Cross selling recommendation

30.08.2022

Problem Statement

XYZ Credit union in Spain is performing very well in selling Banking products (Credit card , deposit amount, retirement account, safe deposit box), but their existing customer is not buying more than 1 product which means bank is not performing good in cross selling (Banks is not able to sell their other offering to existing customers). XYZ credit union decided to approach ABC analytics to solve their problem.

Approach

There are 2 files with different information:

- Train. This is a mapping table that contains all information about customers (years, residention, and their products).
- Test. The same information as in Train file but without the information about products.

Assumptions:

- There are a lot of missing values and outliers. Different approaches were used to working with data.
- There are 13 619 537 rows and 949 612 unique customers.

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There is a correlation between Age and Customer seniority. It is mean the older the customer, the longer the service in the bank.

# Dependencies between categorical features

	Current Accounts	Payroll Account	Payroll	Pensions	Direct Debit	Junior Account	Age group	Long term deposits	Segment
Current Accounts	1	0.59	0.44	0.47	0	0	0	0	0
Payroll Account	0.59	1	0.75	0.78	0.52	0	0	0	0
Payroll	0.44	0.75	1	0.95	0	0	0	0	0
Pensions	0.47	0.78	0.95	1	0	0	0	0	0
Direct Debit	0	0.52	0	0	1	0	0	0	0
Junior Account	0	0	0	0	0	1	0.52	0	0
Age group	0	0	0	0	0	0.52	1	0	0
Long term deposits	0	0	0	0	0	0	0	1	0.43
Segment	0	0	0	0	0	0	0	0.43	1

There are some dependencies between categorical features. For example Age Group and Junior Account, Pensions and Payroll.

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Products distribution
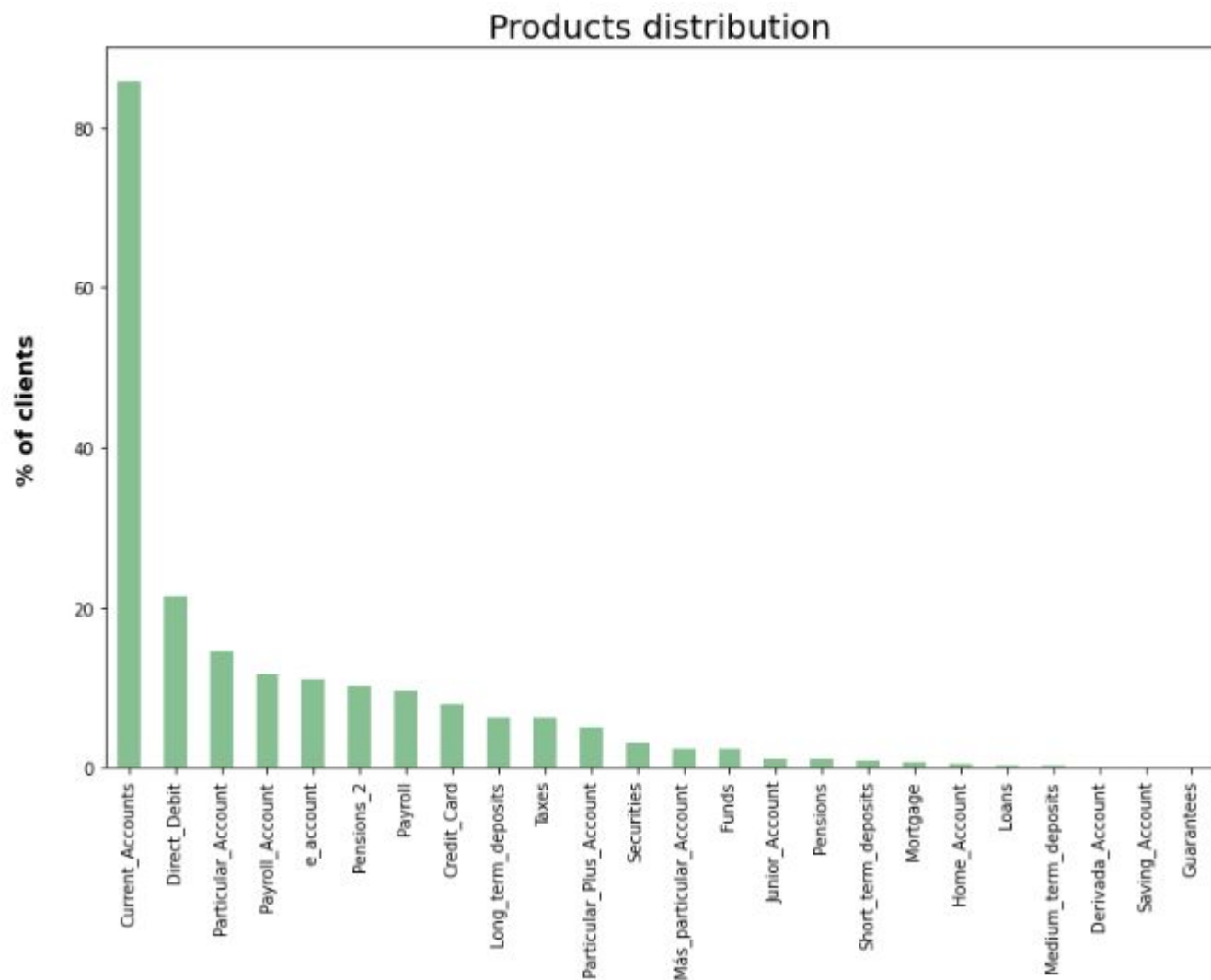
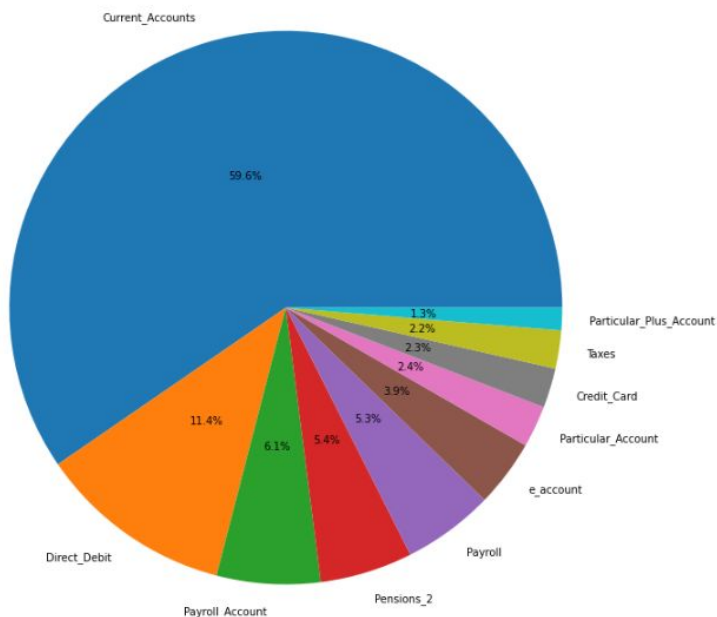General the most popular product for all clients is Current Account - more than 80% of clients have this product. Other products are not so popular.
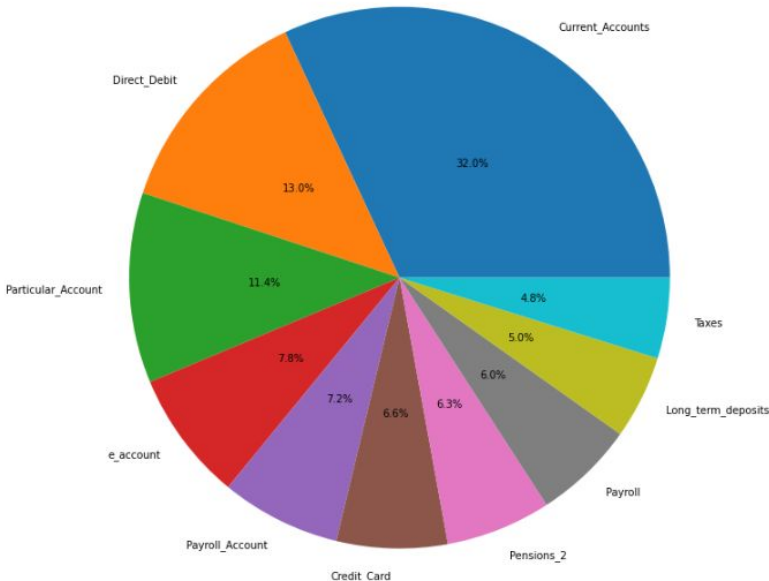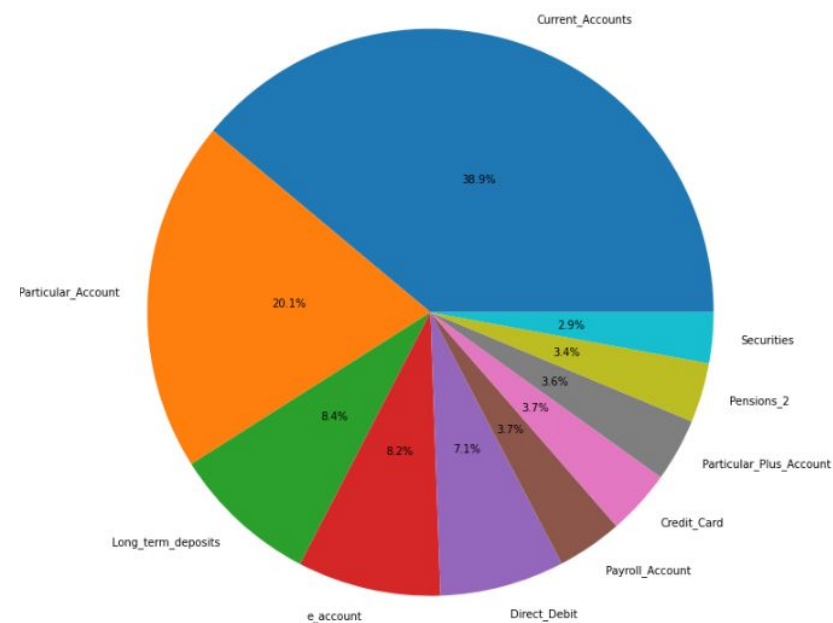
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Product distribution by the age group 21-40

Current_Accounts
59.6%

1.3%
2.2%
2.3%
2.4%
3.9%
5.3%
11.4%
6.1%
5.4%

Particular_Plus_Account
Taxes
Credit_Card
Particular_Account
e_account
Payroll
Pensions_2
Payroll_Account
Direct_Debit

Product distribution by the age group 41-65

Current_Accounts
32.0%

Direct_Debit
13.0%

Particular_Account
11.4%

7.8%
7.2%
6.6%
6.3%
6.0%
5.0%
4.8%

Taxes
Long_term_deposits
Payroll
Pensions_2
Credit_Card
Payroll_Account
e_account

Product distribution by the age group >65

Current_Accounts
38.9%

Particular_Account
20.1%

8.4%
8.2%
7.1%
3.7%
3.7%
3.6%
3.4%
2.9%

Securities
Pensions_2
Particular_Plus_Account
Credit_Card
Payroll_Account
Direct_Debit
e_account
Long_term_deposits

Product distribution by the age group <21

Current_Accounts
74.6%

15.1%
3.7%
2.2%
1.7%
1.2%

Direct_Debit
e_account
Payroll_Account
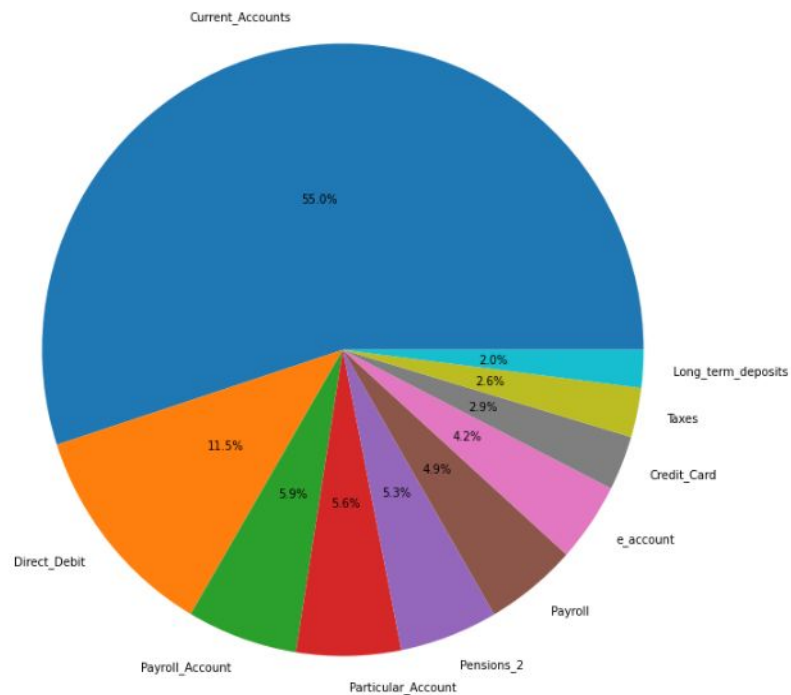Pensions_2
Payroll
Junior_Account

The most popular products in age groups a bit different. We can see that clients in the '<21' age group have Current Account, Junior account and Direct Debit products.
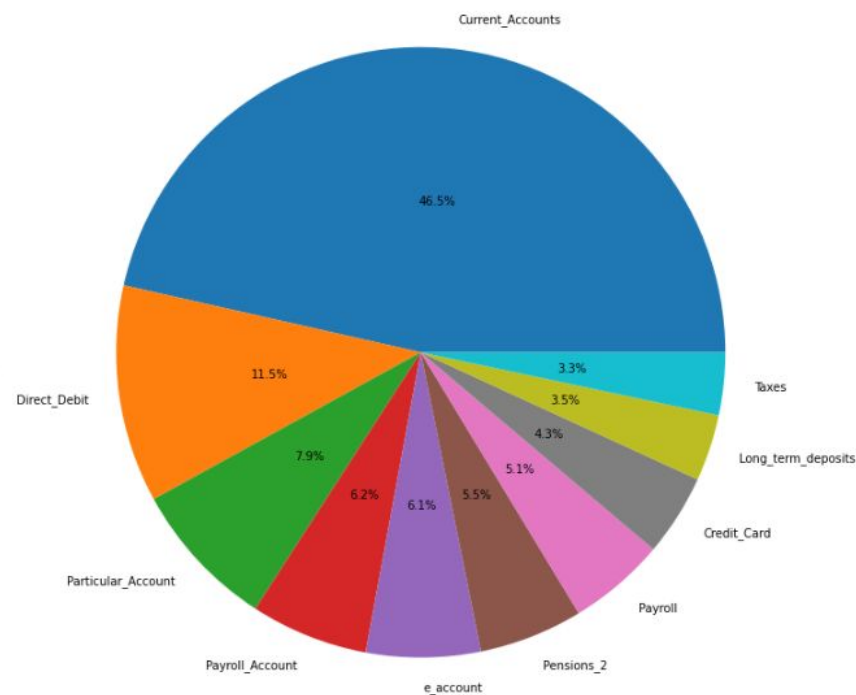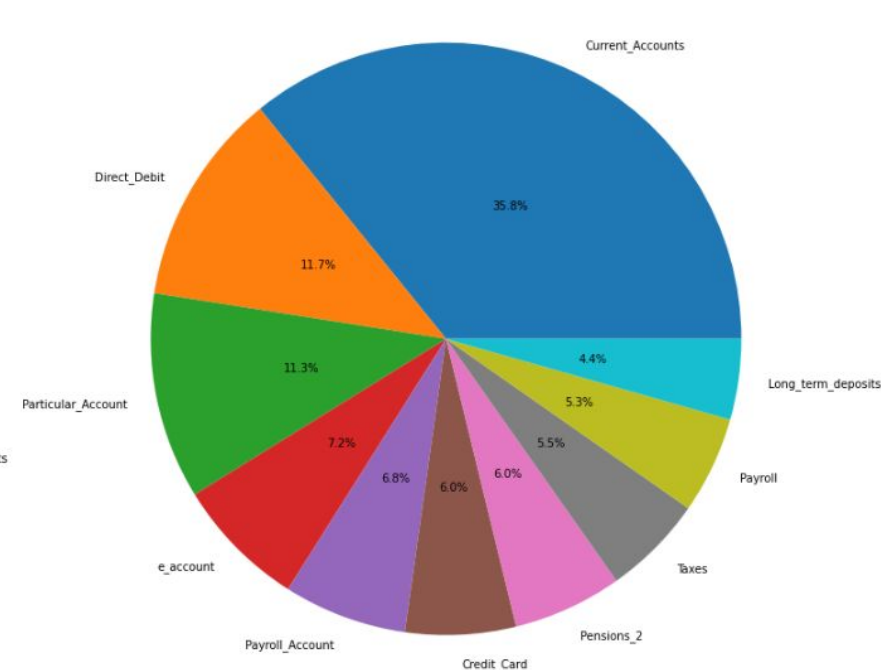'21-40' age group think about pension.

Product distribution by the income group income less 50 000

Product distribution by the income group income 50 000 - 300 000

Product distribution by the income group income 300 000 - 500 000

The reacher clients then less current accounts they have, And more other products like Particular account, Credit cards, Taxes, Long term deposits.
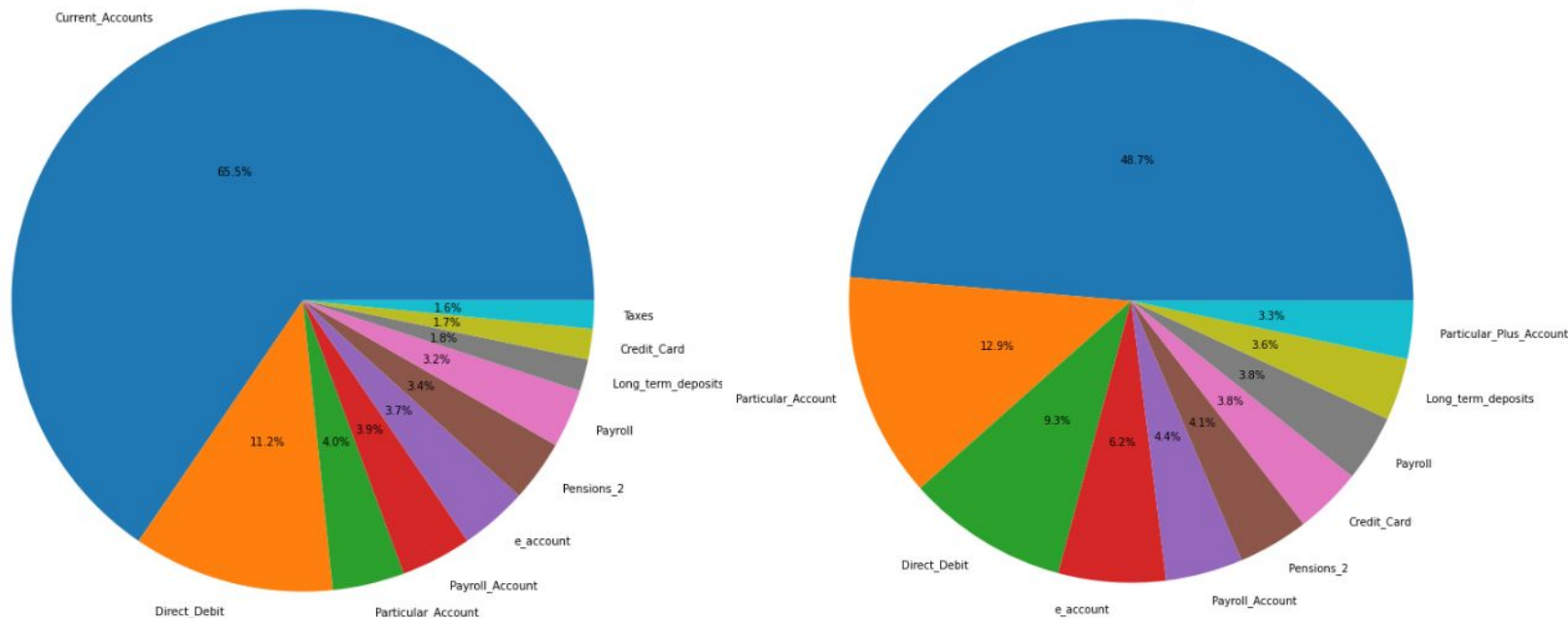
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There are some differences in each province. Since there are many provinces, the results are derived from some provinces to demonstrate differences.
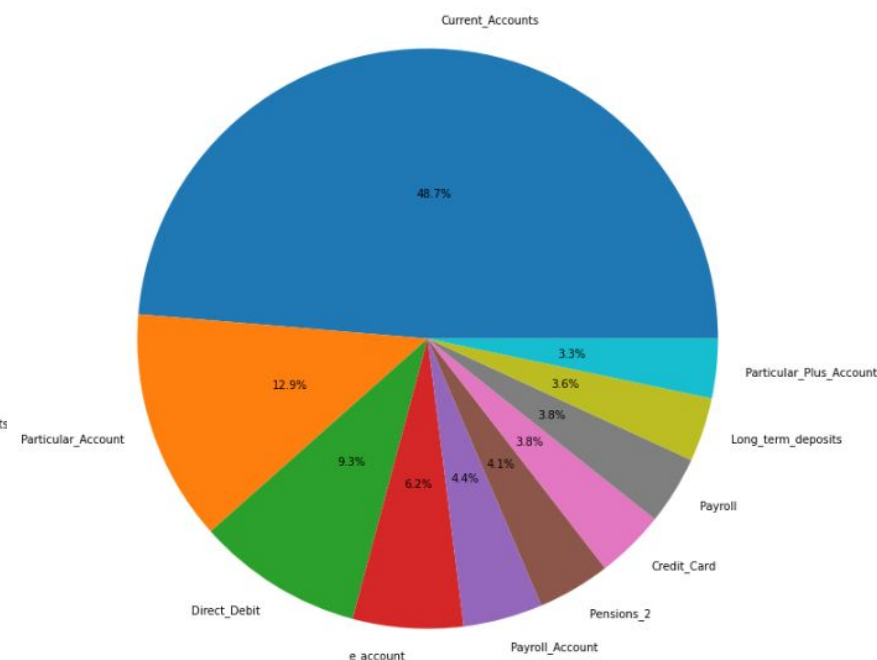
Products analysis
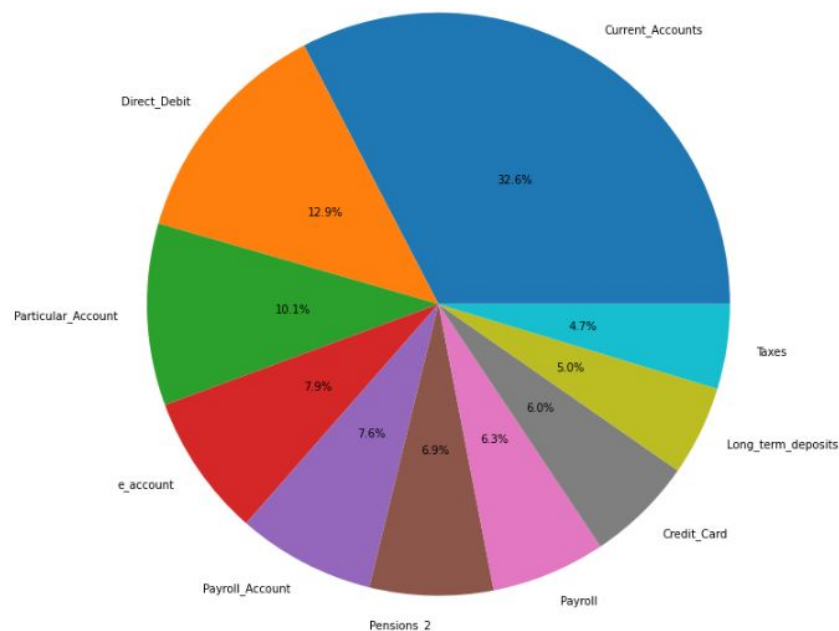
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These table show which products have clients together with the analyzed product.

5 the most popular products

Saving Account	Guarantees	Current Account	Derivada Account	Payroll Account	Junior Account	Más particular Account	Particular Account	Particular Plus Account	Short term deposits	Medium term deposits	Long term deposits
Current Account, Particular Account, Direct Debit, Taxes, Particular Plus Account	Direct Debit, e_account, Pensions_2, Payroll Account, Payroll	Direct Debit, Particular Account, e_account, Payroll Account, Long term deposits	Current Account, Direct Debit, Securities, Particular Account, e_account	Pensions_2, Direct Debit, Payroll, Current Account, Credit Card	e account, Current Account, Payroll Account, Pensions_2, Direct Debit	Current Account, e_account, Direct Debit, Payroll Account, Pensions_2	Current Account, Direct Debit, Credit Card, Payroll Account, Long term deposits	Current Account, Direct Debit, Payroll Account, Pensions_2, Credit Card	Current Account, e_account, Long term deposits, Direct Debit, Más particular Account'	Current Account, Long term deposits, Particular Account, Direct Debit, e_account	Current Account, e_account, Direct Debit, Particular Account, Credit Card

e account	Funds	Mortgage	Pensions	Loans	Taxes	Credit Card	Securities	Home Account	Payroll	Pensions_2	Direct Debit
Current Account, Direct Debit, Payroll Account, Pensions_2, Credit Card	Current Account, Direct Debit, e account, Long term deposits, Particular Account	Direct Debit, Payroll Account, Pensions_2, Payroll, Credit Card	Direct Debit, Current Account, Payroll Account, Credit Card, e_account	Current Account, Direct Debit, Taxes, Payroll Account, Credit Card	Direct Debit, Current Account, Payroll Account, Pensions_2, Payroll	Current Account, Current Account, Payroll Account, Pensions_2, Payroll	Current Account, e account, Payroll Account, Credit Card	Current Account, Particular Account, Direct Debit, Taxes, Payroll Account	Pensions_2, Payroll Account, Direct Debit, Current Account, Credit Card	Payroll Account, Payroll, Direct Debit, Current Account, Credit Card	Payroll Account, Payroll, Direct Debit, Current Account, Credit Card

Recommendation system

The system of recommendations based on cosine similarity was created. On the basis of this system, when registering one product, an employee can see what other products to offer based on the following table:

Credit_Card	Mortgage	Taxes	Pensions	Particular_Plus_Account	Guarantees
Current_Accounts	Mortgage	Pensions	Guarantees	Credit_Card	Taxes
Derivada_Account	Funds	Home_Account	Long_term_deposits	Securities	Saving_Account
Direct_Debit	Loans	Securities	Long_term_deposits	Particular_Plus_Account	Funds
Funds	Derivada_Account	Medium_term_deposits	Securities	Pensions	Home_Account
Guarantees	Mortgage	Pensions	Taxes	Credit_Card	Particular_Plus_Account
Home_Account	Saving_Account	Securities	Derivada_Account	Loans	Funds
Junior_Account	Más_particular_Account	Long_term_deposits	Short_term_deposits	Funds	Securities
Loans	Particular_Plus_Account	Home_Account	Particular_Account	Derivada_Account	e_account
Long_term_deposits	Securities	Derivada_Account	Más_particular_Account	Funds	Home_Account
Medium_term_deposits	Funds	Securities	Derivada_Account	Saving_Account	Home_Account
Mortgage	Guarantees	Taxes	Pensions	Credit_Card	Particular_Plus_Account

Más_particular_Account	Long_term_deposits	Short_term_deposits	Particular_Account	Funds	Securities
Particular_Account	Short_term_deposits	Loans	Long_term_deposits	Más_particular_Account	Derivada_Account
Particular_Plus_Account	Pensions	e_account	Securities	Taxes	Loans
Payroll	Mortgage	Taxes	Credit_Card	Particular_Plus_Account	Guarantees
Payroll_Account	Mortgage	Guarantees	Taxes	Particular_Plus_Account	Credit_Card
Pensions	Particular_Plus_Account	Securities	Taxes	Guarantees	Mortgage
Pensions_2	Mortgage	Taxes	Credit_Card	Guarantees	Particular_Plus_Account
Saving_Account	Home_Account	Derivada_Account	Funds	Medium_term_deposits	Loans
Securities	Particular_Plus_Account	Pensions	Long_term_deposits	Home_Account	Funds
Short_term_deposits	Particular_Account	Más_particular_Account	Long_term_deposits	Medium_term_deposits	Funds
Taxes	Mortgage	Pensions	Particular_Plus_Account	Securities	Credit_Card
e_account	Particular_Plus_Account	Loans	Securities	Pensions	Taxes

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We analyzed dataset and came to the some conclusion:

- For clients less than 20 years an employee can offer junior account, e_account, payroll and direct_debit
- Clients from 21 to 65 years often have direct debit, payroll account, pension, credit cards, e-account, particular account.
- Clients over 65 years have long term deposits
- It is doesn't matter how much the client earns.
- Some products have dependencies. For example: current-account - payroll account, pensions - payroll account and etc.
- Use recommendation table for cross selling

Some general recommendations:

- Communicate with the client and ask about the needs.
- Train employees in cross-selling skills

Thank You