bank_analysis

July 8, 2025

```
   TransactionID  CustomerID TransactionDate TransactionType        Amount  \
0              1        8270      2025-01-29    Card Payment   6980.185223
1              2        1860      2023-02-10         Deposit  10786.371854
2              3        6390      2024-03-07        Transfer   3982.761111
3              4        6191      2023-07-04      Withdrawal  12408.644136
4              5        6734      2025-02-05             Fee   1868.260998

    ProductCategory ProductSubcategory BranchCity  BranchLat  BranchLong  \
0  Checking Account               Gold    Seville    37.3891     -5.9845
1          Mortgage               Gold     Murcia    37.9847     -1.1287
2              Loan           Platinum     Malaga    36.7213     -4.4214
3          Mortgage           Standard    Seville    37.3891     -5.9845
4  Checking Account           Platinum     Murcia    37.9847     -1.1287

  Channel Currency  CreditCardFees  InsuranceFees  LatePaymentAmount  \
0  Branch      EUR             0.0           0.00                0.0
1  Branch      EUR             0.0           0.00                0.0
2     ATM      EUR             0.0          92.46                0.0
3     ATM      EUR             0.0           0.00                0.0
4  Mobile      USD             0.0           0.00                0.0

   CustomerScore  MonthlyIncome        CustomerSegment  \
0            839        5767.68  Middle Income Segment
1            683        2441.00     Low Income Segment
2            500        9957.08    High Income Segment
3            392        1545.80     Low Income Segment
4            368        5825.27  Middle Income Segment

                  RecommendedOffer
0          Mid-tier Savings Booster
1  Financial Literacy Program Access
2       Premium Investment Services
3  Financial Literacy Program Access
4          Mid-tier Savings Booster

          Column Name                                    Description
0       TransactionID            Unique identifier for each transaction
```

1	CustomerID	Unique identifier for each customer
2	TransactionDate	Date when the transaction occurred
3	TransactionType	Type of transaction (e.g., Deposit, Withdrawal…
4	Amount	Monetary value of the transaction
5	ProductCategory	Category of the financial product involved in …
6	ProductSubcategory	Subcategory within the product category
7	BranchCity	City where the transaction occurred or branch …
8	BranchLat	Latitude of the branch location
9	BranchLong	Longitude of the branch location
10	Channel	Channel used for the transaction (e.g., Branch…
11	Currency	Currency in which the transaction was made
12	CreditCardFees	Fees incurred from credit card usage
13	InsuranceFees	Insurance-related fees associated with the tra…
14	LatePaymentAmount	Amount charged due to late payment
15	CustomerScore	Customer's credit score or internal rating
16	MonthlyIncome	Customer's reported monthly income
17	CustomerSegment	Customer's assigned income segment
18	RecommendedOffer	Product or offer recommended to the customer

0.1 Exploratory Data Analysis

Checking data properties

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20000 entries, 0 to 19999
Data columns (total 19 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   TransactionID       20000 non-null  int64
 1   CustomerID          20000 non-null  int64
 2   TransactionDate     20000 non-null  datetime64[ns]
 3   TransactionType     20000 non-null  object
 4   Amount              20000 non-null  float64
 5   ProductCategory     20000 non-null  object
 6   ProductSubcategory  20000 non-null  object
 7   BranchCity          20000 non-null  object
 8   BranchLat           20000 non-null  float64
 9   BranchLong          20000 non-null  float64
 10  Channel             20000 non-null  object
 11  Currency            20000 non-null  object
 12  CreditCardFees      20000 non-null  float64
 13  InsuranceFees       20000 non-null  float64
 14  LatePaymentAmount   20000 non-null  float64
 15  CustomerScore       20000 non-null  int64
 16  MonthlyIncome       20000 non-null  float64
 17  CustomerSegment     20000 non-null  object
 18  RecommendedOffer    20000 non-null  object
dtypes: datetime64[ns](1), float64(7), int64(3), object(8)
```

```
memory usage: 2.9+ MB
```

```
Credit Card         4082
Savings Account     4042
Loan                3998
Mortgage            3990
Checking Account    3888
Name: ProductCategory, dtype: int64
```

```
3415    11
4083     9
5780     9
9125     8
3064     8
        ..
9888     1
7746     1
3406     1
1342     1
3813     1
Name: CustomerID, Length: 8025, dtype: int64
```

Checking statistical distribution

```
       TransactionID    CustomerID        Amount     BranchLat    BranchLong  \
count   20000.000000  20000.000000  20000.000000  20000.000000  20000.000000
mean    10000.500000   5485.626000   5050.355118     39.769383     -2.150508
std      5773.647028   2600.877312   3526.028326      2.150999      2.444790
min         1.000000   1000.000000      8.275197     36.721300     -5.984500
25%      5000.750000   3218.750000   2209.771959     37.389100     -4.421400
50%     10000.500000   5503.000000   4382.682068     39.469900     -1.128700
75%     15000.250000   7728.000000   7350.925301     41.387400     -0.889100
max     20000.000000   9998.000000  14895.170734     43.263000      2.168600

       CreditCardFees  InsuranceFees  LatePaymentAmount  CustomerScore  \
count    20000.000000   20000.000000       20000.000000   20000.000000
mean         5.219896       9.983711          16.654402     575.297450
std         12.221252      23.716191          44.109067     159.418177
min          0.000000       0.000000           0.000000     300.000000
25%          0.000000       0.000000           0.000000     437.000000
50%          0.000000       0.000000           0.000000     577.000000
75%          0.000000       0.000000           0.000000     715.000000
max         49.990000      99.950000         199.980000     849.000000

       MonthlyIncome
count   20000.000000
mean     5484.947090
std      2601.897479
```

```
min      1000.860000
25%      3224.785000
50%      5473.545000
75%      7736.802500
max      9998.880000
```

from the description above, it tells that - over 50% of transaction amount are lower than 5000 with the maximum amount being 14,000 - most customers have a high credit score, with more 75% having above 400 credit score and the max being 800

Meaningfull statistical columns - Amount - MonthlyIncome

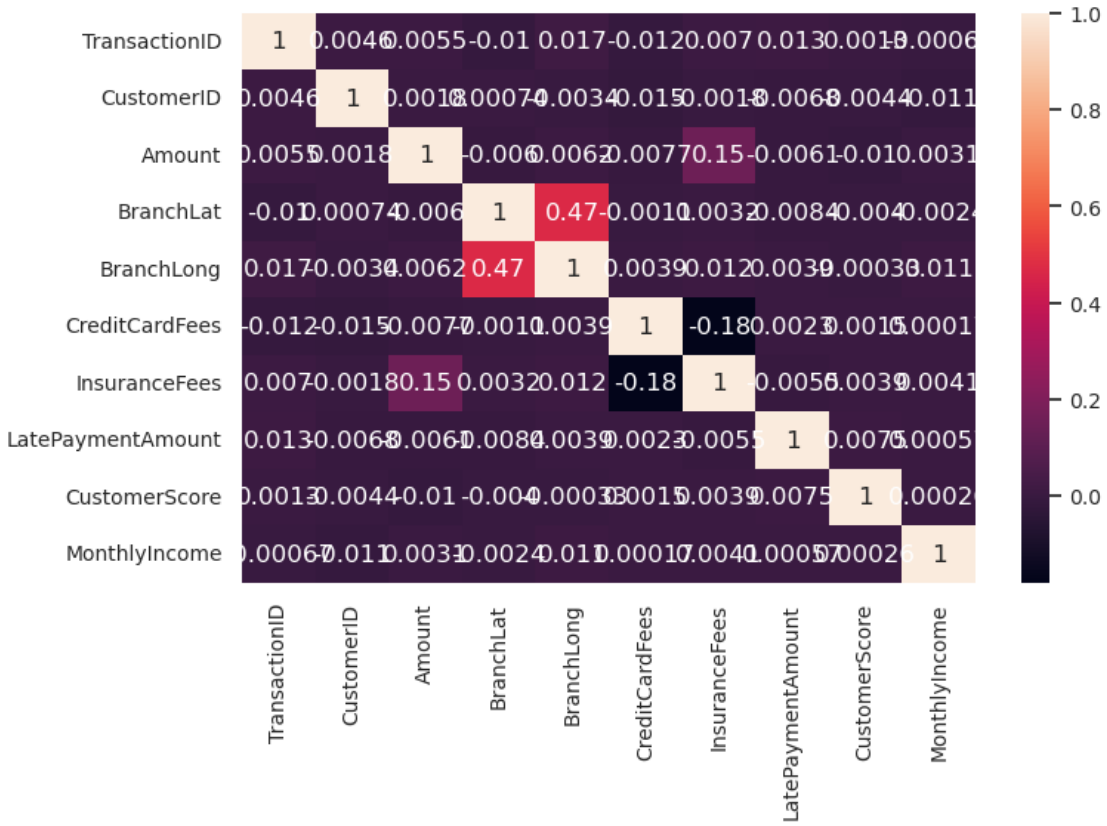
```
       TransactionType ProductCategory ProductSubcategory BranchCity Channel  \
count            20000           20000               20000      20000   20000
unique               6               5                   5          8       4
top         Withdrawal     Credit Card             Student     Murcia  Mobile
freq              3395            4082                4098       2564    5219

       Currency        CustomerSegment          RecommendedOffer
count     20000                  20000                     20000
unique        2                      3                         7
top         EUR  Middle Income Segment  Mid-tier Savings Booster
freq      16974                   8885                      5220

TransactionID         20000
CustomerID             8025
TransactionDate         871
TransactionType           6
Amount                19967
ProductCategory           5
ProductSubcategory        5
BranchCity                8
BranchLat                 8
BranchLong                8
Channel                   4
Currency                  2
CreditCardFees         2801
InsuranceFees          3278
LatePaymentAmount      3120
CustomerScore           550
MonthlyIncome         19792
CustomerSegment           3
RecommendedOffer          7
dtype: int64
```

0.2 Checking correlation between numerical values

	TransactionID	CustomerID	Amount	BranchLat	BranchLong
TransactionID	1.000000	0.004596	0.005504	-0.010391	0.017088
CustomerID	0.004596	1.000000	0.001830	0.000739	-0.003372
Amount	0.005504	0.001830	1.000000	-0.005954	0.006214
BranchLat	-0.010391	0.000739	-0.005954	1.000000	0.466011
BranchLong	0.017088	-0.003372	0.006214	0.466011	1.000000
CreditCardFees	-0.012207	-0.014955	-0.007724	-0.001149	0.003878
InsuranceFees	0.006976	-0.001783	0.150603	0.003204	0.012082
LatePaymentAmount	0.013477	-0.006754	-0.006069	-0.008368	0.003865
CustomerScore	0.001281	-0.004424	-0.010410	-0.003952	-0.000328
MonthlyIncome	-0.000669	-0.011336	0.003100	-0.002368	0.010538

	CreditCardFees	InsuranceFees	LatePaymentAmount
TransactionID	-0.012207	0.006976	0.013477
CustomerID	-0.014955	-0.001783	-0.006754
Amount	-0.007724	0.150603	-0.006069
BranchLat	-0.001149	0.003204	-0.008368
BranchLong	0.003878	0.012082	0.003865
CreditCardFees	1.000000	-0.179810	0.002313
InsuranceFees	-0.179810	1.000000	-0.005473
LatePaymentAmount	0.002313	-0.005473	1.000000
CustomerScore	0.001541	0.003947	0.007530
MonthlyIncome	0.000165	0.004092	0.000569

	CustomerScore	MonthlyIncome
TransactionID	0.001281	-0.000669
CustomerID	-0.004424	-0.011336
Amount	-0.010410	0.003100
BranchLat	-0.003952	-0.002368
BranchLong	-0.000328	0.010538
CreditCardFees	0.001541	0.000165
InsuranceFees	0.003947	0.004092
LatePaymentAmount	0.007530	0.000569
CustomerScore	1.000000	0.000259
MonthlyIncome	0.000259	1.000000



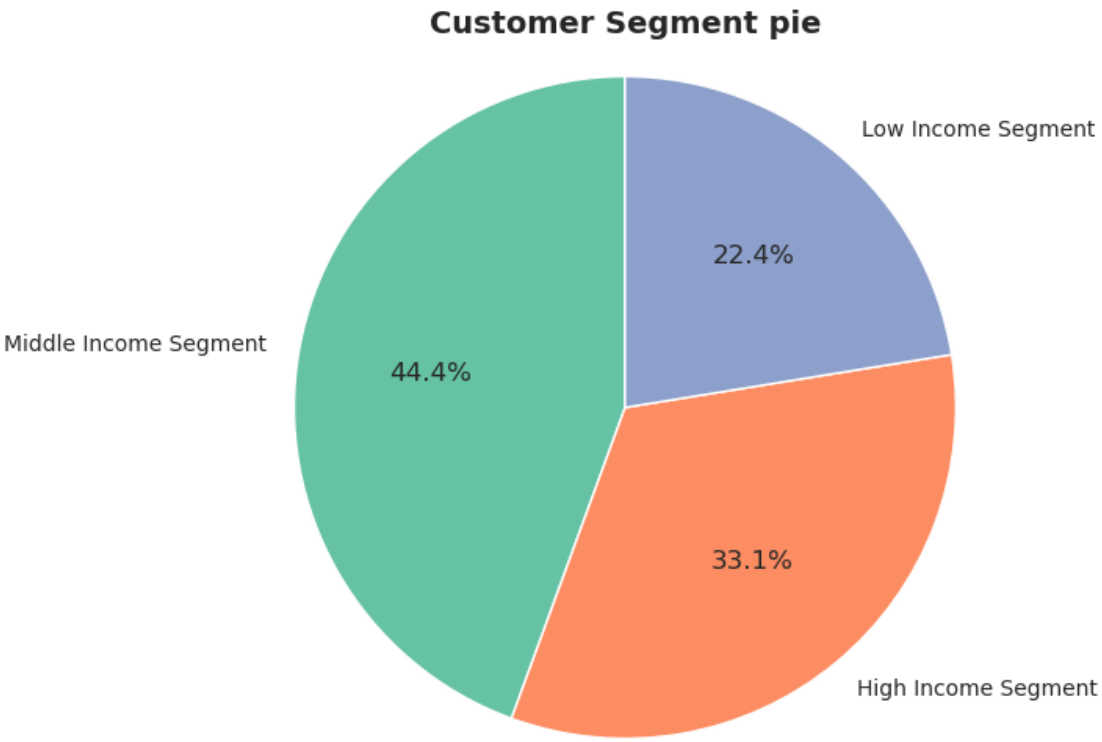
the diagram above shows no correlation nor meaningful relationship between any numerical features

0.3 Checking Data Distribution

here, I'd check the distribution of important columns which are - Amount - ProductCategory - ProductSubcategory - CustomerScore - CustomerSegment - RecommendedOffer

- Product Category and Subcategory seem to be evenly distributed
- Customer Score is also fairly evenly distributed accross low to high values
- Transaction amount show that most of amount fall below 5000
- the most recommended offer is Mid-tier Savings
- Customer Segment shows that most of the customers falls under middle income class and High income class then lower class, there's no significant difference between the three

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

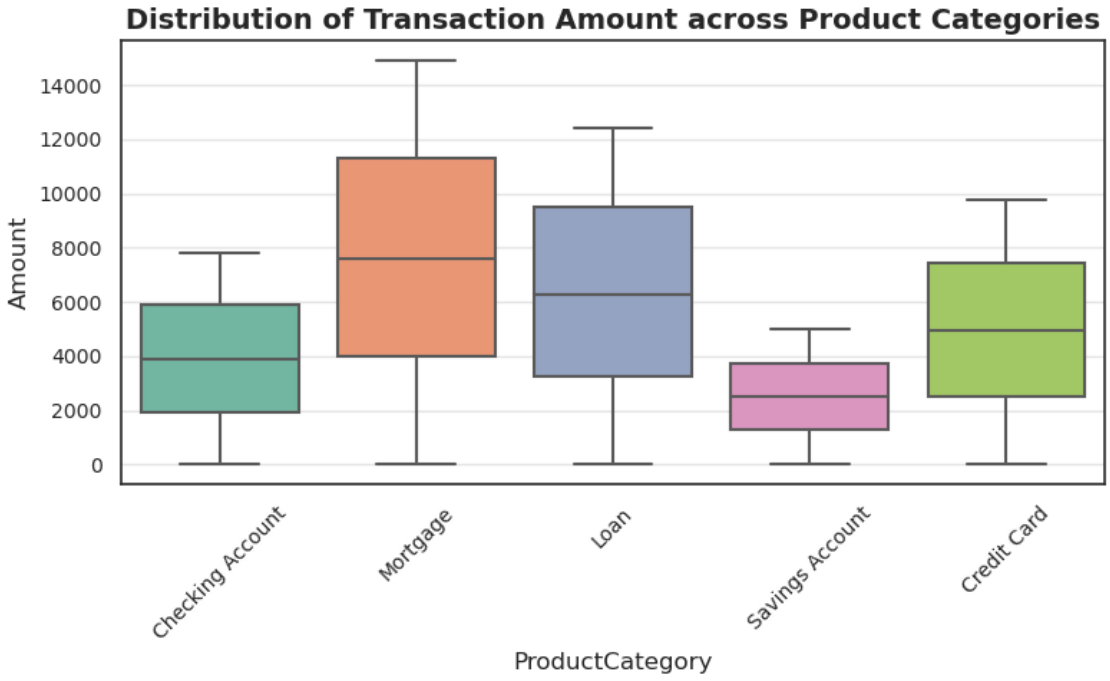


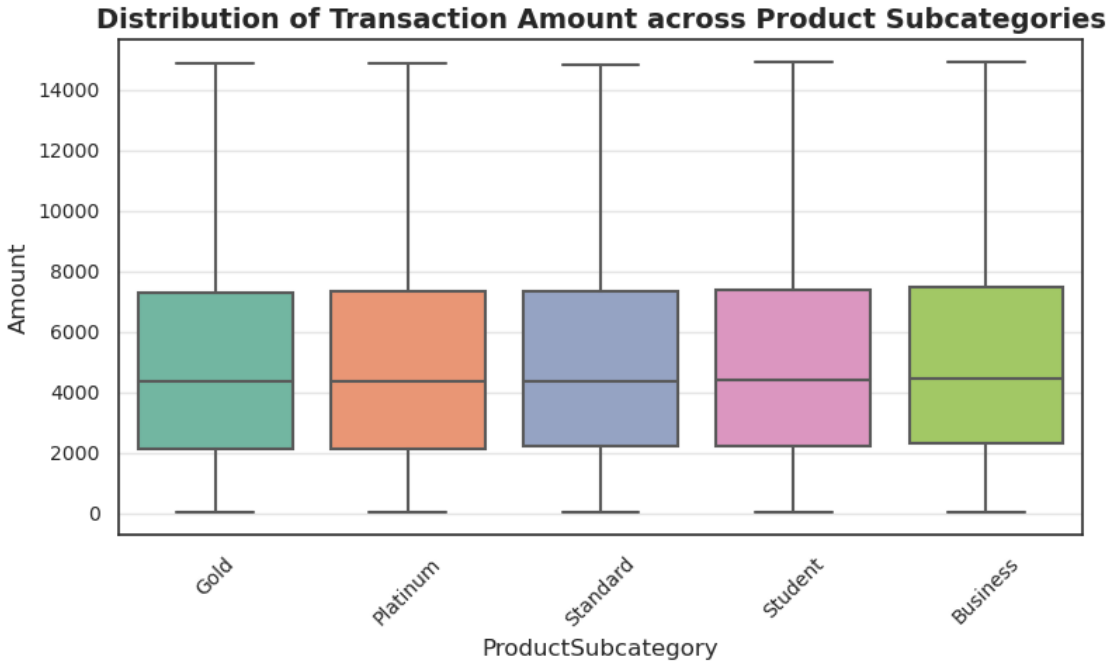
the chart above shows - 44% of customers are Middle Income earners

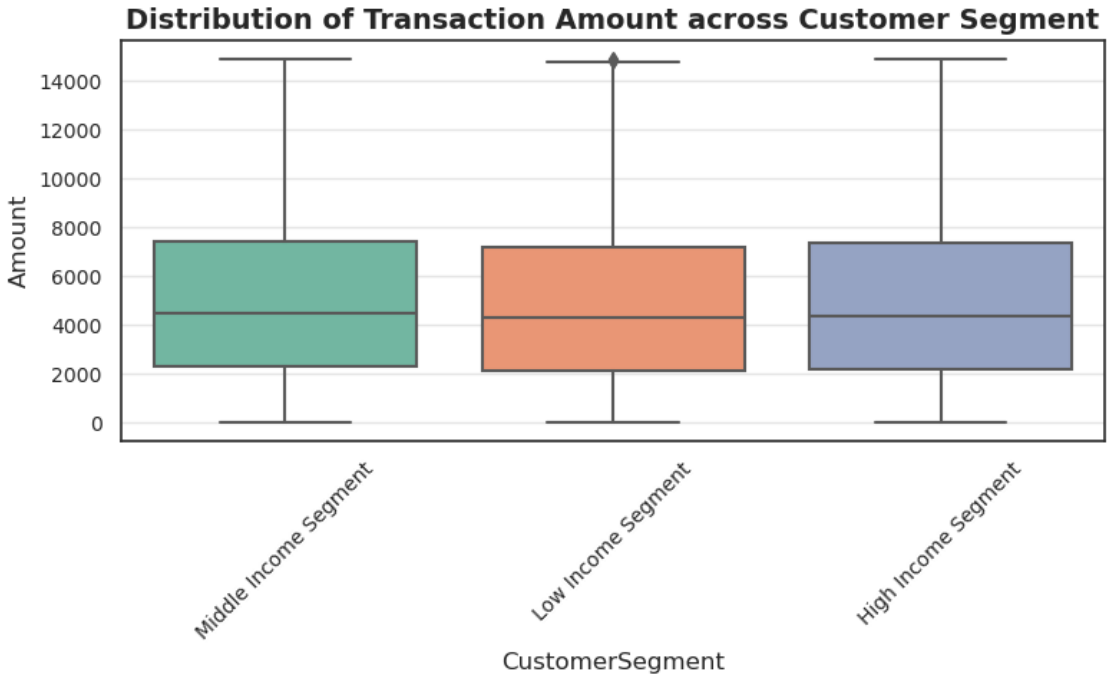
0.4 Segmentation Analysis

0.4.1 Checking the distribution of transaction across various categories

- Transaction x Product Category
- Transaction x Product Subcategory
- Transaction x Customer Segment


Distribution of Transaction Amount across Product Categories
Amount
14000
12000
10000
8000
6000
4000
2000
0
Checking Account
Mortgage
Loan
Savings Account
Credit Card
ProductCategory


Distribution of Transaction Amount across Product Subcategories
Amount
14000
12000
10000
8000
6000
4000
2000
0
Gold
Platinum
Standard
Student
Business
ProductSubcategory



	count	mean	std	min	25%	\
ProductCategory						
Checking Account	3888.0	3896.878949	2281.355637	10.301032	1901.717908	
Credit Card	4082.0	4948.902614	2822.379492	11.825579	2509.453447	
Loan	3998.0	6316.101948	3592.678761	12.999978	3234.306323	
Mortgage	3990.0	7594.518974	4257.295430	18.907984	3998.867352	
Savings Account	4042.0	2498.938702	1429.516756	8.275197	1280.654078	

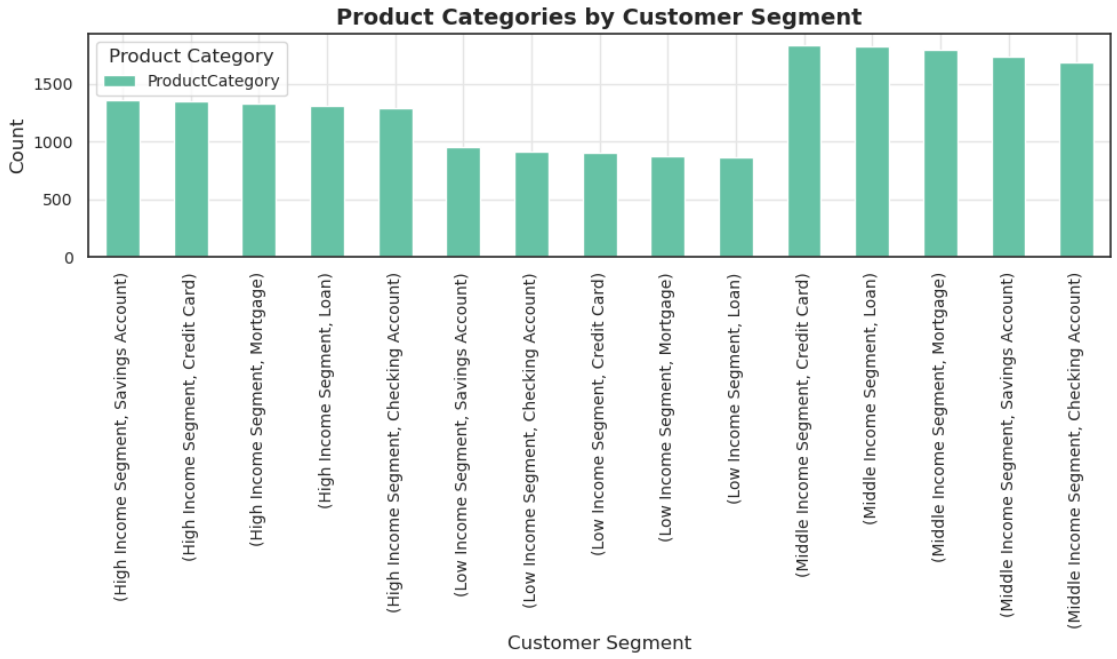
	50%	75%	max
ProductCategory			
Checking Account	3889.922377	5923.764084	7794.185101
Credit Card	4943.043212	7415.337539	9776.408822
Loan	6278.362255	9483.732142	12415.102975
Mortgage	7595.839460	11319.807218	14895.170734
Savings Account	2486.095644	3712.120453	4987.110585

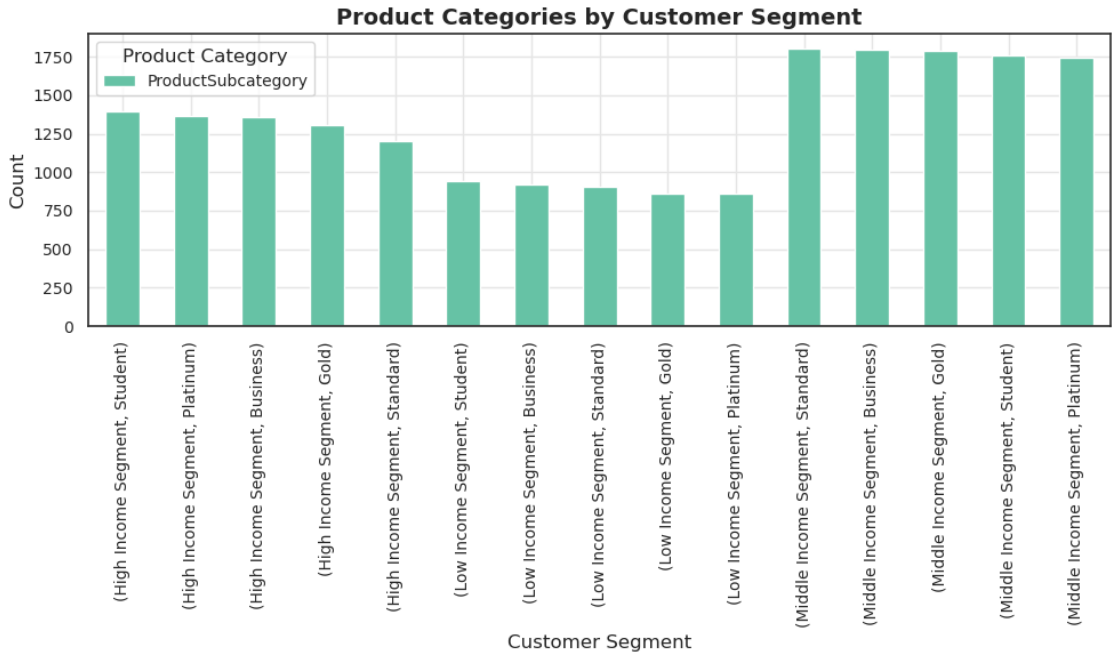
Transaction across product category shows transactions on mortgages and loans were higher than others on average, ranked below 1. Mortgages- {avg: 7.5k, max: 14k} 2. Loans- {avg: 6k, max: 12k} 3. Credit Card- {avg: 4k, max: 9k} 4. Checking account: {avg: 3.8k, max: 7.7k} 5. Savings account- {avg: 2k, max: 4.9k}

Transactions across Product subcategory and Customer Segment are eqully distributed

Their average range falling between 2k and 7k for Product Subcategory and 2k and 8k across all income earners

```
CustomerSegment         ProductCategory
High Income Segment     Savings Account     1356
                        Credit Card         1348
                        Mortgage            1324
                        Loan                1305
                        Checking Account    1293
Low Income Segment      Savings Account      949
                        Checking Account     907
                        Credit Card          897
                        Mortgage             871
                        Loan                 865
Middle Income Segment   Credit Card         1837
                        Loan                1828
                        Mortgage            1795
                        Savings Account     1737
                        Checking Account    1688
Name: ProductCategory, dtype: int64
```

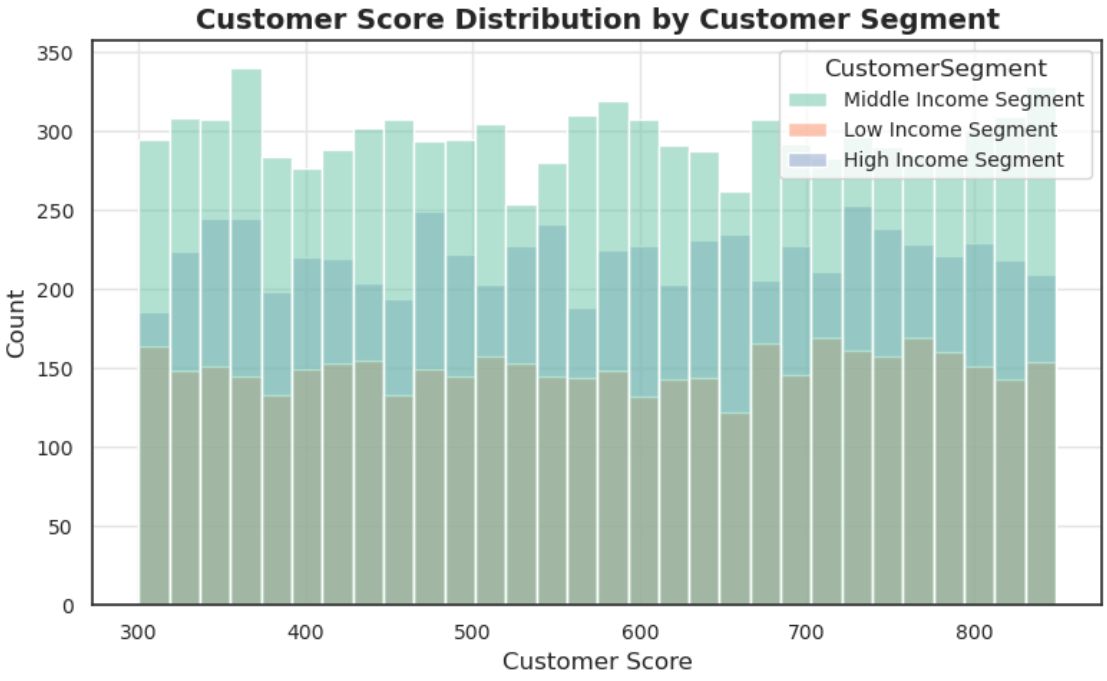




The plot tells us that Middle class earners make a majority of the customers which is also clearly seen from the Customer Segment pie chart above and also there isn't much prefernce of a particular product category or subcategory over others.

```
RecommendedOffer                  CustomerSegment
Exclusive Platinum Package        High Income Segment      2672
Financial Literacy Program Access Low Income Segment       3540
Gold Card with Travel Benefits    Middle Income Segment    1837
Mid-tier Savings Booster          Middle Income Segment    5220
No-Fee Basic Account              Low Income Segment        949
Personal Loan Cashback Offer      Middle Income Segment    1828
Premium Investment Services       High Income Segment      3954
Name: CustomerSegment, dtype: int64
```

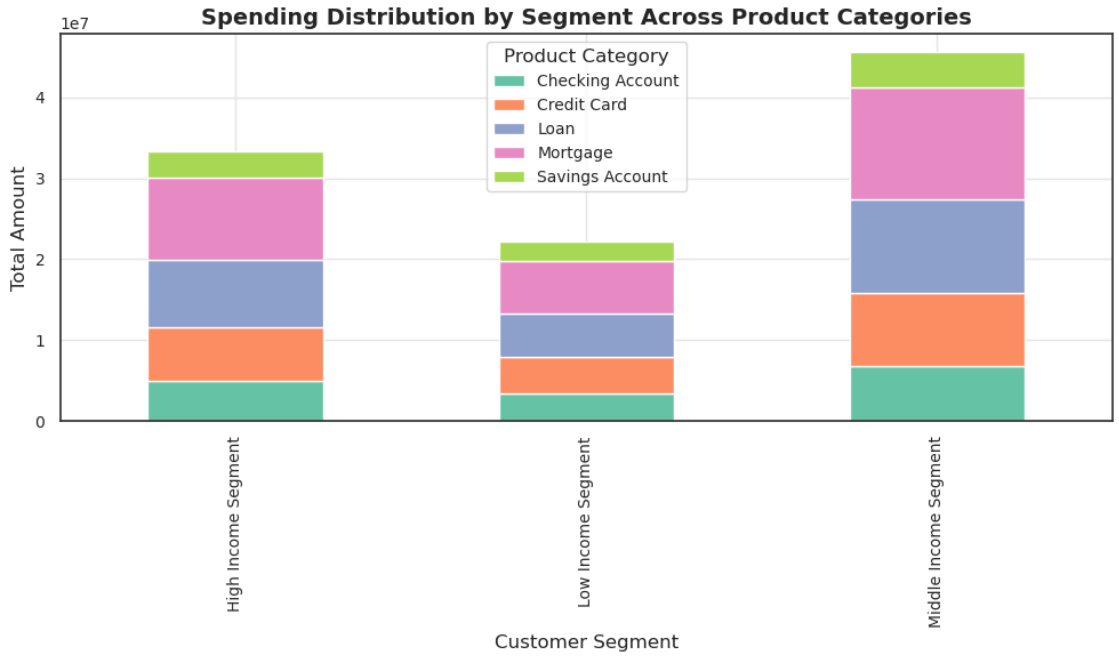
Recommended Offers are products recommended based on Income class which clearly fits the present needs for each income class



	count	mean	std	min	25%	50%	\
CustomerSegment							
High Income Segment	6626.0	576.191669	158.346954	300.0	439.0	578.0	
Low Income Segment	4489.0	576.762976	160.050671	300.0	438.0	577.0	
Middle Income Segment	8885.0	573.890152	159.899903	300.0	435.0	574.0	

	75%	max
CustomerSegment		
High Income Segment	715.0	849.0
Low Income Segment	718.0	849.0
Middle Income Segment	713.0	849.0

The average credit score across all income class is the same, so no class has a higher or lower credit score that usual



		count	mean	std
CustomerSegment	ProductCategory			
High Income Segment	Checking Account	1293.0	3852.494081	2295.064557
	Credit Card	1348.0	4898.537291	2827.972697
	Loan	1305.0	6380.821268	3575.109847
	Mortgage	1324.0	7634.931453	4262.257347
	Savings Account	1356.0	2448.547537	1415.850064
Low Income Segment	Checking Account	907.0	3779.275354	2266.314833
	Credit Card	897.0	4986.589295	2839.121659
	Loan	865.0	6244.075195	3661.799769
	Mortgage	871.0	7370.557491	4237.400380
	Savings Account	949.0	2557.510004	1461.430695
Middle Income Segment	Checking Account	1688.0	3994.068578	2276.190416
	Credit Card	1837.0	4967.458684	2811.077928
	Loan	1828.0	6303.981832	3573.321108
	Mortgage	1795.0	7673.384895	4261.897697
	Savings Account	1737.0	2506.276788	1421.945705

		min	25%	50%
CustomerSegment	ProductCategory			
High Income Segment	Checking Account	10.301032	1831.244344	3837.465872
	Credit Card	13.644899	2492.030525	4781.162867
	Loan	44.177575	3316.173901	6321.887969
	Mortgage	19.801979	3995.280199	7672.894339
	Savings Account	8.275197	1210.955870	2406.396368

```
Low Income Segment    Checking Account  14.394932  1750.364477  3768.680555
                      Credit Card       19.591923  2544.573168  4956.394672
                      Loan              14.018123  3007.452365  6401.340555
                      Mortgage          18.907984  3716.432128  7141.526338
                      Savings Account   12.549967  1351.590573  2562.183561
Middle Income Segment Checking Account  11.915198  2025.536938  3982.861705
                      Credit Card       11.825579  2504.704631  5012.803370
                      Loan              12.999978  3291.623561  6179.111708
                      Mortgage          31.543107  4174.410628  7818.905997
                      Savings Account    9.686819  1283.498521  2533.776541

                                                 75%           max
CustomerSegment       ProductCategory
High Income Segment   Checking Account   5840.490259   7786.394995
                      Credit Card        7330.788071   9769.532575
                      Loan               9550.998026  12401.966417
                      Mortgage          11404.975097  14892.056653
                      Savings Account    3669.946377   4986.841230
Low Income Segment    Checking Account   5841.441604   7771.571178
                      Credit Card        7468.670021   9776.408822
                      Loan               9459.004868  12415.102975
                      Mortgage          11096.707157  14878.169937
                      Savings Account    3808.111990   4979.678371
Middle Income Segment Checking Account   6029.441288   7794.185101
                      Credit Card        7431.168557   9776.330572
                      Loan               9464.269425  12414.693233
                      Mortgage          11340.894314  14895.170734
                      Savings Account    3715.663225   4987.110585

ProductCategory        Checking Account  Credit Card         Loan  \
CustomerSegment
High Income Segment         3852.494081  4898.537291  6380.821268
Low Income Segment          3779.275354  4986.589295  6244.075195
Middle Income Segment       3994.068578  4967.458684  6303.981832

ProductCategory           Mortgage  Savings Account
CustomerSegment
High Income Segment    7634.931453      2448.547537
Low Income Segment     7370.557491      2557.510004
Middle Income Segment  7673.384895      2506.276788
```

There is no significant difference in spending on various products across income segments