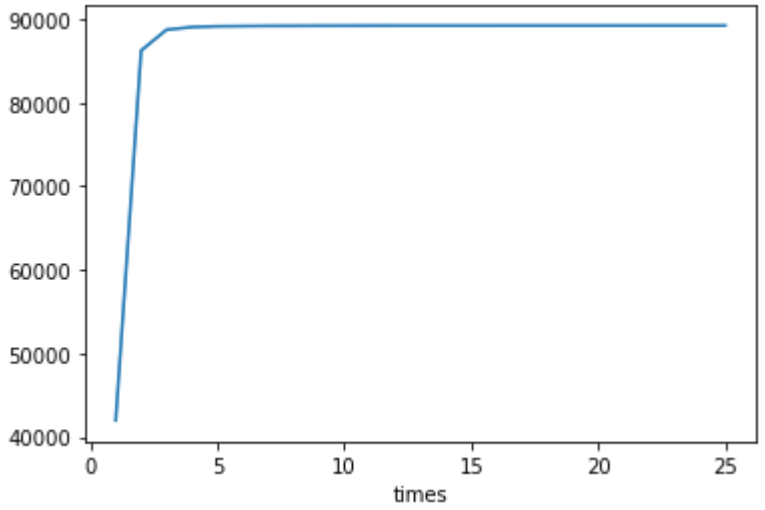


In [73]:
```
def calculate_r(s):
    if s <= 250:
        return 5
    elif s <=370:
        return 4
    elif s <=490:
```

```
        return 3
    elif s <=610:
        return 2
    else:
        return 1

rfm_data['R'] = rfm_data['min_interval'].agg(calculate_r)
```

In [74]:

```
x_f = rfm_data['times'].sort_values()
y_f = rfm_data.index
sns.lineplot(x=x_f,y=y_f,data=rfm_data)
plt.show()
```



In [75]:

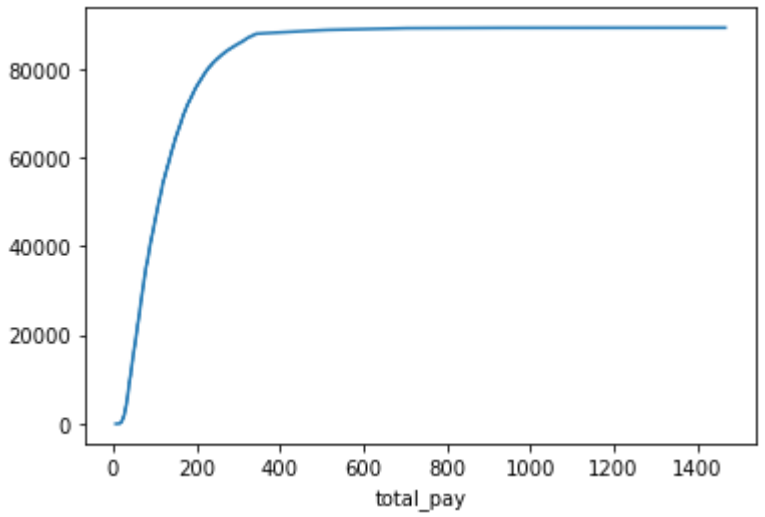
```
def calculate_f(s):
    if s == 0:
        return 1
    elif s == 1:
        return 2
    elif s == 2 :
        return 3
    elif s == 3:
        return 4
    else:
        return 5

rfm_data['F'] = rfm_data['times'].agg(calculate_f)
rfm_data.head()
```

Out[75]:

	cust_id	min_interval	total_pay	times	R	F
0	00012a2ce6f8dcda20d059ce98491703	412	114.74	1	3	2
1	000161a058600d5901f007fab4c27140	533	67.41	1	2	2
2	0001fd6190edaaf884bcaf3d49edf079	671	195.42	1	1	2
3	0002414f95344307404f0ace7a26f1d5	502	179.35	1	2	2
4	000379cdec625522490c315e70c7a9fb	273	107.01	1	4	2

In [76]:

```
x_m = rfm_data['total_pay'].sort_values()
y_m = rfm_data.index
sns.lineplot(x=x_m,y=y_m,data=rfm_data)
plt.show()
```



In [77]:

```
def calculate_m(s):
    if s >= 300:
        return 5
    elif s >= 225:
        return 4
    elif s >= 150 :
        return 3
    elif s >= 75:
```

```
        return 2
    else:
        return 1

rfm_data['M'] = rfm_data['total_pay'].agg(calculate_m)
rfm_data
```

Out[77]:

	cust_id	min_interval	total_pay	times	R	F	M
0	00012a2ce6f8dcda20d059ce98491703	412	114.74	1	3	2	2
1	000161a058600d5901f007fab4c27140	533	67.41	1	2	2	1
2	0001fd6190edaaf884bcaf3d49edf079	671	195.42	1	1	2	3
3	0002414f95344307404f0ace7a26f1d5	502	179.35	1	2	2	3
4	000379cdec625522490c315e70c7a9fb	273	107.01	1	4	2	2
...	...	...	...	...	...	...	...
89222	fffcb937e9dd47a13f05ecb8290f4d3e	289	91.91	1	4	2	2
89223	fffecc9f79fd8c764f843e9951b11341	277	81.36	3	4	4	2
89224	fffeda5b6d849fbd39689bb92087f431	223	63.13	1	5	2	1
89225	ffff42319e9b2d713724ae527742af25	201	214.13	1	5	2	3
89226	ffffa3172527f765de70084a7e53aae8	485	45.50	1	3	2	1

89227 rows × 7 columns

In [78]:

```
r_avg = round(rfm_data['R'].mean(),2)
f_avg = round(rfm_data['F'].mean(),2)
m_avg = round(rfm_data['M'].mean(),2)
print('the average of R is {},the average of R is {},the average of R is {}.'.format(r_avg,f_avg,m_avg))
```

```
the average of R is 3.54,the average of R is 2.07,the average of R is 2.06.
```

Get customer's evaluation value of R, F, and M

In [79]:

```
rfm_data['R'] = (rfm_data['R'] > r_avg) * 1
rfm_data['F'] = (rfm_data['F'] > f_avg) * 1
rfm_data['M'] = (rfm_data['M'] > m_avg) * 1
```

```
rfm_data.head()
```

Out[79]:

	cust_id	min_interval	total_pay	times	R	F	M
0	00012a2ce6f8dcda20d059ce98491703	412	114.74	1	0	0	0
1	000161a058600d5901f007fab4c27140	533	67.41	1	0	0	0
2	0001fd6190edaaf884bcaf3d49edf079	671	195.42	1	0	0	1
3	0002414f95344307404f0ace7a26f1d5	502	179.35	1	0	0	1
4	000379cdec625522490c315e70c7a9fb	273	107.01	1	1	0	0

In [80]:

```
rfm_data_score = rfm_data['R'].astype(str) + rfm_data['F'].astype(str) + rfm_data['M'].astype(str)

trans_label = {
                '111':'Important value customers','101':'Important development customers',
                '011':'Important to keep customers','001':'Important to retain customers',
                '110':'General value customers','100':'General development customers',
                '010':'General to keep customers','000':'General to retain customers',
              }

rfm_data['Customer Style'] = rfm_data_score.replace(trans_label)

rfm_data
```

Out[80]:

	cust_id	min_interval	total_pay	times	R	F	M	Customer Style
0	00012a2ce6f8dcda20d059ce98491703	412	114.74	1	0	0	0	General to retain customers
1	000161a058600d5901f007fab4c27140	533	67.41	1	0	0	0	General to retain customers
2	0001fd6190edaaf884bcaf3d49edf079	671	195.42	1	0	0	1	Important to retain customers
3	0002414f95344307404f0ace7a26f1d5	502	179.35	1	0	0	1	Important to retain customers
4	000379cdec625522490c315e70c7a9fb	273	107.01	1	1	0	0	General development customers
...	...	...	...	...	...	...	...	...
89222	fffcb937e9dd47a13f05ecb8290f4d3e	289	91.91	1	1	0	0	General development customers
89223	fffecc9f79fd8c764f843e9951b11341	277	81.36	3	1	1	0	General value customers

	cust_id	min_interval	total_pay	times	R	F	M	Customer Style
89224	fffeda5b6d849fbd39689bb92087f431	223	63.13	1	1	0	0	General development customers
89225	ffff42319e9b2d713724ae527742af25	201	214.13	1	1	0	1	Important development customers
89226	ffffa3172527f765de70084a7e53aae8	485	45.50	1	0	0	0	General to retain customers

89227 rows × 8 columns

Conclusion

In [82]:

```
rfm_result = rfm_data.groupby('Customer Style')['cust_id'].count().reset_index().rename(columns={'cust_id':'cust_num'})

rfm_result['ratio'] = (rfm_result['cust_num']/len(rfm_data)*100).round(2)

rfm_result
```

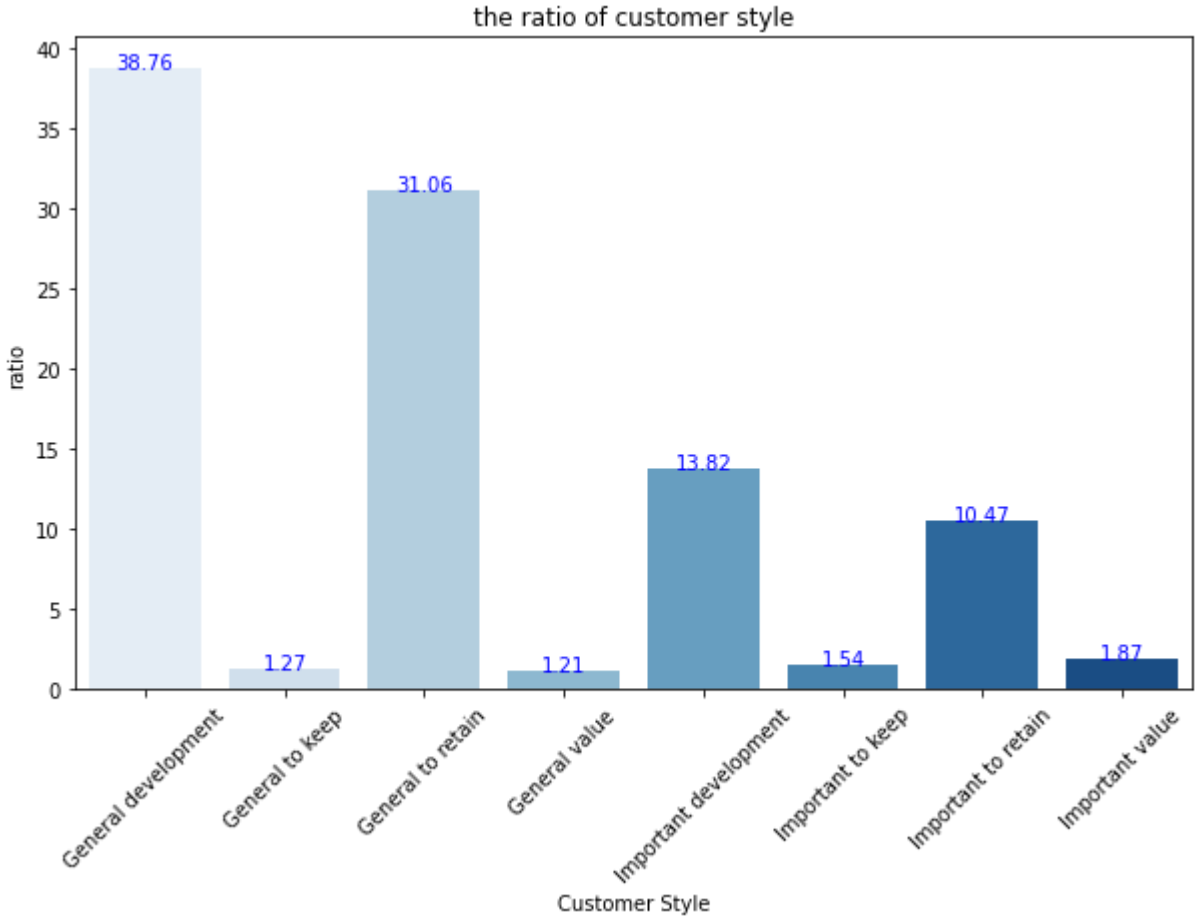
Out[82]:

	Customer Style	cust_num	ratio
0	General development customers	34580	38.76
1	General to keep customers	1137	1.27
2	General to retain customers	27717	31.06
3	General value customers	1077	1.21
4	Important development customers	12330	13.82
5	Important to keep customers	1370	1.54
6	Important to retain customers	9346	10.47
7	Important value customers	1670	1.87

In [160…

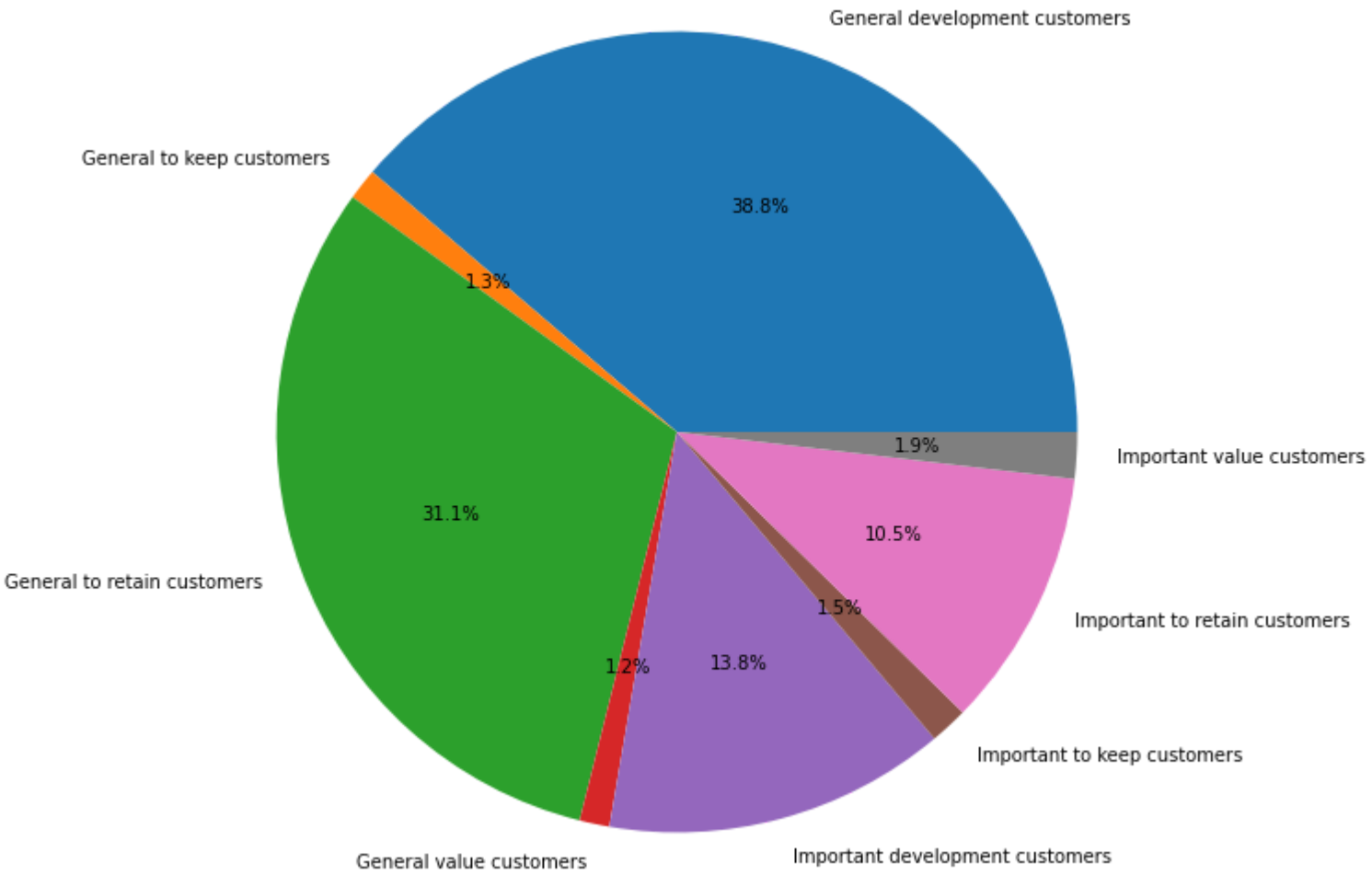
```
# draw the bar chart
g = sns.barplot(x='Customer Style',y='ratio',data=rfm_result,palette='Blues')

g.set_xticklabels(labels=['General development','General to keep','General to retain','General value','Important developm
# add the tags for every bar
for index,row in rfm_result.iterrows():
    g.text(row.name,row['ratio'],round(row['ratio'],2),color='blue',ha='center')
```

```
plt.xlabel('Customer Style')
plt.ylabel('ratio')

plt.title('the ratio of customer style')
plt.show()
```



In [161…

```
plt.figure(figsize=(15,10))

#rfm_result_pie = rfm_result.groupby('Customer Style')

plt.pie(rfm_result['cust_num'],labels=rfm_result['Customer Style'],autopct='%0.1f%%')
plt.show()
```


General development customers
General to keep customers
38.8%
1.3%
1.9%
Important value customers
31.1%
10.5%
General to retain customers
1.5%
Important to retain customers
1.2%
13.8%
Important to keep customers
General value customers
Important development customers