Week 4 - Make Data Model Ready

In [1]:
```
import pandas as pd
import numpy as np
# import dask.dataframe as dd
import seaborn as sns
import matplotlib.pyplot as plt
# from sklearn.model_selection import train_test_split
```

In [2]:
```
pd.set_option('display.max_columns', None)

train = pd.read_csv('train_set.csv')
```

```
C:\Users\MARIA\AppData\Local\Temp\ipykernel_1220\2926943440.py:3: DtypeWarning: Colum
ns (12) have mixed types. Specify dtype option on import or set low_memory=False.
  train = pd.read_csv('train_set.csv')
```

In [3]:
```
#Setting a variable for all products the bank offers
products = ['savings_acct', 'guarantees', 'current_acct', 'derivada_acct', 'payroll_ac
            'junior_acct', 'mas_particular_acct', 'particular_acct', 'particular_plus_
            'short_term_depo', 'medium_term_depo', 'long_term_depo', 'e_acct', 'funds'
            'mortgage', 'pension', 'loans', 'taxes', 'credit_card', 'securities',
            'home_acct', 'payroll_acct', 'pensions_2', 'direct_debt']
```

In [4]:
```
train.shape
```

Out[4]:
```
(8400805, 47)
```

In [5]:
```
train.head(10)
```

Out[5]:

	Unnamed: 0	date	customer_code	employee_index	country	sex_H	age	first_contract_date	new_c
0	679341	2015-07-28	664160	N	ES	0	64	2006-12-21	
1	8746819	2016-04-28	557322	N	ES	0	66	2005-09-19	
2	4652767	2015-11-28	1359505	N	ES	0	22	2014-11-24	
3	6752599	2016-01-28	1076784	N	ES	0	23	2012-10-08	
4	5540137	2015-12-28	672465	N	ES	0	40	2007-01-28	
5	3886068	2015-10-28	774528	N	ES	0	41	2008-06-19	
6	6966113	2016-02-28	1516255	N	ES	0	32	2015-12-15	
7	9683247	2016-05-28	569598	N	ES	0	47	2005-10-19	
8	7902877	2016-03-28	1358634	N	ES	0	21	2014-11-21	
9	2396364	2015-09-28	464033	N	ES	1	57	2004-03-15	

In [6]:

```
# Column 'Unnamed: 0' populated when we exported train set from last week. This is lik
train = train.drop(columns=['Unnamed: 0'])
```

In [7]:

```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 8400805 entries, 0 to 8400804
Data columns (total 46 columns):
 #   Column                Dtype  
---  ------                -----  
 0   date                  object 
 1   customer_code         int64  
 2   employee_index        object 
 3   country               object 
 4   sex_H                 int64  
 5   age                   int64  
 6   first_contract_date   object 
 7   new_cust              int64  
 8   seniority_in_months   int64  
 9   primary_cust          int64  
 10  last_date_primary     object 
 11  cust_type             object 
 12  cust_relationship     object 
 13  residency_spain       int64  
 14  birth_spain           int64  
 15  join_channel          object 
 16  deceased              int64  
 17  province_name         object 
 18  active_cust           int64  
 19  income                float64
 20  segment               object 
 21  savings_acct          int64  
 22  guarantees            int64  
 23  current_acct          int64  
 24  derivada_acct         int64  
 25  payroll_acct          int64  
 26  junior_acct           int64  
 27  mas_particular_acct   int64  
 28  particular_acct       int64  
 29  particular_plus_acct  int64  
 30  short_term_depo       int64  
 31  medium_term_depo      int64  
 32  long_term_depo        int64  
 33  e_acct                int64  
 34  funds                 int64  
 35  mortgage              int64  
 36  pension               int64  
 37  loans                 int64  
 38  taxes                 int64  
 39  credit_card           int64  
 40  securities            int64  
 41  home_acct             int64  
 42  payroll_acct.1        int64  
 43  pensions_2            int64  
 44  direct_debt           int64  
 45  total_products        int64  
dtypes: float64(1), int64(35), object(10)
memory usage: 2.9+ GB
```

Since we exported, we lost some of the types we had previously set

In [8]:
```
dtype_mapping = {
    'date': 'datetime64[ns]',
    'customer_code': 'int',
```

```
    'country': 'str',
    'first_contract_date': 'datetime64[ns]',
    'last_date_primary': 'object',
    'join_channel': 'str',
    'province_name': 'object'}

train = train.astype(dtype_mapping)
train = train.rename(columns={'sex_H': 'female'})
```

In [9]:
```
train.describe().round(2)
```

Out[9]:

	date	customer_code	female	age	first_contract_date	new_cust	seni
count	8400805	8400805.00	8400805.00	8400805.00	8400805	8400805.00	
mean	2015-12-20 07:09:03.262078464	851018.10	0.46	40.09	2009-04-12 19:52:06.461951744	0.07	
min	2015-06-28 00:00:00	15889.00	0.00	2.00	1995-01-16 00:00:00	0.00	
25%	2015-09-28 00:00:00	464392.00	0.00	24.00	2004-07-07 00:00:00	0.00	
50%	2015-12-28 00:00:00	943495.00	0.00	39.00	2011-09-26 00:00:00	0.00	
75%	2016-03-28 00:00:00	1220538.00	1.00	50.00	2013-11-22 00:00:00	0.00	
max	2016-05-28 00:00:00	1553687.00	1.00	164.00	2016-05-31 00:00:00	1.00	
std	NaN	437194.93	0.50	17.23	NaN	0.26	

Data Processing

The first problem we identified was: Non-primary and deceased are only 0.2% of the dataset which imbalances the dataset and may not produce significant results, so we decided to drop them.
In addition to that, since we will be working only with primary customers, the column last_date_primary is not helpful anymore, so we will drop it as well.

In [10]:
```
#Dropping rows with primary_cust == 99
train = train[train['primary_cust'] != 99]
(train['primary_cust'] == 99).value_counts()
```

Out[10]:
```
primary_cust
False    8384163
Name: count, dtype: int64
```

Deceased clients have a few products, but they are not going to buy any more products -which is not valuable to our ultimate goal of predicting which products clients will buy, so we will drop the rows of deceased clients and drop the column

In [11]:
```
#Dropping rows with deceased == 1
train = train[train['deceased'] == 0]
(train['deceased'] == 1).value_counts()
```

Out[11]:
```
deceased
False    8363048
Name: count, dtype: int64
```

We will drop columns where age is 0 and over 100. We believe these clients are not going to be valuable on our model

In [12]:
```
((train['age'] == 0) | (train['age'] > 100)).value_counts()
```

Out[12]:
```
age
False    8356036
True        7012
Name: count, dtype: int64
```

In [13]:
```
train = train[(train['age'] > 0) & (train['age'] <= 100)]
((train['age'] == 0) | (train['age'] > 100)).value_counts()
```

Out[13]:
```
age
False    8356036
Name: count, dtype: int64
```

We will drop the rows on column seniority_in_months with values -999999 and null values under province_name (that were previously filled up with 'other') since those variables cause some noise on the data

In [14]:
```
train = train[train['seniority_in_months'] != -999999]
train = train[train['province_name'] != 'other']
```

We had the impression the columns seniority in months and first contract date were giving us the same information and we decided to check the correlation. Turns out it is highly correlated, so we'll keep the column seniority in months.

In [15]:
```
correlation = train[['seniority_in_months', 'first_contract_date']].corr()
correlation
```

Out[15]:

	seniority_in_months	first_contract_date
seniority_in_months	1.000000	-0.966175
first_contract_date	-0.966175	1.000000

Dropping primary_customer , last_date_primary, deceased and first_contract_date columns since after cleaning the dataset, they do not provide any additional information

In [16]:
```
train = train.drop(columns=['primary_cust', 'last_date_primary', 'deceased', 'first_cc
```

In [17]:
```
(train['income'] == 0).value_counts()
```

Out[17]:
```
income
False    6579717
True     1738614
Name: count, dtype: int64
```

There is a lot of missing values for the income variable. We will check it makes sense for us to fill those missing incomes with the median income per province.
We will check first if there is any province with a higher number of missing incomes compared to the others

In [18]:
```
zero_income_per_province = train[train['income'] == 0].groupby('province_name').size()
zero_income_per_province = zero_income_per_province.reset_index(name='count').sort_val
zero_income_per_province
```

Out[18]:

	province_name	count
30	MADRID	324911
8	BARCELONA	130563
9	BIZKAIA	113416
48	VALENCIA	84683
18	CORUÑA, A	72586
33	MURCIA	71039
43	SEVILLA	58356
34	NAVARRA	54358
38	PONTEVEDRA	50738
31	MALAGA	49947
2	ALICANTE	49922
20	GIPUZKOA	43976
4	ASTURIAS	41162
12	CADIZ	40052
37	PALMAS, LAS	38119
7	BALEARS, ILLES	35883
51	ZARAGOZA	32590
13	CANTABRIA	27643
6	BADAJOZ	25887
22	GRANADA	25533
0	ALAVA	23210
47	TOLEDO	22113
40	SALAMANCA	20664
45	TARRAGONA	20341
17	CORDOBA	18729
14	CASTELLON	18720
11	CACERES	17702
29	LUGO	17417
49	VALLADOLID	16296
35	OURENSE	16260
21	GIRONA	13988
24	HUELVA	13609
41	SANTA CRUZ DE TENERIFE	13105
16	CIUDAD REAL	12096

	province_name	count
28	LERIDA	11482
1	ALBACETE	10462
10	BURGOS	10442
27	LEON	10209
23	GUADALAJARA	8748
3	ALMERIA	8725
50	ZAMORA	8156
19	CUENCA	8016
26	JAEN	7879
39	RIOJA, LA	7042
25	HUESCA	6343
36	PALENCIA	5792
42	SEGOVIA	5652
5	AVILA	4862
46	TERUEL	3715
44	SORIA	2776
15	CEUTA	1433
32	MELILLA	1266

In [19]:

```
# Group by province_name and aggregate
result = train.groupby('province_name').agg(
    zero_income_count=('income', lambda x: (x == 0).sum()),  # Count where income is 0
    zero_income_with_products=('total_products', lambda x: ((train['income'] == 0) & (
    max_total_products=('total_products', 'max')  # Max total products consumed
).reset_index()

# Sort by zero_income_count in descending order
result = result.sort_values(by='zero_income_count', ascending=False)

print(result)
```

	province_name	zero_income_count	zero_income_with_products	\
30	MADRID	324911	200604	
8	BARCELONA	130563	83102	
9	BIZKAIA	113416	82153	
48	VALENCIA	84683	63114	
18	CORUÑA, A	72586	61432	
33	MURCIA	71039	58729	
43	SEVILLA	58356	43061	
34	NAVARRA	54358	39715	
38	PONTEVEDRA	50738	42818	
31	MALAGA	49947	38369	
2	ALICANTE	49922	36911	
20	GIPUZKOA	43976	31586	
4	ASTURIAS	41162	33259	
12	CADIZ	40052	31104	
37	PALMAS, LAS	38119	30669	
7	BALEARS, ILLES	35883	25644	
51	ZARAGOZA	32590	25404	
13	CANTABRIA	27643	21294	
6	BADAJOZ	25887	21171	
22	GRANADA	25533	17144	
0	ALAVA	23210	17154	
47	TOLEDO	22113	16594	
40	SALAMANCA	20664	17784	
45	TARRAGONA	20341	14926	
17	CORDOBA	18729	15363	
14	CASTELLON	18720	14621	
11	CACERES	17702	15338	
29	LUGO	17417	14820	
49	VALLADOLID	16296	12902	
35	OURENSE	16260	13805	
21	GIRONA	13988	9567	
24	HUELVA	13609	11132	
41	SANTA CRUZ DE TENERIFE	13105	8627	
16	CIUDAD REAL	12096	9580	
28	LERIDA	11482	8128	
1	ALBACETE	10462	8361	
10	BURGOS	10442	8248	
27	LEON	10209	7781	
23	GUADALAJARA	8748	4443	
3	ALMERIA	8725	5972	
50	ZAMORA	8156	6762	
19	CUENCA	8016	6735	
26	JAEN	7879	5687	
39	RIOJA, LA	7042	5450	
25	HUESCA	6343	5121	
36	PALENCIA	5792	4712	
42	SEGOVIA	5652	4052	
5	AVILA	4862	3846	
46	TERUEL	3715	3104	
44	SORIA	2776	2243	
15	CEUTA	1433	987	
32	MELILLA	1266	863	

	max_total_products
30	15
8	12
9	11
48	13
18	11

```
33            10
43            13
34            11
38            11
31            13
2             12
20            10
4             12
12            12
37            13
7             12
51            13
13            12
6             10
22            12
0             12
47            10
40            11
45            12
17            12
14            12
11            10
29            10
49            12
35            10
21            10
24            10
41            11
16            10
28            10
1             11
10            11
27            10
23            12
3             12
50             9
19            10
26            12
39            11
25            11
36            11
42            10
5             10
46             9
44            13
15             9
32            10
```

There are many people with income == 0 but has multiple products. In that case, we will be looking in to deleting people with 0 income and 0 products and primary.

In [20]:

```
zero_income_zero_products = len(train[
    (train['income'] == 0) &
    (train['total_products'] == 0)
])

print(zero_income_zero_products)
```

```
466623
```

In [21]:
```
train = train[~((train['income'] == 0) &
                (train['total_products'] == 0))]
train.reset_index(drop=True, inplace=True)
train.shape
```

Out[21]:
```
(7851708, 42)
```

In [22]:
```
(train['income'] == 0).value_counts()
```

Out[22]:
```
income
False    6579717
True     1271991
Name: count, dtype: int64
```

In [23]:
```
percentage_zero_income = ((train['income'] == 0).mean() * 100)
print(f'{percentage_zero_income.round()}% of income data is still missing')
```

```
16.0% of income data is still missing
```

In [24]:
```
# One-hot encode province_name
dummies = pd.get_dummies(train['province_name'], drop_first=True)

# Combine the dummy variables with the original DataFrame
train_with_dummies = pd.concat([train['income'], dummies], axis=1)

# Calculate the correlation matrix
correlation_matrix = train_with_dummies.corr()

# Display the correlation with income
income_correlation = correlation_matrix['income'].drop('income')  # D
print(income_correlation)
```

```
ALBACETE                 -0.016871
ALICANTE                 -0.030158
ALMERIA                  -0.012723
ASTURIAS                 -0.021192
AVILA                    -0.012026
BADAJOZ                  -0.029492
BALEARS, ILLES           -0.001865
BARCELONA                 0.050475
BIZKAIA                  -0.052565
BURGOS                   -0.011116
CACERES                  -0.023468
CADIZ                    -0.021515
CANTABRIA                -0.009860
CASTELLON                -0.021022
CEUTA                     0.003701
CIUDAD REAL              -0.022515
CORDOBA                  -0.020134
CORUÑA, A                -0.022676
CUENCA                   -0.016866
GIPUZKOA                 -0.032458
GIRONA                    0.002337
GRANADA                  -0.016806
GUADALAJARA              -0.008941
HUELVA                   -0.020739
HUESCA                   -0.010680
JAEN                     -0.014861
LEON                     -0.012202
LERIDA                   -0.015809
LUGO                     -0.021256
MADRID                    0.165661
MALAGA                   -0.010159
MELILLA                   0.001488
MURCIA                   -0.042343
NAVARRA                  -0.036447
OURENSE                  -0.018993
PALENCIA                 -0.009556
PALMAS, LAS              -0.021241
PONTEVEDRA               -0.019016
RIOJA, LA                -0.008646
SALAMANCA                -0.013254
SANTA CRUZ DE TENERIFE   -0.010572
SEGOVIA                  -0.007628
SEVILLA                  -0.009242
SORIA                    -0.007227
TARRAGONA                -0.013604
TERUEL                   -0.008433
TOLEDO                   -0.023756
VALENCIA                 -0.039163
VALLADOLID               -0.012371
ZAMORA                   -0.013490
ZARAGOZA                 -0.011894
Name: income, dtype: float64
```

As visible, there is no strong correlation between province and state. So, imputing values w.r.t province might not be a good idea. Since we lack any good sources to impute the data, we will drop it the values.

In [25]:
```
train = train[train['income'] != 0]
train.shape
```

Out[25]:
```
(6579717, 42)
```

In [26]:
```
train.isnull().sum()
```

Out[26]:
```
date                     0
customer_code            0
employee_index           0
country                  0
female                   0
age                      0
new_cust                 0
seniority_in_months      0
cust_type                0
cust_relationship        0
residency_spain          0
birth_spain              0
join_channel             0
province_name            0
active_cust              0
income                   0
segment                  0
savings_acct             0
guarantees               0
current_acct             0
derivada_acct            0
payroll_acct             0
junior_acct              0
mas_particular_acct      0
particular_acct          0
particular_plus_acct     0
short_term_depo          0
medium_term_depo         0
long_term_depo           0
e_acct                   0
funds                    0
mortgage                 0
pension                  0
loans                    0
taxes                    0
credit_card              0
securities               0
home_acct                0
payroll_acct.1           0
pensions_2               0
direct_debt              0
total_products           0
dtype: int64
```

In [27]:
```
# Checking unique variables for cust_type
print(train['cust_type'].unique())
print(train['cust_type'].isna().sum())
```

```
['1.0' '1' '0' '3.0' 'P' 1.0 0.0 3.0 '2' '3' '2.0' 2.0 '4' '4.0' 4.0 '0.0']
0
```

In [28]:
```
# Fixing cust_type variables so they are consistent across rows
train['cust_type'] = train['cust_type'].astype(str).str.strip()
cust_type_map = {'0.0': '0', '1.0': '1', '2.0': '2', '3.0': '3', '4.0': '4'}
train['cust_type'] = train['cust_type'].replace(cust_type_map)
```

```
train['cust_type'] = train['cust_type'].astype(object)

print(train['cust_type'].value_counts())
print(train['cust_relationship'].value_counts())
```

```
cust_type
1    6553268
0      25345
3        726
2        193
P        142
4         43
Name: count, dtype: int64
cust_relationship
I    3652879
A    2900582
0      25345
P        769
R        142
Name: count, dtype: int64
```

In [29]:

```
train.describe().round(2)
#Check for 0s, outliers - that are too different from the 4th quartile
```

Out[29]:

	date	customer_code	female	age	new_cust	seniority_in_months	re
count	6579717	6579717.00	6579717.00	6579717.00	6579717.00	6579717.00	
mean	2015-12-16 16:20:53.392265216	812413.67	0.45	40.68	0.03	83.16	
min	2015-06-28 00:00:00	15889.00	0.00	2.00	0.00	0.00	
25%	2015-09-28 00:00:00	437616.00	0.00	25.00	0.00	26.00	
50%	2015-12-28 00:00:00	909524.00	0.00	40.00	0.00	54.00	
75%	2016-03-28 00:00:00	1180751.00	1.00	51.00	0.00	139.00	
max	2016-05-28 00:00:00	1454620.00	1.00	100.00	1.00	256.00	
std	NaN	423713.60	0.50	17.08	0.18	66.29	

Plotting outliers

In [30]:

```
# Create a variable with numerical columns to plot them easier
numeric_col = train.select_dtypes(include=['int', 'float']).columns.tolist()
numeric_col = [col for col in numeric_col if col not in products]
numeric_col
```

Out[30]:
```
['customer_code',
 'female',
 'age',
 'new_cust',
 'seniority_in_months',
 'residency_spain',
 'birth_spain',
 'active_cust',
 'income',
 'payroll_acct.1',
 'total_products']
```

In [31]:
```
dummy = pd.DataFrame(columns=['age', 'seniority_in_months', 'income', 'product'])

for col in products:
    df = pd.DataFrame({
        'age': train.age[train[col] == 1],
        'seniority_in_months': train.seniority_in_months[train[col] == 1],
        'income': np.log1p(train.income[train[col] == 1]),
        'product': col
    })

    dummy = pd.concat([dummy, df], ignore_index=True)
```

```
C:\Users\MARIA\AppData\Local\Temp\ipykernel_1220\451807204.py:11: FutureWarning: The
behavior of DataFrame concatenation with empty or all-NA entries is deprecated. In a
future version, this will no longer exclude empty or all-NA columns when determining
the result dtypes. To retain the old behavior, exclude the relevant entries before th
e concat operation.
  dummy = pd.concat([dummy, df], ignore_index=True)
```

In [32]:
```
plt.figure(figsize=(15, 18))

# Plot for Age
plt.subplot(3, 1, 1)
sns.boxplot(data=dummy, x='product', y='age', palette='rainbow')
plt.title('Distribution of Age by Product')
plt.xticks(rotation=90)

# Plot for Seniority in Months
plt.subplot(3, 1, 2)
sns.boxplot(data=dummy, x='product', y='seniority_in_months', palette='rainbow')
plt.title('Distribution of Seniority in Months by Product')
plt.xticks(rotation=90)

# Plot for Income
plt.subplot(3, 1, 3)
sns.boxplot(data=dummy, x='product', y='income', palette='rainbow')
plt.title('Distribution of Log Income by Product')
plt.xticks(rotation=90)

plt.tight_layout()
plt.show()
```

```
C:\Users\MARIA\AppData\Local\Temp\ipykernel_1220\561250127.py:5: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.
0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.boxplot(data=dummy, x='product', y='age', palette='rainbow')
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
```

```
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
```

```
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
```

```
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
C:\Users\MARIA\AppData\Local\Temp\ipykernel_1220\561250127.py:11: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.
0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.boxplot(data=dummy, x='product', y='seniority_in_months', palette='rainbow')
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
```

```
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
```

```
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
```

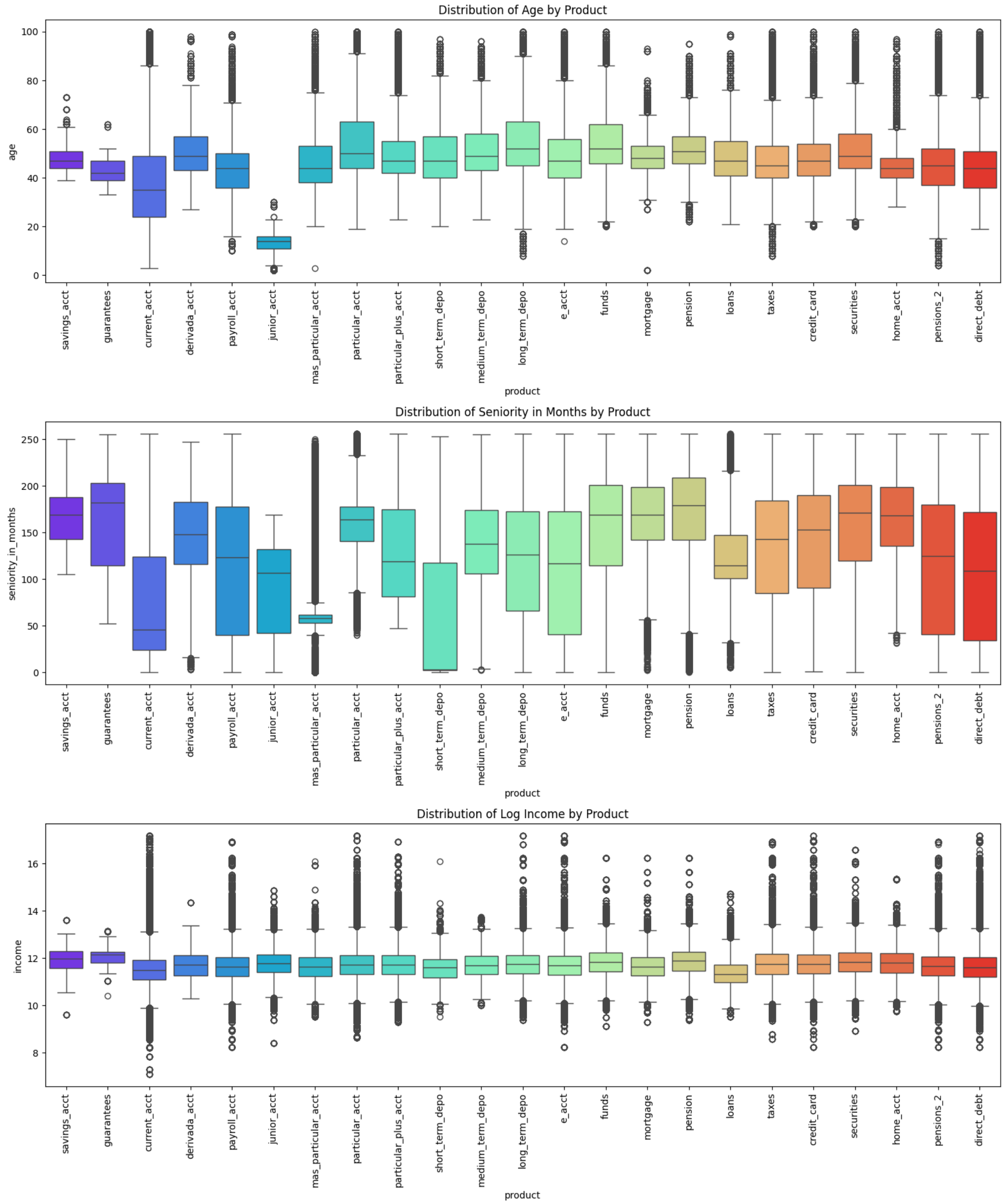
```
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
```

```
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
C:\Users\MARIA\AppData\Local\Temp\ipykernel_1220\561250127.py:17: FutureWarning:

Passing `palette` without assigning `hue` is deprecated and will be removed in v0.14.
0. Assign the `x` variable to `hue` and set `legend=False` for the same effect.

  sns.boxplot(data=dummy, x='product', y='income', palette='rainbow')
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
```

```
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
```

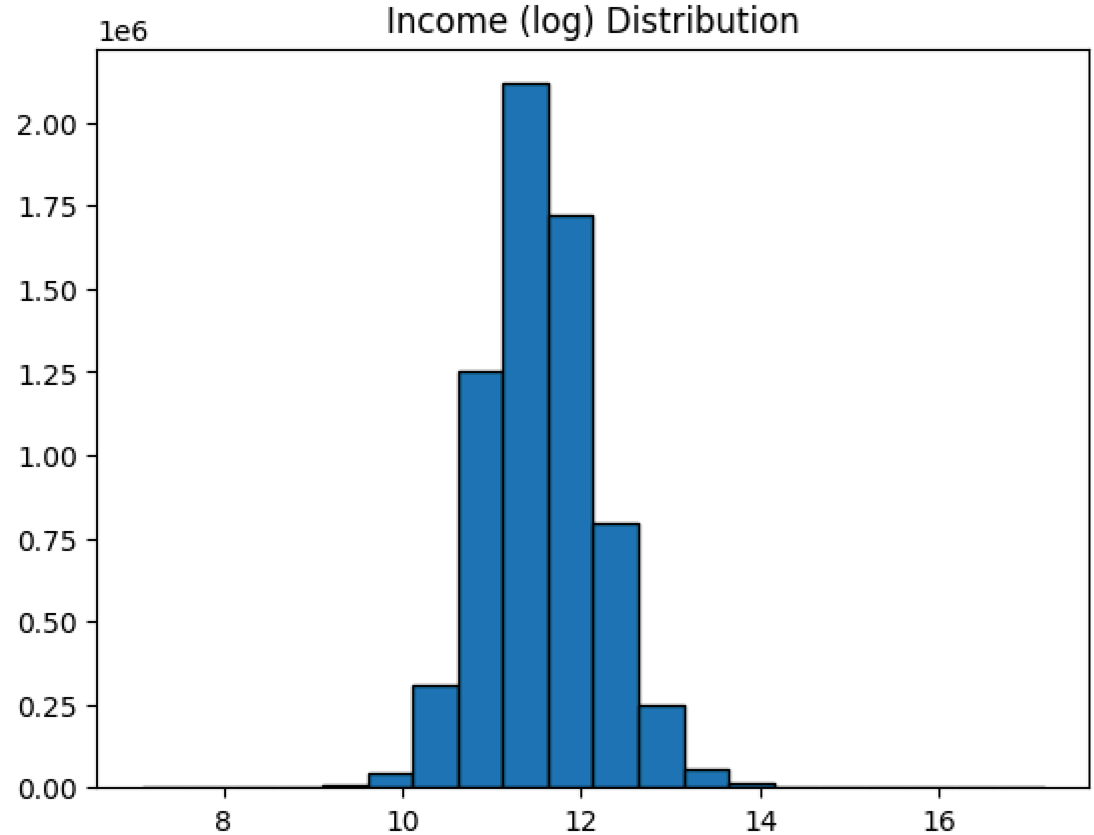
```
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
```

```
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\_bas
e.py:949: FutureWarning: When grouping with a length-1 list-like, you will need to pa
ss a length-1 tuple to get_group in a future version of pandas. Pass `(name,)` instea
d of `name` to silence this warning.
  data_subset = grouped_data.get_group(pd_key)
c:\Users\MARIA\AppData\Local\Programs\Python\Python311\Lib\site-packages\seaborn\cate
gorical.py:640: FutureWarning: SeriesGroupBy.grouper is deprecated and will be remove
d in a future version of pandas.
  positions = grouped.grouper.result_index.to_numpy(dtype=float)
```



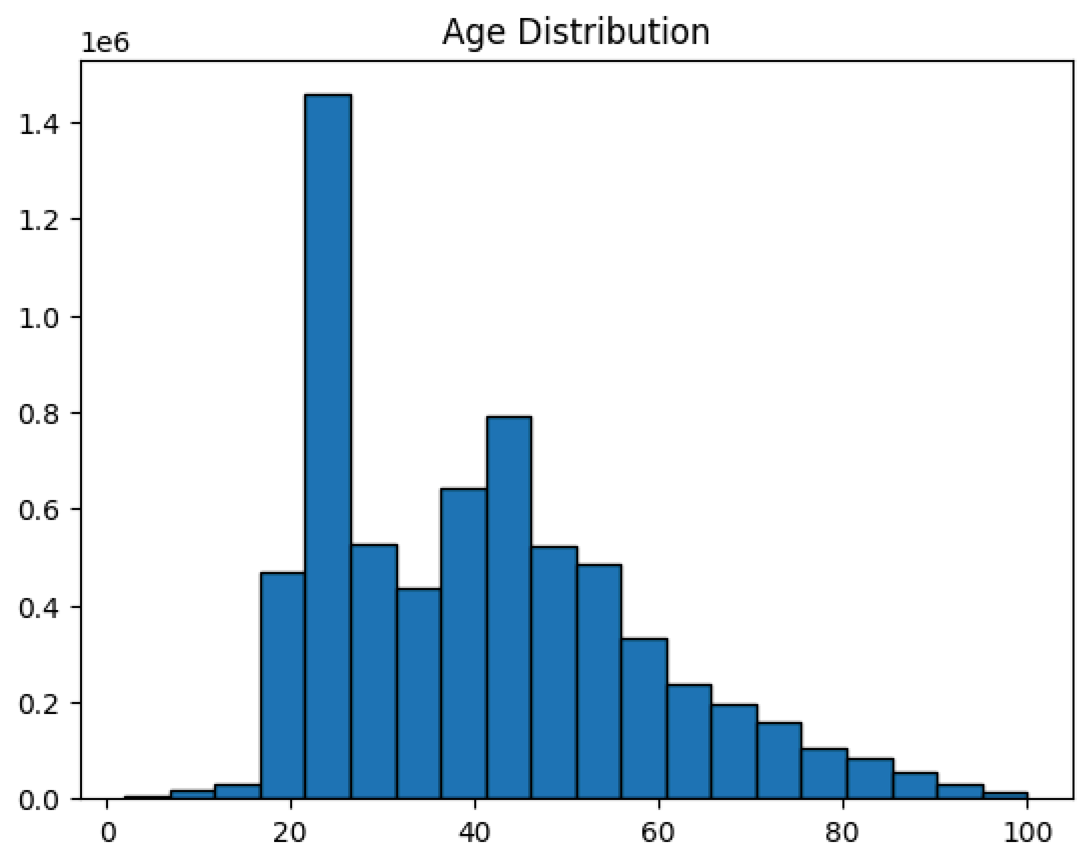
In [33]:
```python
plt.hist(np.log(train['income']), bins=20, edgecolor='black')
plt.title('Income (log) Distribution')
```

Out[33]: Text(0.5, 1.0, 'Income (log) Distribution')



In [34]:
```
plt.hist(train['age'], bins=20, edgecolor='black')
plt.title('Age Distribution')
```

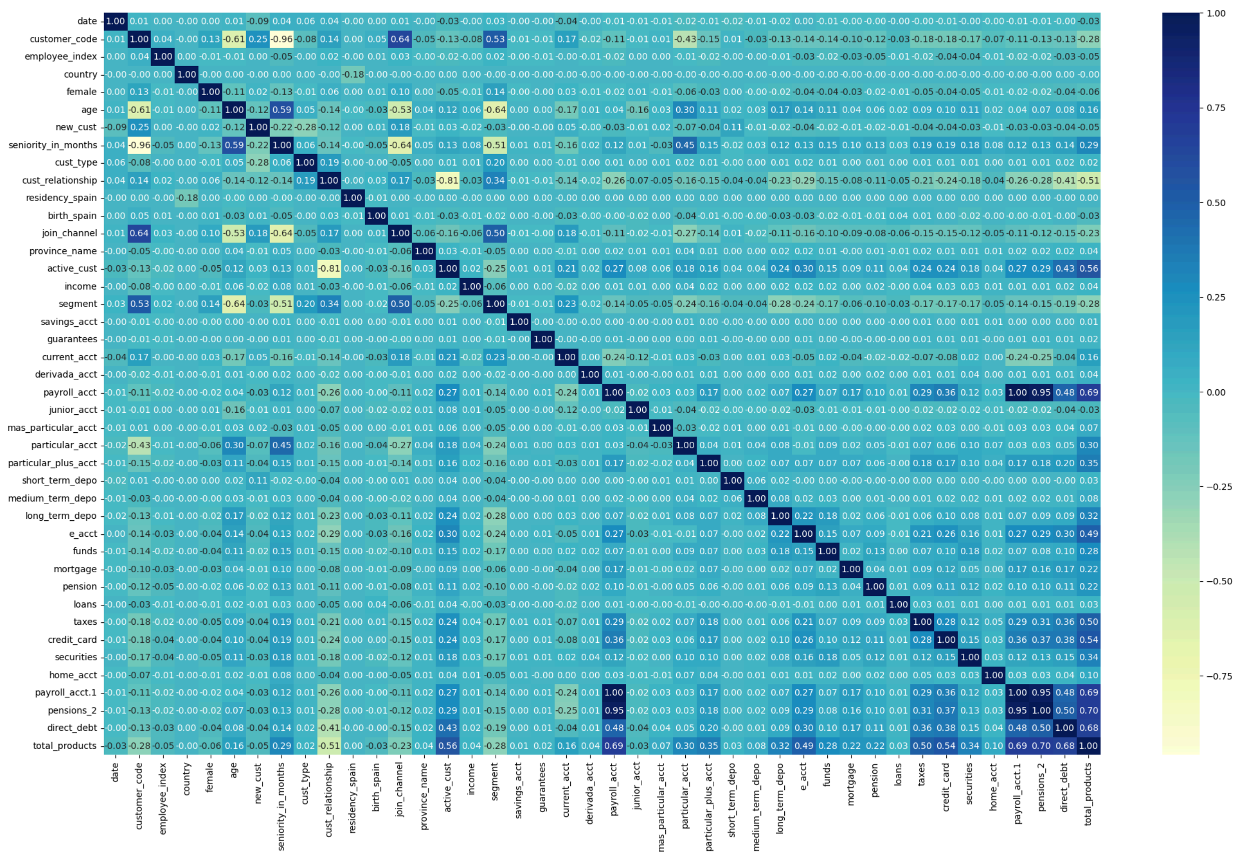
Out[34]:
```
Text(0.5, 1.0, 'Age Distribution')
```



Transform categorical variables with label encoder to plot correlation. This will not be a final transformation, it is just to detect correlation

In [35]:
```
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()

correlation = train.copy()

columns_to_encode = ['employee_index', 'country', 'cust_type', 'cust_relationship',
                     'join_channel', 'province_name', 'segment']

for col in columns_to_encode:
    correlation[col] = le.fit_transform(correlation[col])
```

In [36]:
```
plt.figure(figsize=(25,15))
sns.heatmap(correlation.corr(),annot=True, cmap="YlGnBu", fmt= '.2f')
plt.show()
```



There are two correlations that draw attention to us. The first one is active_cust and cust_relationship, which is 0.81. The second one is payroll_acct and payroll_acct.1 which is 1. They will both be dropped, the payroll_acct.1 gives us the same information as the payroll_acct and we believe that having such a high correlation between active_cust and cust_relationship would hinder our model

In [37]:
```
train = train.drop(columns=['payroll_acct.1', 'cust_relationship'])
```

Dealing with the categorical values

Since most of the data is from clients that comes from Spain, we will combine non-spanish clients into an "others" group so we will have only two variables: ES and others. After that we will transform the column in a dummy variable for Spain.

In [38]:
```
train['country'] = np.where(train['country'] == 'ES', 1, 0)
```

We will transform the segment column using get_dummies to create two different binary columns for the variables

In [39]:
```
segment_dummy = pd.get_dummies(train['segment'],drop_first=True)
train = pd.concat([train, segment_dummy], axis=1)
```

Since total_products is a continuous variable representing how many products each customer has purchased, we will use it as a target for encoding the categorical variables join_channel and province_name, since those have many different variables. We chose target encoding because we would have a dimensionality problem if we chose to transform each variable in a dummy column, and we did not want to use label encoder since it is not an ordinal variable

In [40]:
```
# pip install category_encoders
```

In [50]:
```
import category_encoders as ce

target_encoder = ce.TargetEncoder(cols=['join_channel', 'province_name', 'employee_inc

train[['join_channel_encoded', 'province_name_encoded', 'employee_index_encoded']] = t
    train[['join_channel', 'province_name', 'employee_index']], train['total_products'

train[['join_channel', 'province_name', 'join_channel_encoded', 'province_name_encodec
```

Out[50]:

	join_channel	province_name	join_channel_encoded	province_name_encoded	employee_index_encod
0	KAR	MADRID	1.424185	1.749698	1.4072
1	KHE	LERIDA	0.886876	1.006139	1.4072
2	KFC	SEVILLA	1.559984	1.382030	1.4072
3	KFA	MURCIA	1.850124	1.075147	1.4072
5	KAT	MADRID	1.942077	1.749698	1.4072

In [47]:
```
train['cust_type'] = train['cust_type'].replace({"P": 5})
train['cust_type'] = train['cust_type'].astype(int)
```

In [51]:
```
train.columns
```

Out[51]:
```
Index(['date', 'customer_code', 'employee_index', 'country', 'female', 'age',
       'new_cust', 'seniority_in_months', 'cust_type', 'residency_spain',
       'birth_spain', 'join_channel', 'province_name', 'active_cust', 'income',
       'segment', 'savings_acct', 'guarantees', 'current_acct',
       'derivada_acct', 'payroll_acct', 'junior_acct', 'mas_particular_acct',
       'particular_acct', 'particular_plus_acct', 'short_term_depo',
       'medium_term_depo', 'long_term_depo', 'e_acct', 'funds', 'mortgage',
       'pension', 'loans', 'taxes', 'credit_card', 'securities', 'home_acct',
       'pensions_2', 'direct_debt', 'total_products', '01 - TOP',
       '02 - PARTICULARES', '03 - UNIVERSITARIO', 'join_channel_encoded',
       'province_name_encoded', 'employee_index_encoded'],
      dtype='object')
```

Normalization/Standartization of data

We will normalize data for age and seniority in months since it is not normally distributed

We will standardize income since its log is normally distributed

In [52]:
```python
# #Decide whether to do normalization or standartization
from sklearn.preprocessing import MinMaxScaler, StandardScaler

# Normalize using MinMaxScaler
cols_to_normalize = ['age', 'seniority_in_months']
scaler = MinMaxScaler(feature_range=(0, 1))
train[cols_to_normalize] = scaler.fit_transform(train[cols_to_normalize])

# Standardize using StandardScaler
cols_to_standardize = ['income']
scaler = StandardScaler()
train[cols_to_standardize] = scaler.fit_transform(train[cols_to_standardize])

print(train[cols_to_normalize].head())
print(train[cols_to_standardize].head())
```

```
        age  seniority_in_months
0  0.632653             0.402344
1  0.214286             0.152344
2  0.387755             0.417969
3  0.397959             0.343750
5  0.459184             0.496094
     income
0  1.989686
1 -0.306603
2 -0.148205
3 -0.228531
5  0.588748
```

In [44]:
```python
train.to_csv('train_data.csv', index=False)
```