WHO WILL LEAVE ?

CAN YOU PREDICT IF BANK CUSTOMERS WILL TURNOVER NEXT CYCLE?

羅健華

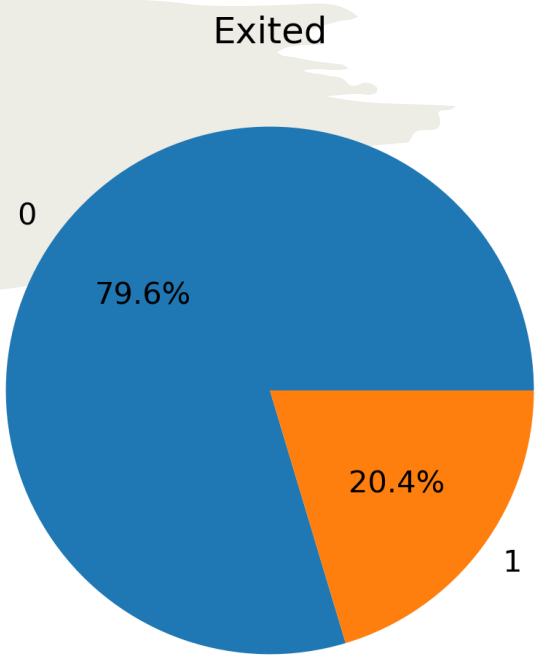
Target

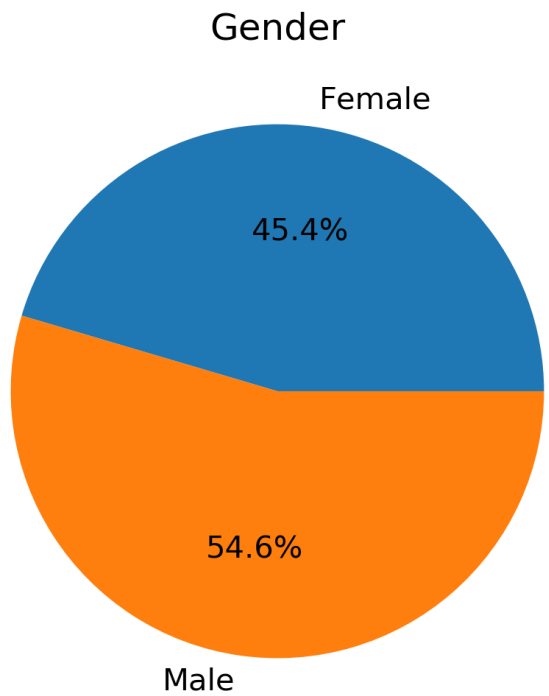
Given a Bank customer, can we build a classifier which can determine whether they will leave in the next 6 months or not?

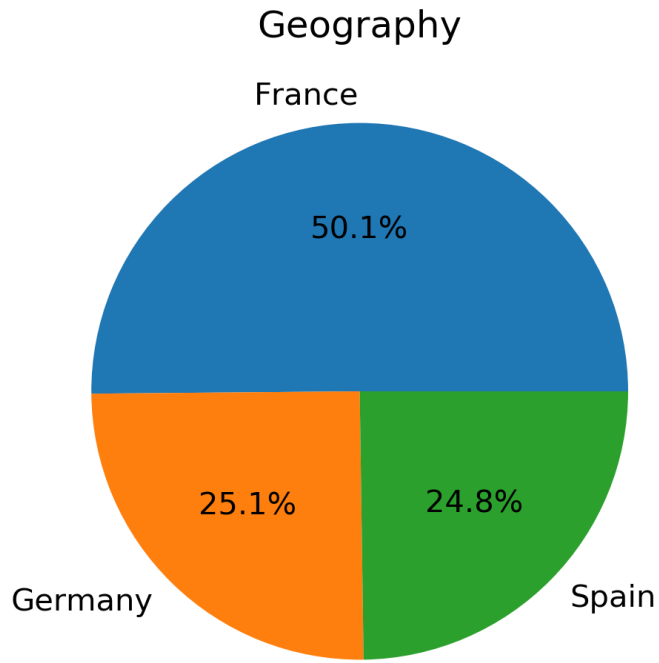
Data Source

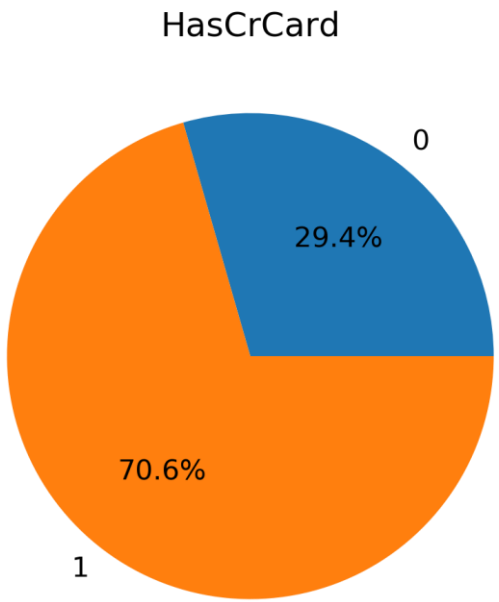
https://www.kaggle.com/barelydedicated/bank-customer-churn-modeling

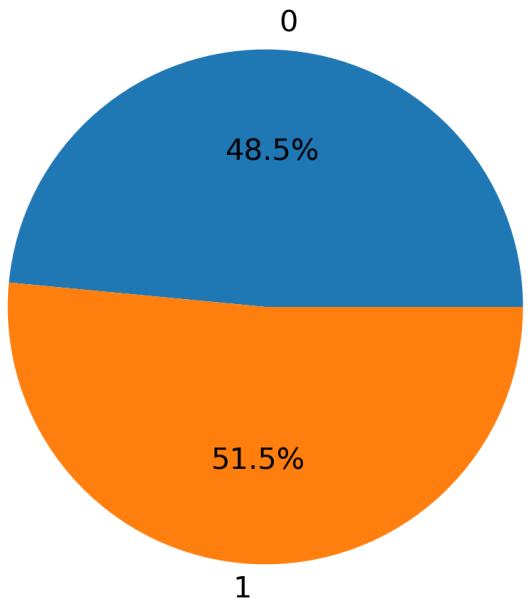
Valuables	Definition
dependent variable	
Exited	= 1 if customer leaves
independent variable	
Age	
Gender	Male, Female
Geography	France, Germany, Spain
Estimated Salary	
Tenure	
Balance	
Credit Score	
Number Of Products	
Has Credit Card	= 1 if customer has
Is Active Member	= 1 if customer is


Exited
0
79.6%
20.4%
1

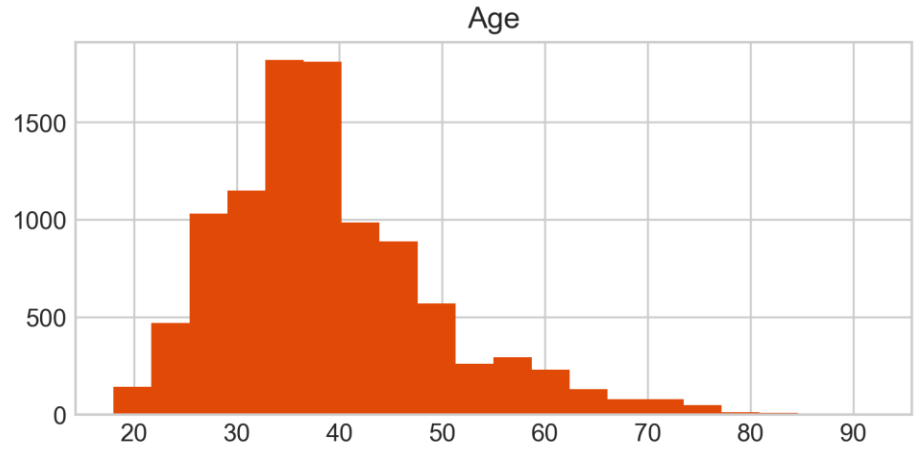

Gender
Female
45.4%
54.6%
Male

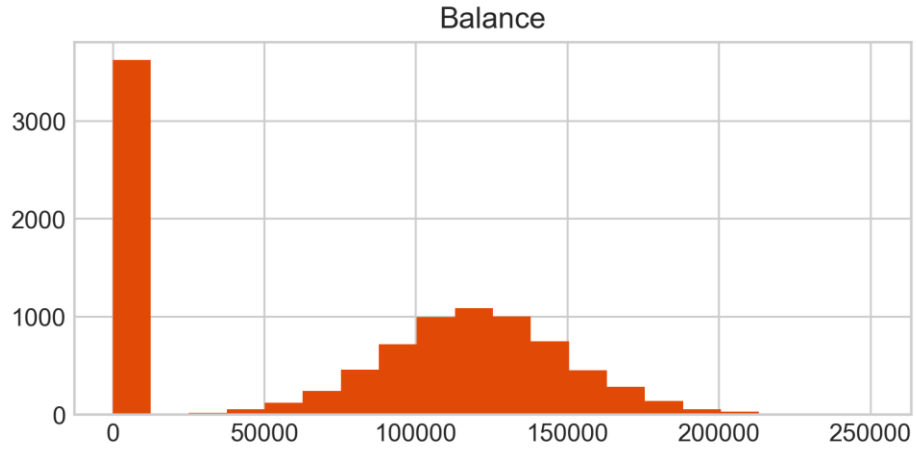

Geography
France
50.1%
25.1%
24.8%
Germany
Spain

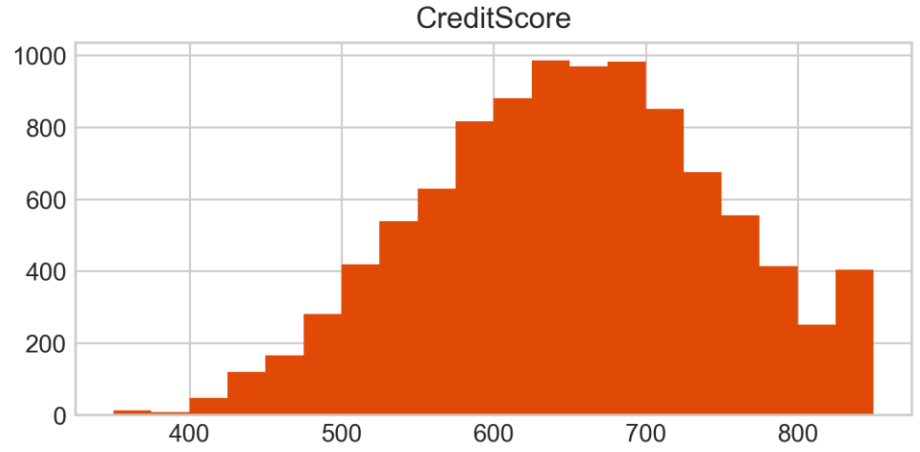

HasCrCard
0
29.4%
70.6%
1


IsActiveMember
0
48.5%
51.5%
1

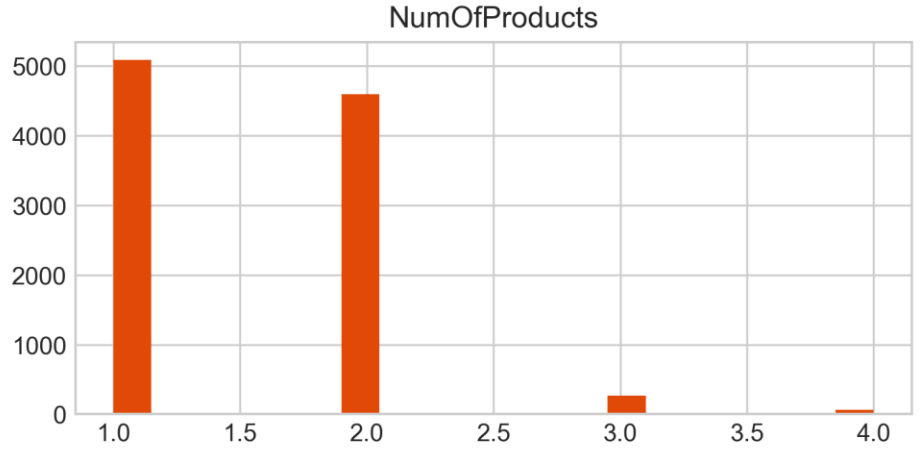
	Credit Score	Age	Tenure	Balance	Number Of Products	Estimated Salary
count	10000.00	10000.00	10000.00	10000.00	10000.00	10000.00
mean	650.53	38.92	5.012	76485.89	1.53	100090.24
Std	96.65	10.49	2.89	62397.41	0.58	57510.49
min	350.00	18.00	0.00	0.00	1.00	11.58
25%	584.00	32.00	3.00	0.00	1.00	51002.11
50%	652.00	37.00	5.00	97198.54	1.00	100193.91
75%	718.00	44.00	7.00	127644.24	2.00	149388.25
max	850.00	92.00	10.00	250898.09	4.00	199992.48

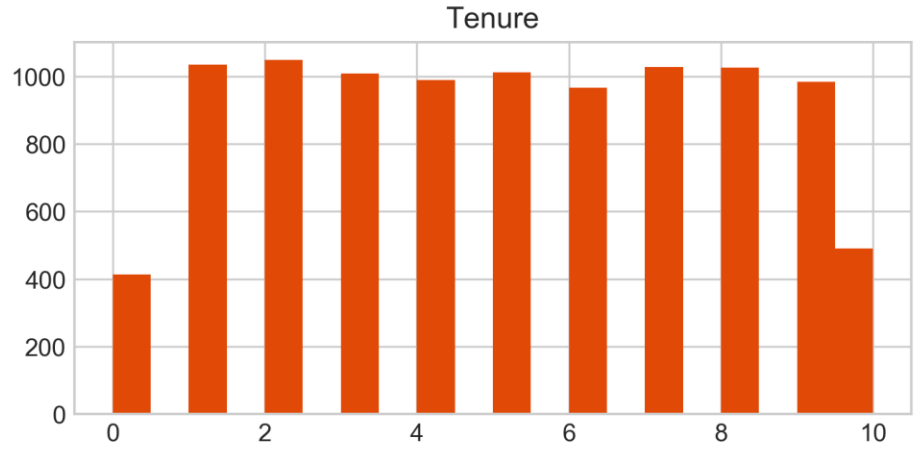

Age
1500
1000
500
0
20
30
40
50
60
70
80
90

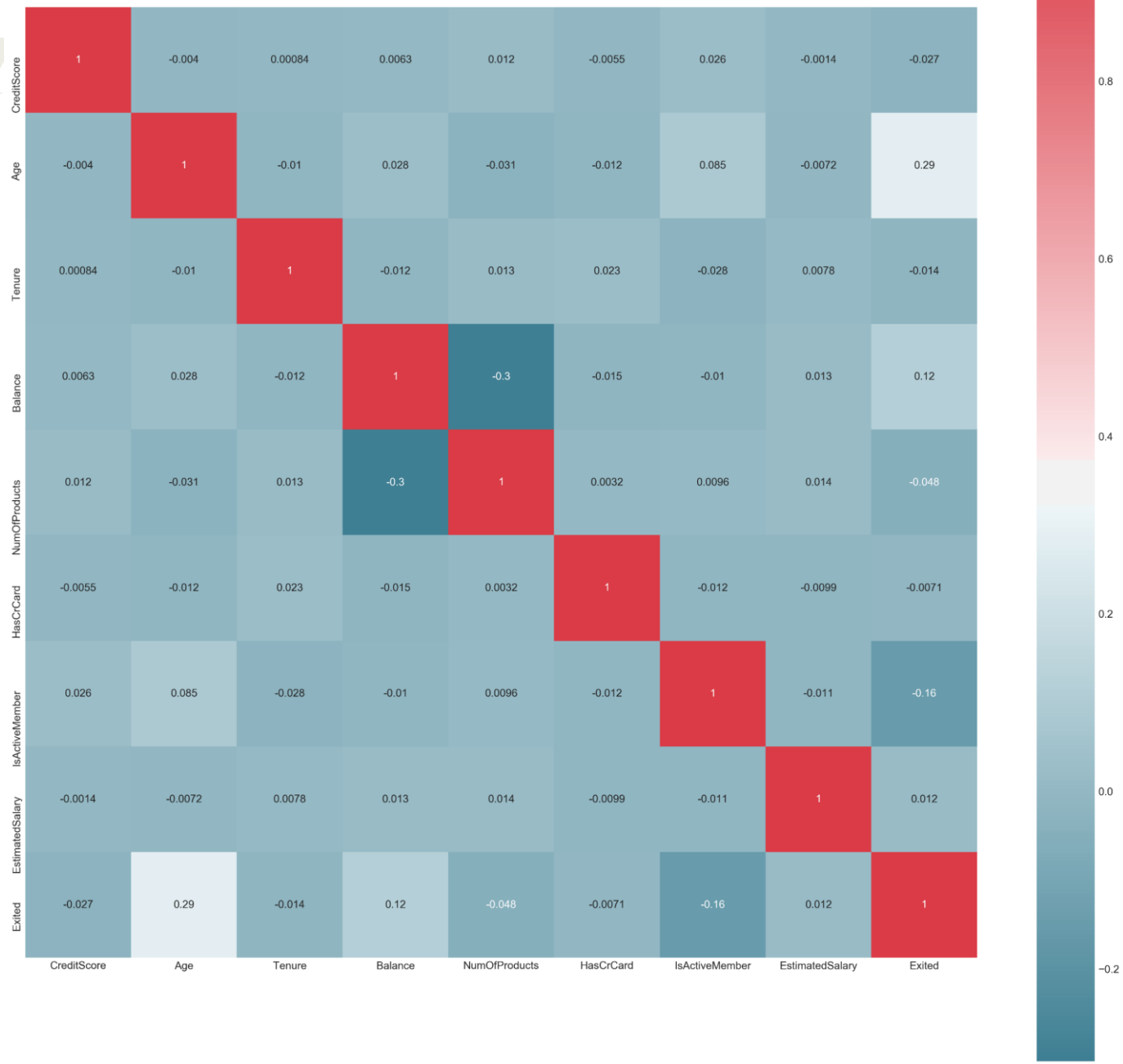

Balance
3000
2000
1000
0
0
50000
100000
150000
200000
250000

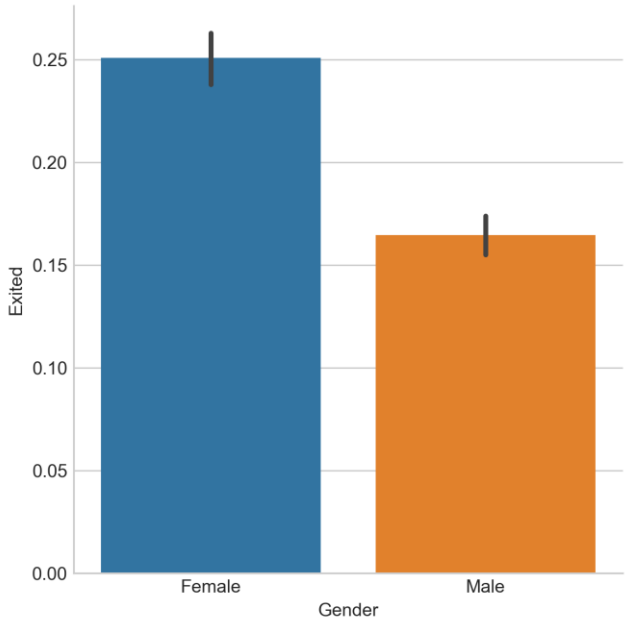

CreditScore
1000
800
600
400
200
0
400
500
600
700
800

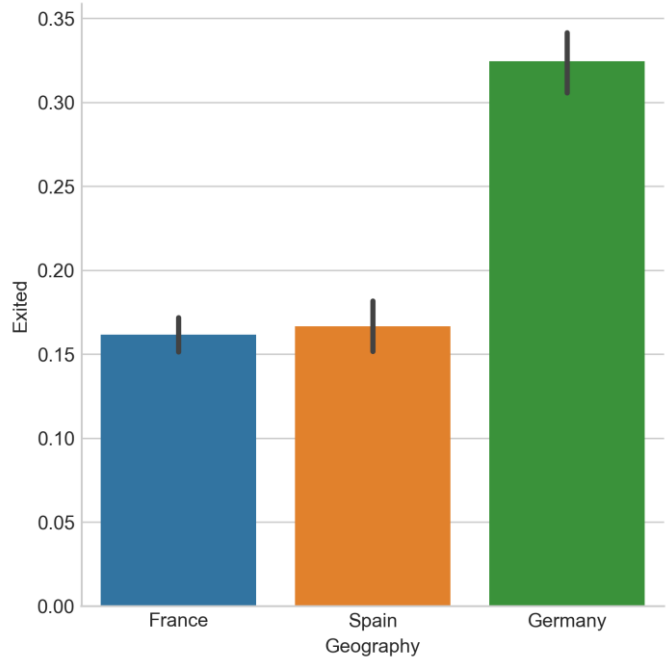

EstimatedSalary
500
400
300
200
100
0
0
25000
50000
75000
100000
125000
150000
175000
200000

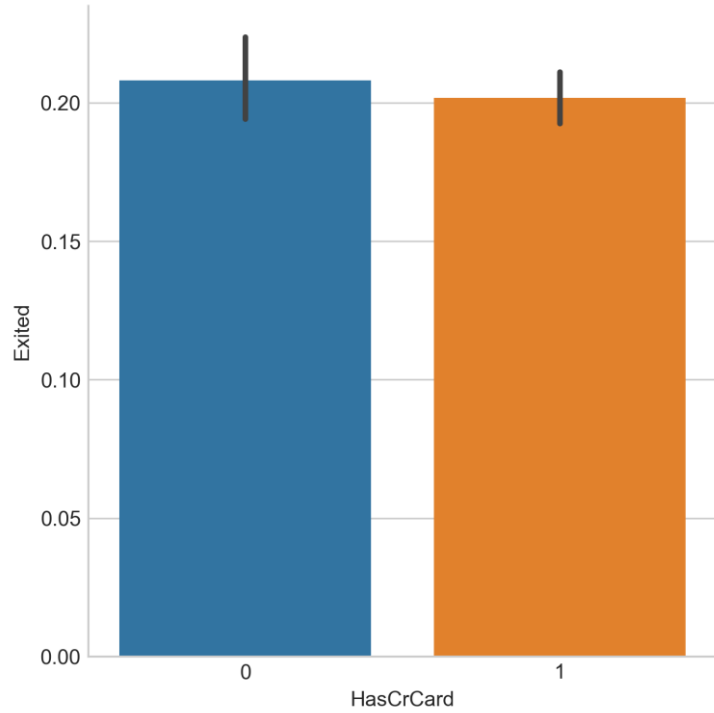

NumOfProducts
5000
4000
3000
2000
1000
0
1.0
1.5
2.0
2.5
3.0
3.5
4.0

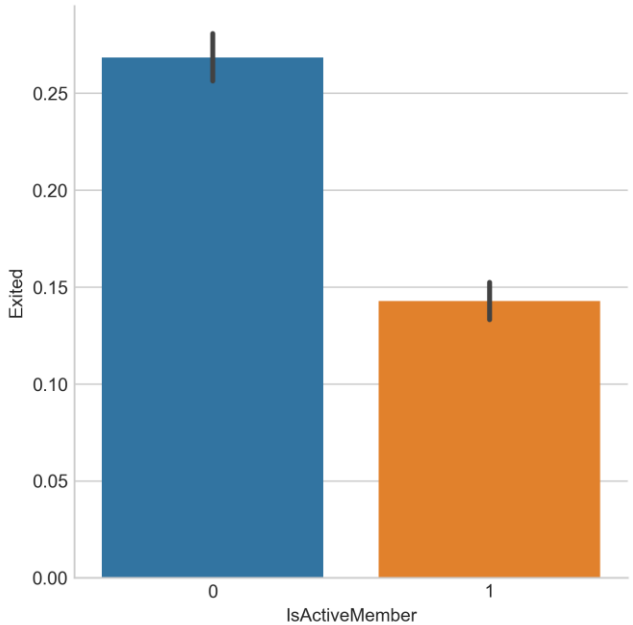

Tenure
1000
800
600
400
200
0
0
2
4
6
8
10

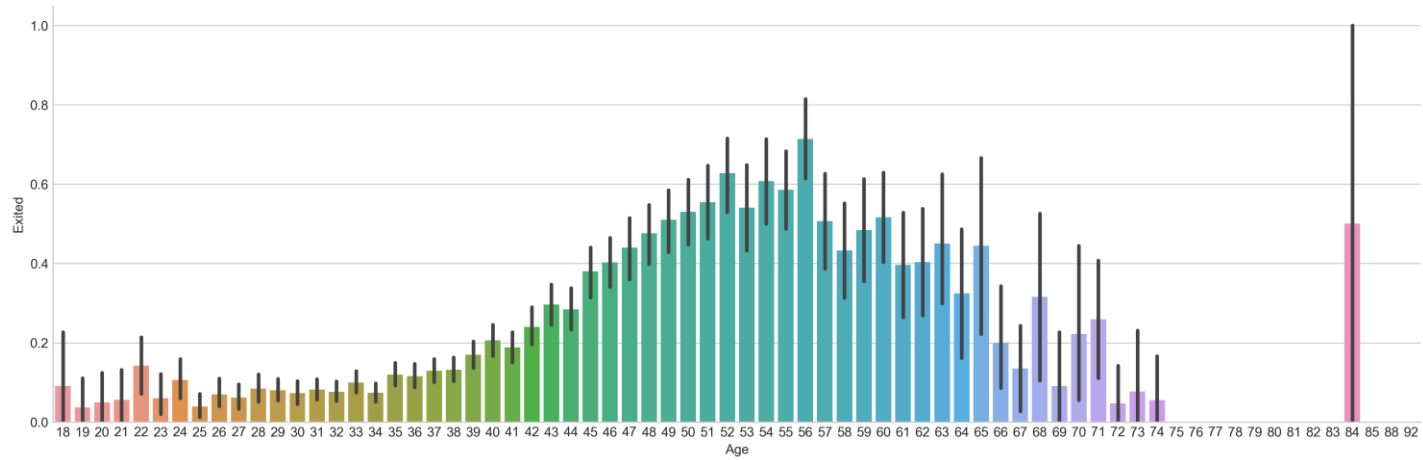

CreditScore
Age
Tenure
Balance
NumOfProducts
HasCrCard
IsActiveMember
EstimatedSalary
Exited
1 -0.004 0.00084 0.0063 0.012 -0.0055 0.026 -0.0014 -0.027
-0.004 1 -0.01 0.028 -0.031 -0.012 0.085 -0.0072 0.29
0.00084 -0.01 1 -0.012 0.013 0.023 -0.028 0.0078 -0.014
0.0063 0.028 -0.012 1 -0.3 -0.015 -0.01 0.013 0.12
0.012 -0.031 0.013 -0.3 1 0.0032 0.0096 0.014 -0.048
-0.0055 -0.012 0.023 -0.015 0.0032 1 -0.012 -0.0099 -0.0071
0.026 0.085 -0.028 -0.01 0.0096 -0.012 1 -0.011 -0.16
-0.0014 -0.0072 0.0078 0.013 0.014 -0.0099 -0.011 1 0.012
-0.027 0.29 -0.014 0.12 -0.048 -0.0071 -0.16 0.012 1
1.0
0.8
0.6
0.4
0.2
0.0
−0.2

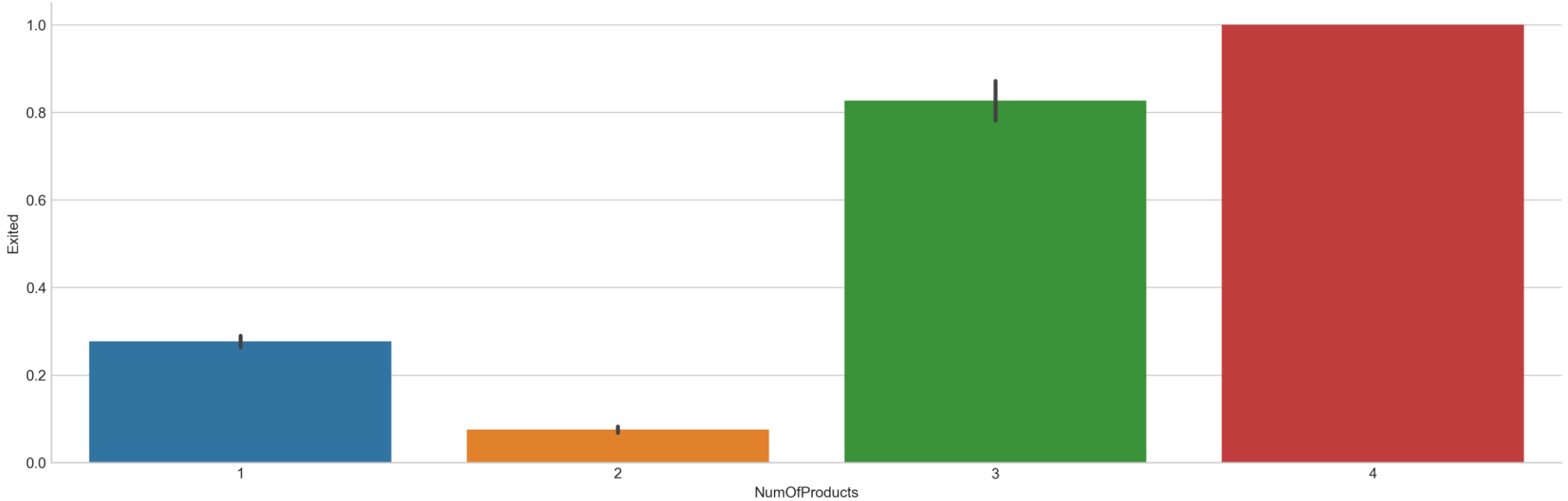

Exited
0.25
0.20
0.15
0.10
0.05
0.00
Female
Male
Gender

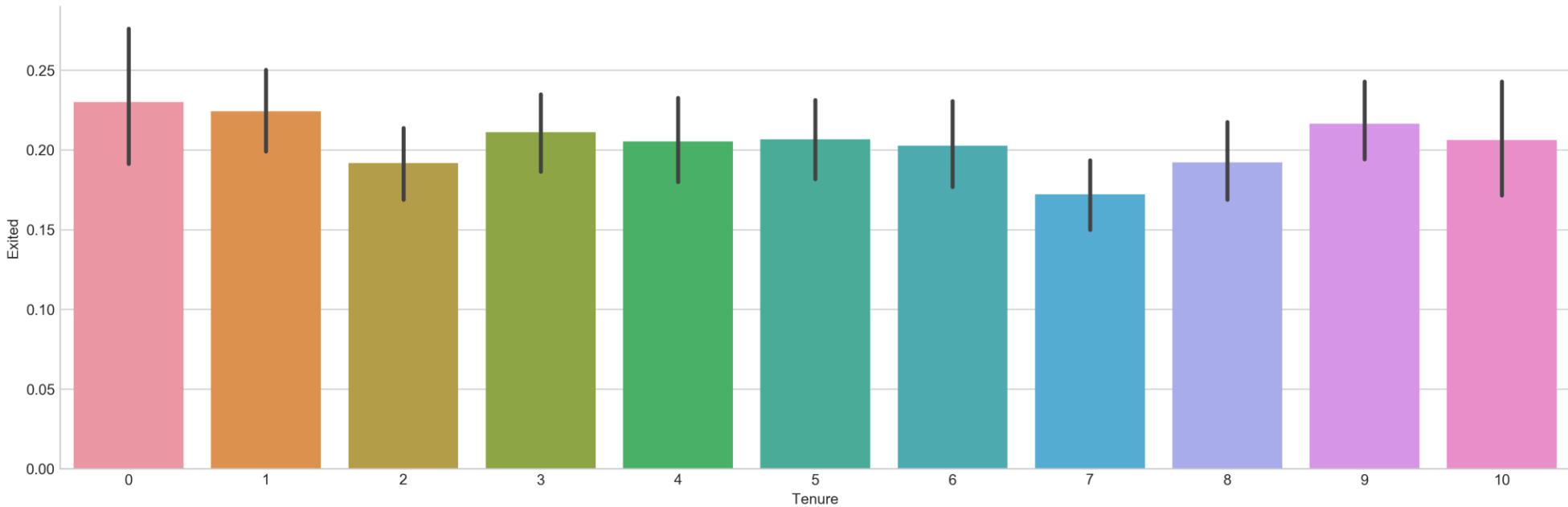

Exited
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
France
Spain
Germany
Geography

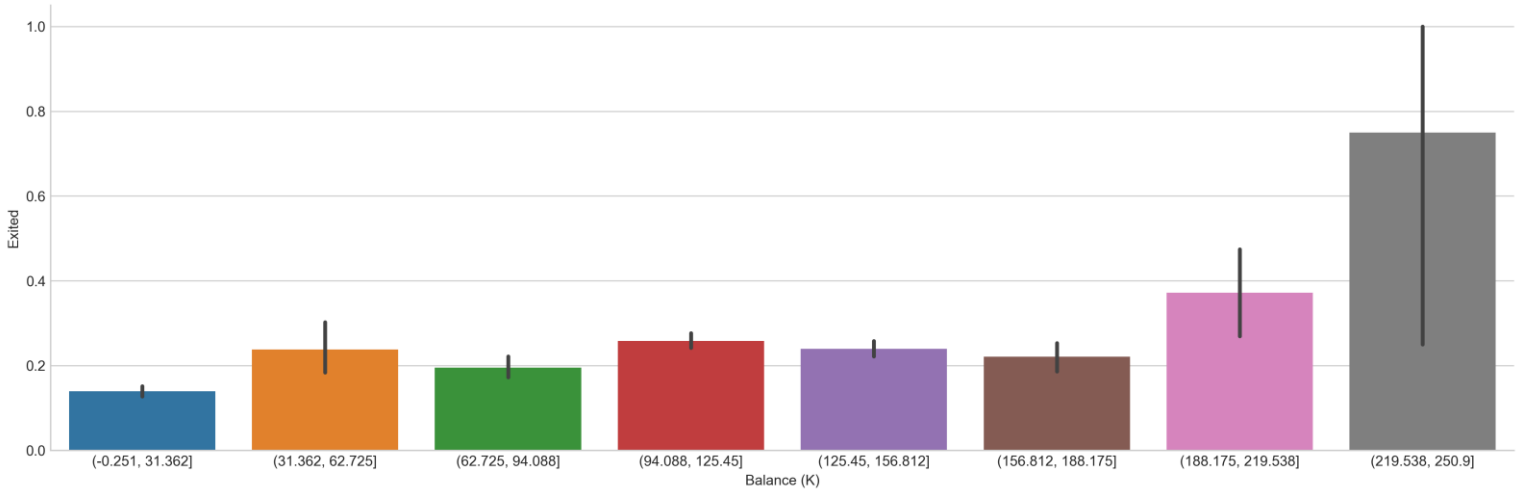

Exited
0.20
0.15
0.10
0.05
0.00
0
1
HasCrCard

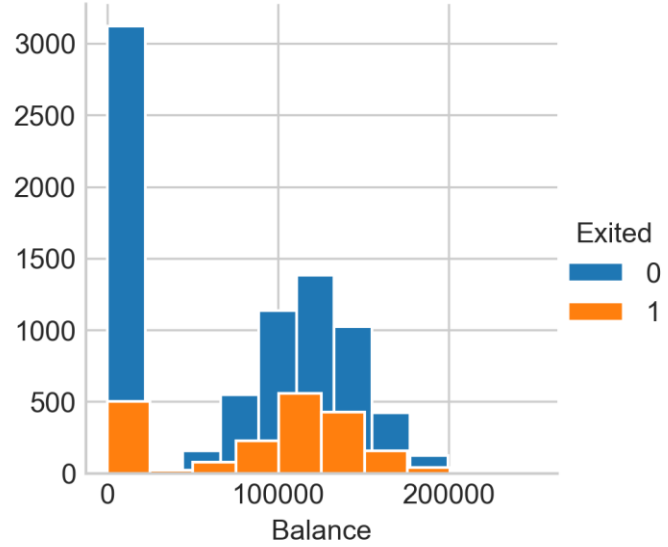

Exited
0.25
0.20
0.15
0.10
0.05
0.00
0
1
IsActiveMember

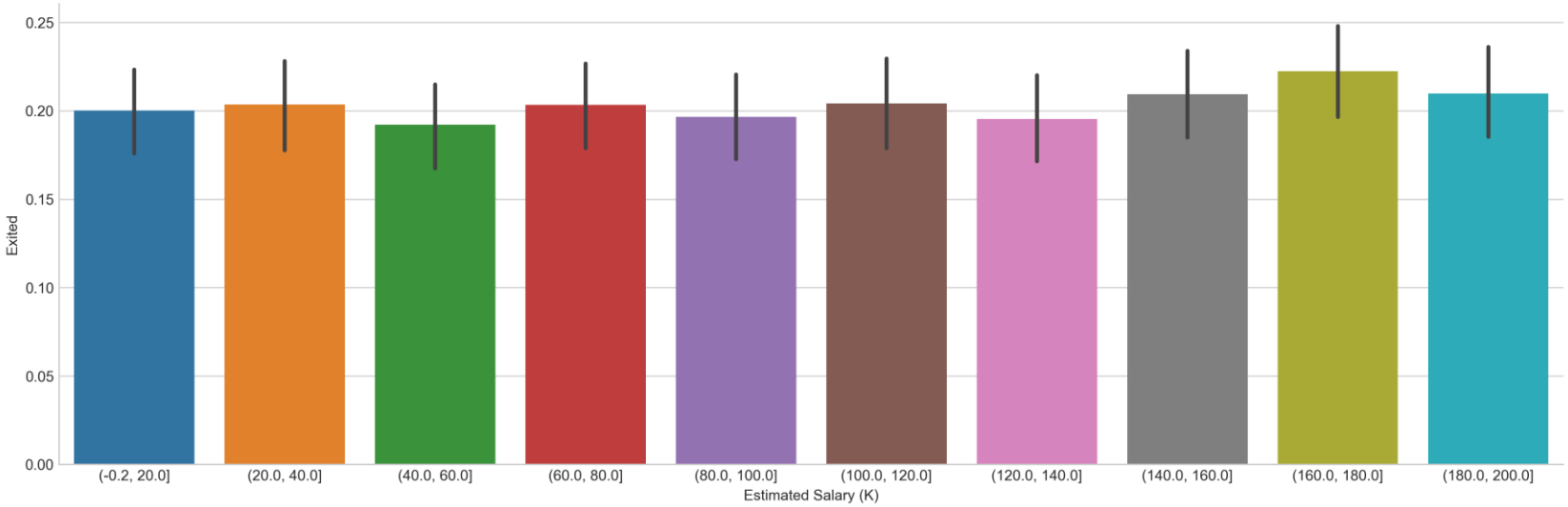

Exited
1.0
0.8
0.6
0.4
0.2
0.0
18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 88 92
Age

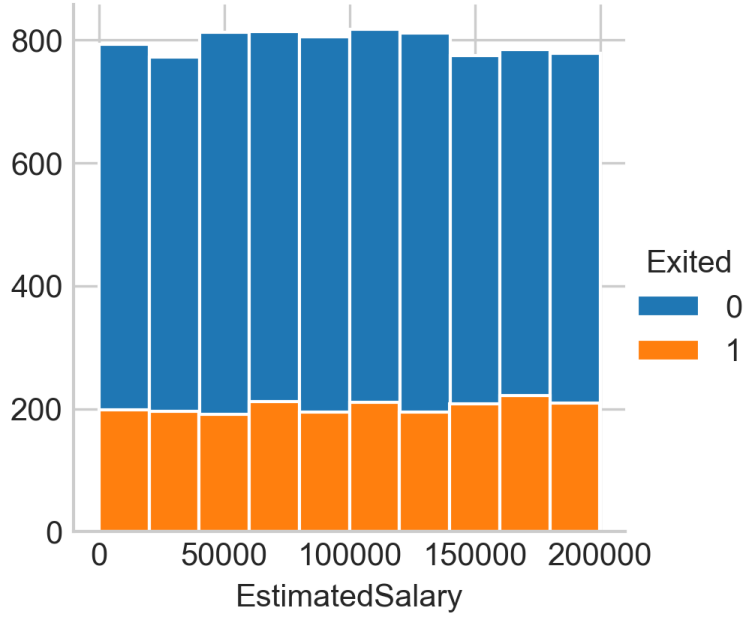

1.0
0.8
0.6
0.4
0.2
0.0
Exited
1
2
3
4
NumOfProducts

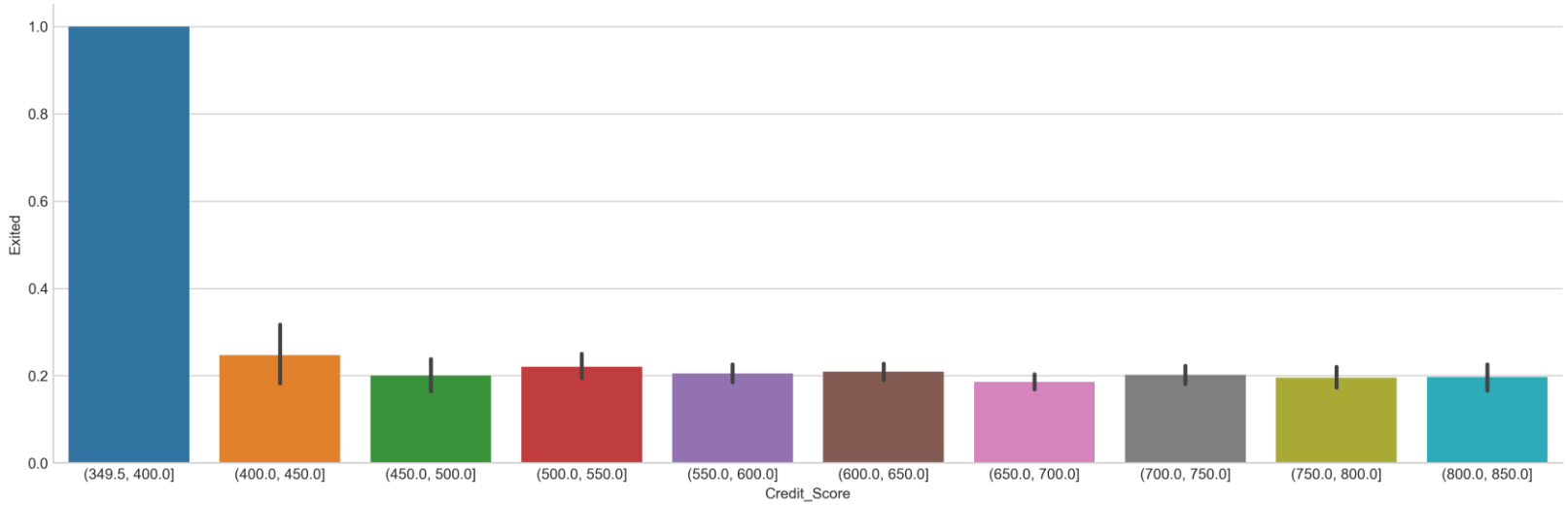

0.25
0.20
0.15
0.10
0.05
0.00
Exited
0
1
2
3
4
5
6
7
8
9
10
Tenure

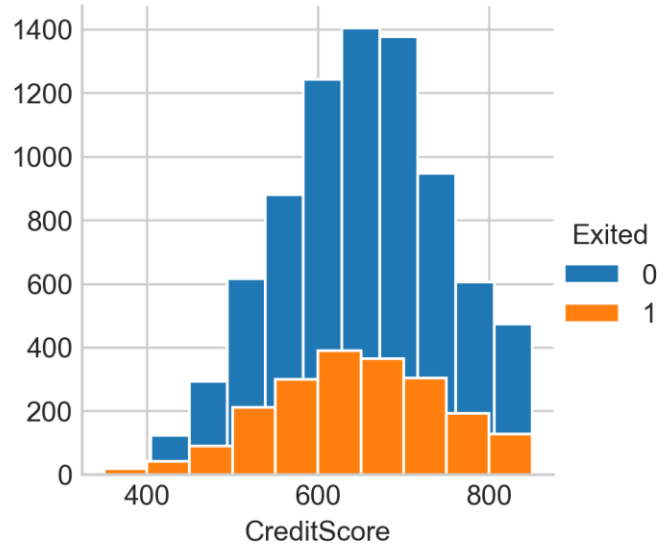

1.0
0.8
0.6
0.4
0.2
0.0
Exited
(-0.251, 31.362]
(31.362, 62.725]
(62.725, 94.088]
(94.088, 125.45]
(125.45, 156.812]
(156.812, 188.175]
(188.175, 219.538]
(219.538, 250.9]
Balance (K)


3000
2500
2000
1500
1000
500
0
0
100000
200000
Balance
Exited
0
1


0.25
0.20
0.15
0.10
0.05
0.00
Exited
(-0.2, 20.0]
(20.0, 40.0]
(40.0, 60.0]
(60.0, 80.0]
(80.0, 100.0]
(100.0, 120.0]
(120.0, 140.0]
(140.0, 160.0]
(160.0, 180.0]
(180.0, 200.0]
Estimated Salary (K)

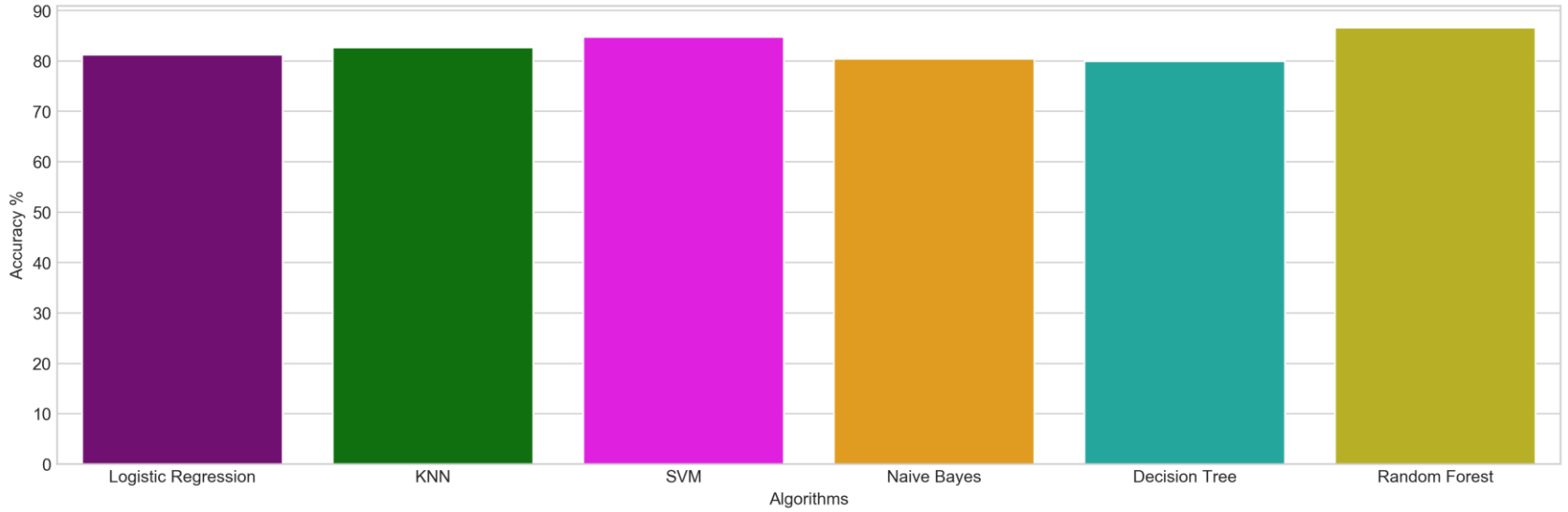

800
600
400
200
0
0
50000
100000
150000
200000
EstimatedSalary
Exited
0
1


1.0
0.8
0.6
0.4
0.2
0.0
Exited
(349.5, 400.0]
(400.0, 450.0]
(450.0, 500.0]
(500.0, 550.0]
(550.0, 600.0]
(600.0, 650.0]
(650.0, 700.0]
(700.0, 750.0]
(750.0, 800.0]
(800.0, 850.0]
Credit_Score

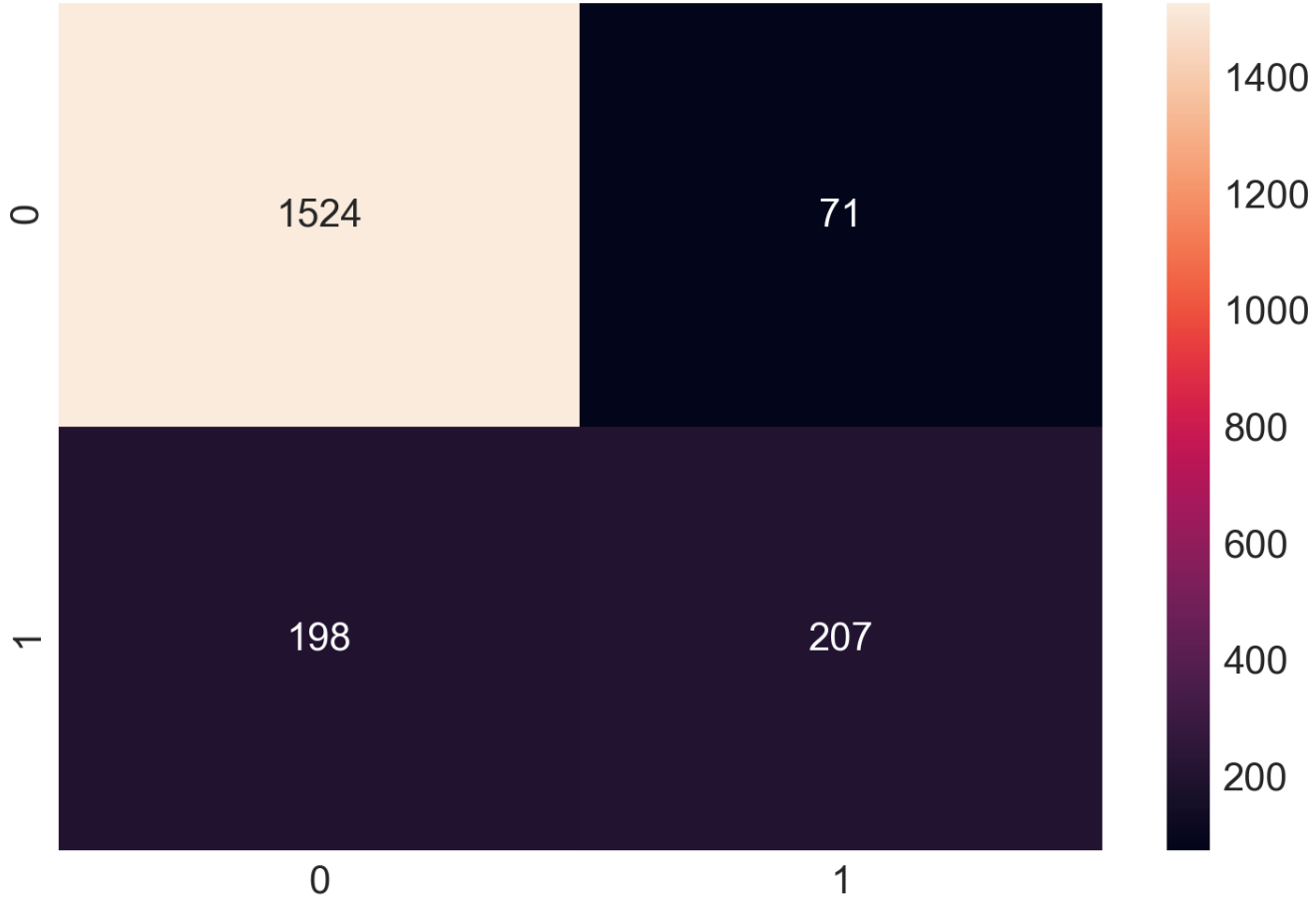

1400
1200
1000
800
600
400
200
0
400
600
800
CreditScore
Exited
0
1

Predict with Different Model

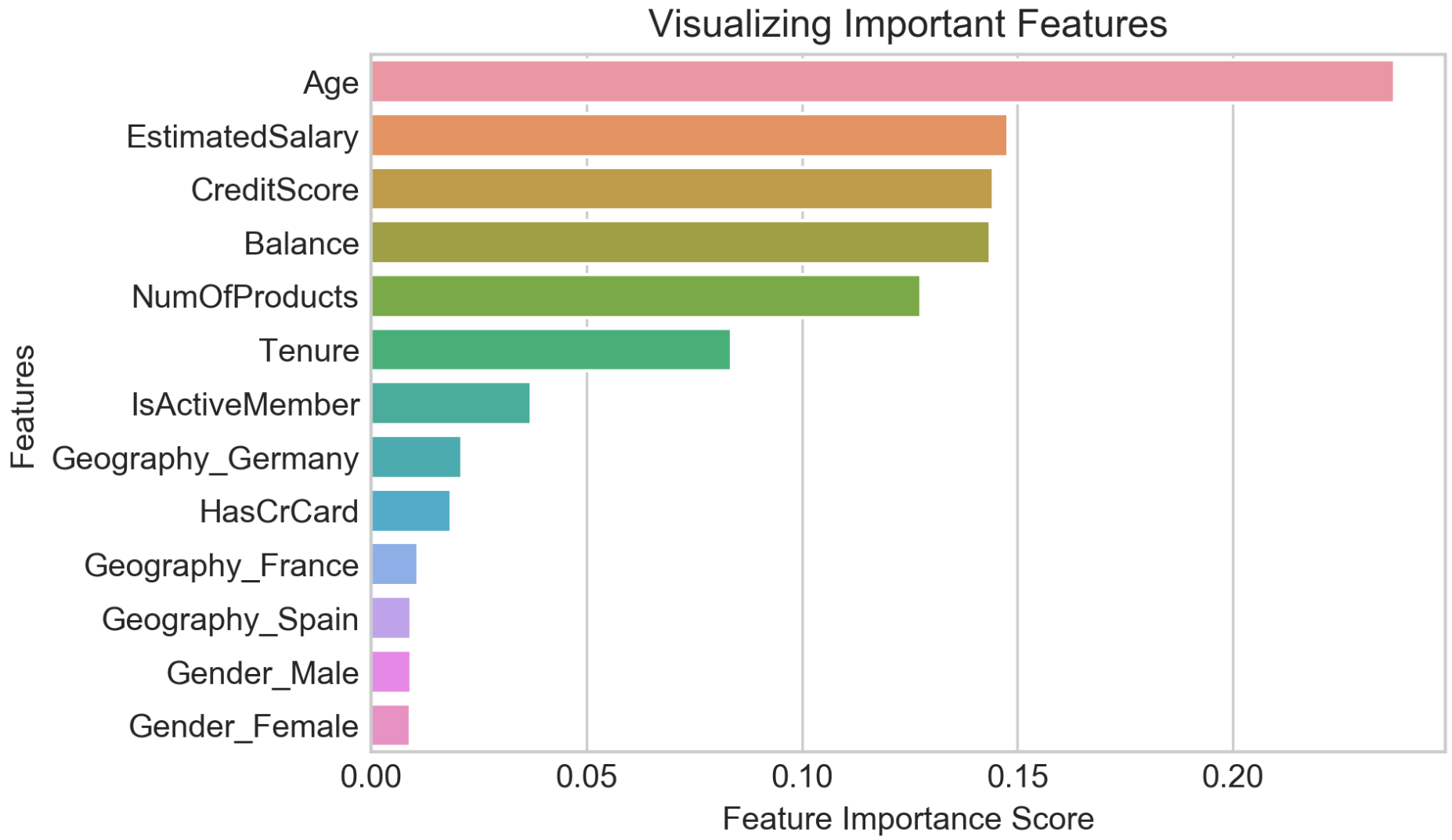
Model	Accuracy
Logistic Regression	81.20%
KNN (k=7)	82.60%
SVM	84.70%
Naive Bayes	80.35%
Decision Tree	81.15%
Random Forest	86.55%



Random Forest – Confusion Matrix



Random Forest – Important Features



Conclusion

- limitation: imbalanced dataset
- Who is more likely to leave?
  - Female
  - Germany
  - Not active Member
  - 40 ~ 50 years old
  - who has products > 2
  - whose balance > 190000