```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn import preprocessing
%matplotlib inline
```

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call
```

```
df = pd.read_csv('/content/Churn_Modelling.csv')
df
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Gender	Age	Ten
0	1	15634602	Hargrave	619	France	Female	42	
1	2	15647311	Hill	608	Spain	Female	41	
2	3	15619304	Onio	502	France	Female	42	
3	4	15701354	Boni	699	France	Female	39	
4	5	15737888	Mitchell	850	Spain	Female	43	
...	...	...	...	...	...	...	...	...
9995	9996	15606229	Obijiaku	771	France	Male	39	
9996	9997	15569892	Johnstone	516	France	Male	35	
9997	9998	15584532	Liu	709	France	Female	36	
9998	9999	15682355	Sabbatini	772	Germany	Male	42	
9999	10000	15628319	Walker	792	France	Female	28	

10000 rows × 14 columns

```
df.shape
```

```
(10000, 14)
```

```
df.columns
```

```
Index(['RowNumber', 'CustomerId', 'Surname', 'CreditScore', 'Geography',
       'Gender', 'Age', 'Tenure', 'Balance', 'NumOfProducts', 'HasCrCard',
       'IsActiveMember', 'EstimatedSalary', 'Exited'],
      dtype='object')
```

```
df['Male'] = pd.get_dummies(df['Gender']).drop('Female', axis=1)
df['Male'].head()
```

```
0    0
1    0
2    0
3    0
4    0
Name: Male, dtype: uint8
```

```
df = df.drop('Gender', axis=1)
df.head()
```

	RowNumber	CustomerId	Surname	CreditScore	Geography	Age	Tenure	Balan
0	1	15634602	Hargrave	619	France	42	2	0.
1	2	15647311	Hill	608	Spain	41	1	83807.
2	3	15619304	Onio	502	France	42	8	159660.
3	4	15701354	Boni	699	France	39	1	0.
4	5	15737888	Mitchell	850	Spain	43	2	125510.

```
encoder = preprocessing.LabelEncoder()
print(df['Geography'].unique())
print(encoder.fit_transform(df['Geography'].unique()))
df['Geography'] = encoder.fit_transform(df['Geography'])
```

```
['France' 'Spain' 'Germany']
[0 2 1]
```

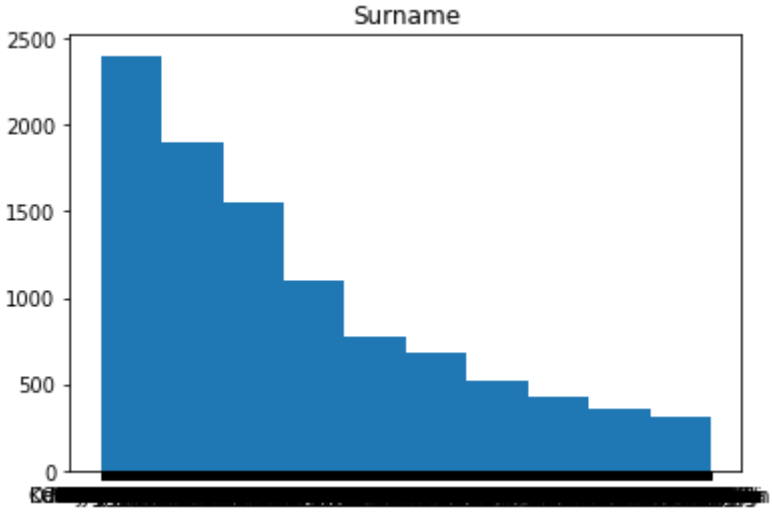
```
df = df.drop('RowNumber', axis=1)
```

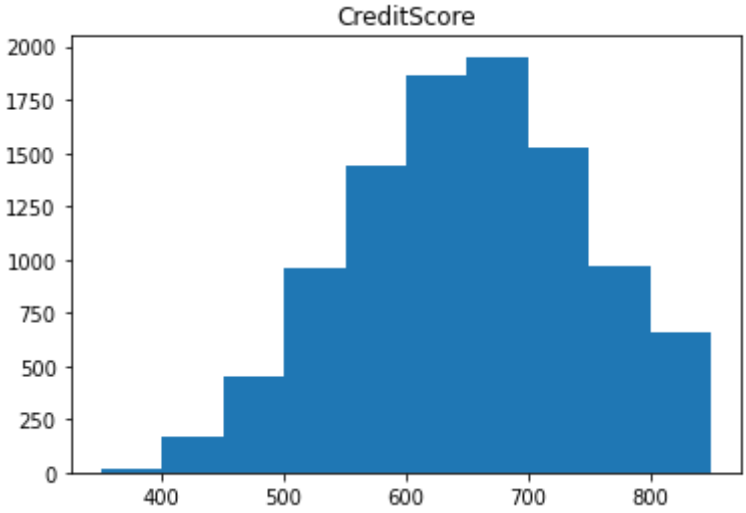
```
df = df.drop('CustomerId', axis=1)
```

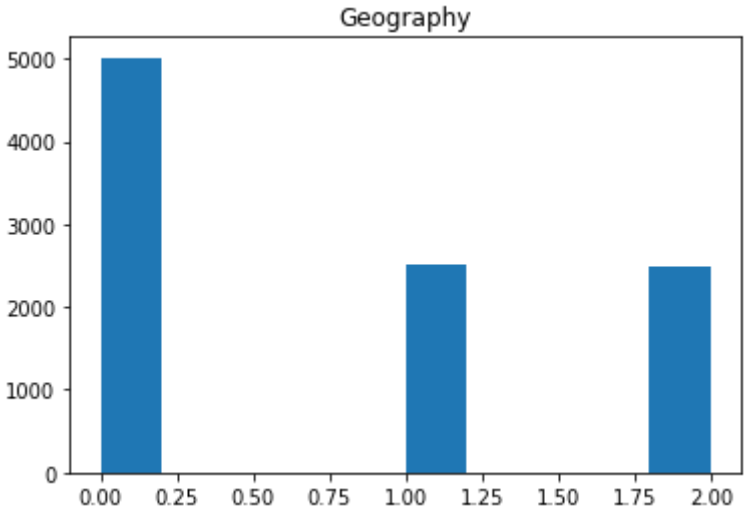
Univariate Analysis

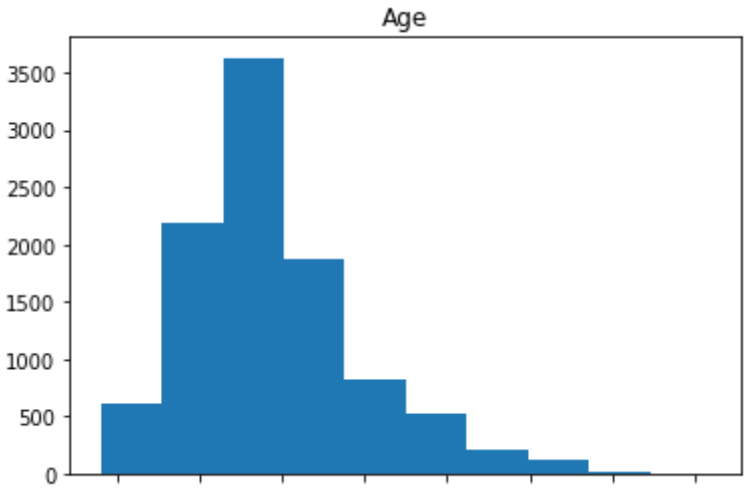
Histogram

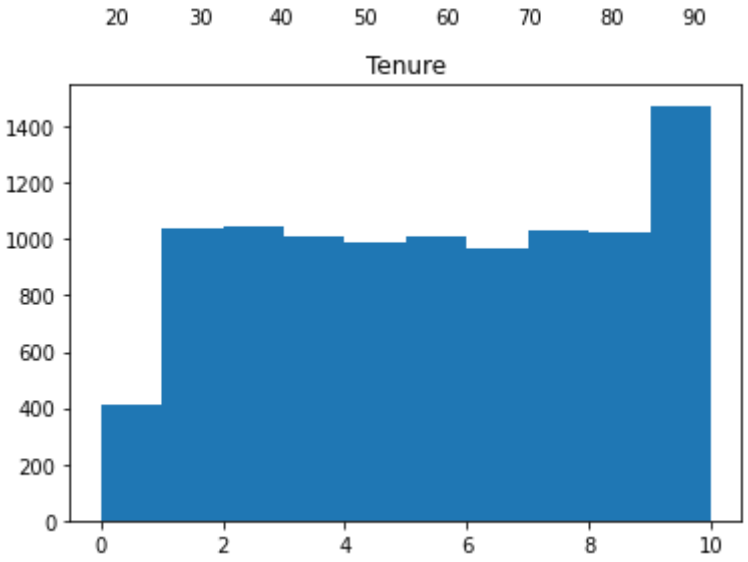
```
for i in df.columns:
  plt.hist(df[i])
  plt.title(i)
  plt.show()
```

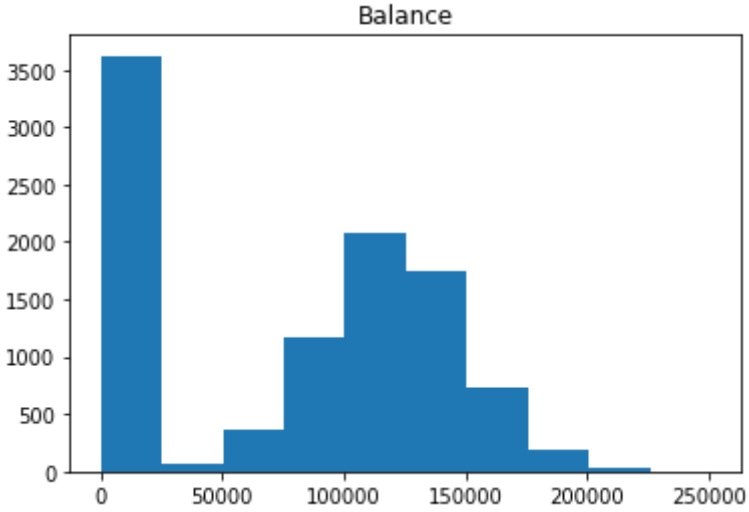

Surname
2500
2000
1500
1000
500
0

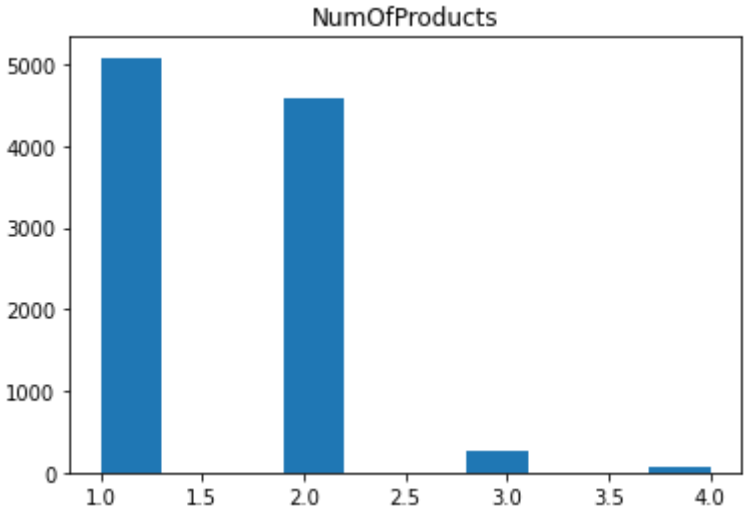

CreditScore
2000
1750
1500
1250
1000
750
500
250
0
400
500
600
700
800

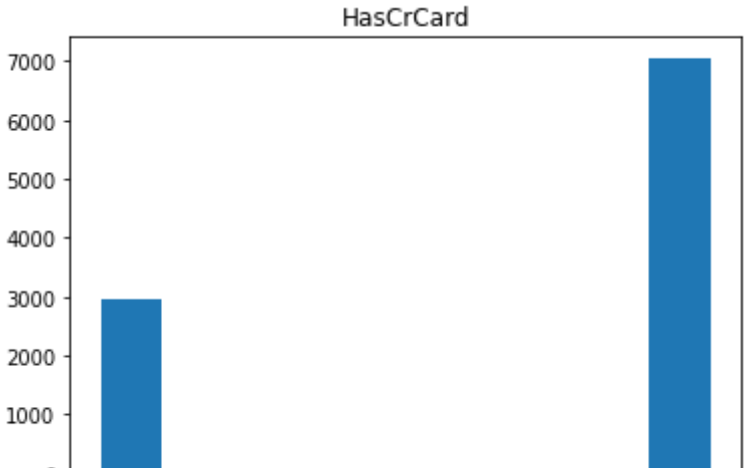

Geography
5000
4000
3000
2000
1000
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

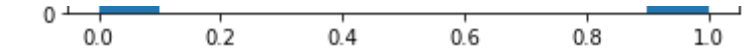

Age
3500
3000
2500
2000
1500
1000
500
0

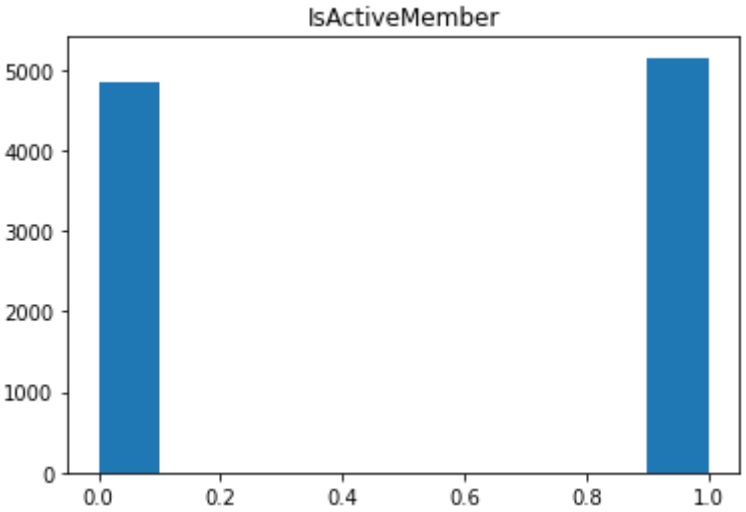

20 30 40 50 60 70 80 90
Tenure
1400
1200
1000
800
600
400
200
0
0 2 4 6 8 10

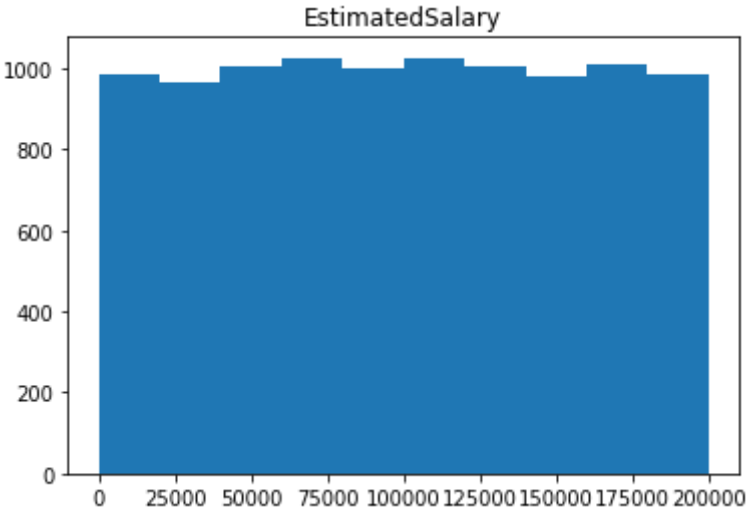

Balance
3500
3000
2500
2000
1500
1000
500
0
0 50000 100000 150000 200000 250000

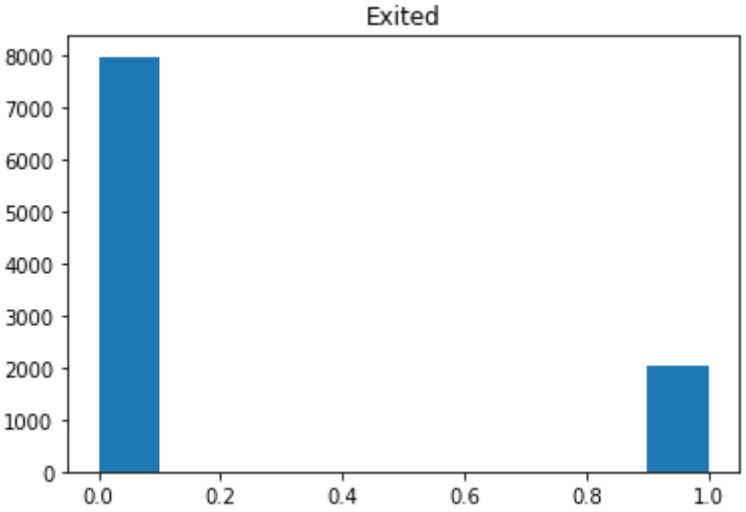

NumOfProducts
5000
4000
3000
2000
1000
0
1.0 1.5 2.0 2.5 3.0 3.5 4.0

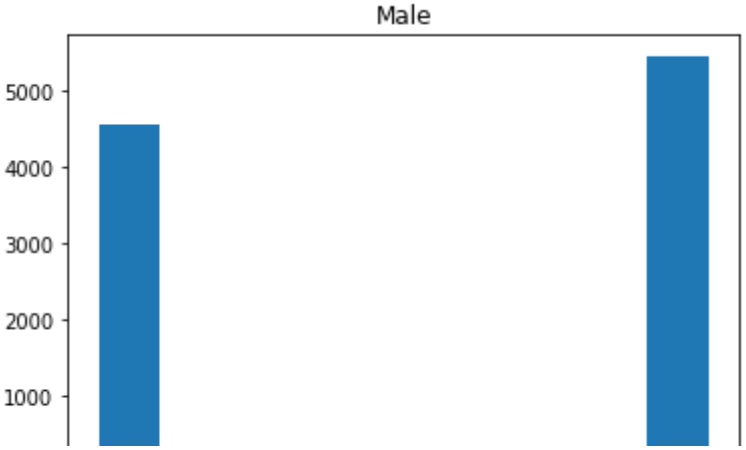

HasCrCard
7000
6000
5000
4000
3000
2000
1000


0
0.0
0.2
0.4
0.6
0.8
1.0


IsActiveMember
5000
4000
3000
2000
1000
0
0.0
0.2
0.4
0.6
0.8
1.0

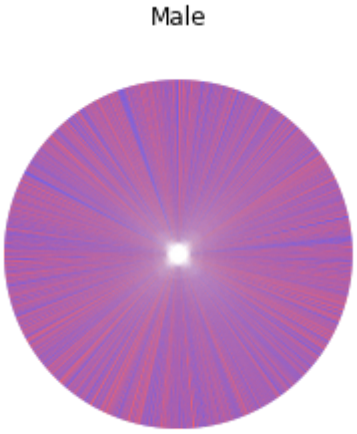

EstimatedSalary
1000
800
600
400
200
0
0
25000
50000
75000
100000
125000
150000
175000
200000


Exited
8000
7000
6000
5000
4000
3000
2000
1000
0
0.0
0.2
0.4
0.6
0.8
1.0


Male
5000
4000
3000
2000
1000

Pie Chart

```
column_name = 'Male'
plt.pie(df[column_name], colors = ['red','blue'])
plt.title(column_name)
plt.show()
```

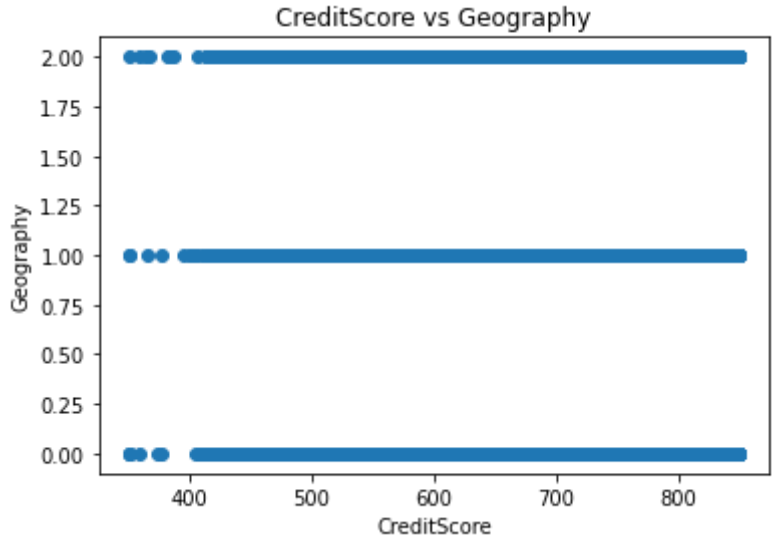


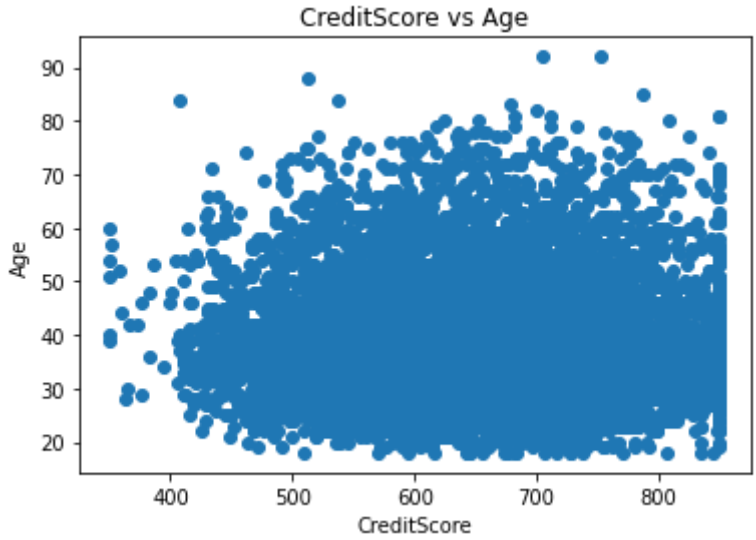
Bivariate Analysis

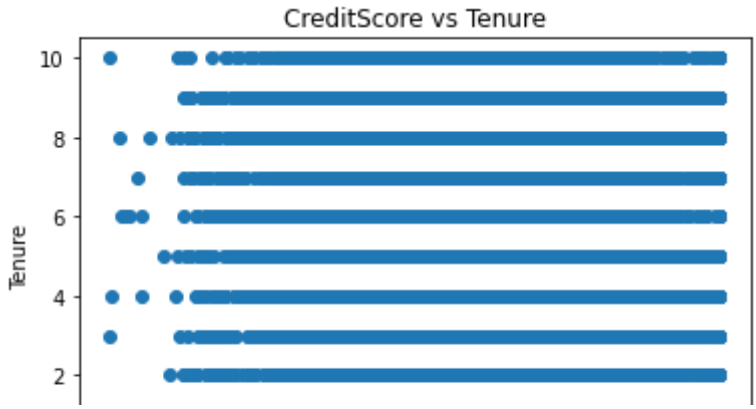
Scatter Plot

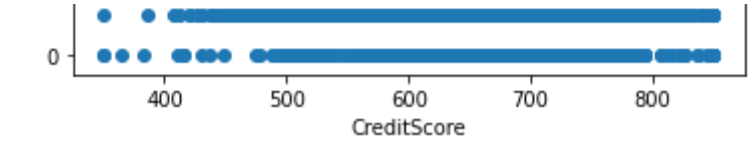
```
for i in df.columns:
  for j in df.columns:
    if i != 'Surname':
      if j != 'Surname':
        plt.scatter(df[i],df[j])
        plt.xlabel(i)
        plt.ylabel(j)
        plt.title(f'{i} vs {j}')
        plt.show()
```

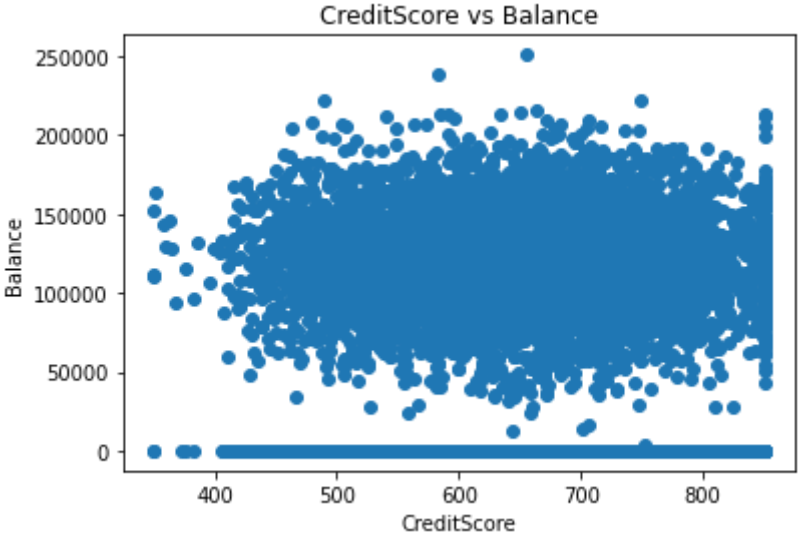
CreditScore vs CreditScore
CreditScore
CreditScore
400
500
600
700
800

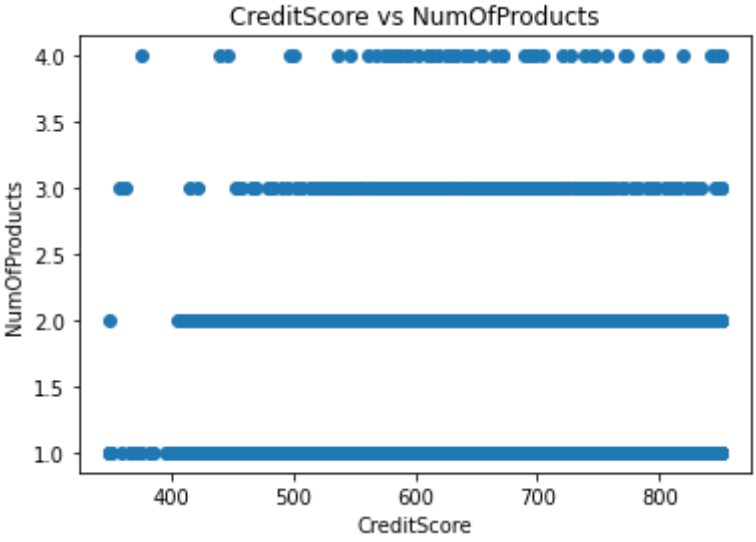

CreditScore vs Geography
Geography
CreditScore
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
400
500
600
700
800

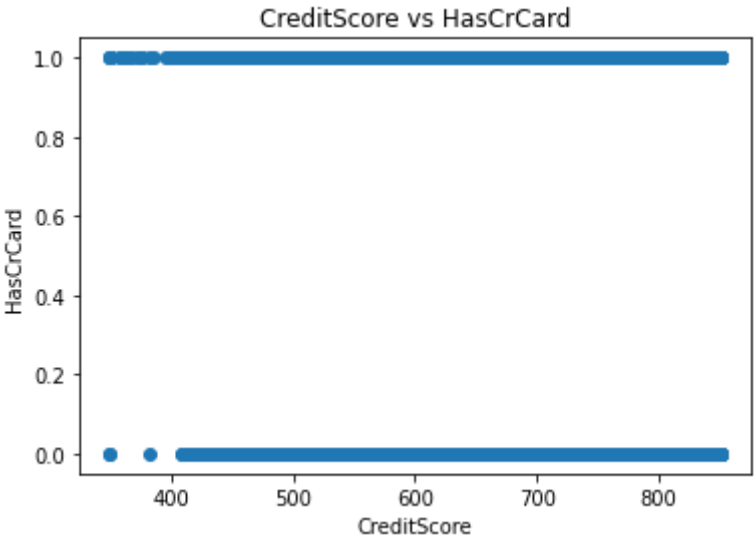

CreditScore vs Age
Age
CreditScore
20
30
40
50
60
70
80
90
400
500
600
700
800

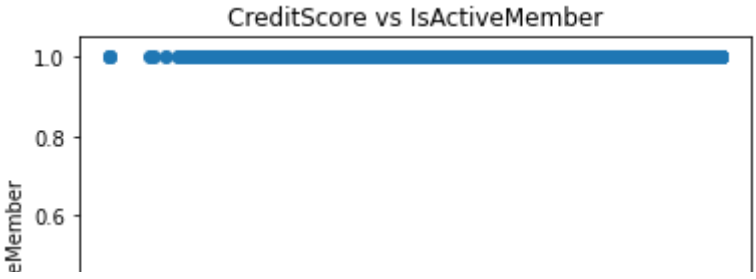

CreditScore vs Tenure
Tenure
2
4
6
8
10

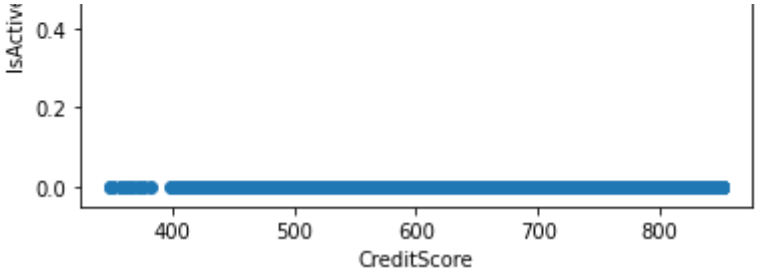

0
400
500
600
700
800
CreditScore

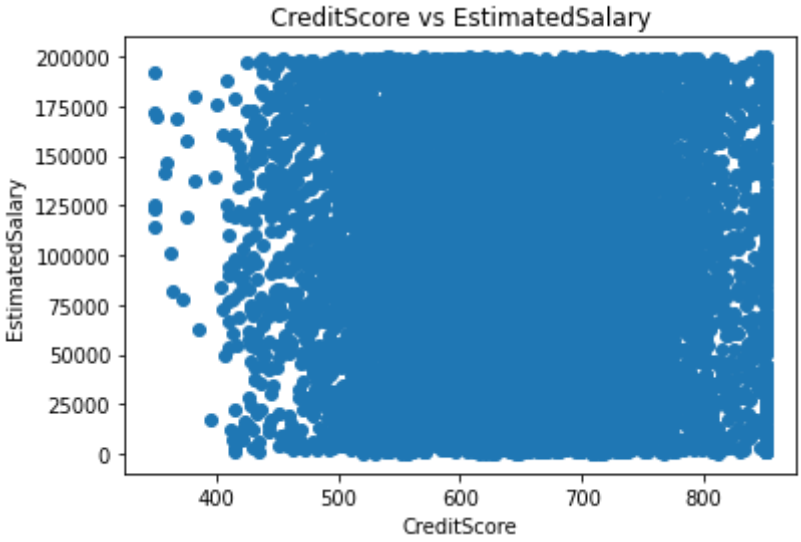

CreditScore vs Balance
250000
200000
150000
100000
50000
0
Balance
400
500
600
700
800
CreditScore

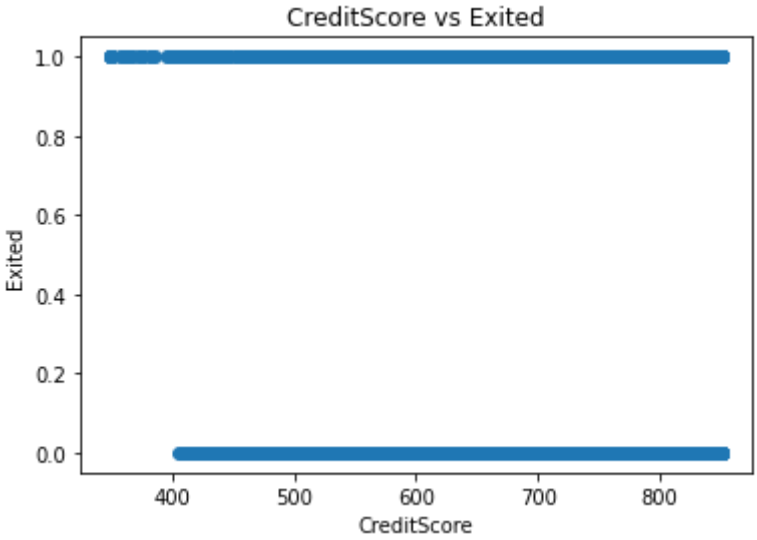

CreditScore vs NumOfProducts
4.0
3.5
3.0
2.5
2.0
1.5
1.0
NumOfProducts
400
500
600
700
800
CreditScore

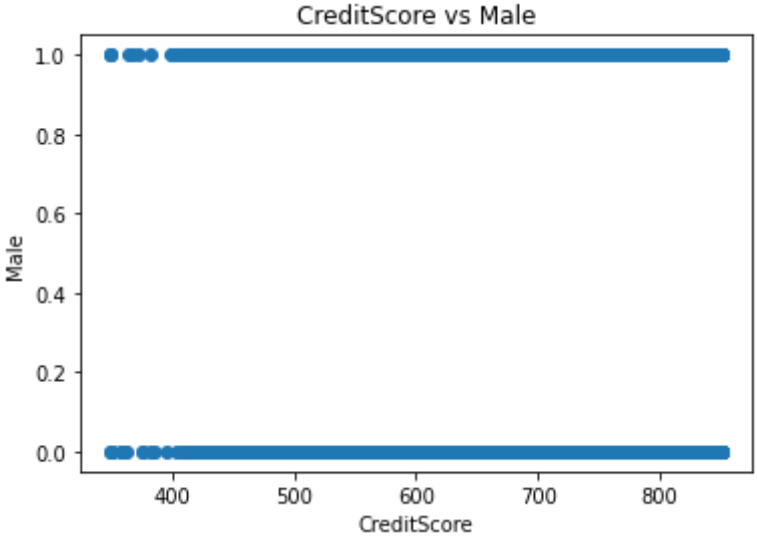

CreditScore vs HasCrCard
1.0
0.8
0.6
0.4
0.2
0.0
HasCrCard
400
500
600
700
800
CreditScore

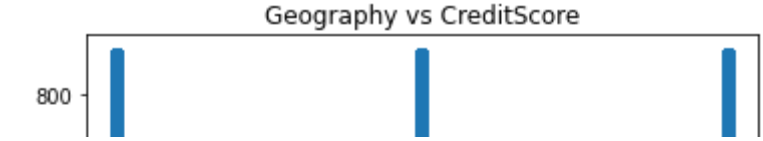

CreditScore vs IsActiveMember
1.0
0.8
0.6

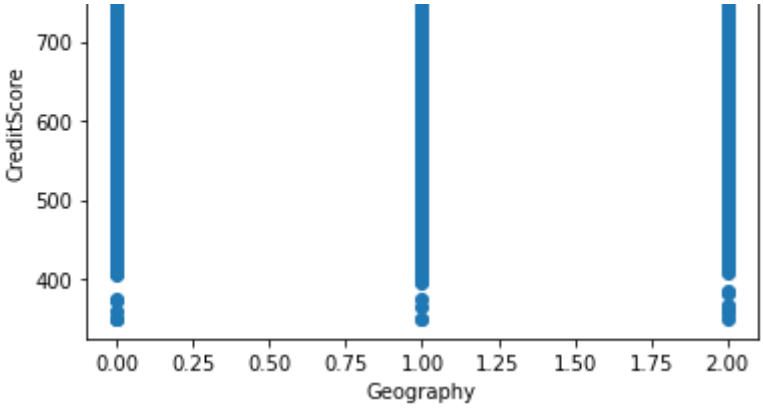

IsActiv
0.4
0.2
0.0
400
500
600
700
800
CreditScore

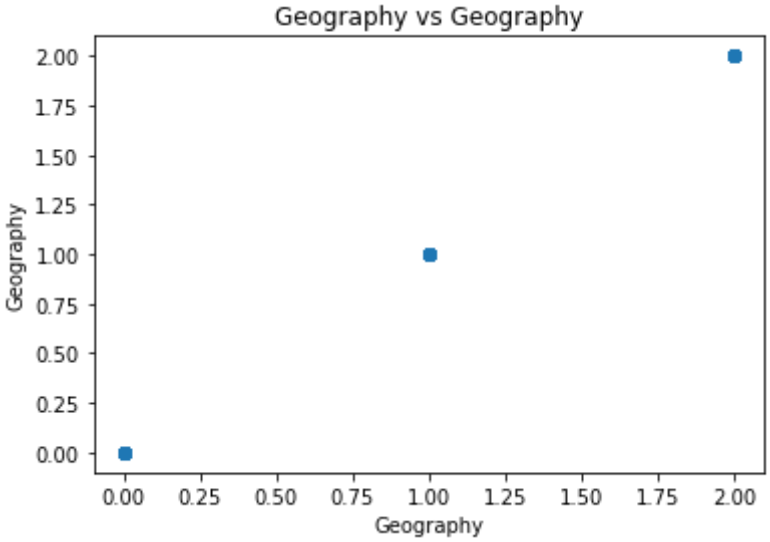

CreditScore vs EstimatedSalary
EstimatedSalary
200000
175000
150000
125000
100000
75000
50000
25000
0
400
500
600
700
800
CreditScore

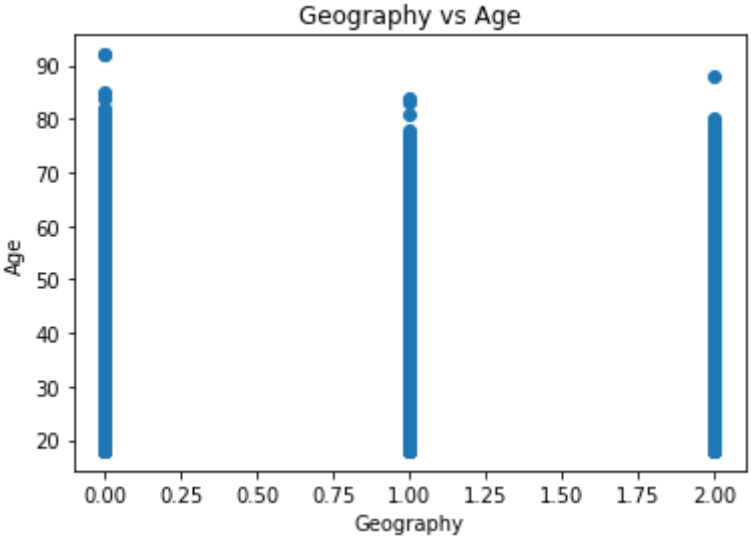

CreditScore vs Exited
Exited
1.0
0.8
0.6
0.4
0.2
0.0
400
500
600
700
800
CreditScore

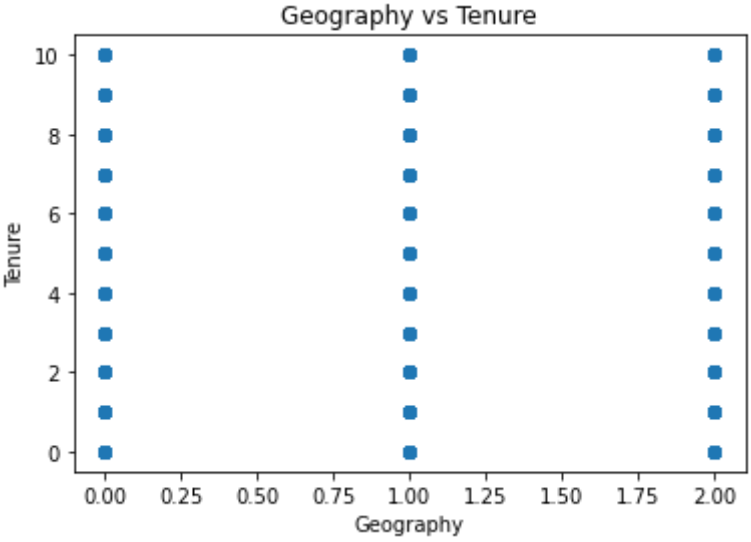

CreditScore vs Male
Male
1.0
0.8
0.6
0.4
0.2
0.0
400
500
600
700
800
CreditScore

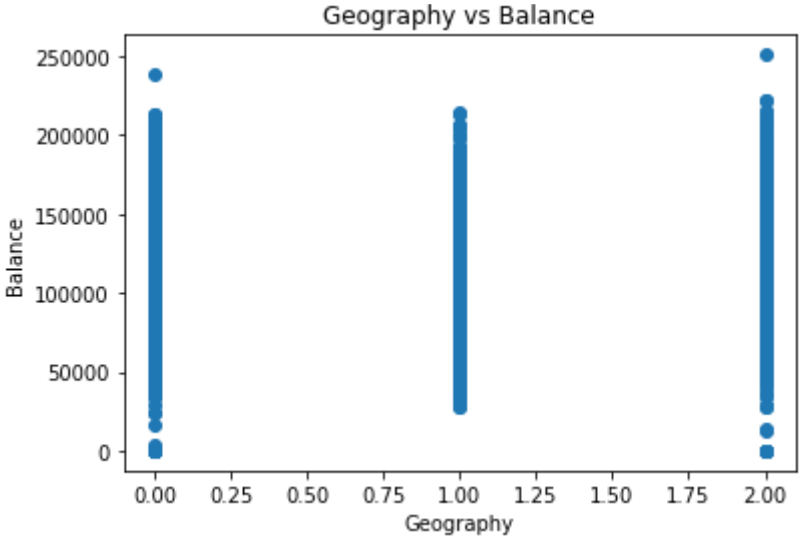

Geography vs CreditScore
800

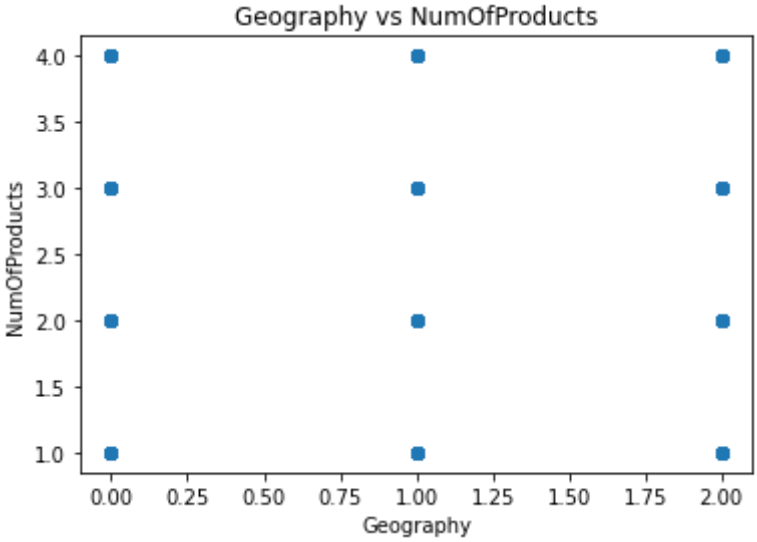

CreditScore
700
600
500
400
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Geography

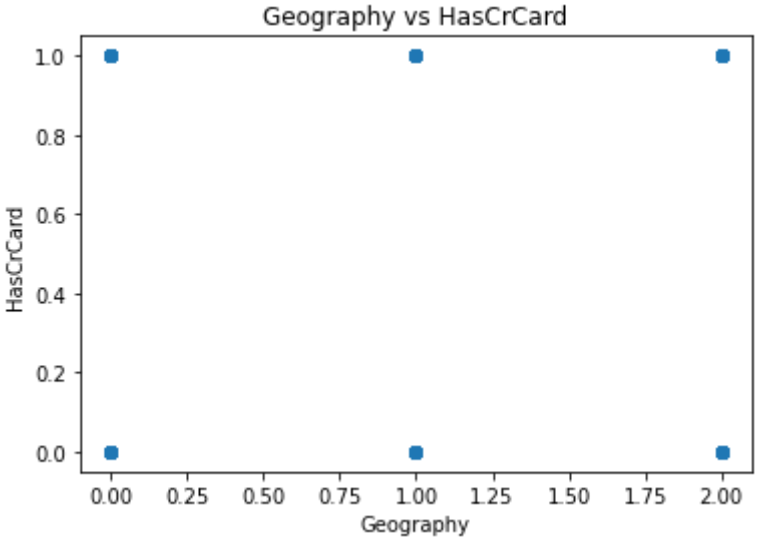

Geography vs Geography
Geography
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Geography

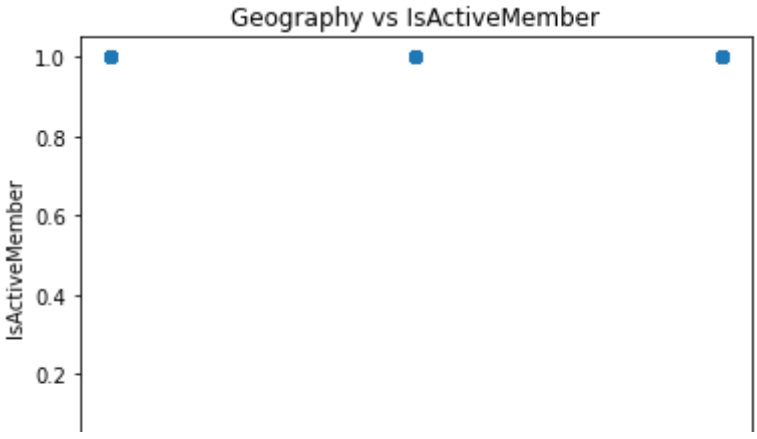

Geography vs Age
Age
90
80
70
60
50
40
30
20
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Geography

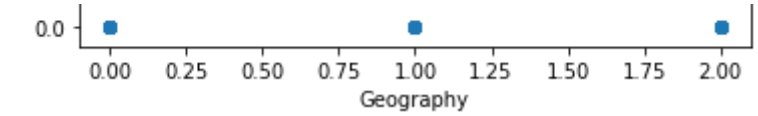

Geography vs Tenure
Tenure
10
8
6
4
2
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Geography

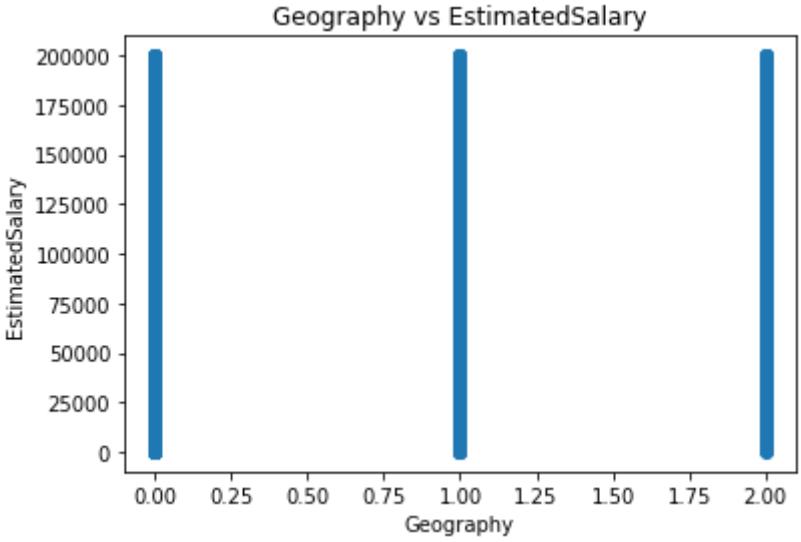

Geography vs Balance
Balance
Geography
250000
200000
150000
100000
50000
0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

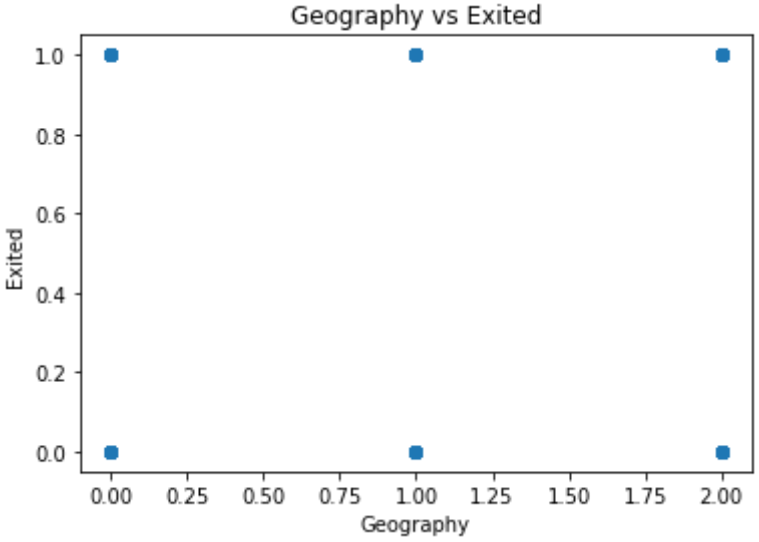

Geography vs NumOfProducts
NumOfProducts
Geography
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

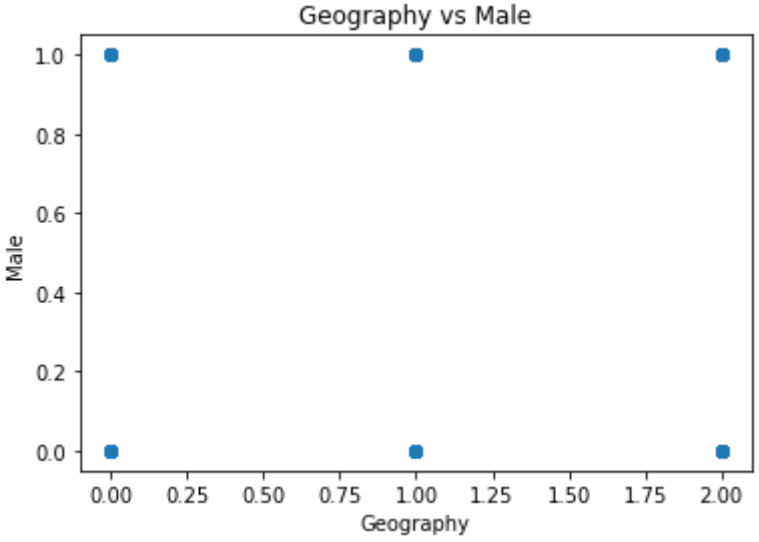

Geography vs HasCrCard
HasCrCard
Geography
1.0
0.8
0.6
0.4
0.2
0.0
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00

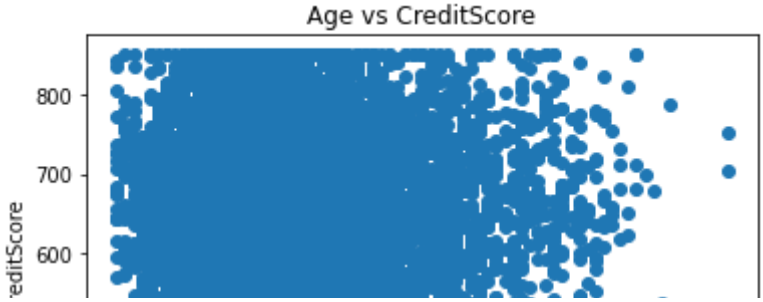

Geography vs IsActiveMember
IsActiveMember
1.0
0.8
0.6
0.4
0.2

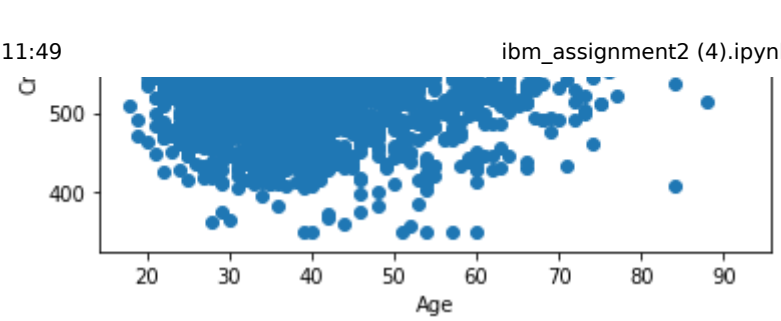

0.0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Geography

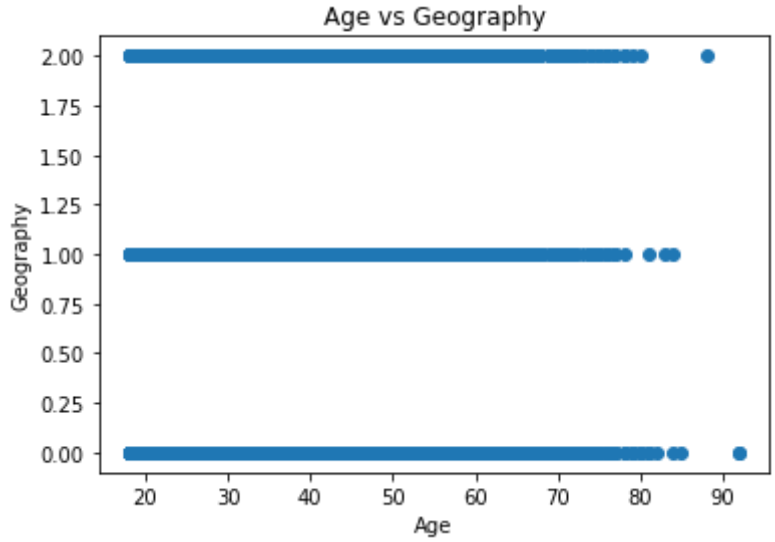

Geography vs EstimatedSalary
EstimatedSalary
200000
175000
150000
125000
100000
75000
50000
25000
0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Geography

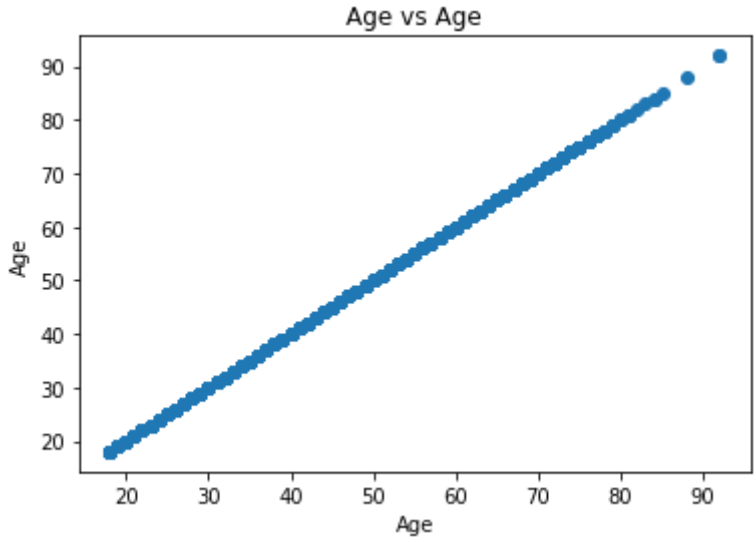

Geography vs Exited
Exited
1.0
0.8
0.6
0.4
0.2
0.0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Geography

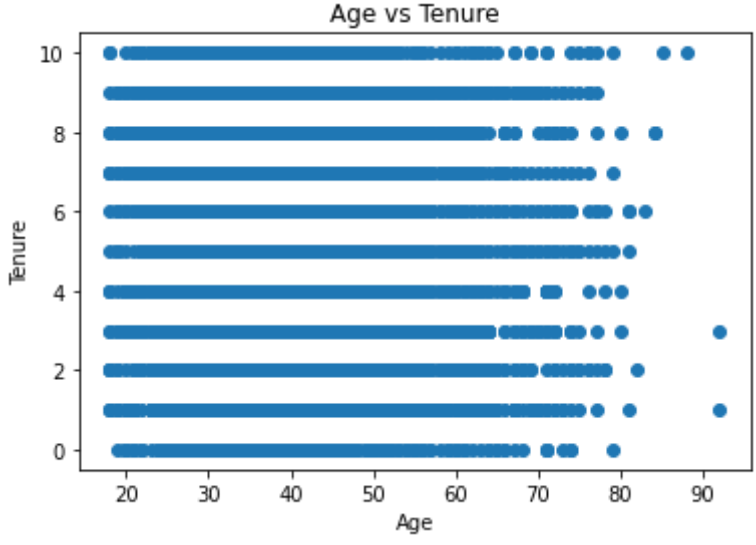

Geography vs Male
Male
1.0
0.8
0.6
0.4
0.2
0.0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Geography

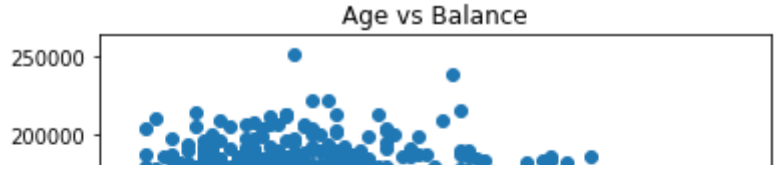

Age vs CreditScore
800
700
600

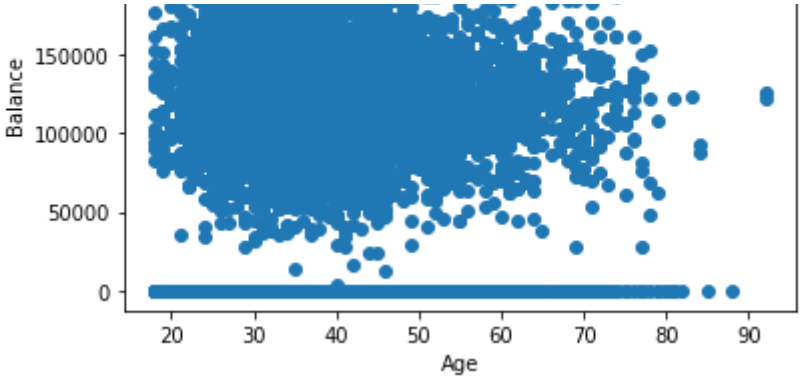

Cr
500
400
20
30
40
50
60
70
80
90
Age

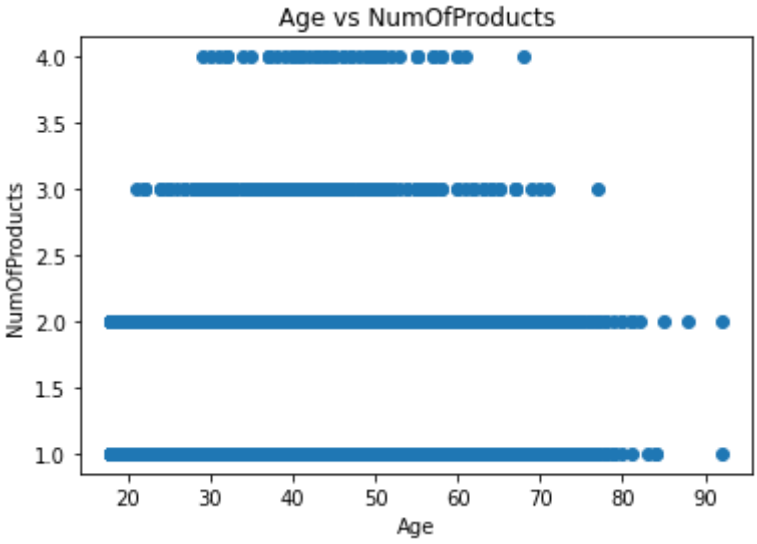

Age vs Geography
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Geography
20
30
40
50
60
70
80
90
Age

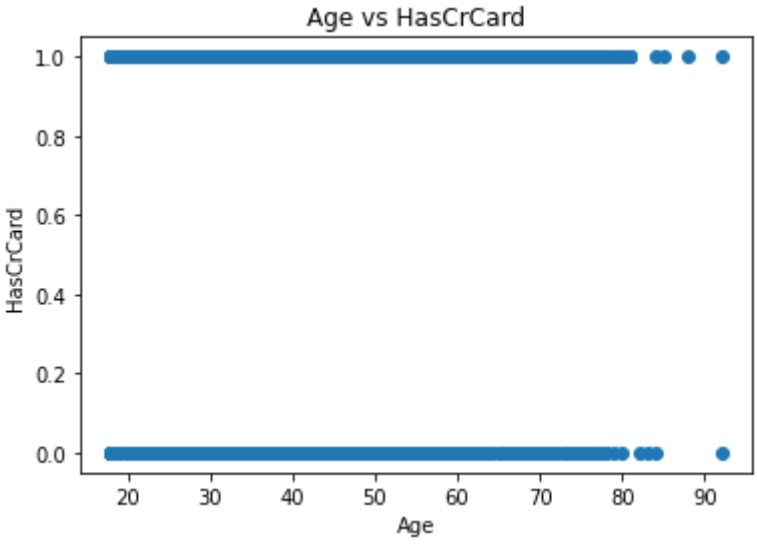

Age vs Age
90
80
70
60
50
40
30
20
Age
20
30
40
50
60
70
80
90
Age

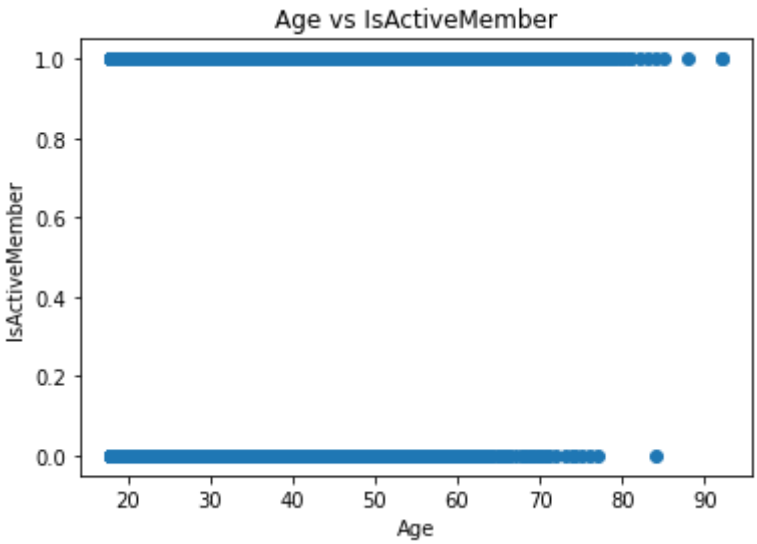

Age vs Tenure
10
8
6
4
2
0
Tenure
20
30
40
50
60
70
80
90
Age


Age vs Balance
250000
200000

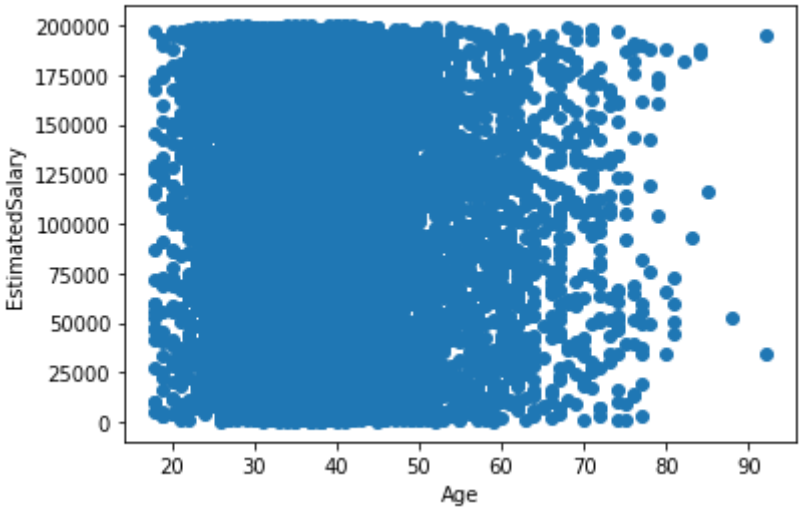


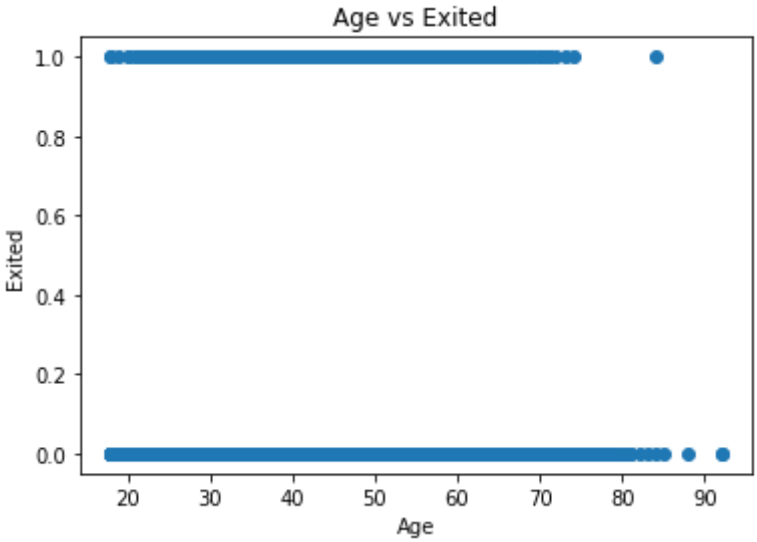


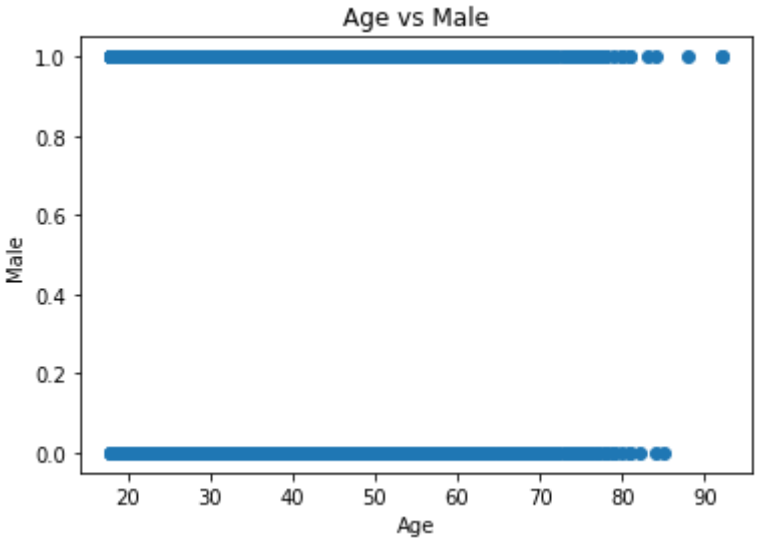


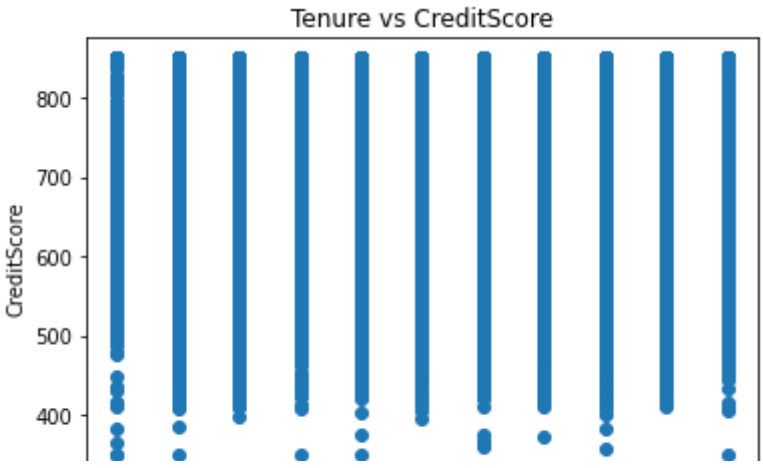


Age vs EstimatedSalary

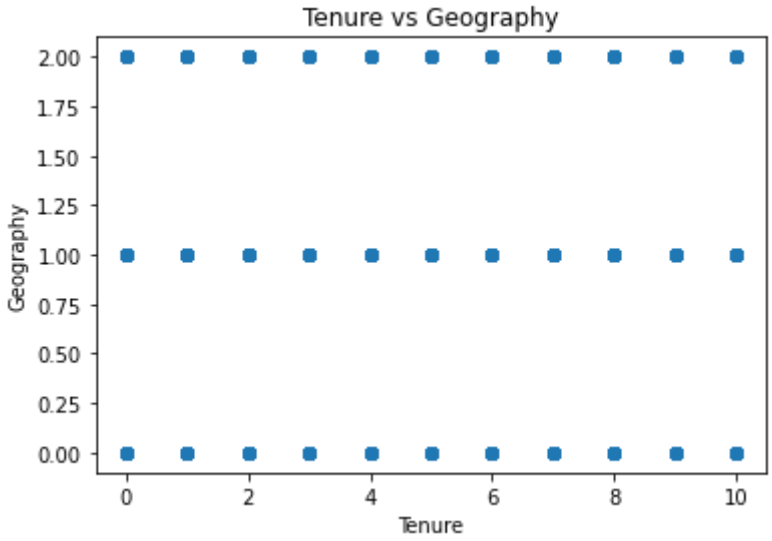

EstimatedSalary
Age

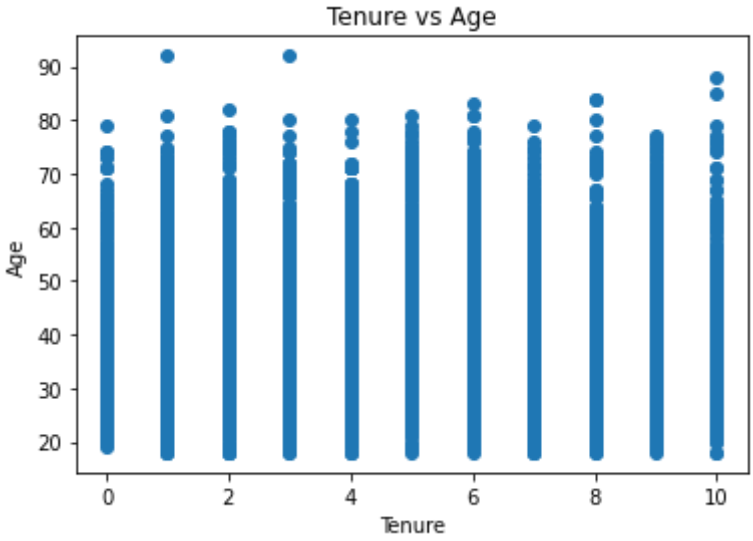

Age vs Exited
Exited
Age

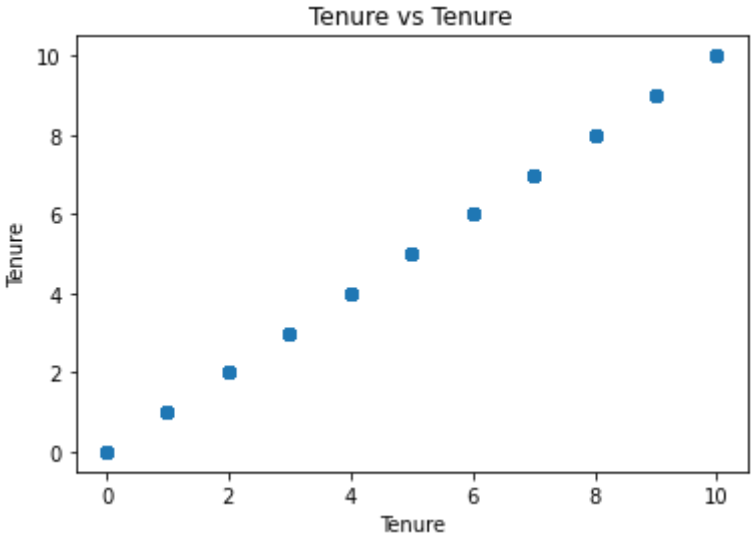

Age vs Male
Male
Age

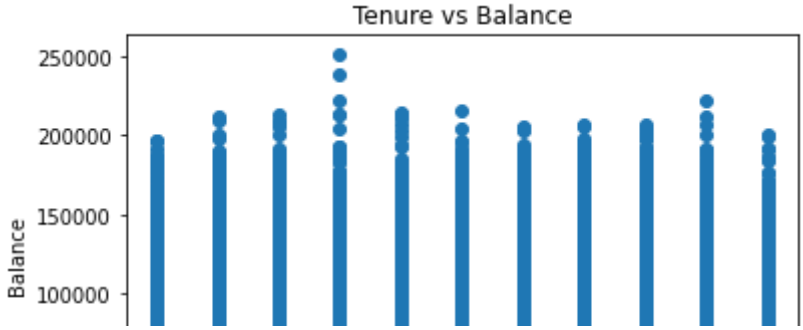

Tenure vs CreditScore
CreditScore

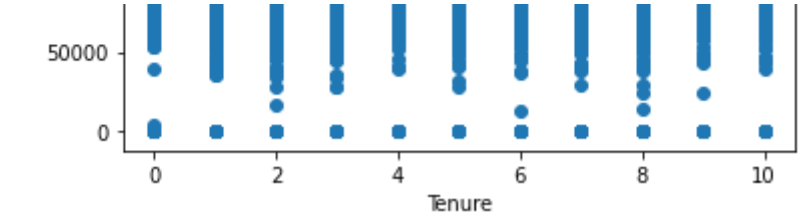
0
2
4
6
8
10
Tenure

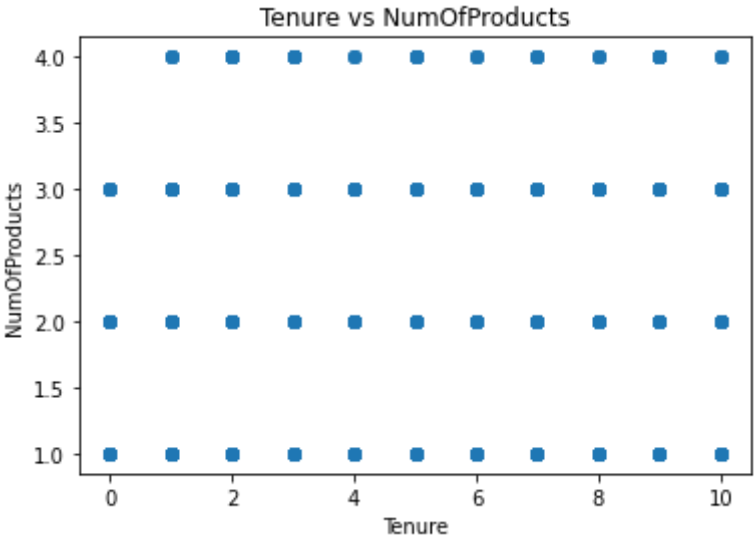

Tenure vs Geography
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Geography
0
2
4
6
8
10
Tenure

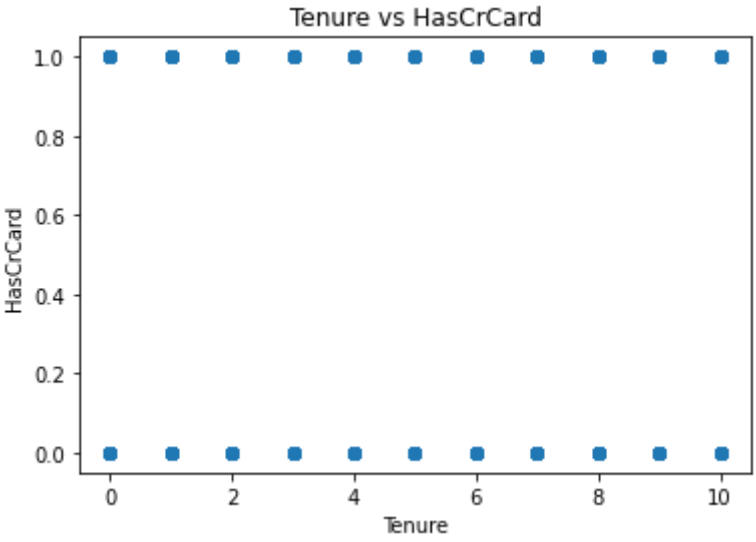

Tenure vs Age
90
80
70
60
50
40
30
20
Age
0
2
4
6
8
10
Tenure

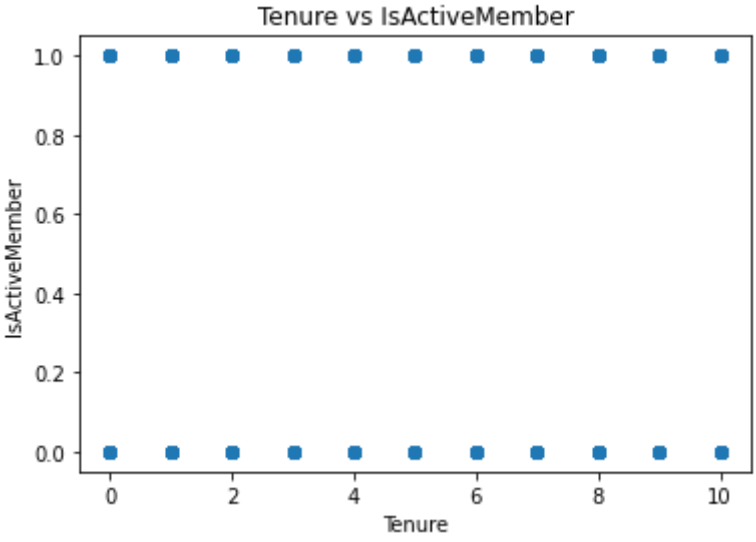

Tenure vs Tenure
10
8
6
4
2
0
Tenure
0
2
4
6
8
10
Tenure

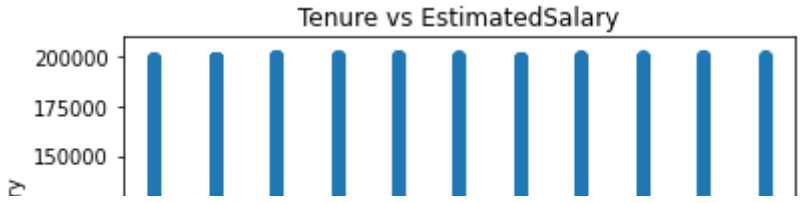

Tenure vs Balance
250000
200000
150000
100000
Balance

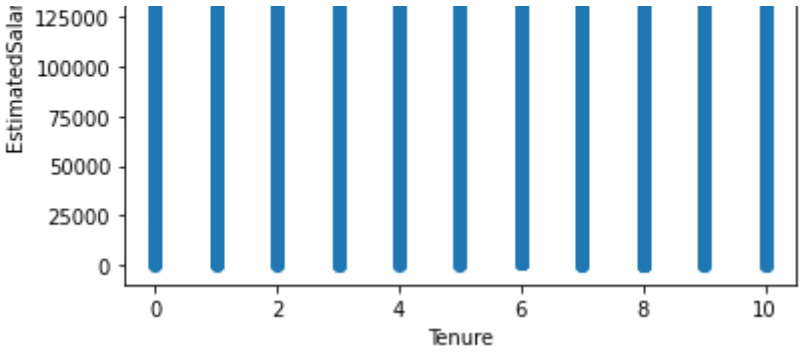

50000
0
0
2
4
6
8
10
Tenure

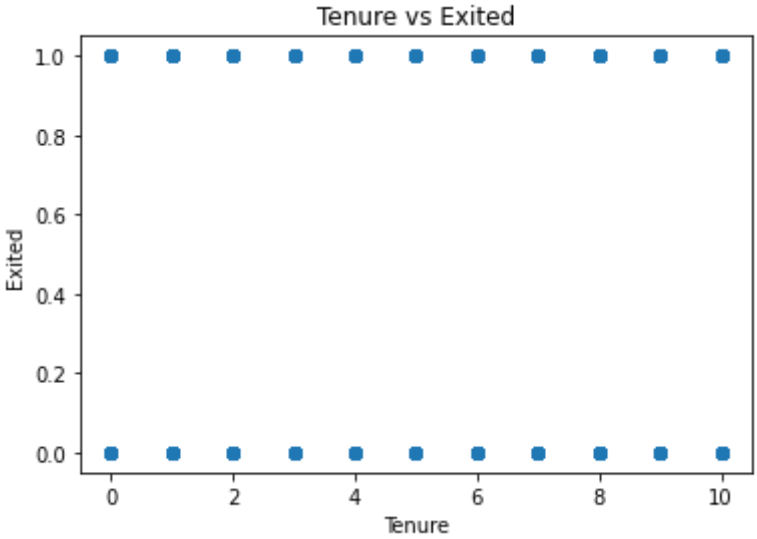

Tenure vs NumOfProducts
NumOfProducts
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
2
4
6
8
10
Tenure

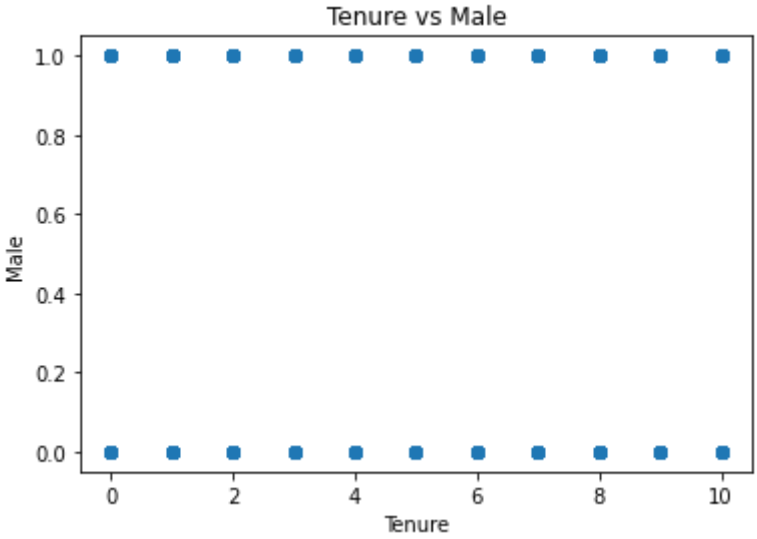

Tenure vs HasCrCard
HasCrCard
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
Tenure

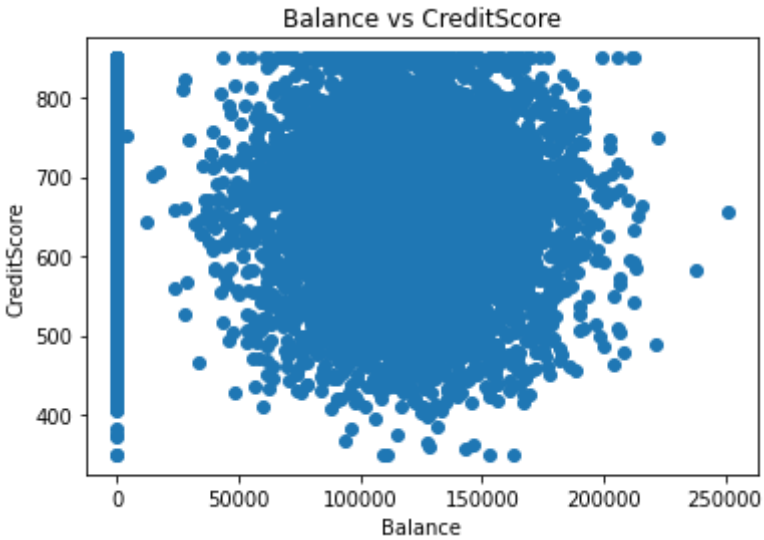

Tenure vs IsActiveMember
IsActiveMember
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
Tenure

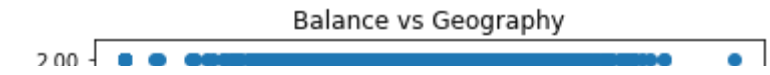

Tenure vs EstimatedSalary
200000
175000
150000

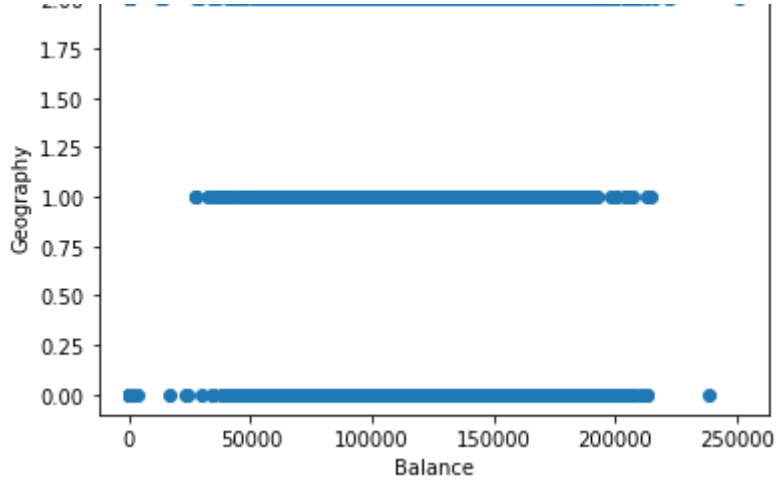

EstimatedSalar
125000
100000
75000
50000
25000
0
0
2
4
6
8
10
Tenure

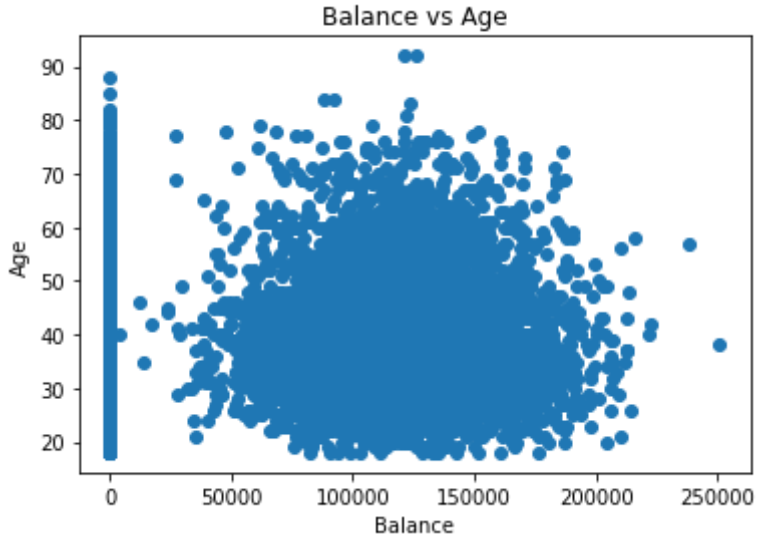

Tenure vs Exited
Exited
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
Tenure

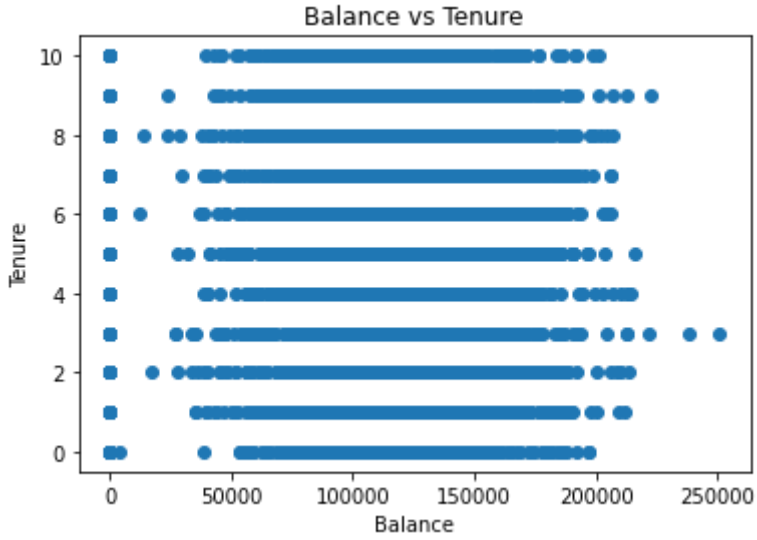

Tenure vs Male
Male
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
10
Tenure


Balance vs CreditScore
CreditScore
800
700
600
500
400
0
50000
100000
150000
200000
250000
Balance

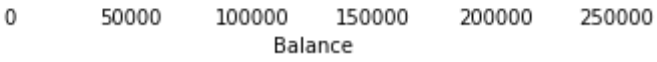

Balance vs Geography

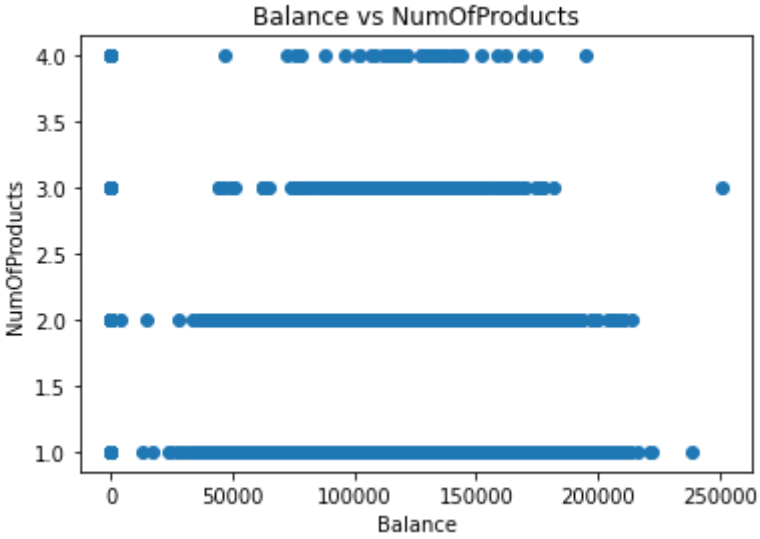

Geography
Balance
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
0
50000
100000
150000
200000
250000

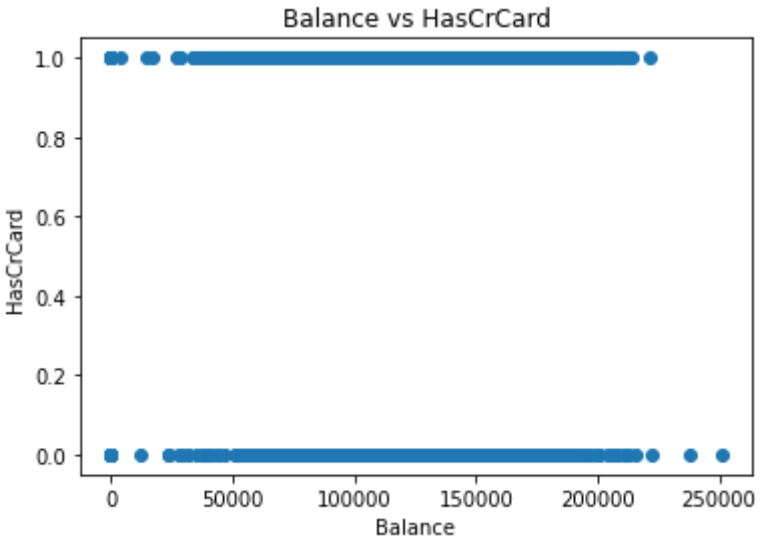

Balance vs Age
Age
Balance
20
30
40
50
60
70
80
90
0
50000
100000
150000
200000
250000

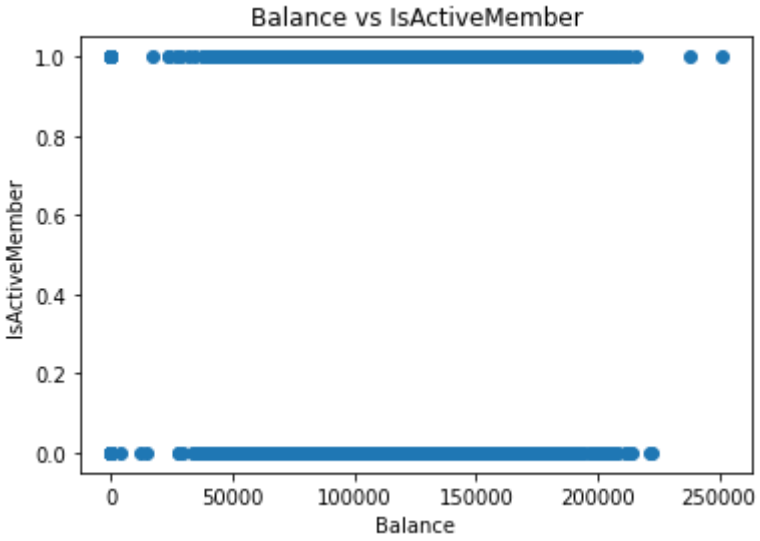

Balance vs Tenure
Tenure
Balance
0
2
4
6
8
10
0
50000
100000
150000
200000
250000

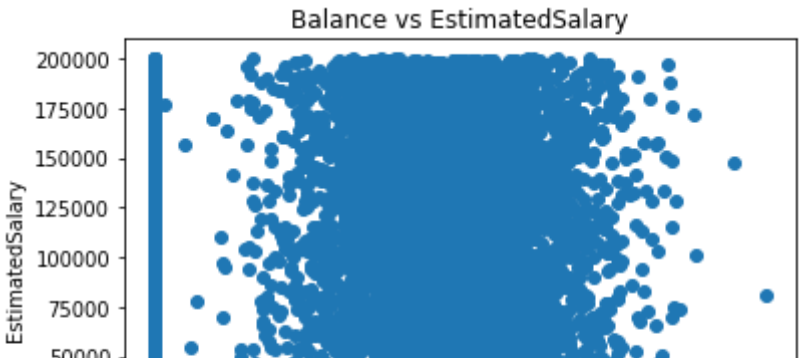
Balance vs Balance
Balance
0
50000
100000
150000
200000
250000

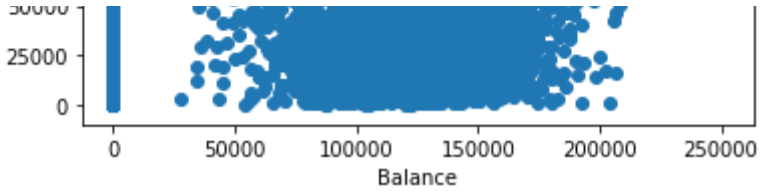

0
50000
100000
150000
200000
250000
Balance

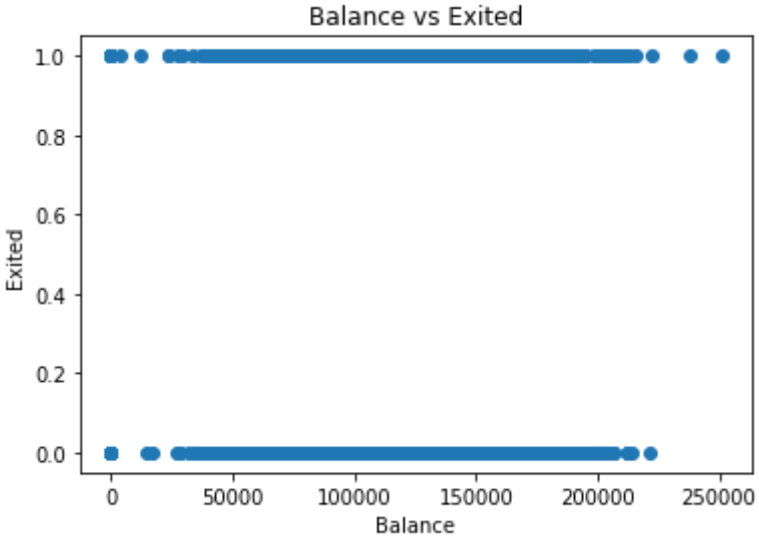

Balance vs NumOfProducts
NumOfProducts
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0
50000
100000
150000
200000
250000
Balance

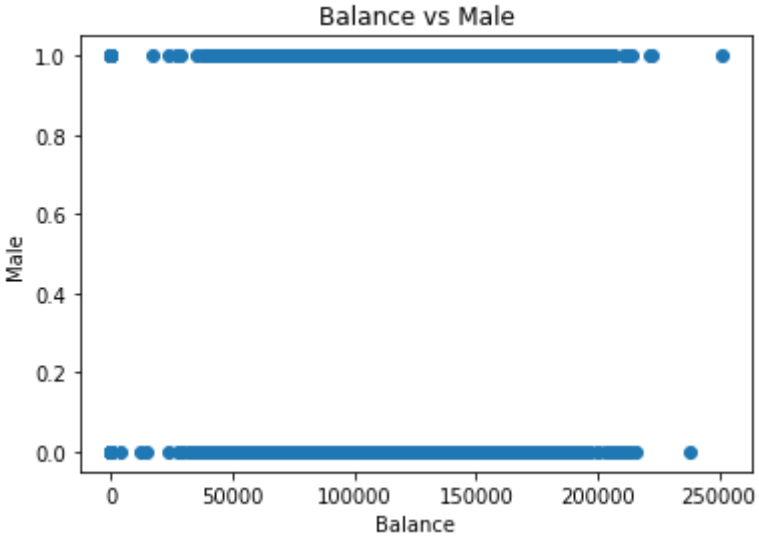

Balance vs HasCrCard
HasCrCard
1.0
0.8
0.6
0.4
0.2
0.0
0
50000
100000
150000
200000
250000
Balance

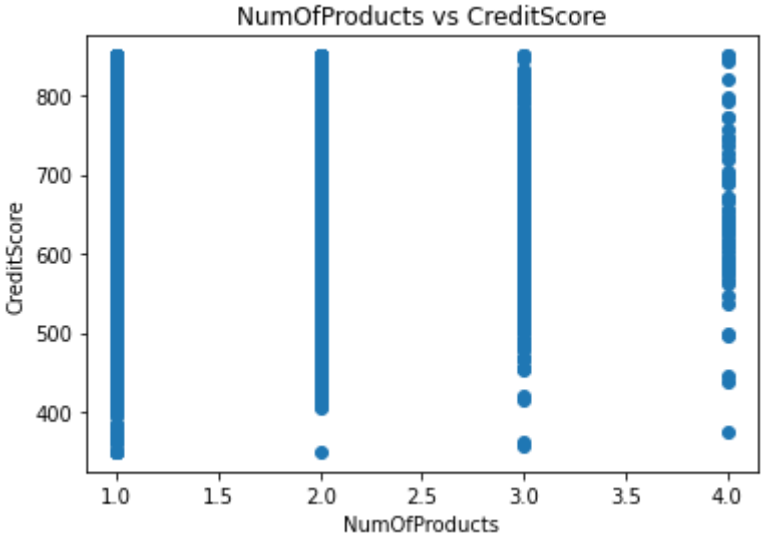

Balance vs IsActiveMember
IsActiveMember
1.0
0.8
0.6
0.4
0.2
0.0
0
50000
100000
150000
200000
250000
Balance

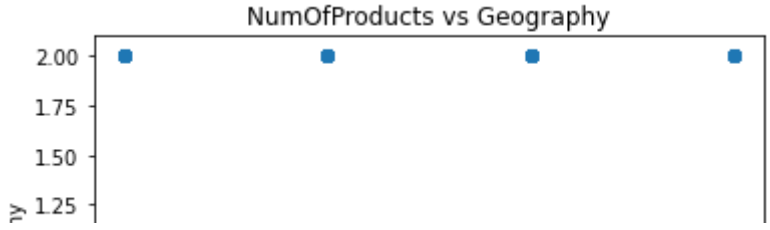

Balance vs EstimatedSalary
EstimatedSalary
200000
175000
150000
125000
100000
75000

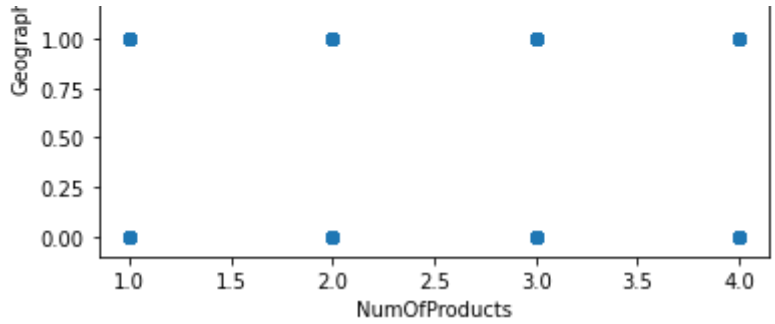

25000
0
0
50000
100000
150000
200000
250000
Balance

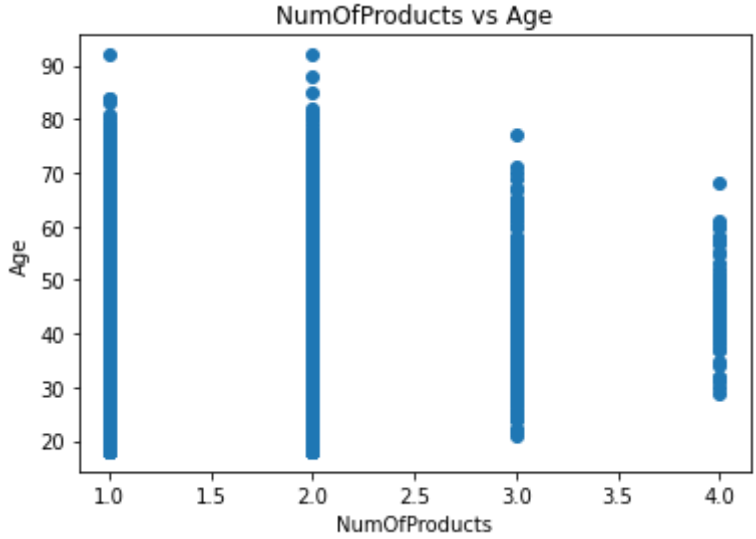

Balance vs Exited
Exited
1.0
0.8
0.6
0.4
0.2
0.0
0
50000
100000
150000
200000
250000
Balance

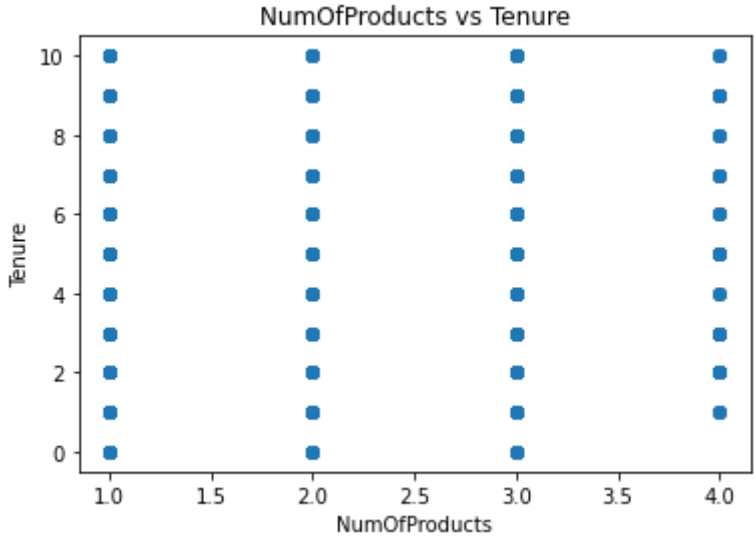

Balance vs Male
Male
1.0
0.8
0.6
0.4
0.2
0.0
0
50000
100000
150000
200000
250000
Balance

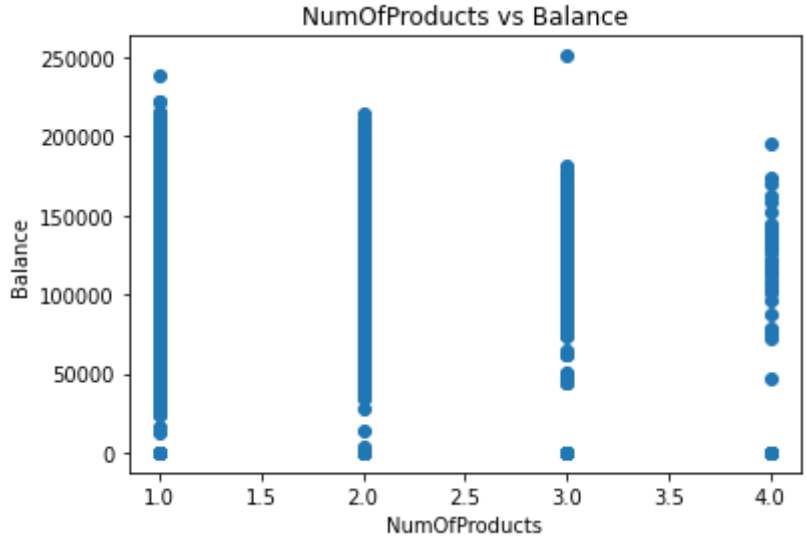

NumOfProducts vs CreditScore
CreditScore
800
700
600
500
400
1.0
1.5
2.0
2.5
3.0
3.5
4.0
NumOfProducts

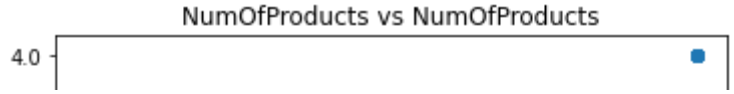

NumOfProducts vs Geography
2.00
1.75
1.50
1.25

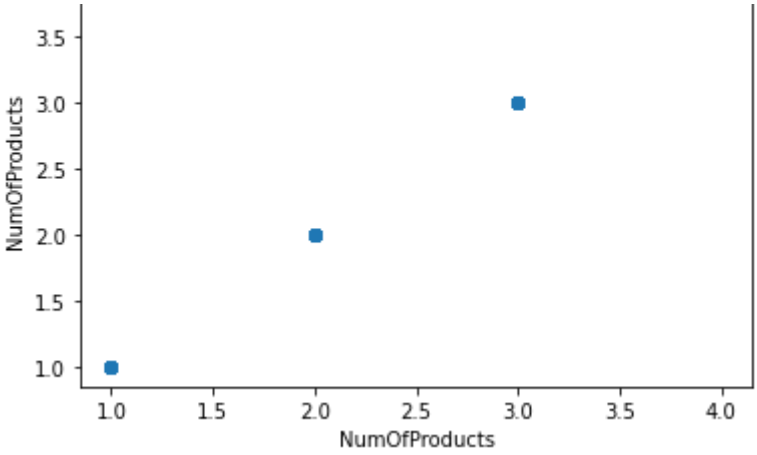

Geograph
1.00
0.75
0.50
0.25
0.00
1.0
1.5
2.0
2.5
3.0
3.5
4.0
NumOfProducts

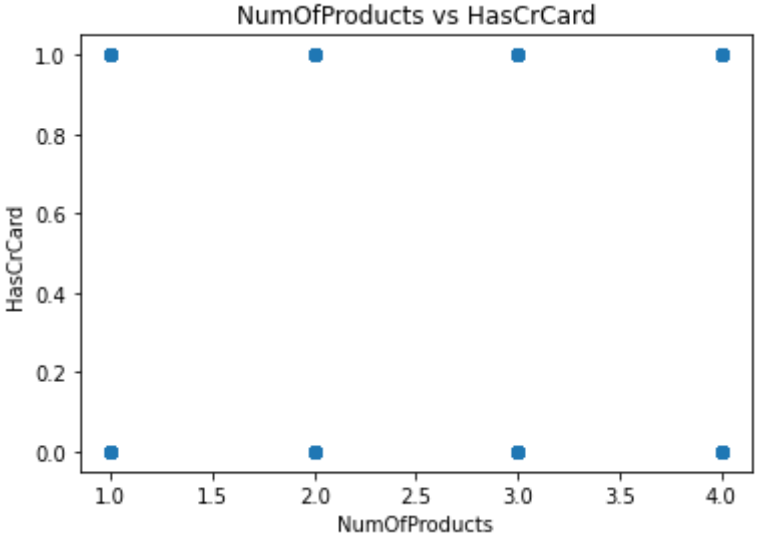

NumOfProducts vs Age
Age
90
80
70
60
50
40
30
20
1.0
1.5
2.0
2.5
3.0
3.5
4.0
NumOfProducts

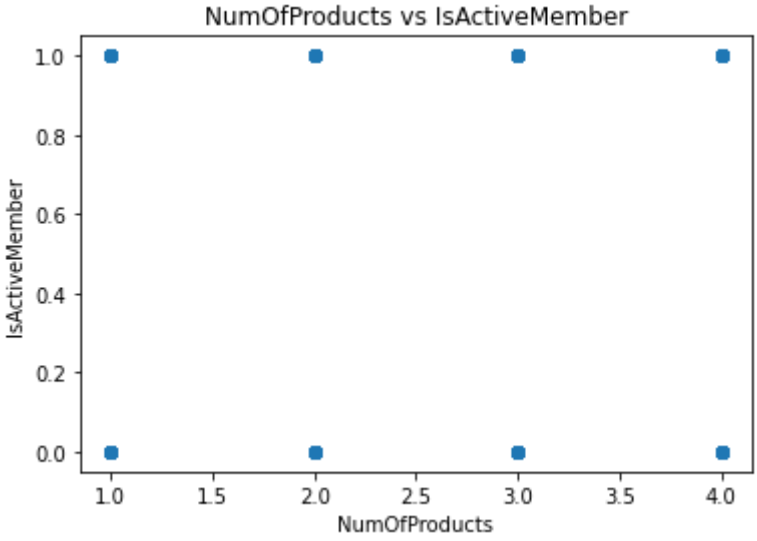

NumOfProducts vs Tenure
Tenure
10
8
6
4
2
0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
NumOfProducts

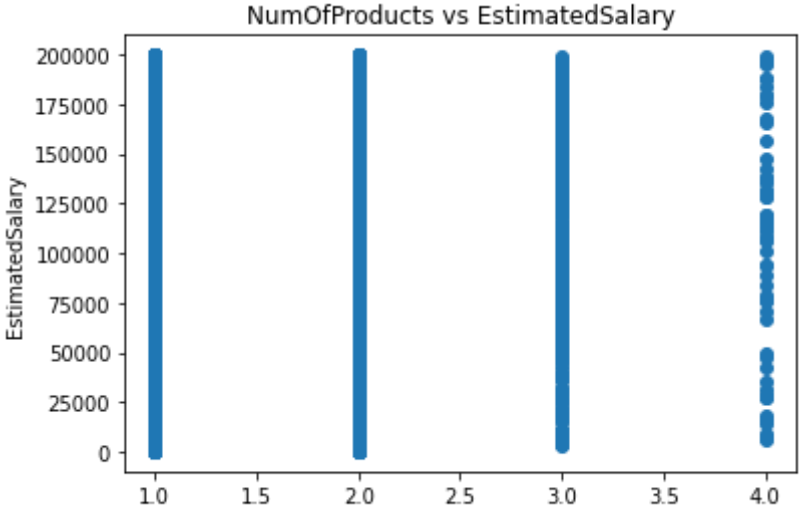

NumOfProducts vs Balance
Balance
250000
200000
150000
100000
50000
0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
NumOfProducts

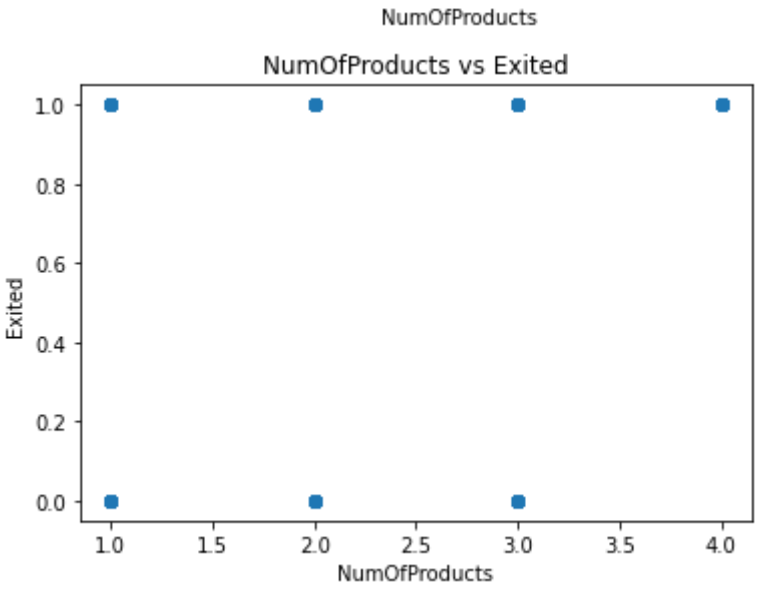

NumOfProducts vs NumOfProducts
4.0

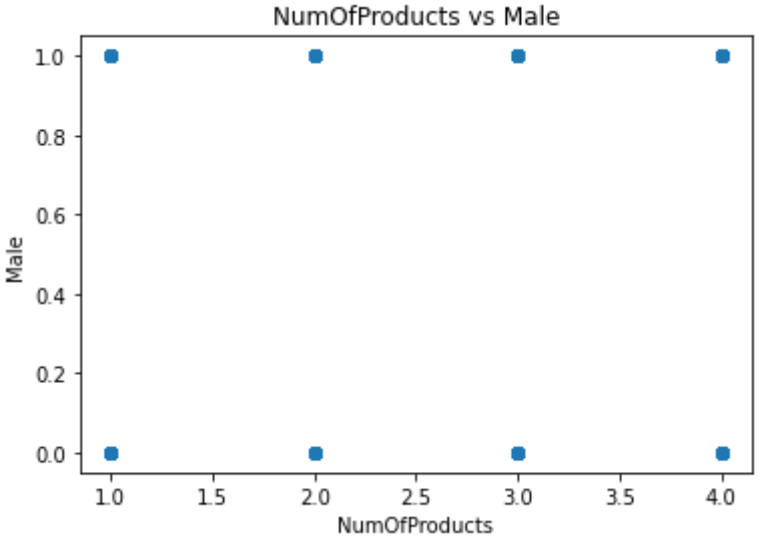

NumOfProducts
NumOfProducts

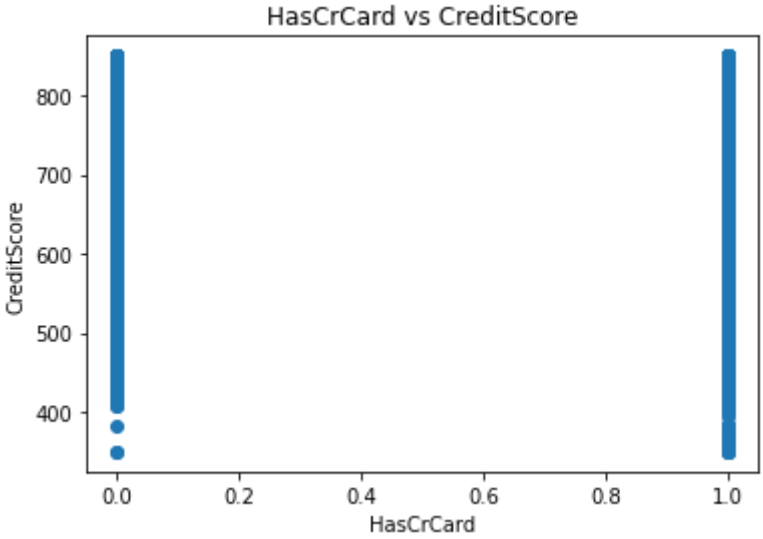

NumOfProducts vs HasCrCard
HasCrCard
NumOfProducts

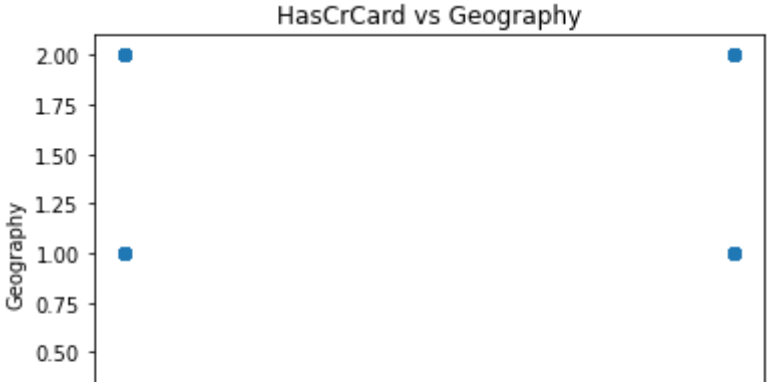

NumOfProducts vs IsActiveMember
IsActiveMember
NumOfProducts

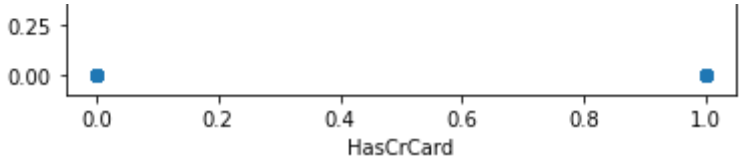

NumOfProducts vs EstimatedSalary
EstimatedSalary

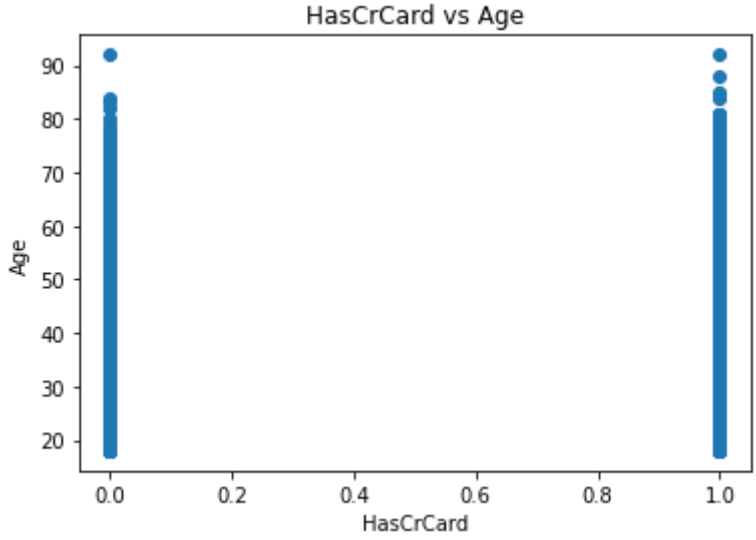

NumOfProducts
NumOfProducts vs Exited
Exited
NumOfProducts

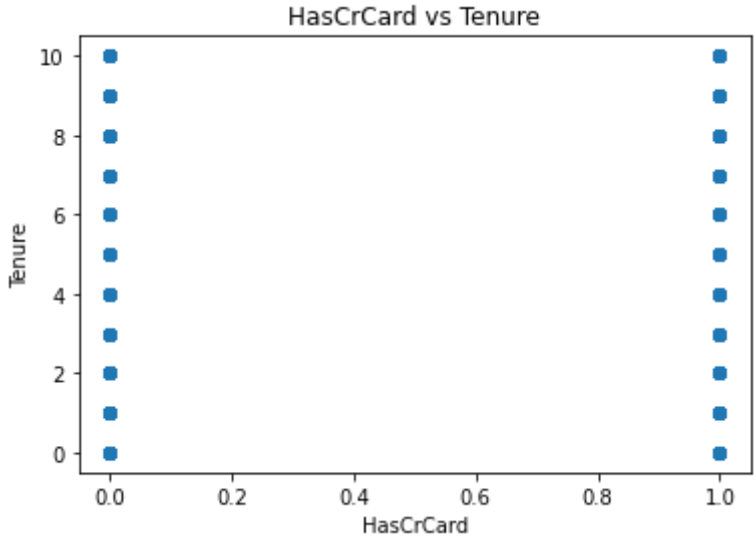

NumOfProducts vs Male
Male
NumOfProducts

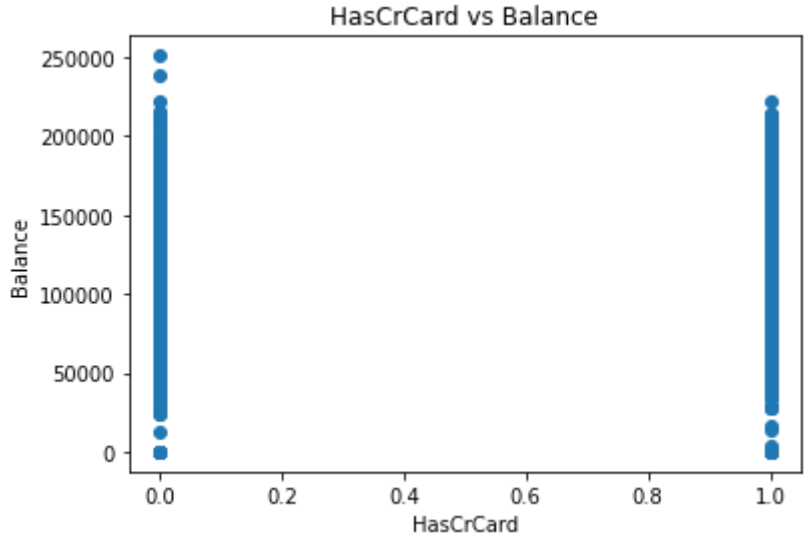

HasCrCard vs CreditScore
CreditScore
HasCrCard

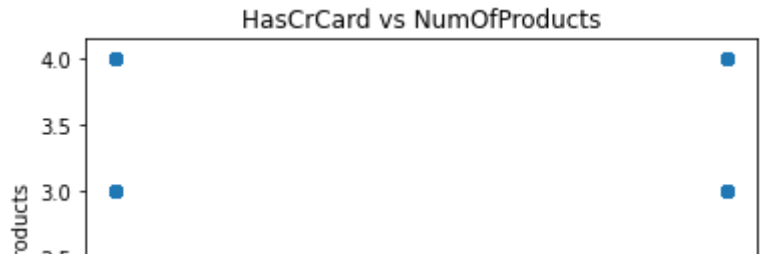

HasCrCard vs Geography
Geography

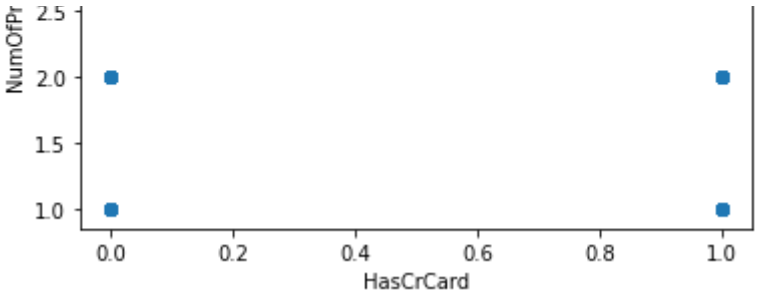

0.25
0.00
0.0
0.2
0.4
0.6
0.8
1.0
HasCrCard

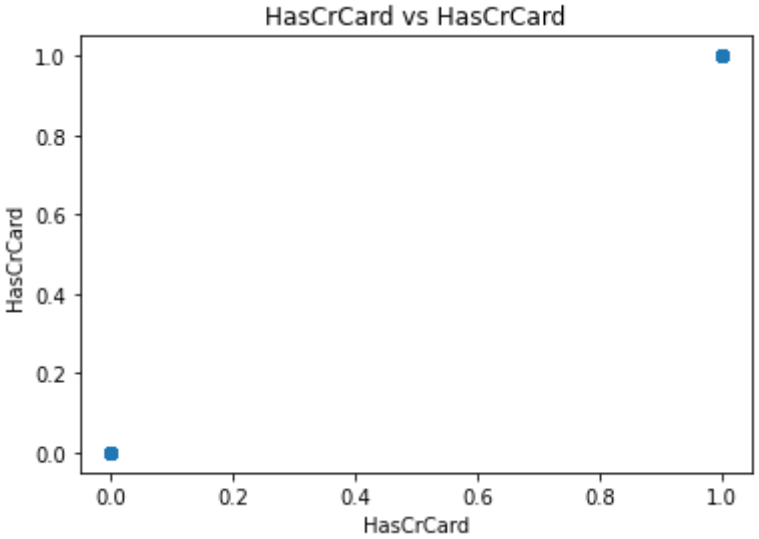

HasCrCard vs Age
Age
HasCrCard

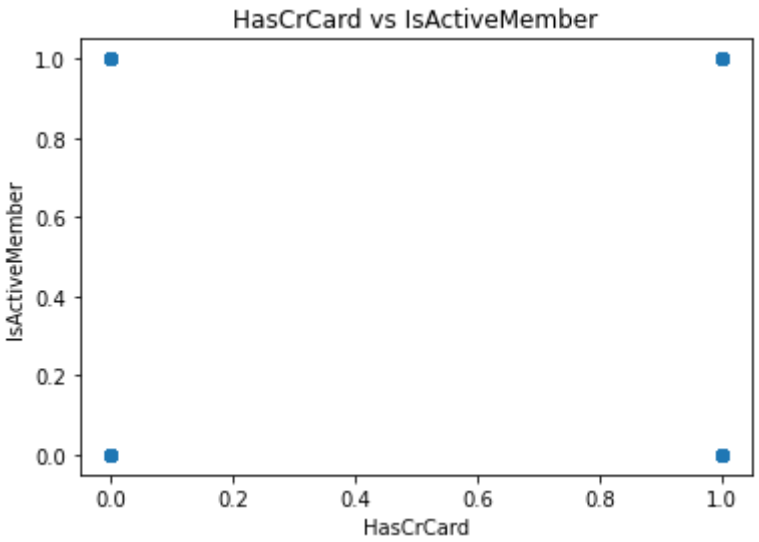

HasCrCard vs Tenure
Tenure
HasCrCard

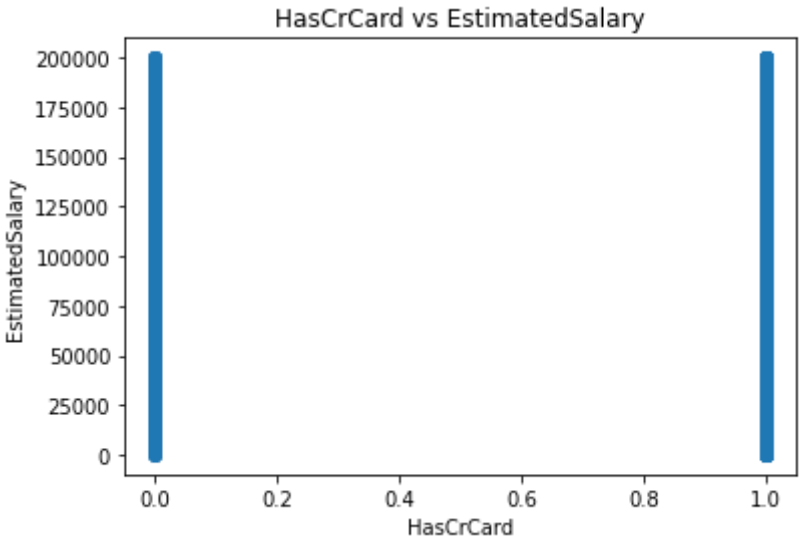

HasCrCard vs Balance
Balance
HasCrCard

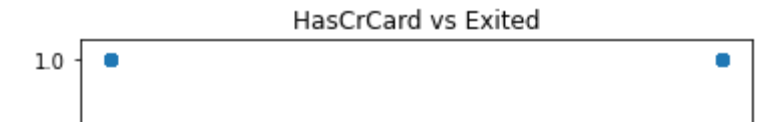

HasCrCard vs NumOfProducts

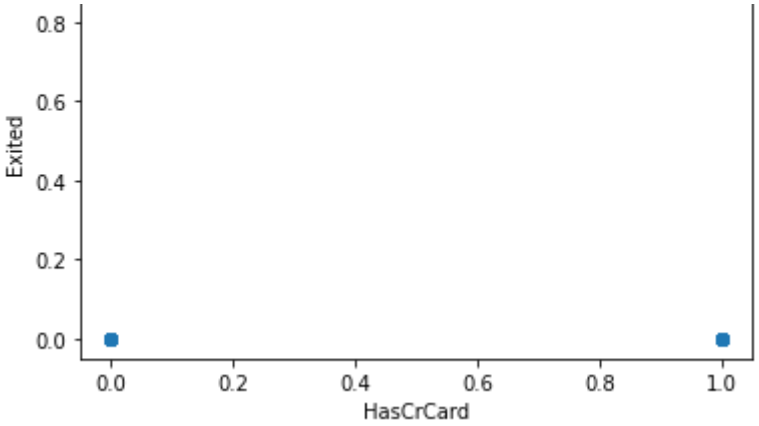

NumOfPr
2.5
2.0
1.5
1.0
0.0
0.2
0.4
0.6
0.8
1.0
HasCrCard

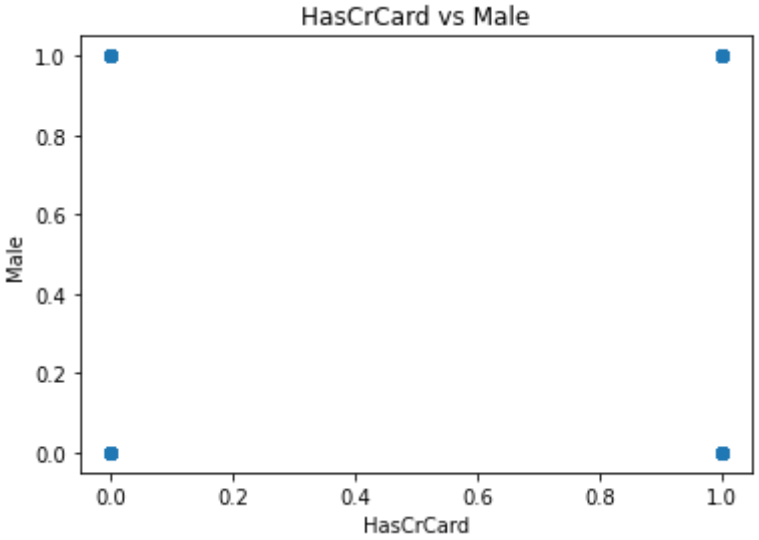

HasCrCard vs HasCrCard
HasCrCard
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
HasCrCard

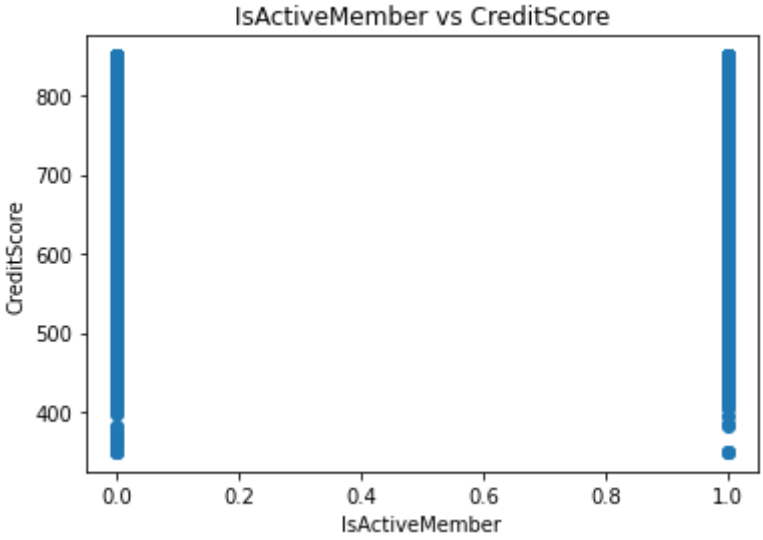

HasCrCard vs IsActiveMember
IsActiveMember
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
HasCrCard

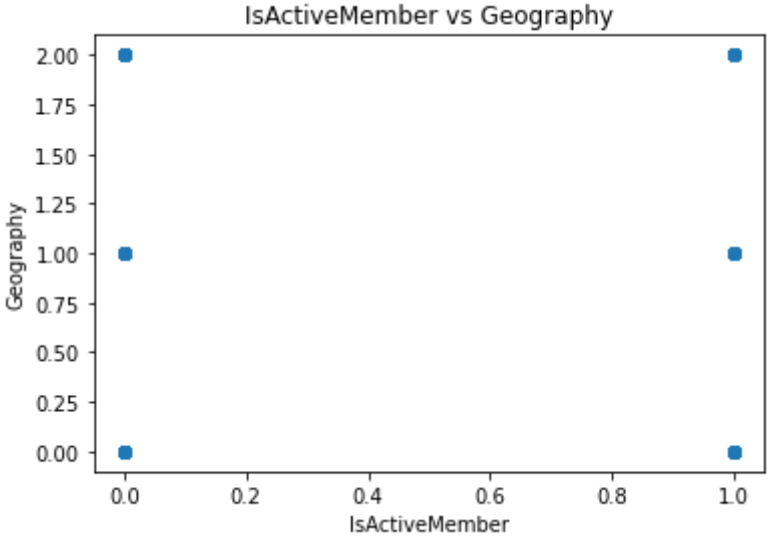

HasCrCard vs EstimatedSalary
EstimatedSalary
200000
175000
150000
125000
100000
75000
50000
25000
0
0.0
0.2
0.4
0.6
0.8
1.0
HasCrCard

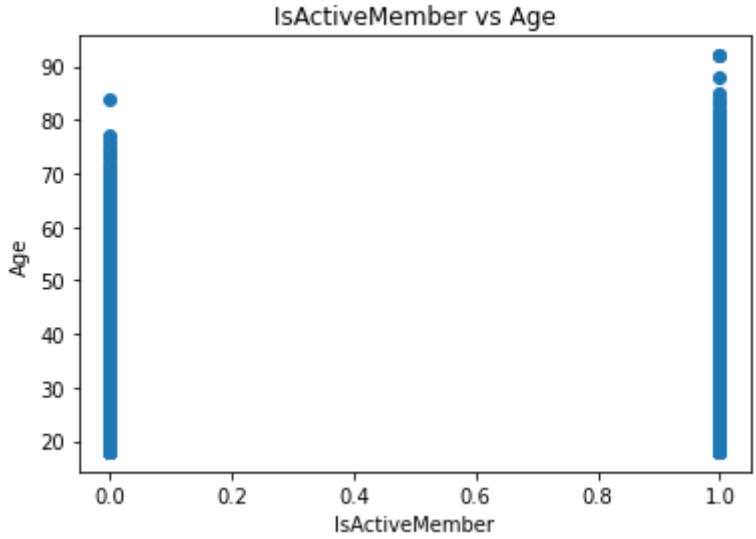

HasCrCard vs Exited
1.0

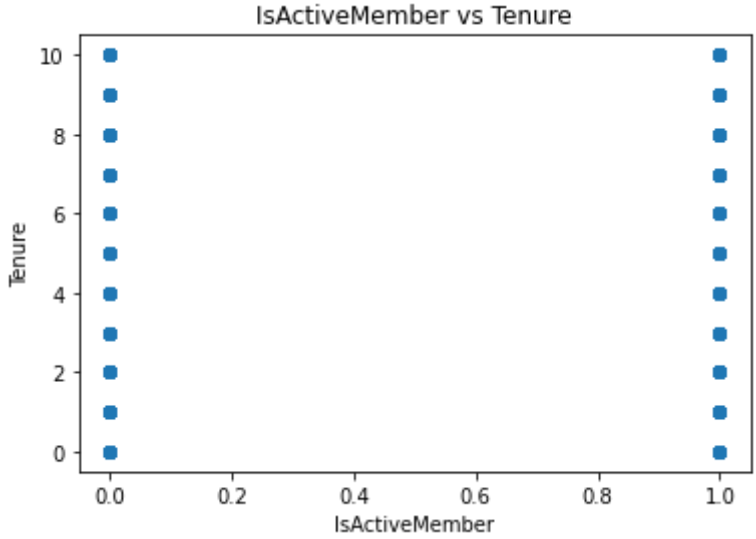

Exited
HasCrCard

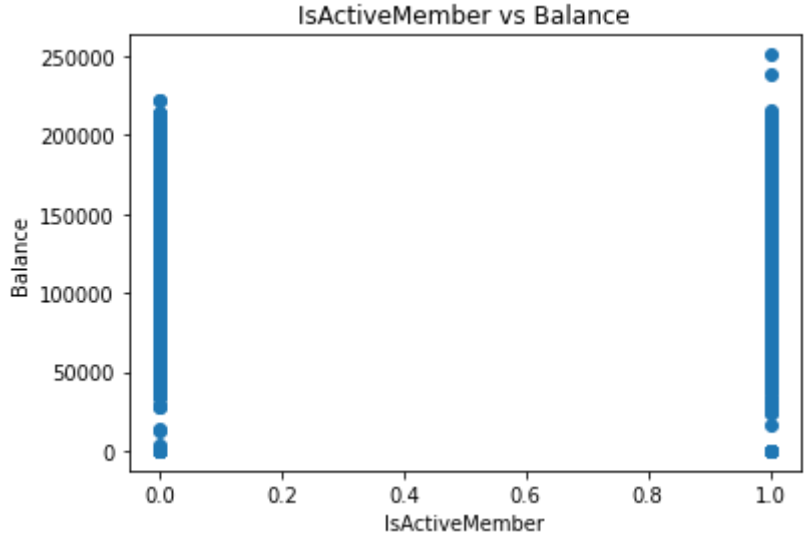

HasCrCard vs Male
Male
HasCrCard


IsActiveMember vs CreditScore
CreditScore
IsActiveMember

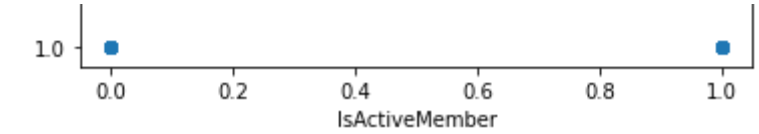

IsActiveMember vs Geography
Geography
IsActiveMember

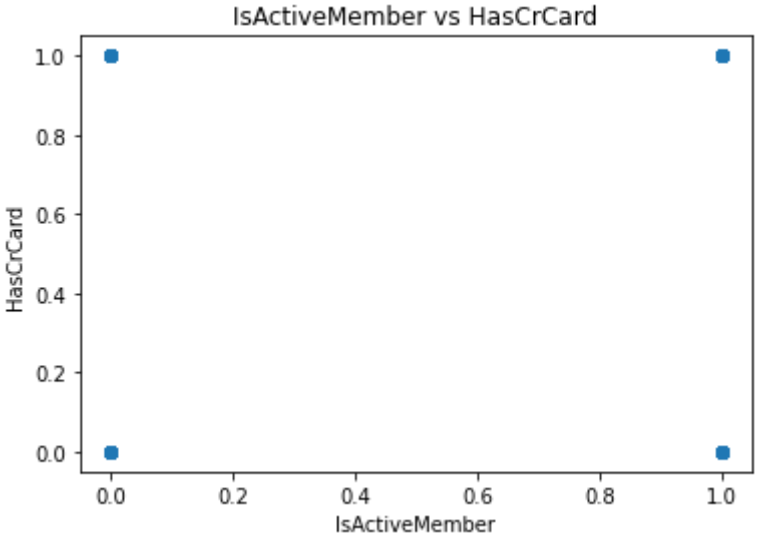

IsActiveMember vs Age
Age
IsActiveMember
90
80
70
60
50
40
30
20
0.0
0.2
0.4
0.6
0.8
1.0

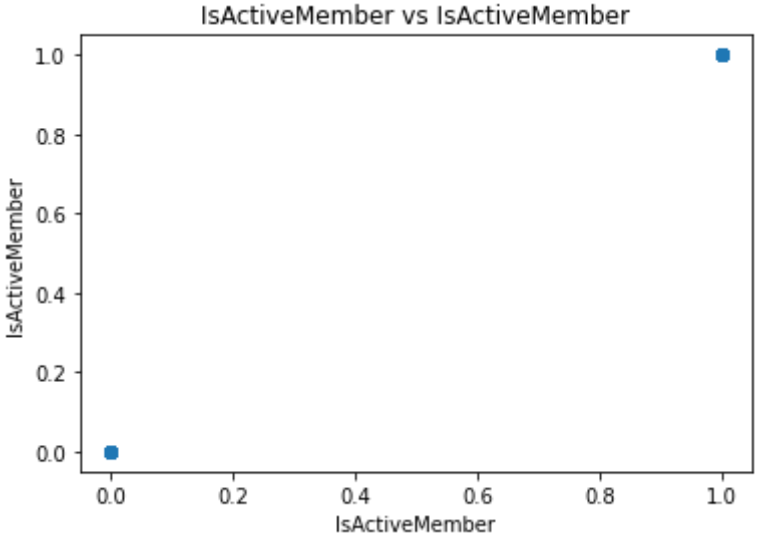

IsActiveMember vs Tenure
Tenure
IsActiveMember
10
8
6
4
2
0
0.0
0.2
0.4
0.6
0.8
1.0

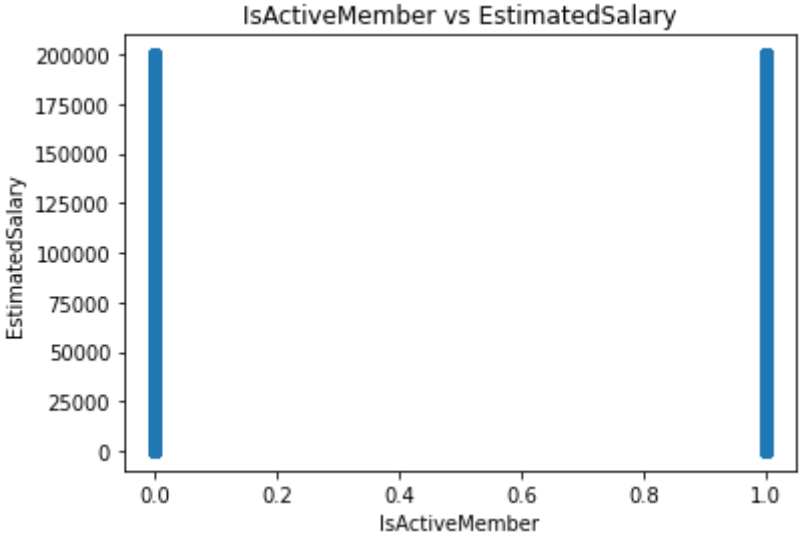

IsActiveMember vs Balance
Balance
IsActiveMember
250000
200000
150000
100000
50000
0
0.0
0.2
0.4
0.6
0.8
1.0

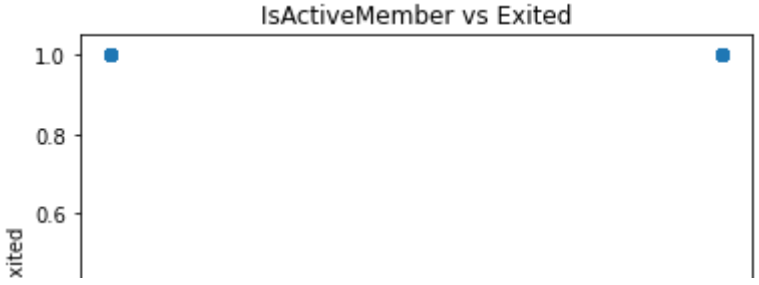
IsActiveMember vs NumOfProducts
NumOfProducts
4.0
3.5
3.0
2.5
2.0
1.5

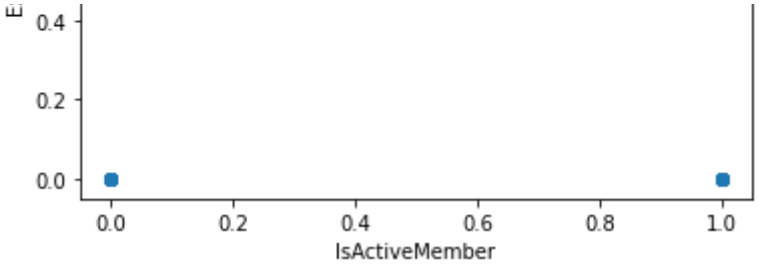

1.0
0.0
0.2
0.4
0.6
0.8
1.0
IsActiveMember

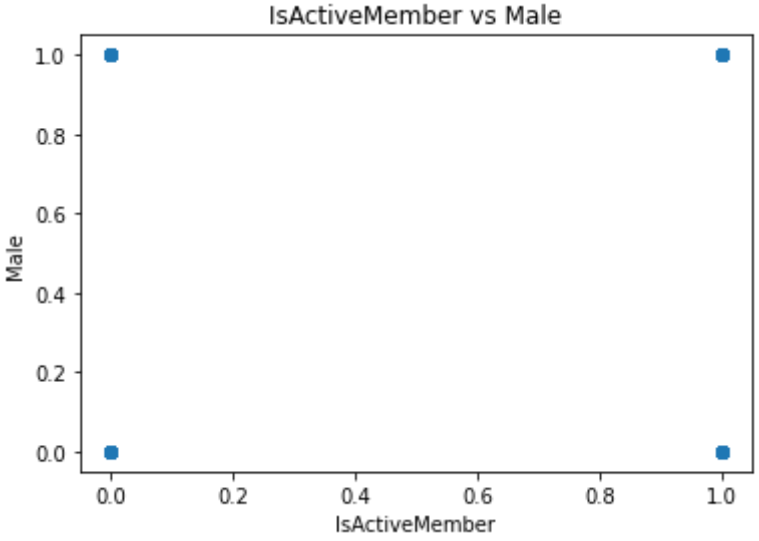

IsActiveMember vs HasCrCard
HasCrCard
IsActiveMember
0.0
0.2
0.4
0.6
0.8
1.0

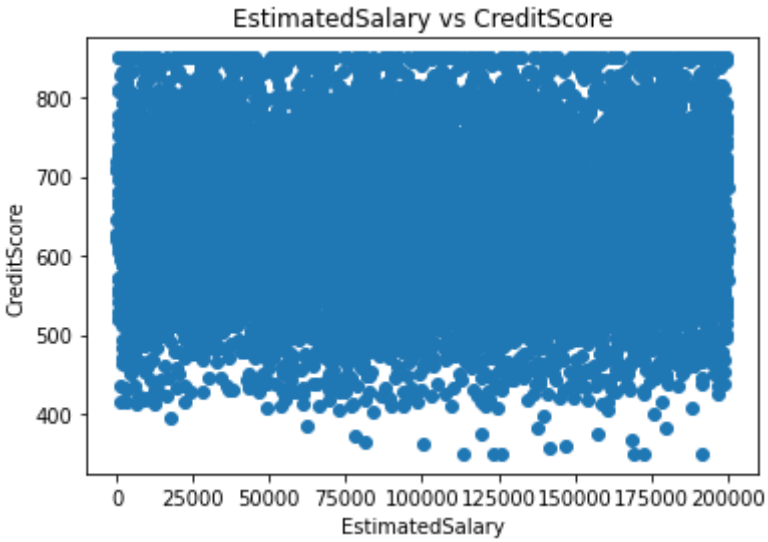

IsActiveMember vs IsActiveMember
IsActiveMember
IsActiveMember
0.0
0.2
0.4
0.6
0.8
1.0

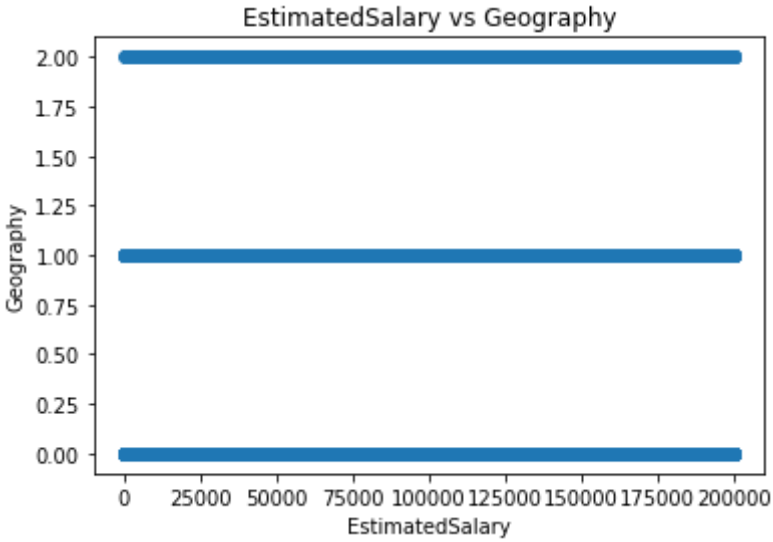

IsActiveMember vs EstimatedSalary
EstimatedSalary
IsActiveMember
0
25000
50000
75000
100000
125000
150000
175000
200000
0.0
0.2
0.4
0.6
0.8
1.0

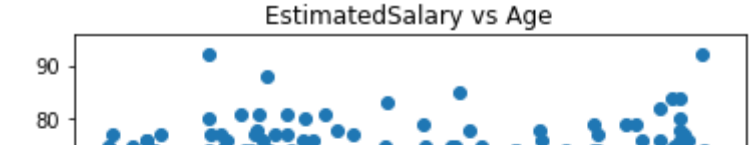

IsActiveMember vs Exited
xited
1.0
0.8
0.6

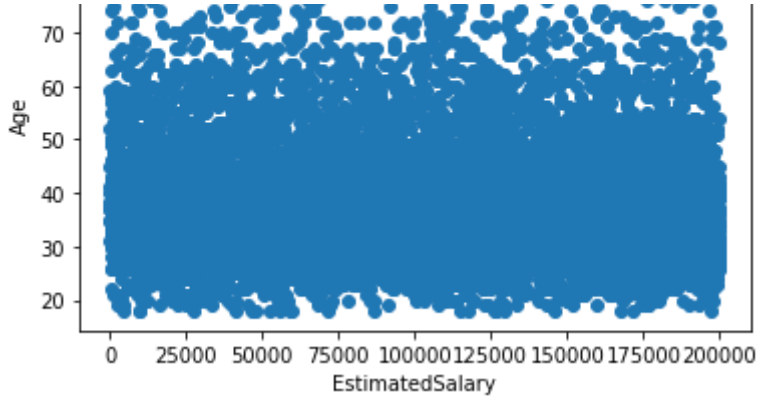

0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0
IsActiveMember

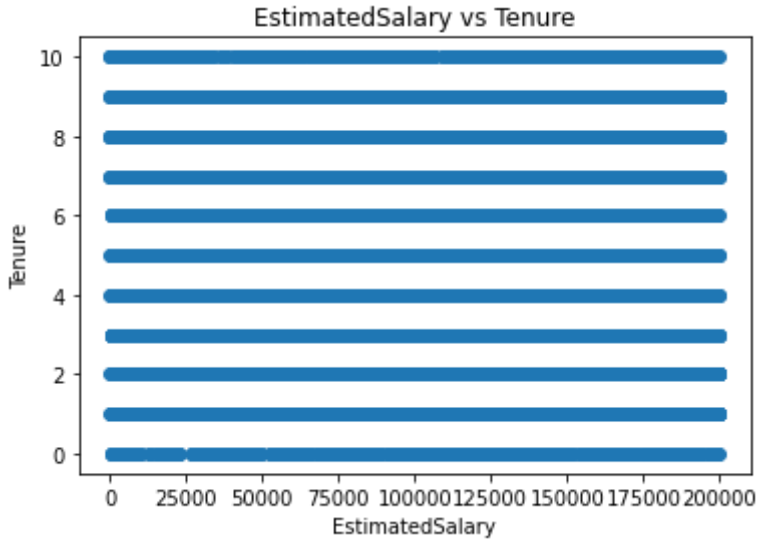

IsActiveMember vs Male
1.0
0.8
0.6
0.4
0.2
0.0
Male
0.0
0.2
0.4
0.6
0.8
1.0
IsActiveMember

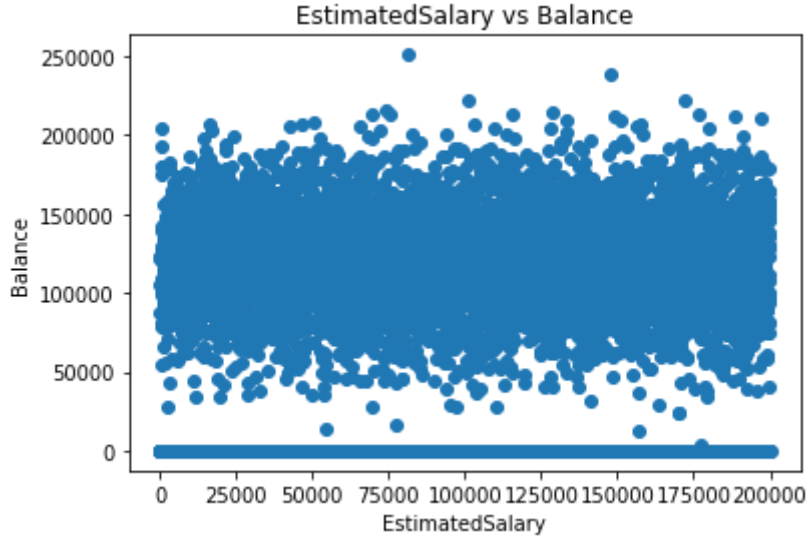

EstimatedSalary vs CreditScore
800
700
600
500
400
CreditScore
0
25000
50000
75000
100000
125000
150000
175000
200000
EstimatedSalary

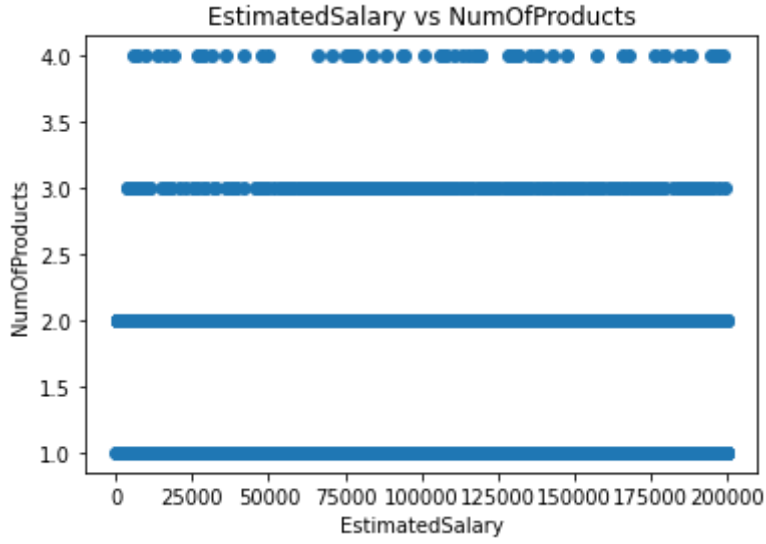

EstimatedSalary vs Geography
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Geography
0
25000
50000
75000
100000
125000
150000
175000
200000
EstimatedSalary

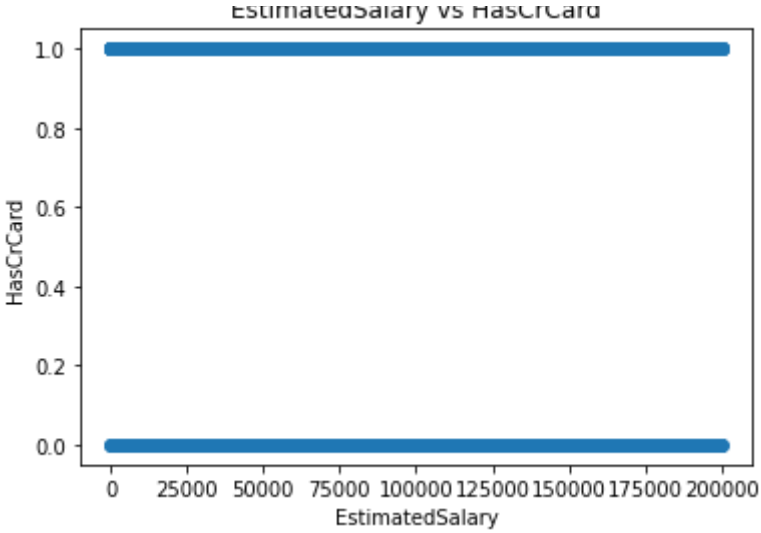

EstimatedSalary vs Age
90
80

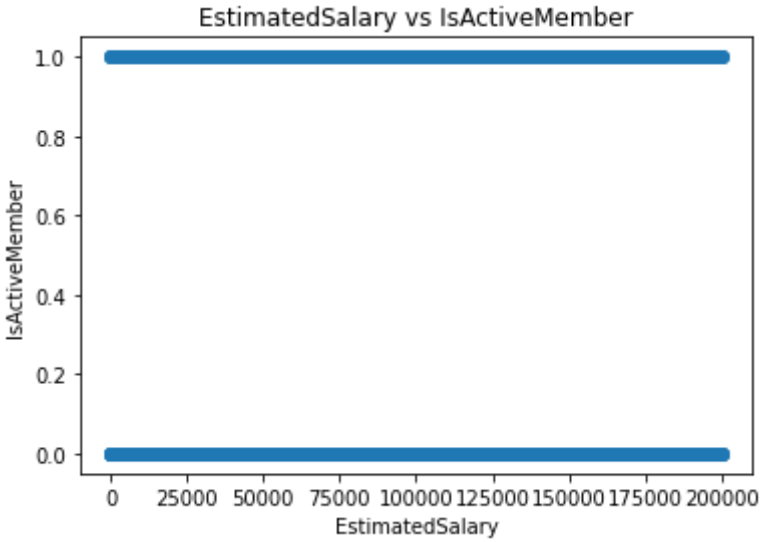

Age
EstimatedSalary

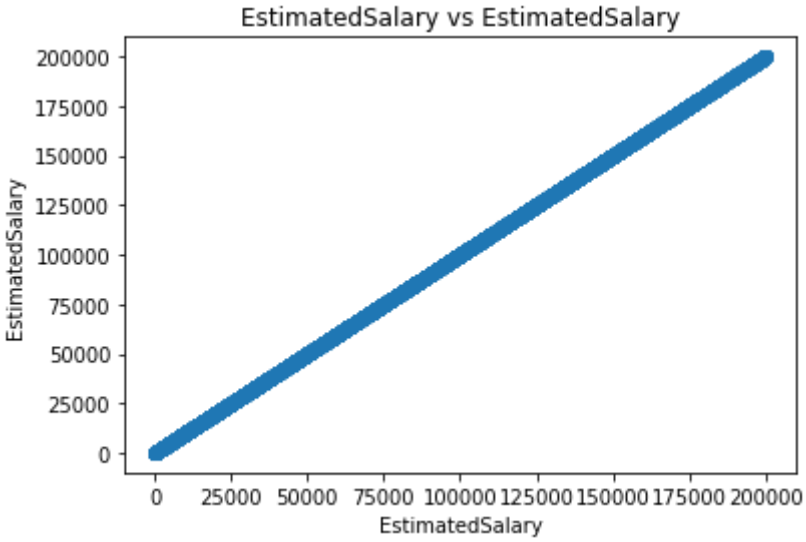

EstimatedSalary vs Tenure
Tenure
EstimatedSalary

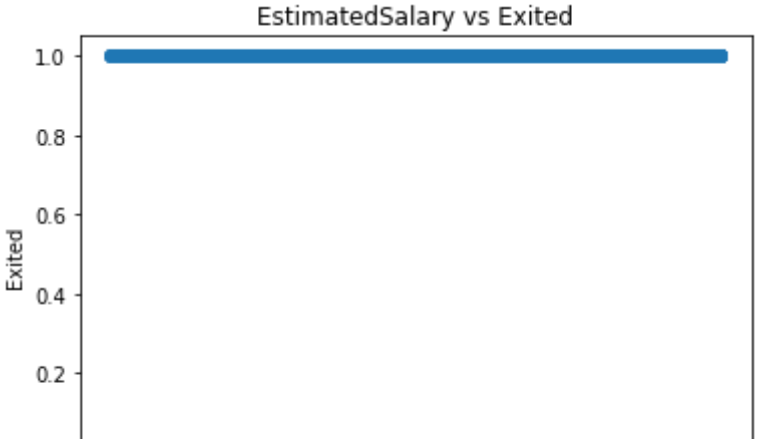

EstimatedSalary vs Balance
Balance
EstimatedSalary

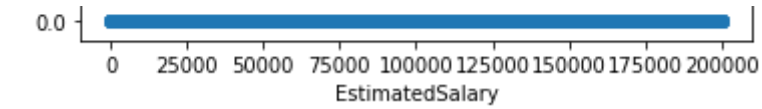

EstimatedSalary vs NumOfProducts
NumOfProducts
EstimatedSalary

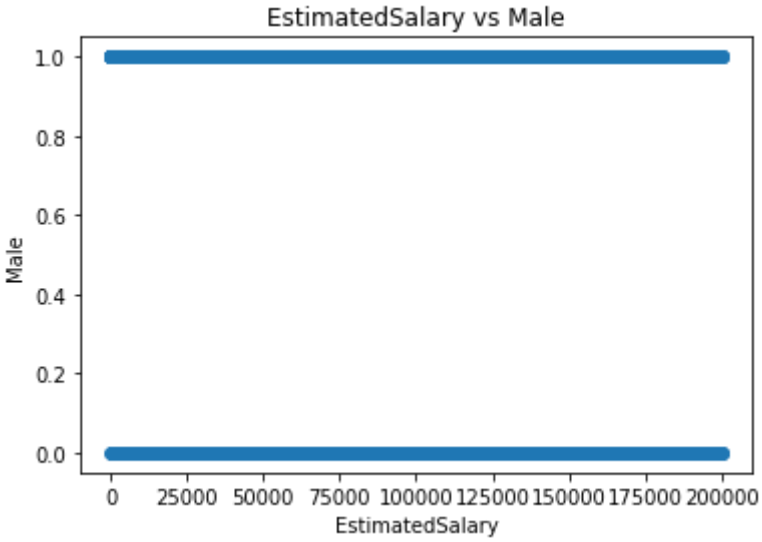

EstimatedSalary vs HasCrCard
HasCrCard
EstimatedSalary
0.0
0.2
0.4
0.6
0.8
1.0
0
25000
50000
75000
100000
125000
150000
175000
200000

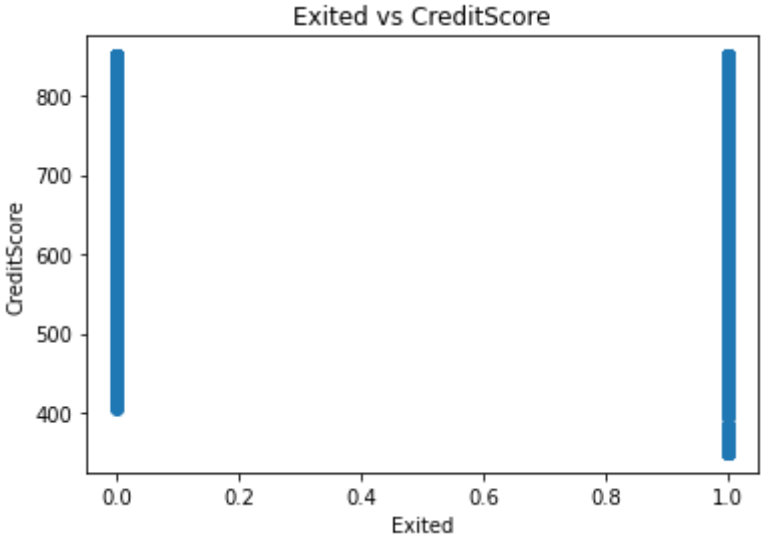

EstimatedSalary vs IsActiveMember
IsActiveMember
EstimatedSalary
0.0
0.2
0.4
0.6
0.8
1.0
0
25000
50000
75000
100000
125000
150000
175000
200000

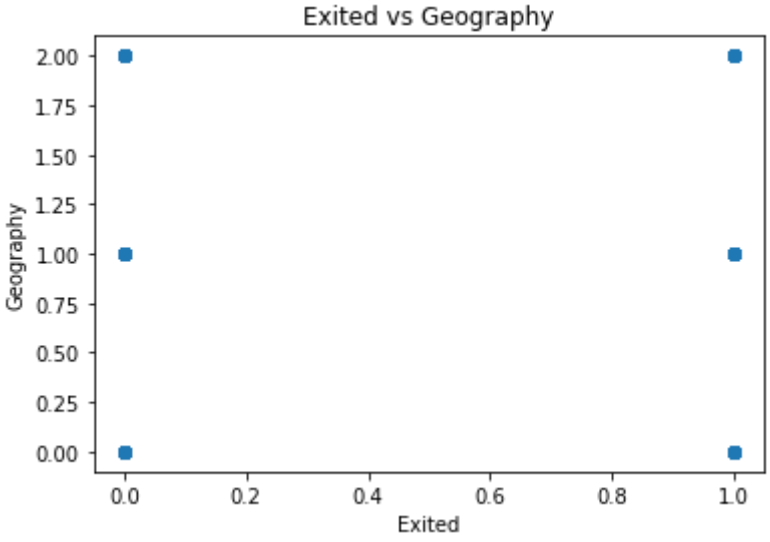

EstimatedSalary vs EstimatedSalary
EstimatedSalary
EstimatedSalary
0
25000
50000
75000
100000
125000
150000
175000
200000

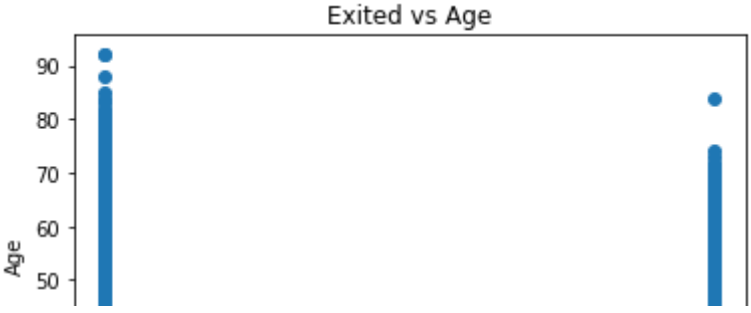

EstimatedSalary vs Exited
Exited
0.2
0.4
0.6
0.8
1.0

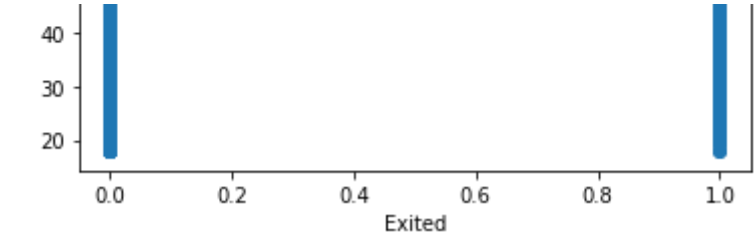

0.0
0
25000
50000
75000
100000
125000
150000
175000
200000
EstimatedSalary

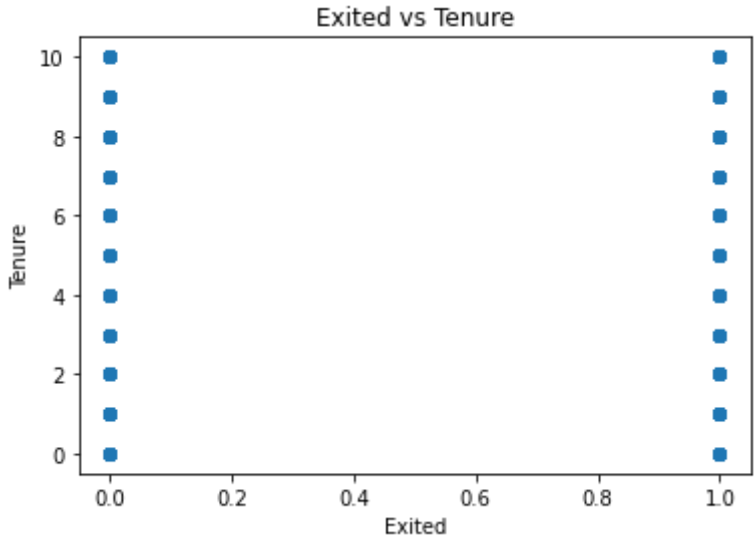

EstimatedSalary vs Male
Male
1.0
0.8
0.6
0.4
0.2
0.0
0
25000
50000
75000
100000
125000
150000
175000
200000
EstimatedSalary

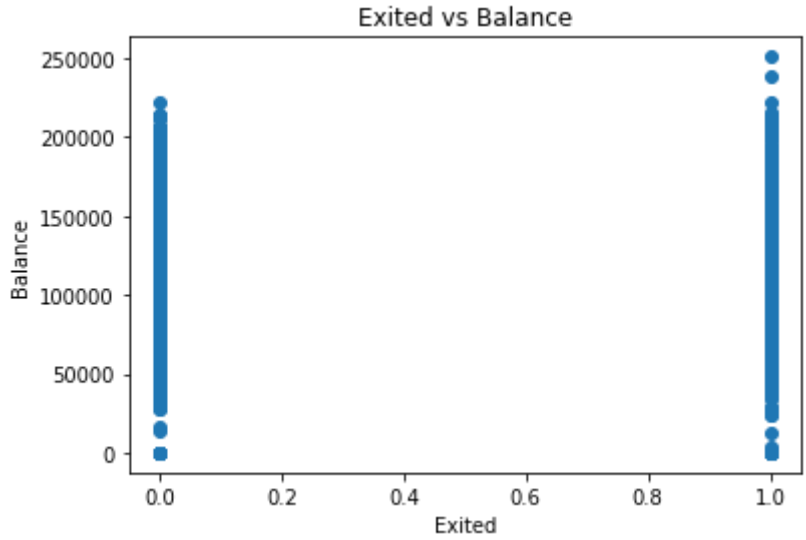

Exited vs CreditScore
CreditScore
800
700
600
500
400
0.0
0.2
0.4
0.6
0.8
1.0
Exited

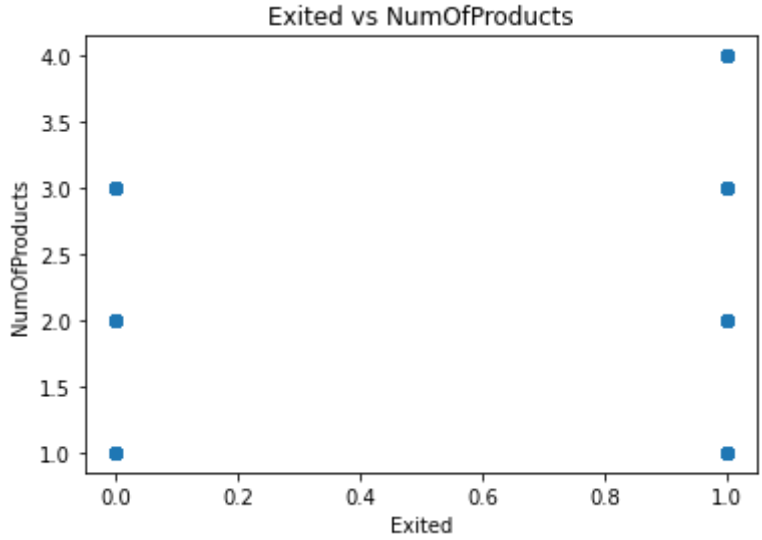

Exited vs Geography
Geography
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
0.0
0.2
0.4
0.6
0.8
1.0
Exited

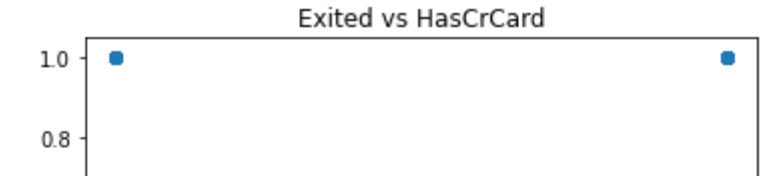

Exited vs Age
Age
90
80
70
60
50

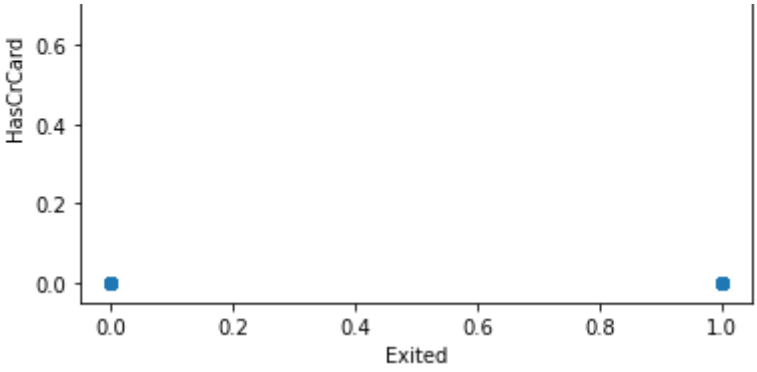

40
30
20
0.0
0.2
0.4
0.6
0.8
1.0
Exited

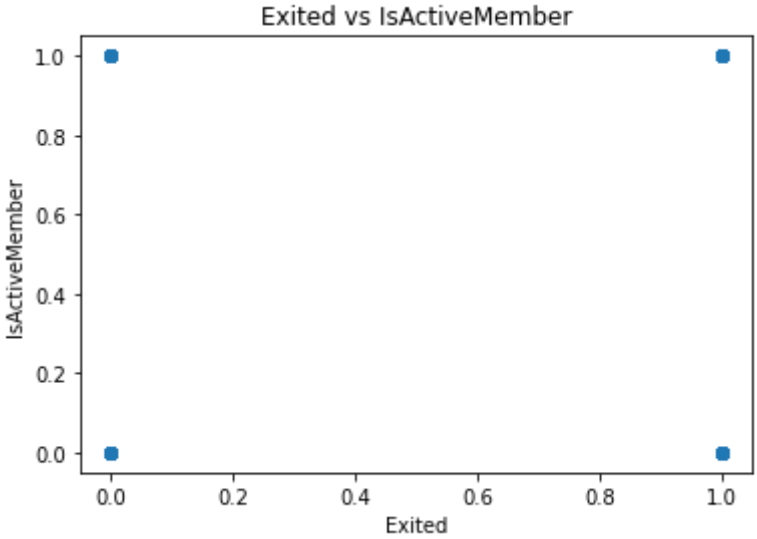

Exited vs Tenure
10
8
6
4
2
0
Tenure
0.0
0.2
0.4
0.6
0.8
1.0
Exited

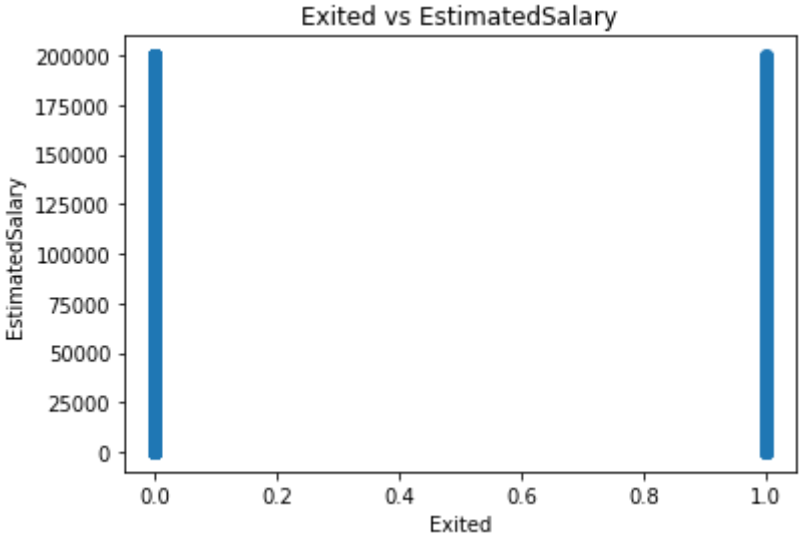

Exited vs Balance
250000
200000
150000
100000
50000
0
Balance
0.0
0.2
0.4
0.6
0.8
1.0
Exited

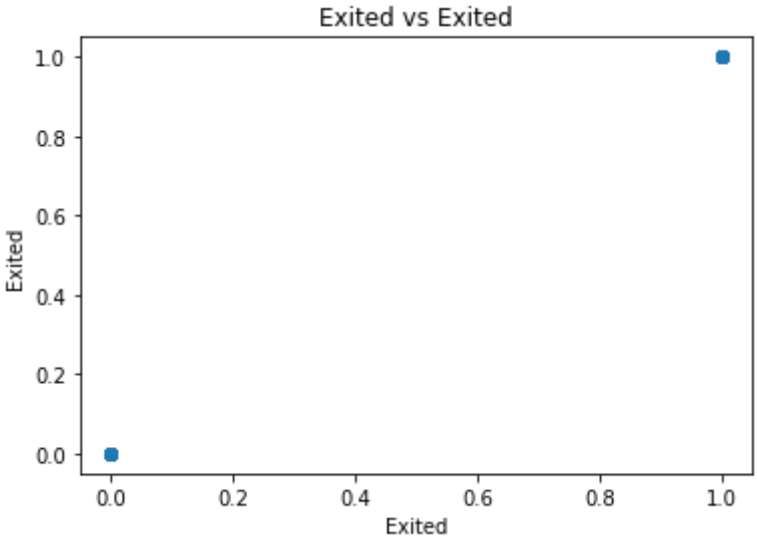

Exited vs NumOfProducts
4.0
3.5
3.0
2.5
2.0
1.5
1.0
NumOfProducts
0.0
0.2
0.4
0.6
0.8
1.0
Exited

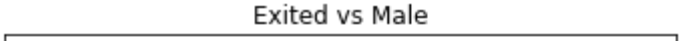

Exited vs HasCrCard
1.0
0.8

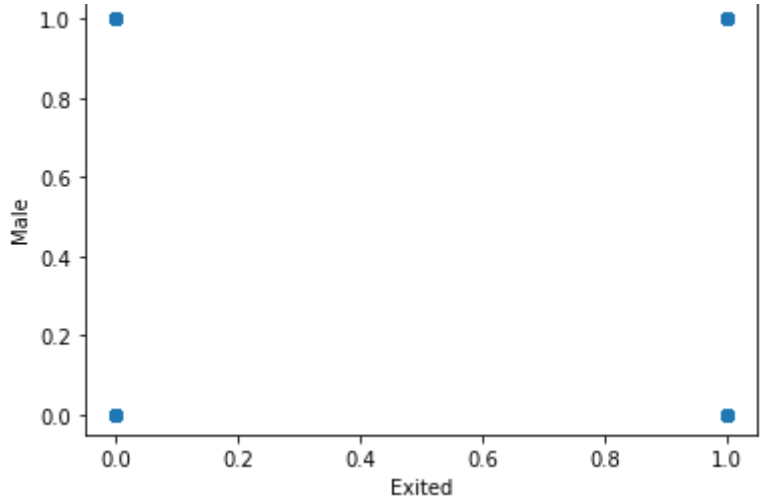

HasCrCard
0.0
0.2
0.4
0.6
0.0
0.2
0.4
0.6
0.8
1.0
Exited

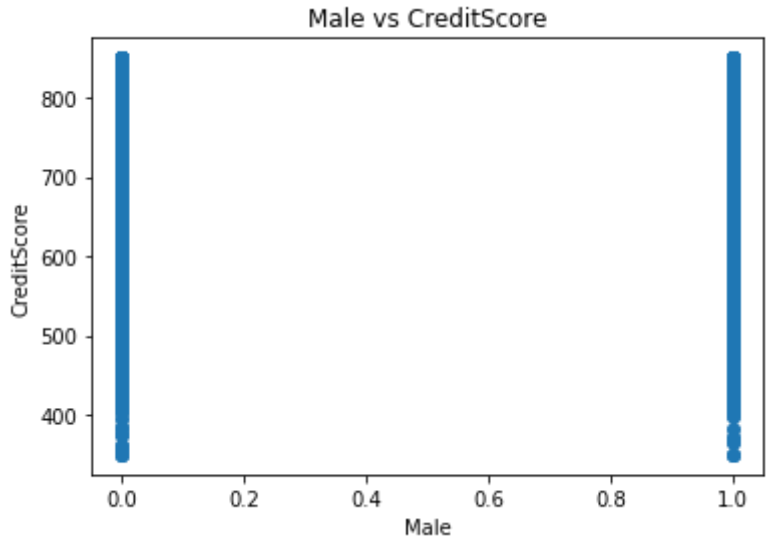

Exited vs IsActiveMember
IsActiveMember
0.0
0.2
0.4
0.6
0.8
1.0
Exited

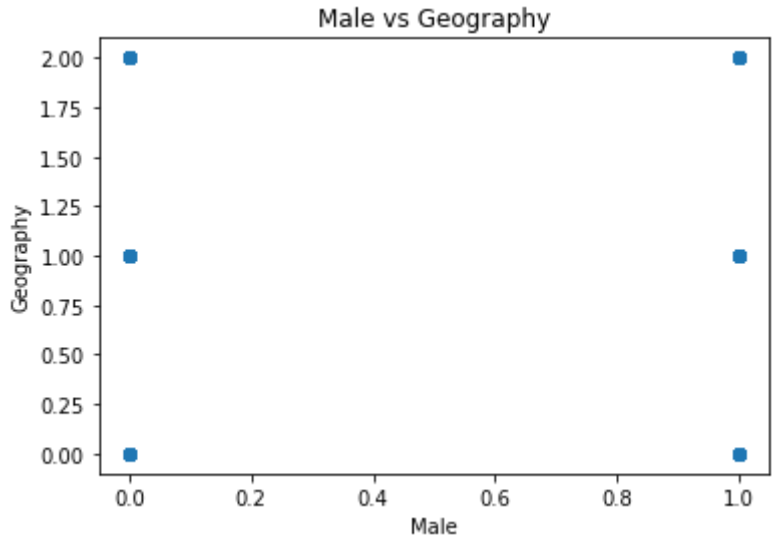

Exited vs EstimatedSalary
EstimatedSalary
0
25000
50000
75000
100000
125000
150000
175000
200000
0.0
0.2
0.4
0.6
0.8
1.0
Exited


Exited vs Exited
Exited
0.0
0.2
0.4
0.6
0.8
1.0
Exited

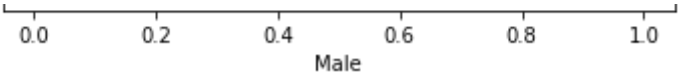

Exited vs Male

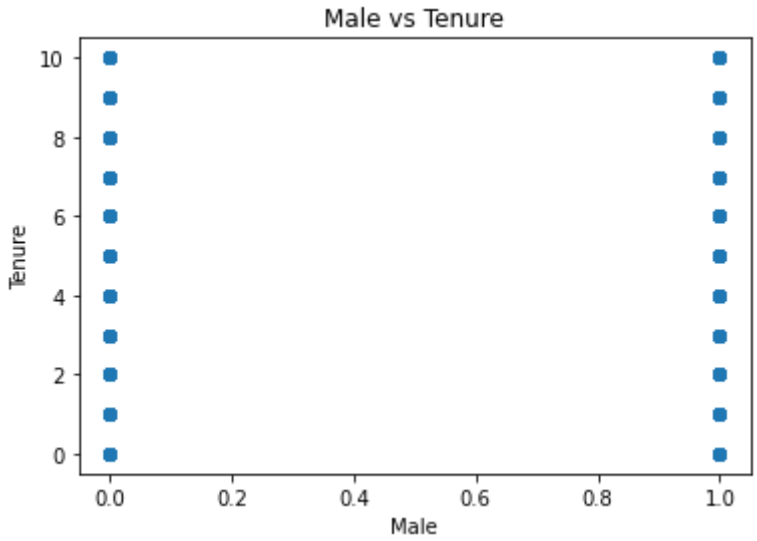

Male
Exited

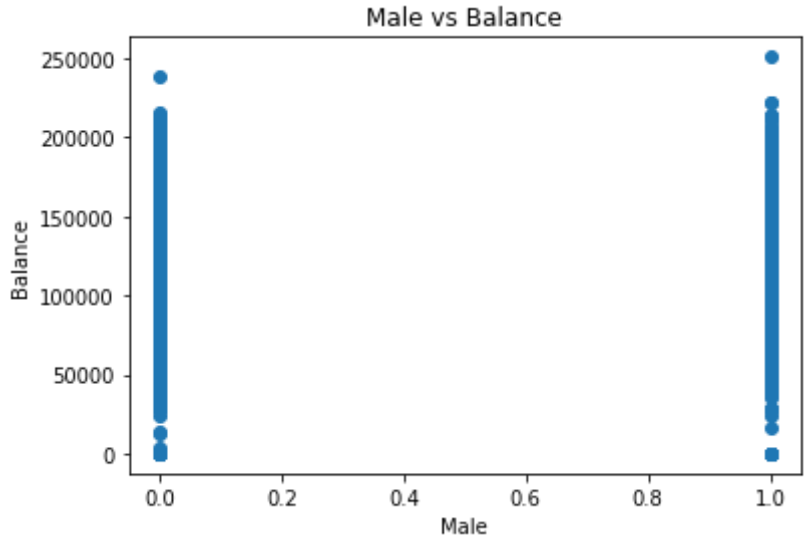

Male vs CreditScore
CreditScore
Male

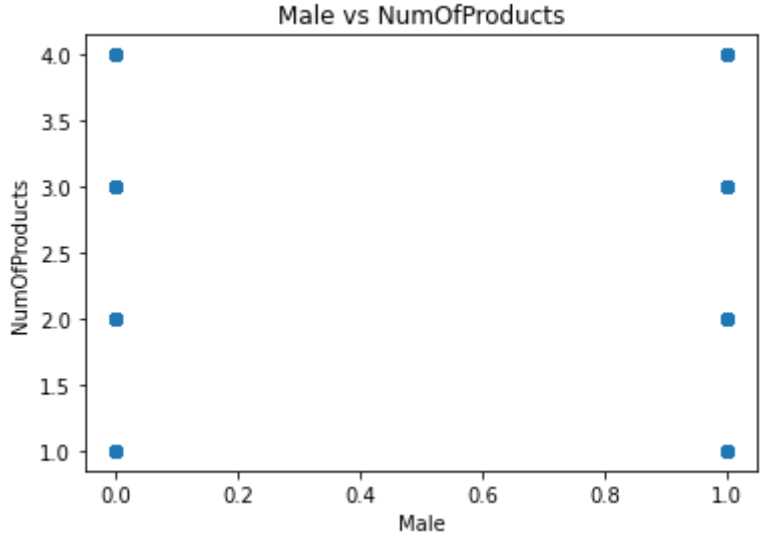

Male vs Geography
Geography
Male

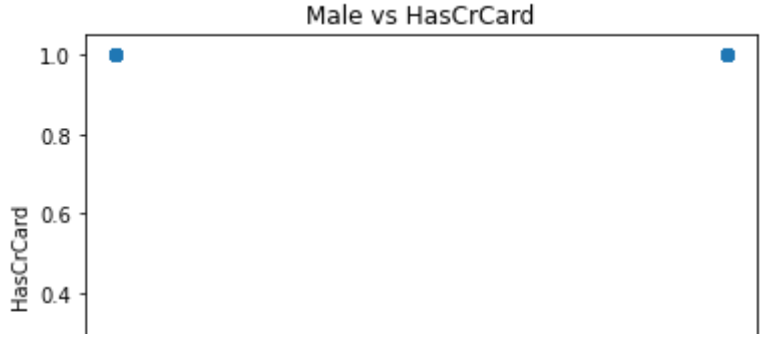
Male vs Age
Age

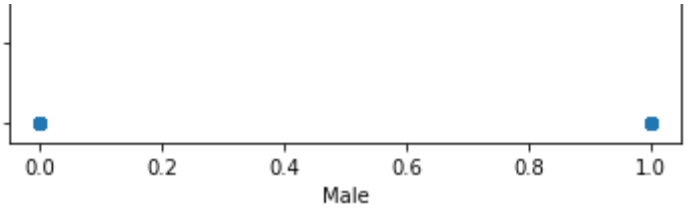

0.0
0.2
0.4
0.6
0.8
1.0
Male

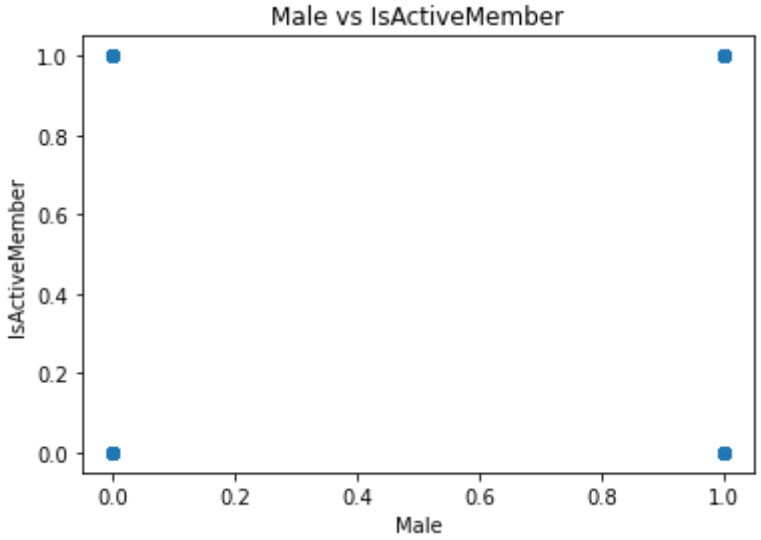

Male vs Tenure
Tenure
Male
0
2
4
6
8
10
0.0
0.2
0.4
0.6
0.8
1.0

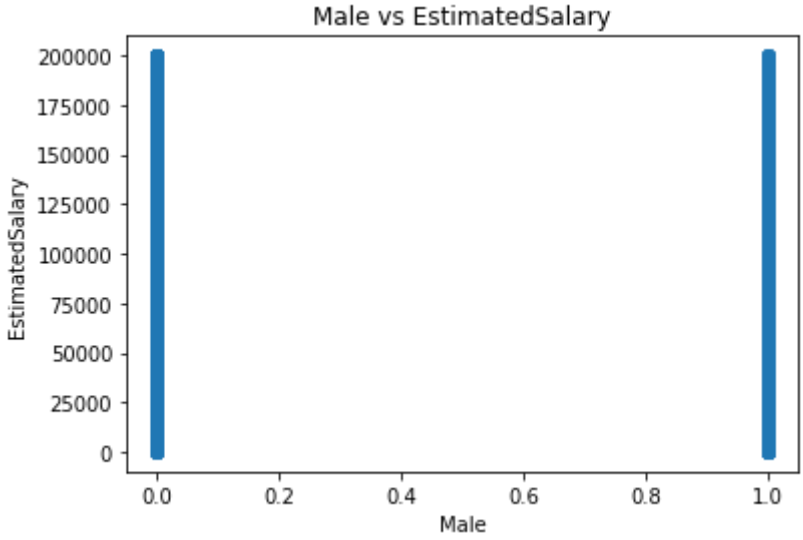

Male vs Balance
Balance
Male
0
50000
100000
150000
200000
250000
0.0
0.2
0.4
0.6
0.8
1.0

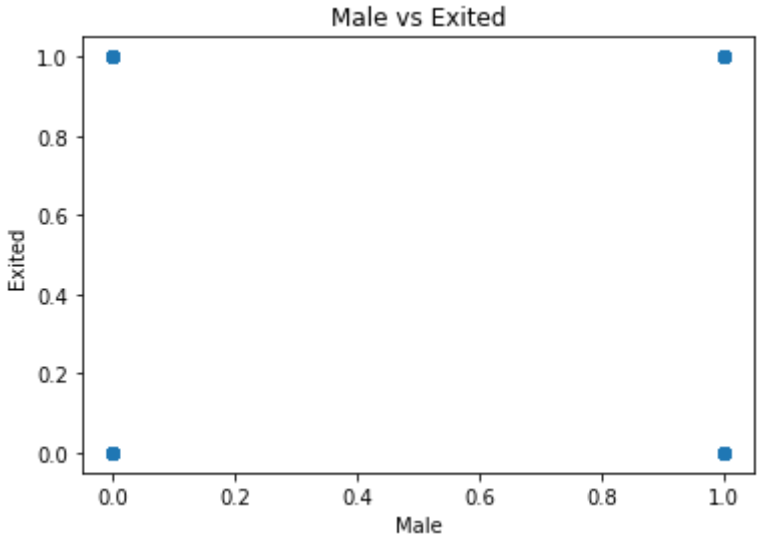

Male vs NumOfProducts
NumOfProducts
Male
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0.0
0.2
0.4
0.6
0.8
1.0

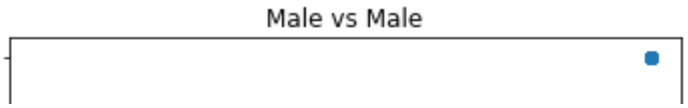

Male vs HasCrCard
HasCrCard
0.4
0.6
0.8
1.0





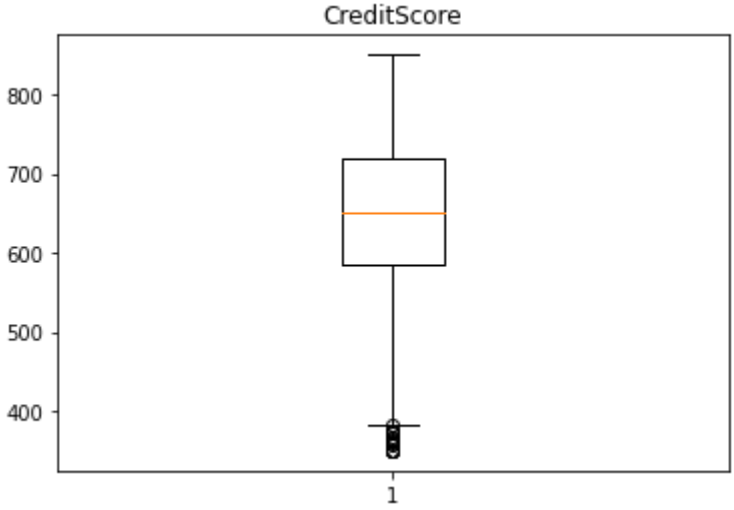


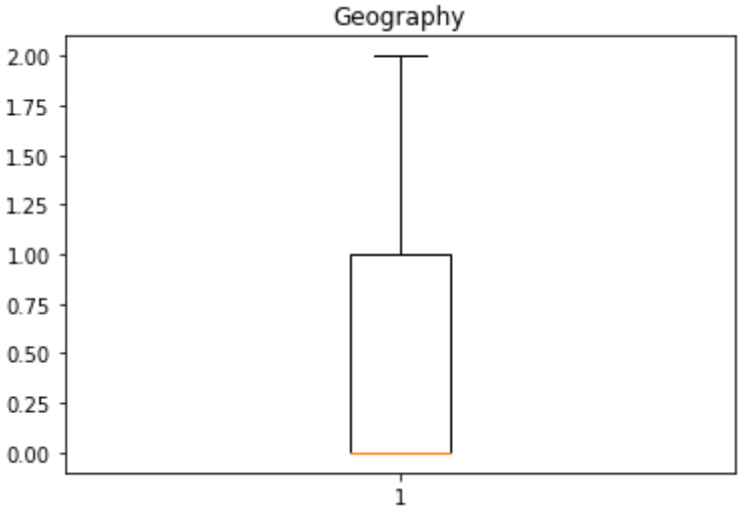


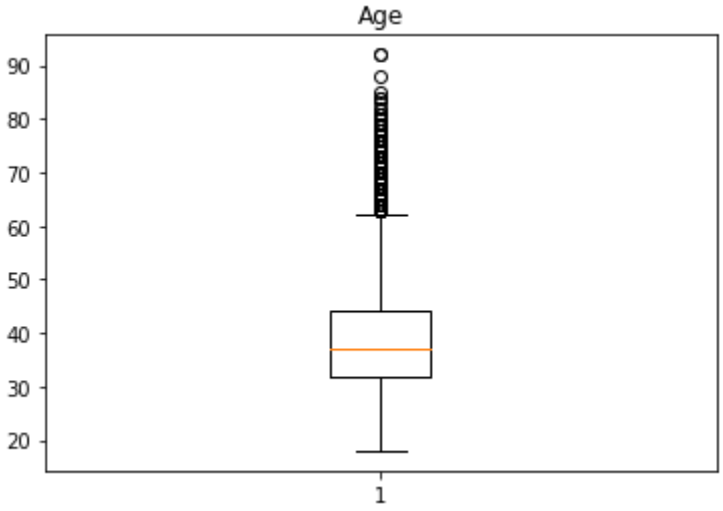


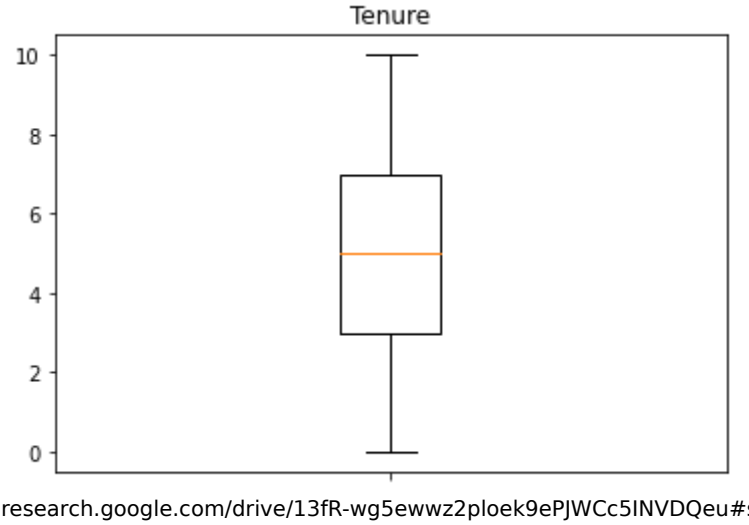

```
for i in df.columns:
  if i != 'Surname':
```

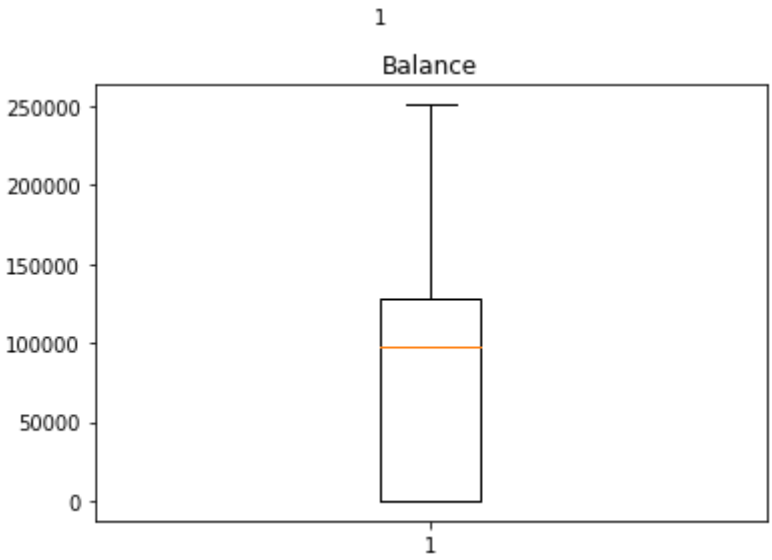
```
        plt.boxplot(df[i])
        plt.title(i)
        plt.show()
```

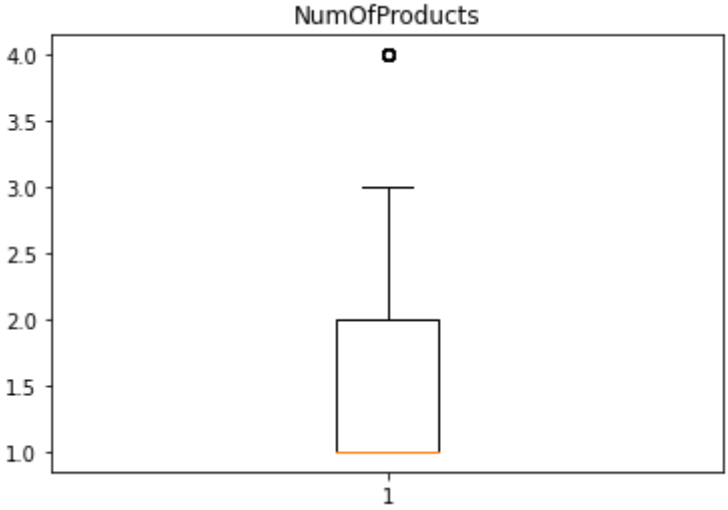

CreditScore
800
700
600
500
400
1

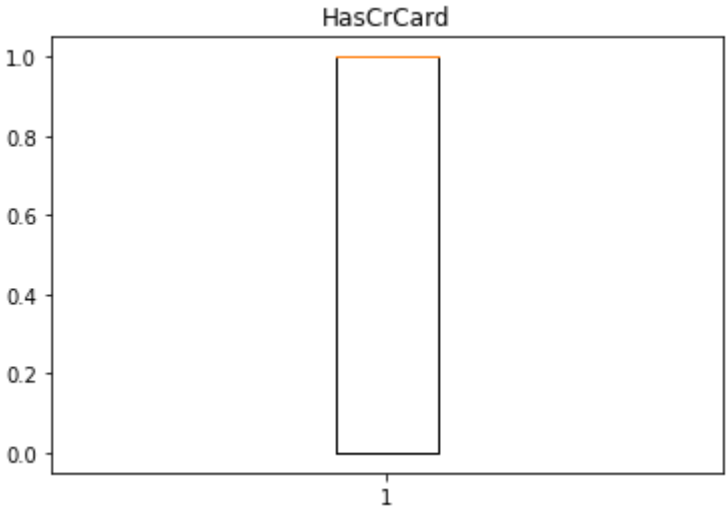

Geography
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1


Age
90
80
70
60
50
40
30
20
1

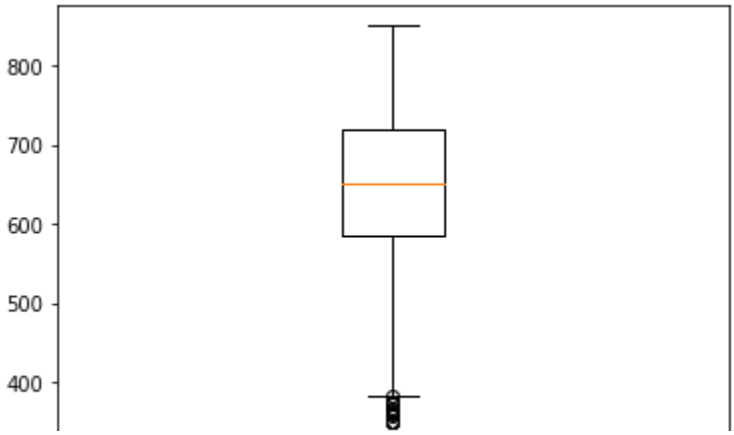

Tenure
10
8
6
4
2
0







```
sample = df['CreditScore']
plt.boxplot(sample)
plt.show()
```

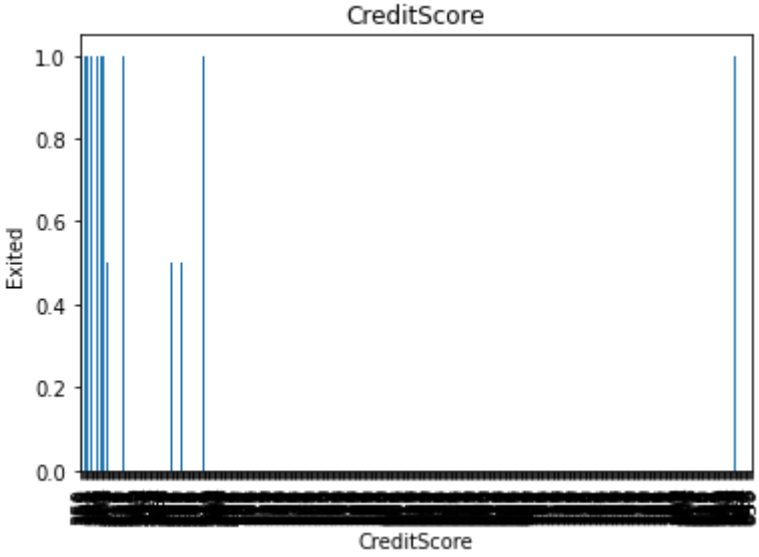


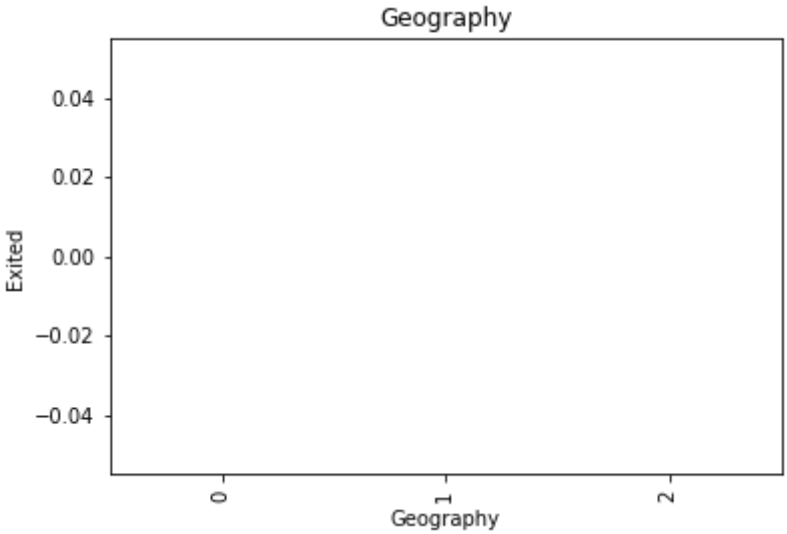

```
df.describe()
```

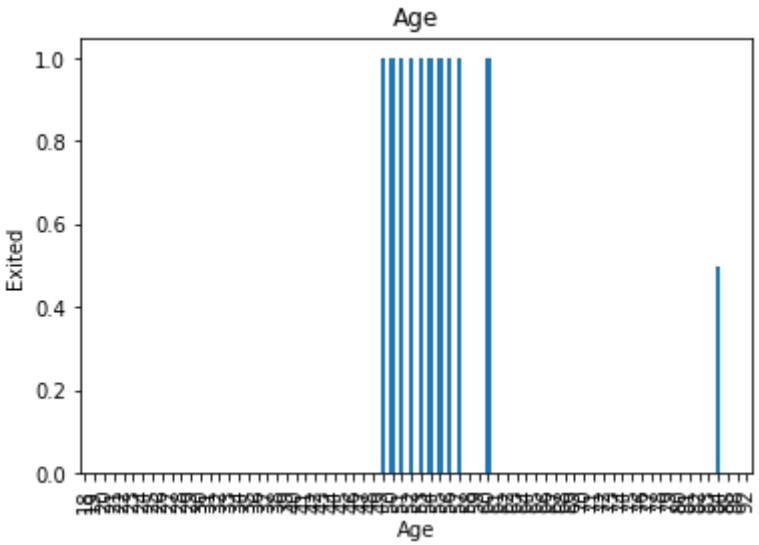
	CreditScore	Geography	Age	Tenure	Balance	NumOfP
count	10000.000000	10000.000000	10000.000000	10000.000000	10000.000000	10000
mean	650.528800	0.746300	38.921800	5.012800	76485.889288	
std	96.653299	0.827529	10.487806	2.892174	62397.405202	
min	350.000000	0.000000	18.000000	0.000000	0.000000	
25%	584.000000	0.000000	32.000000	3.000000	0.000000	
50%	652.000000	0.000000	37.000000	5.000000	97198.540000	
75%	718.000000	1.000000	44.000000	7.000000	127644.240000	
max	850.000000	2.000000	92.000000	10.000000	250898.090000	

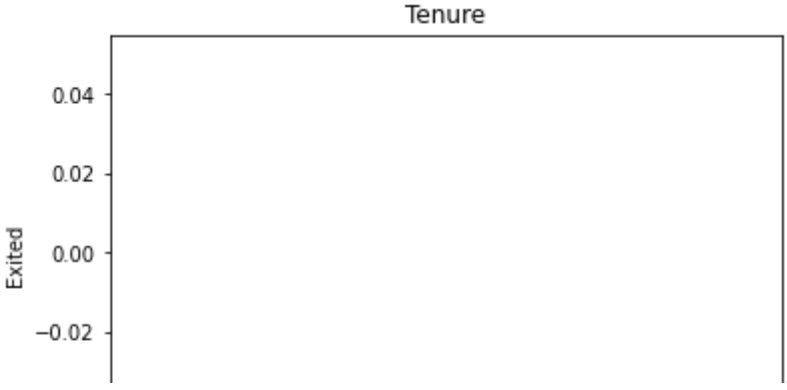
Male

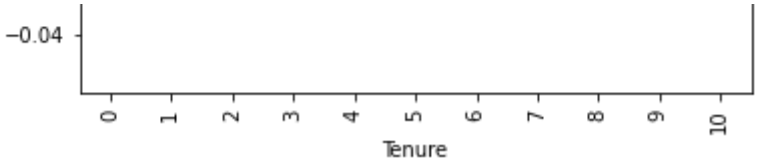
```
for feature in df.columns:
  if df[feature].dtype != 'O':
    data = df.copy()
    data.groupby(feature)['Exited'].median().plot.bar()
    plt.xlabel(feature)
    plt.ylabel('Exited')
    plt.title(feature)
    plt.show()
```

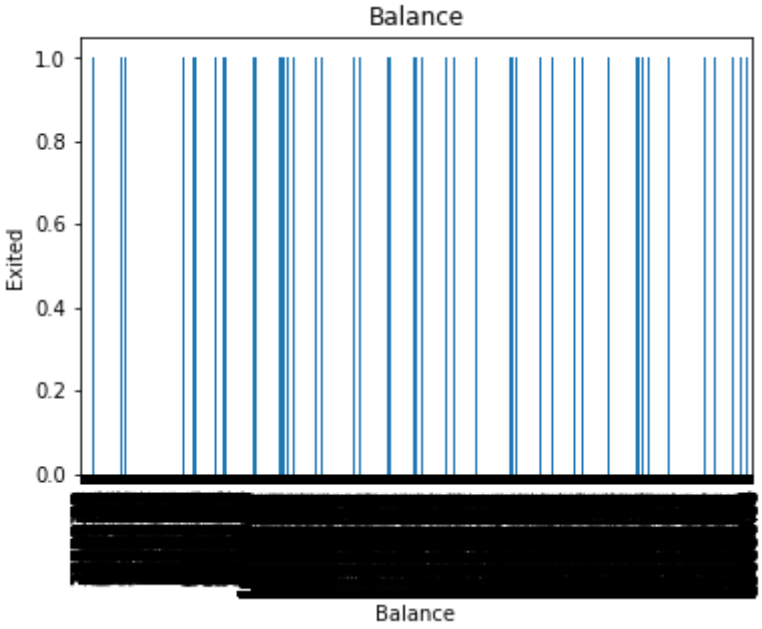

CreditScore
Exited
1.0
0.8
0.6
0.4
0.2
0.0
CreditScore

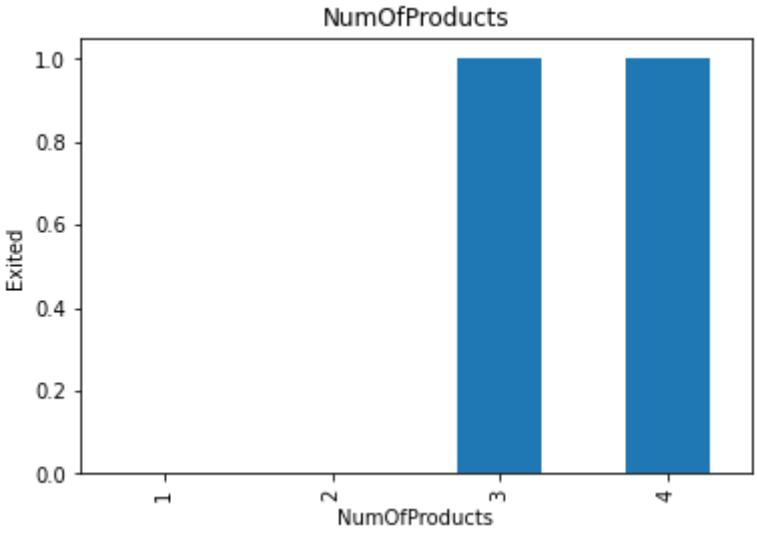

Geography
Exited
0.04
0.02
0.00
−0.02
−0.04
0
1
2
Geography

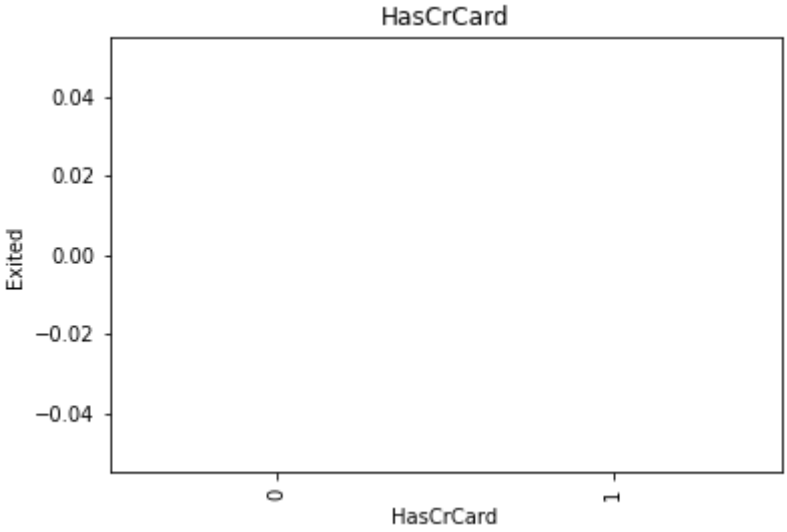

Age
Exited
1.0
0.8
0.6
0.4
0.2
0.0
Age


Tenure
Exited
0.04
0.02
0.00
−0.02

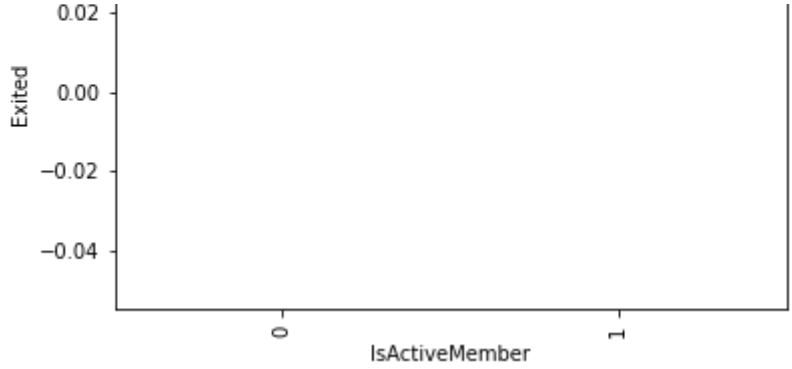

−0.04
0
1
2
3
4
5
6
7
8
9
10
Tenure

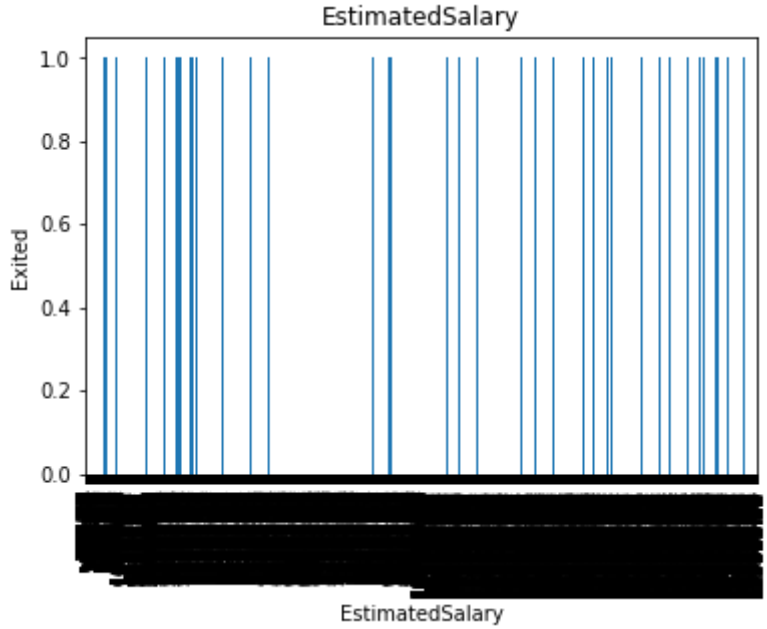

Balance
1.0
0.8
0.6
0.4
0.2
0.0
Exited
Balance

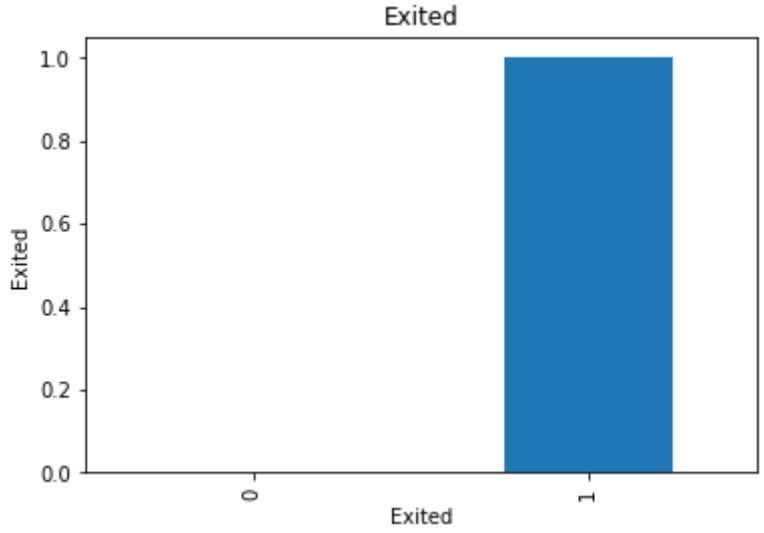

NumOfProducts
1.0
0.8
0.6
0.4
0.2
0.0
Exited
1
2
3
4
NumOfProducts


HasCrCard
0.04
0.02
0.00
−0.02
−0.04
Exited
0
1
HasCrCard

IsActiveMember
0.04

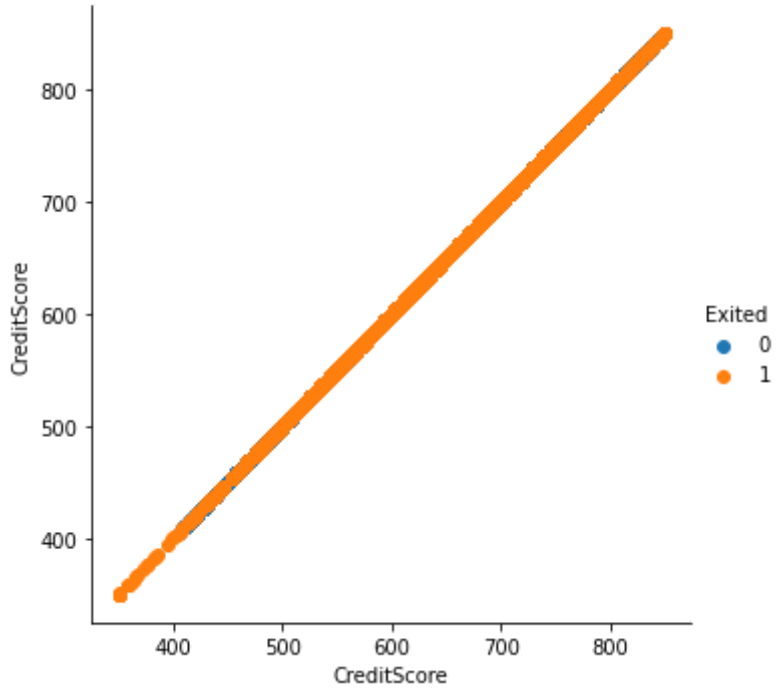







```
i = 0
for feature in df.columns:
  for feature2 in df.columns:
    if df[feature].dtype != 'O':
      if df[feature2].dtype != 'O':
        sns.FacetGrid(df,hue='Exited',size=5).map(plt.scatter,feature,feature2).ad
        plt.show()
        i += 1
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
  warnings.warn(msg, UserWarning)
```

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/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
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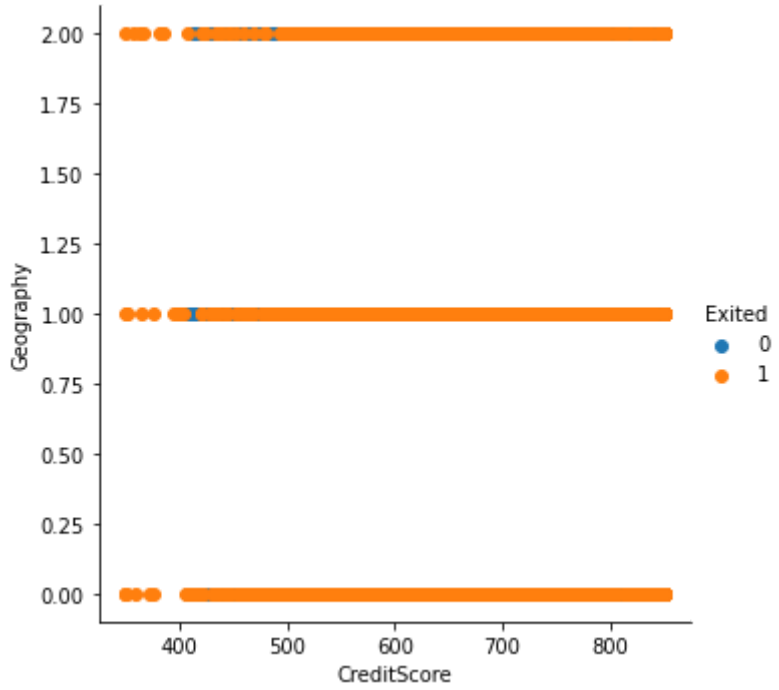


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/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
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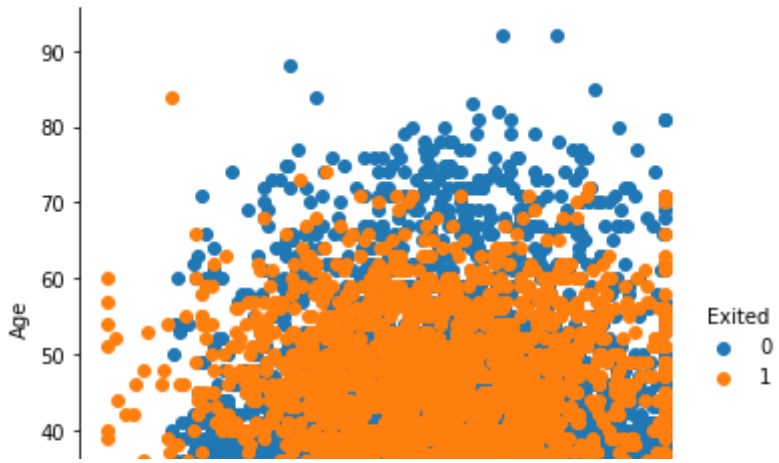

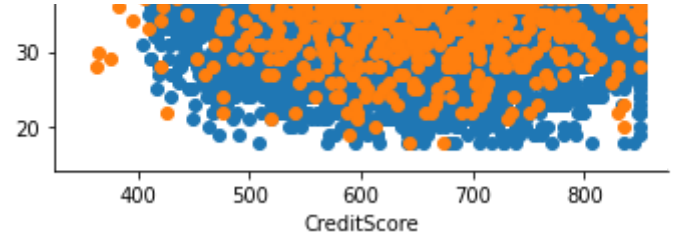


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/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
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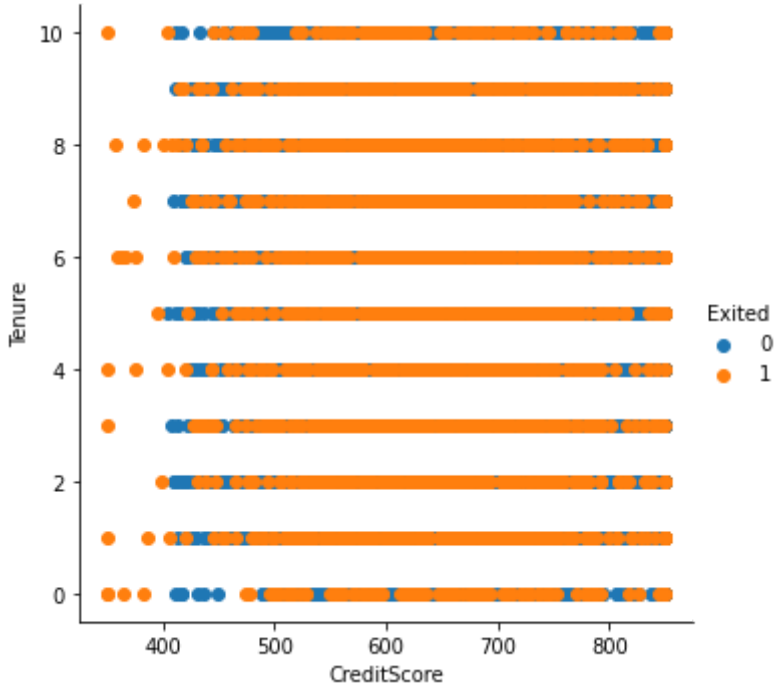


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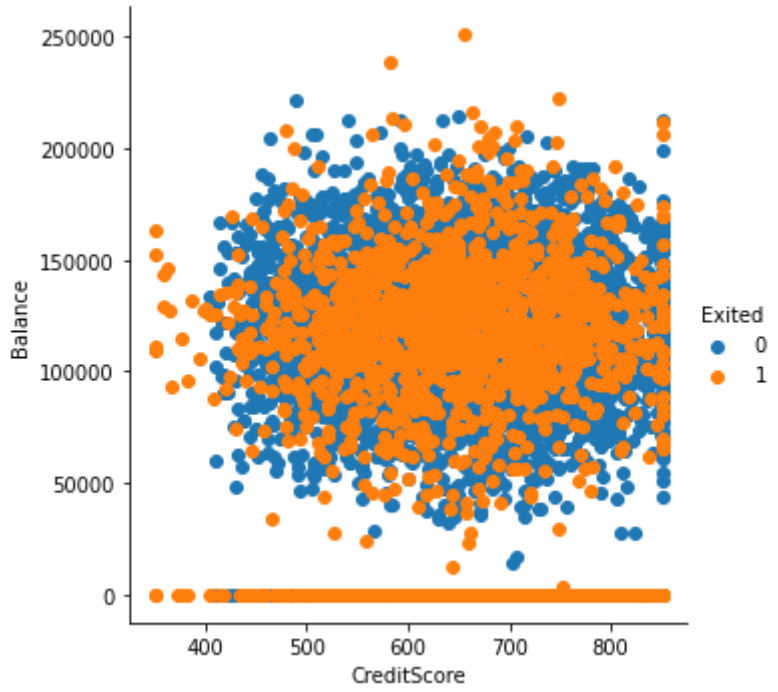


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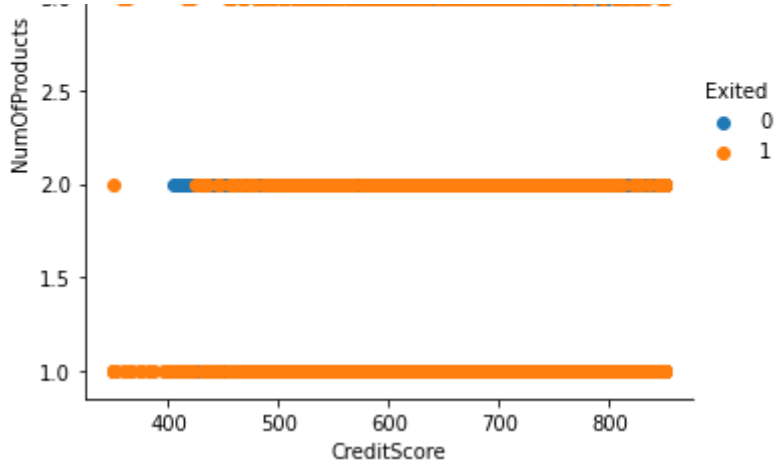


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/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
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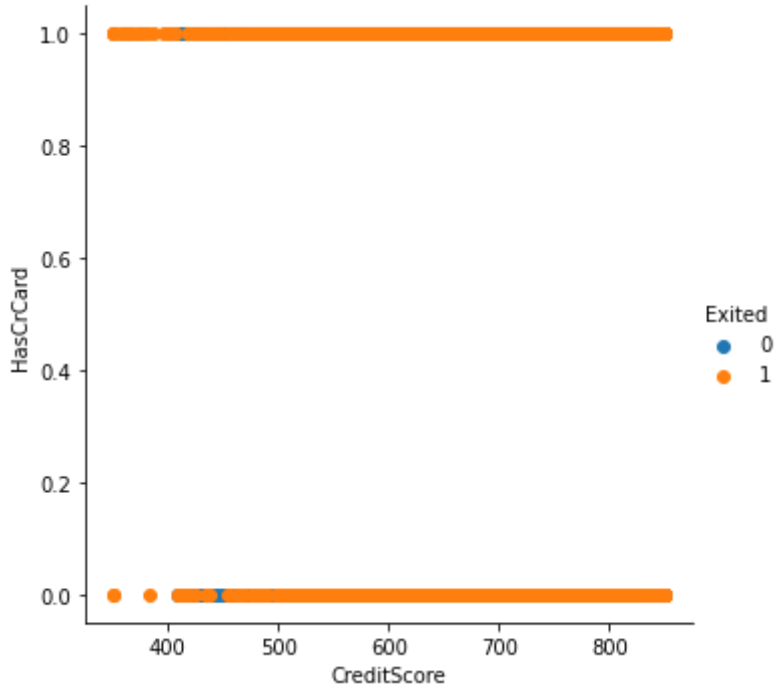


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/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
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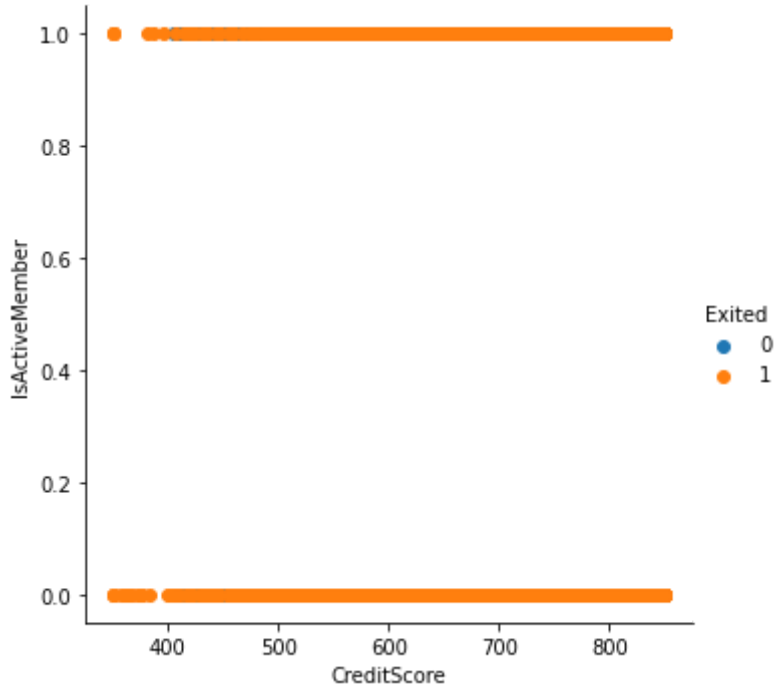


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/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
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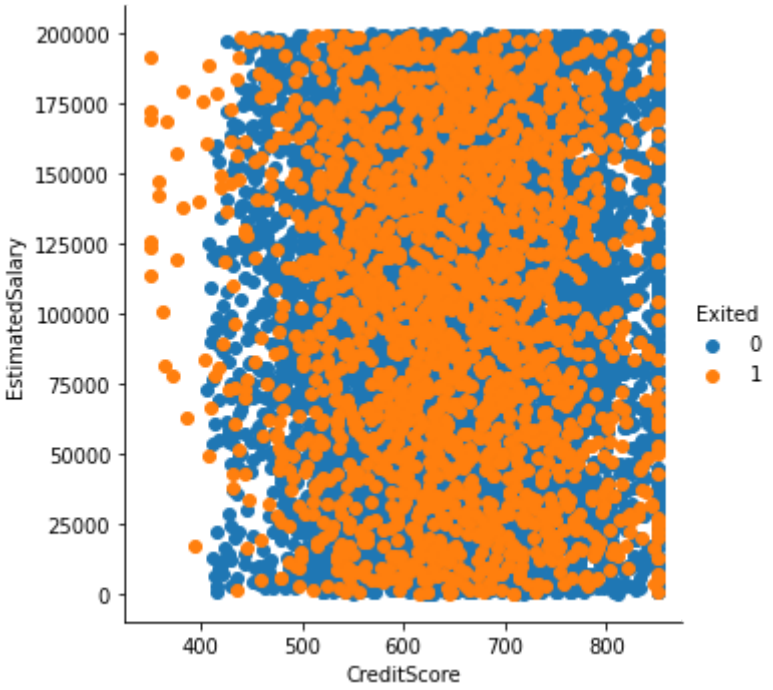


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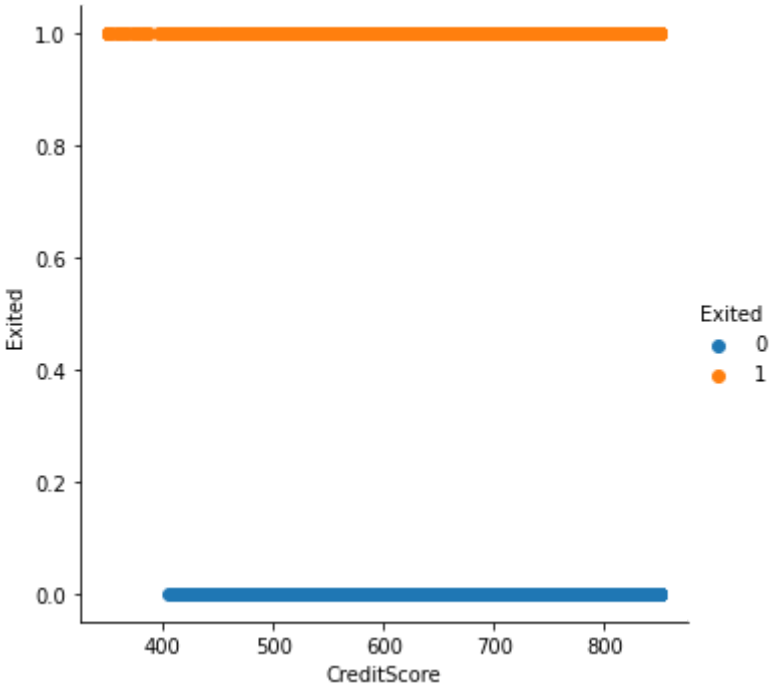


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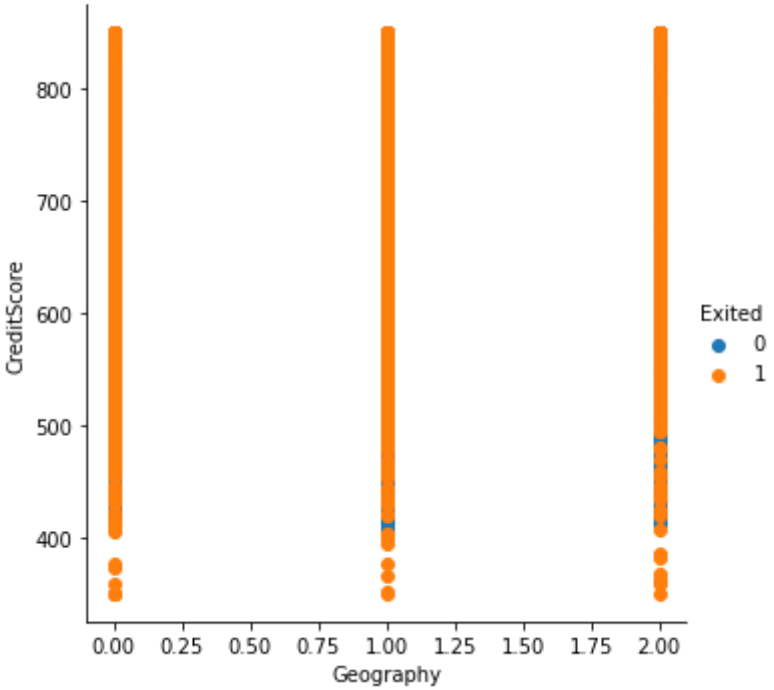


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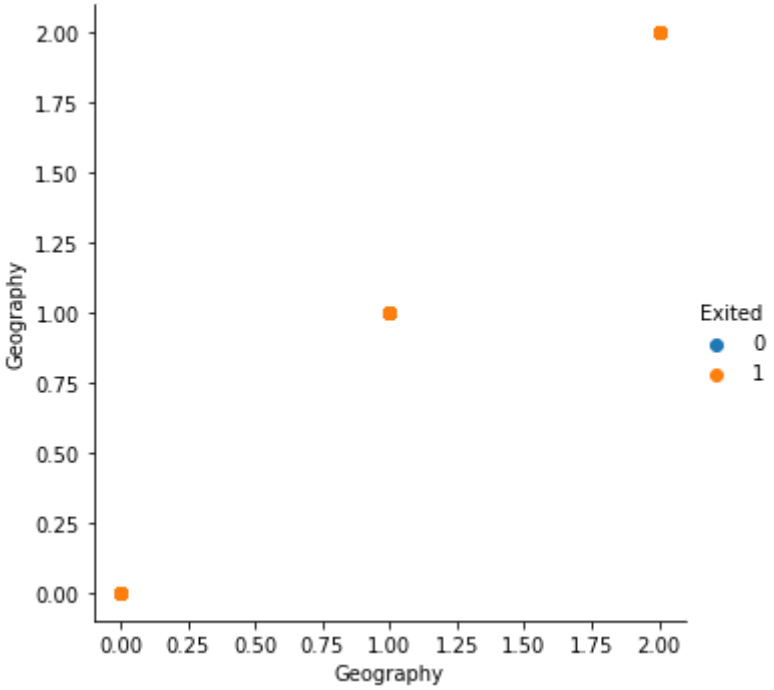


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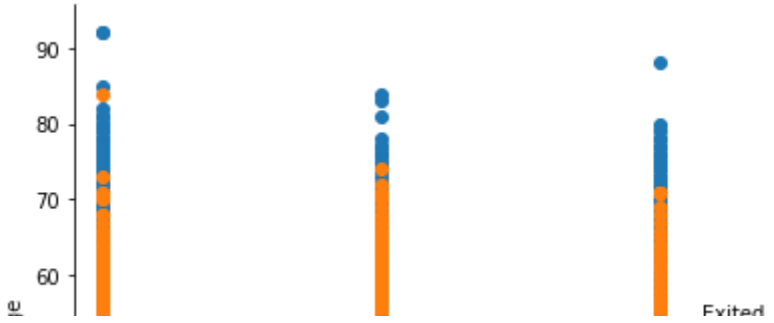

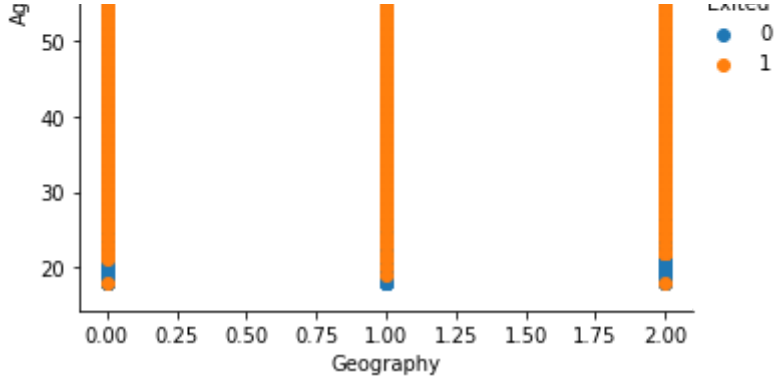


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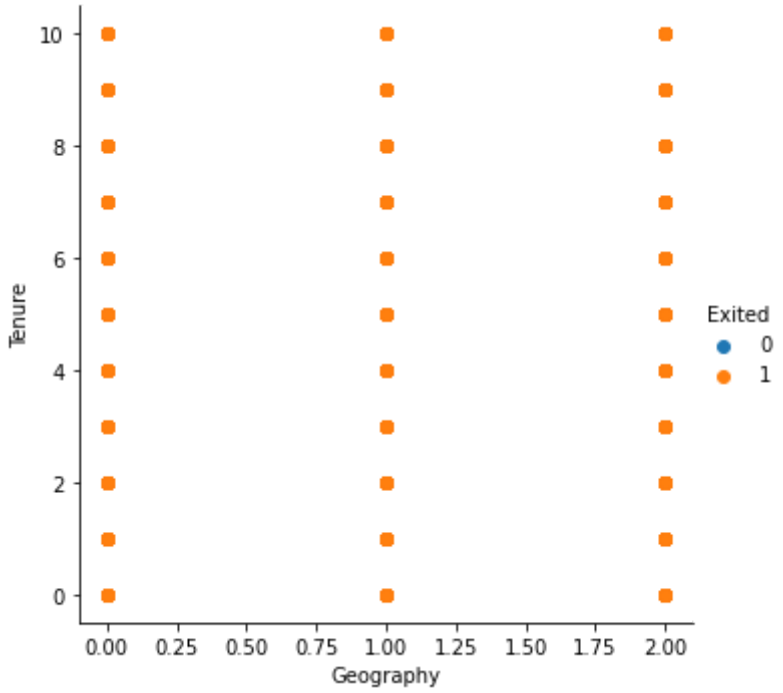


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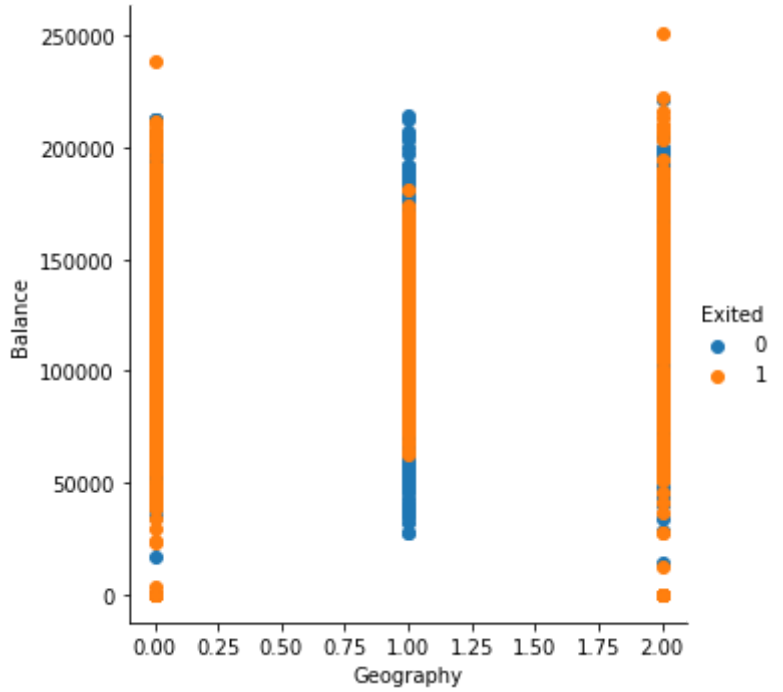


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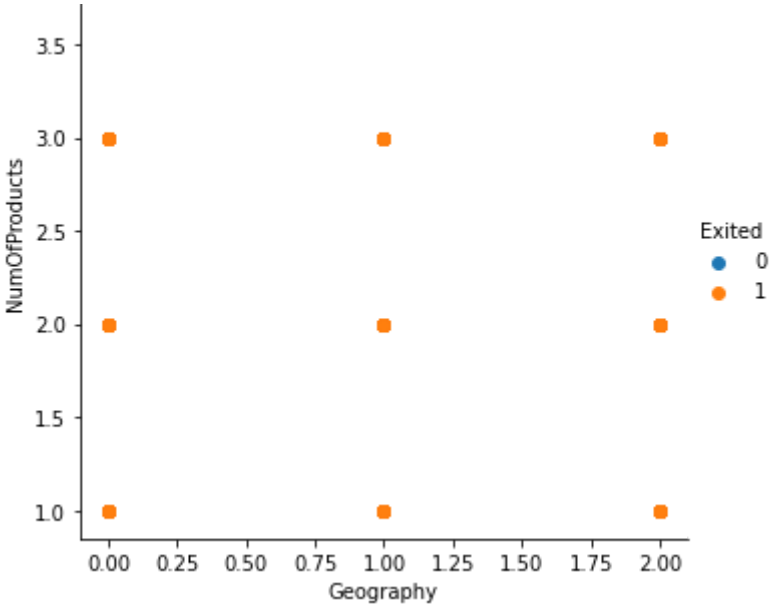


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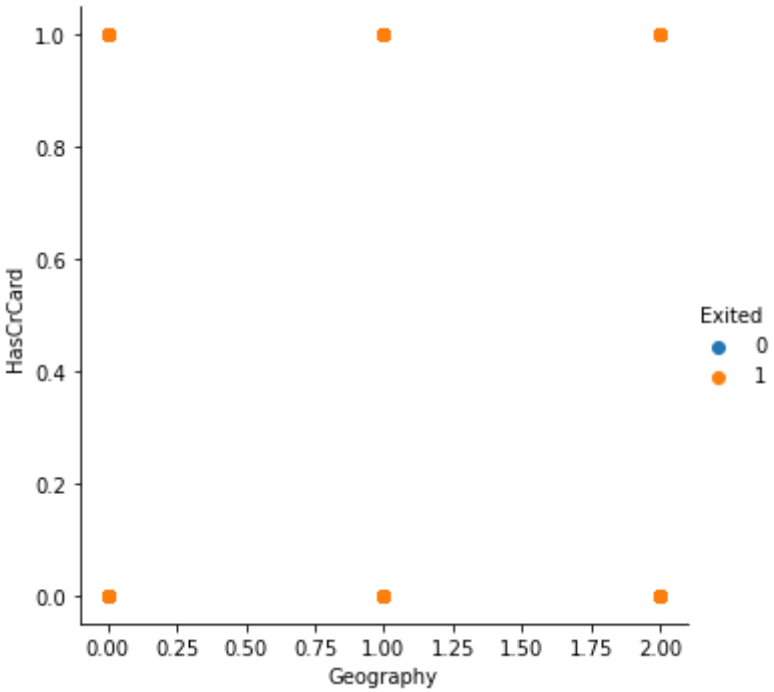


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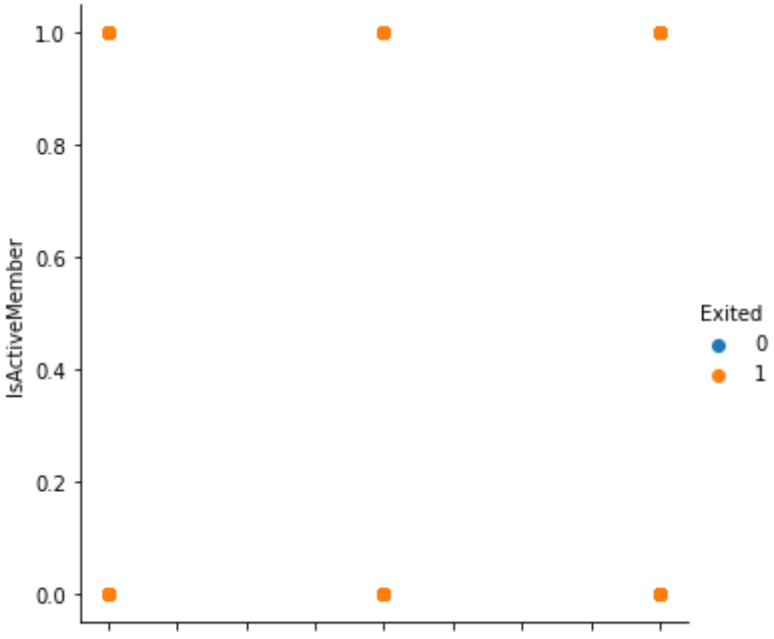

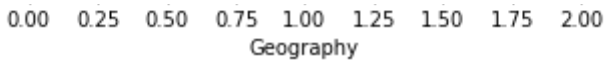


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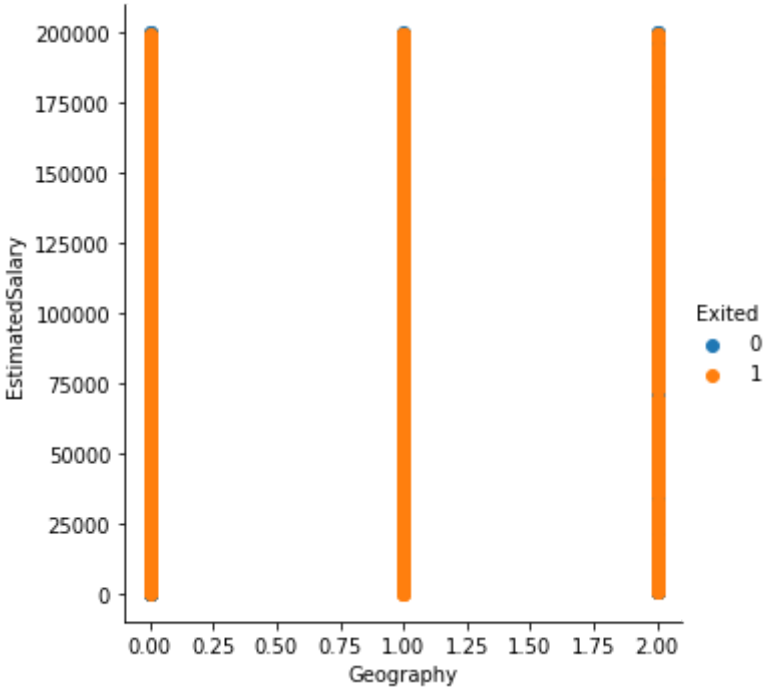


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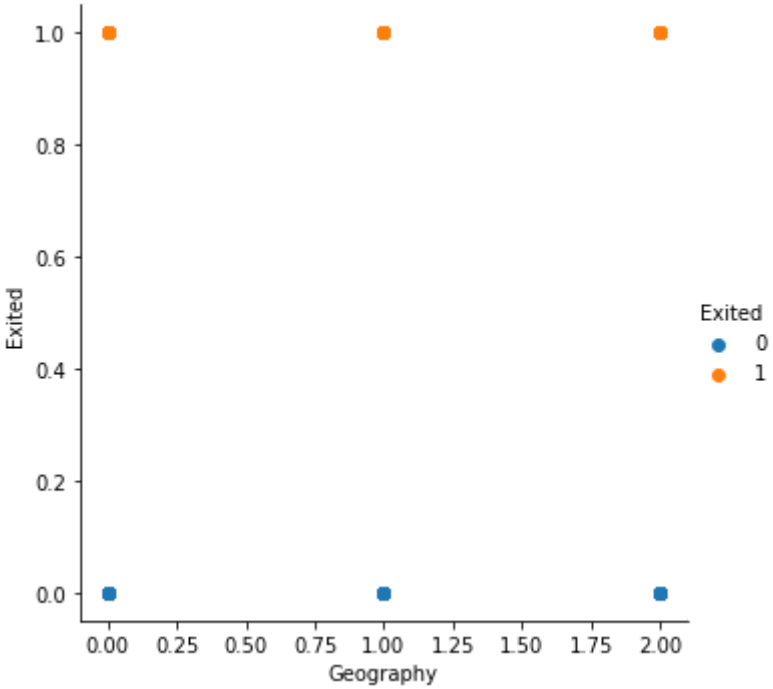


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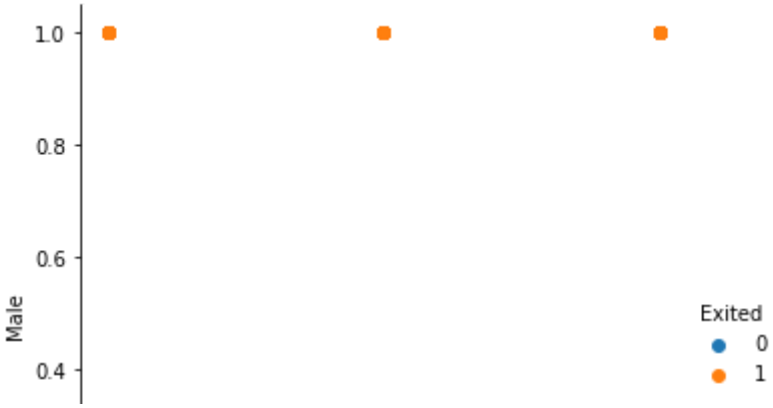

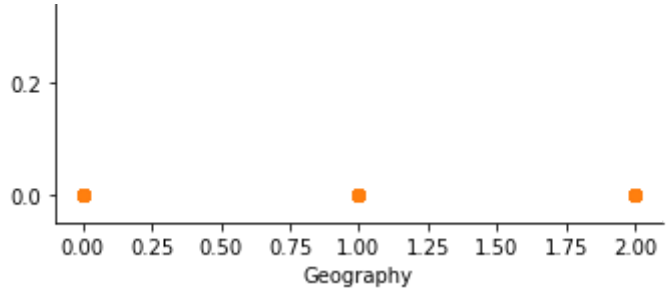


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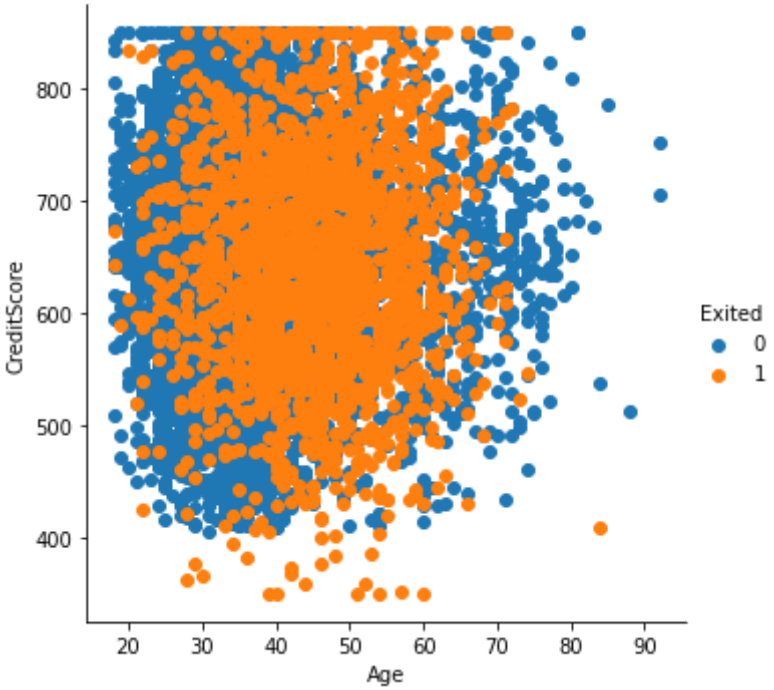


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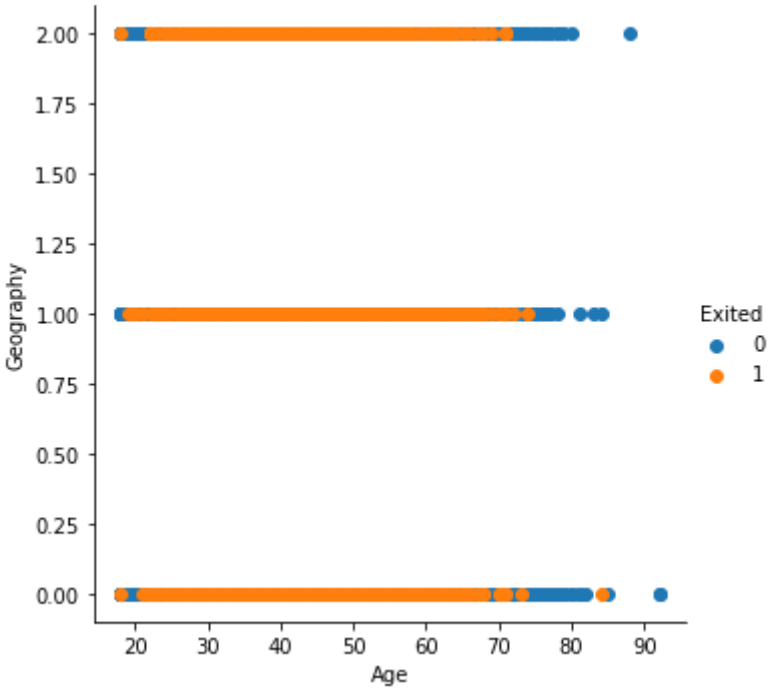


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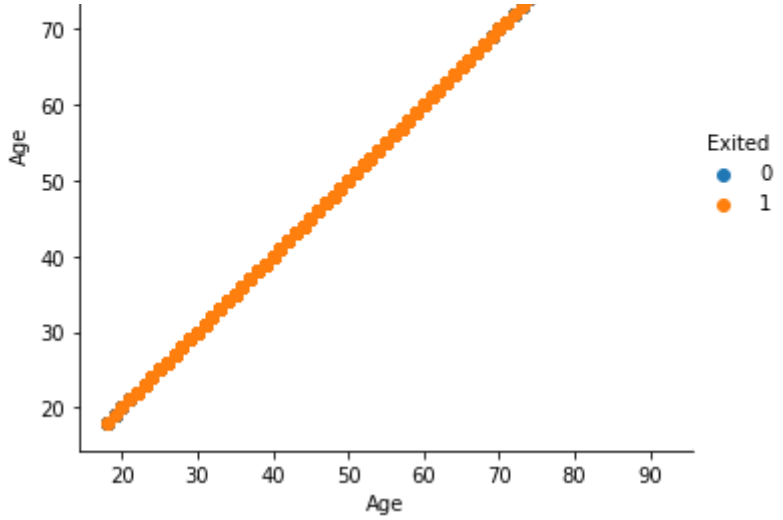


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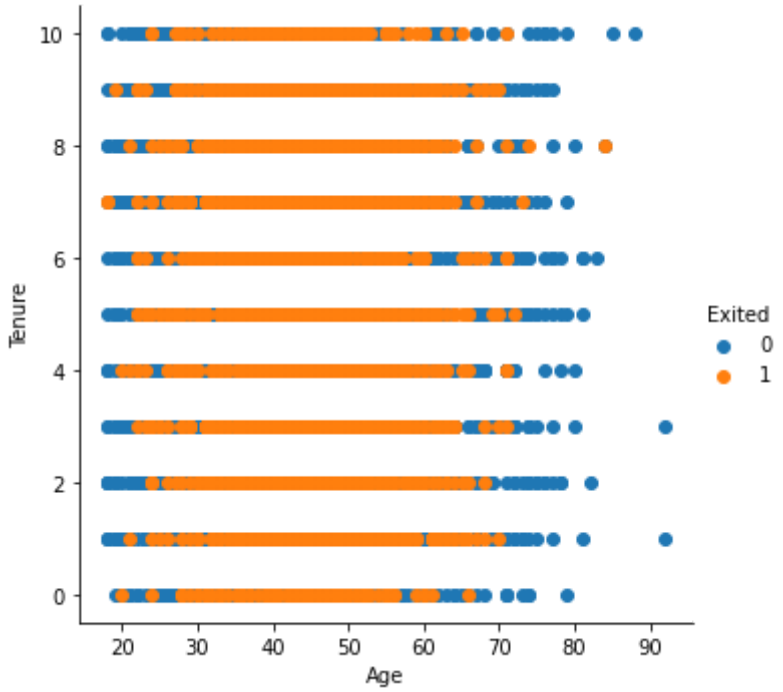


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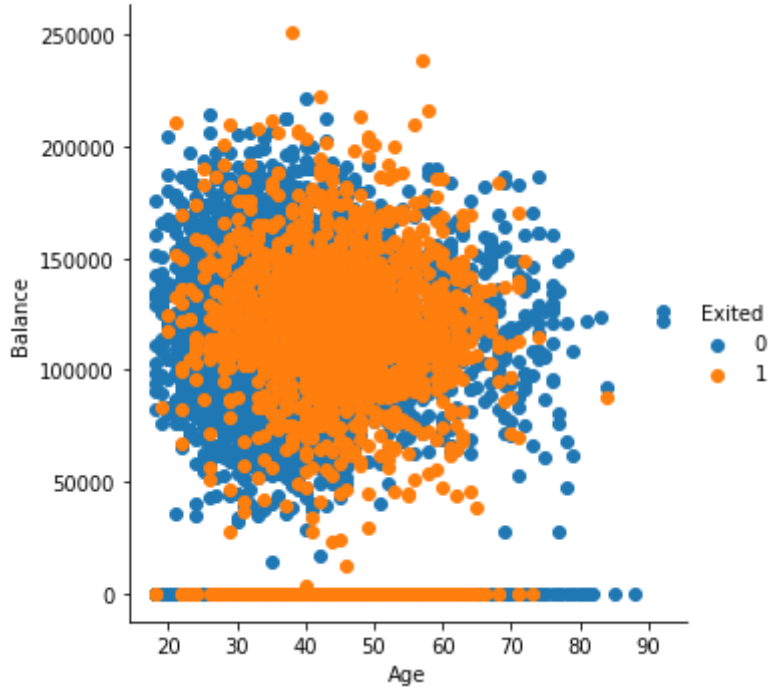


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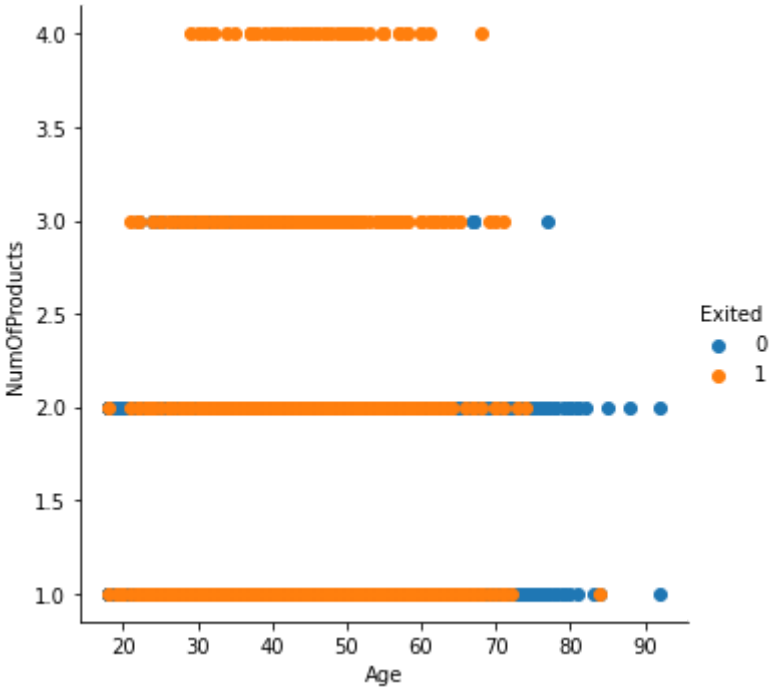


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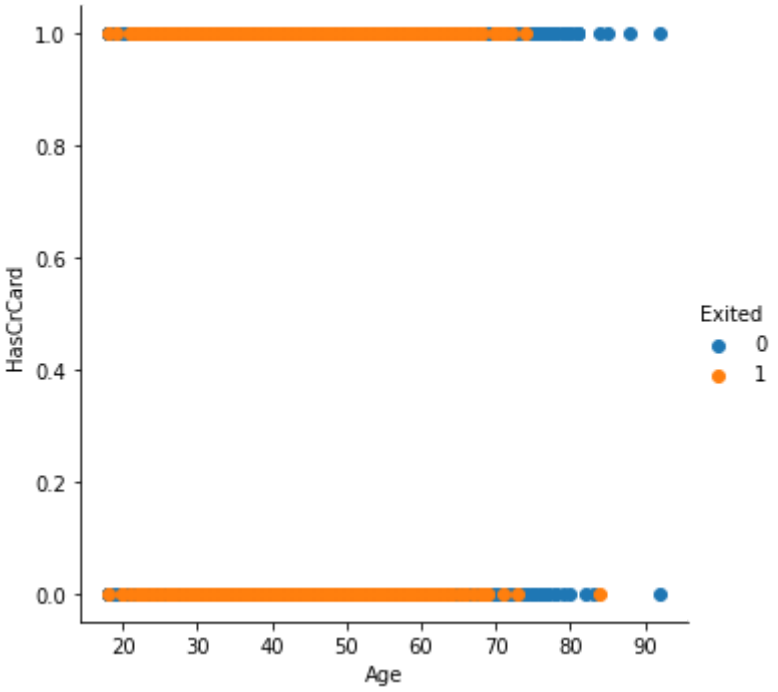


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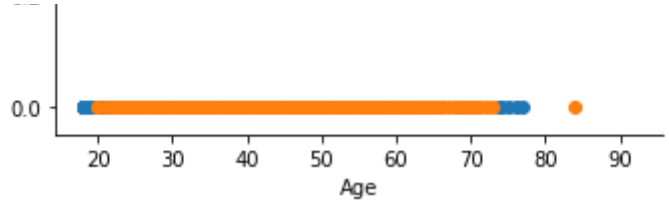


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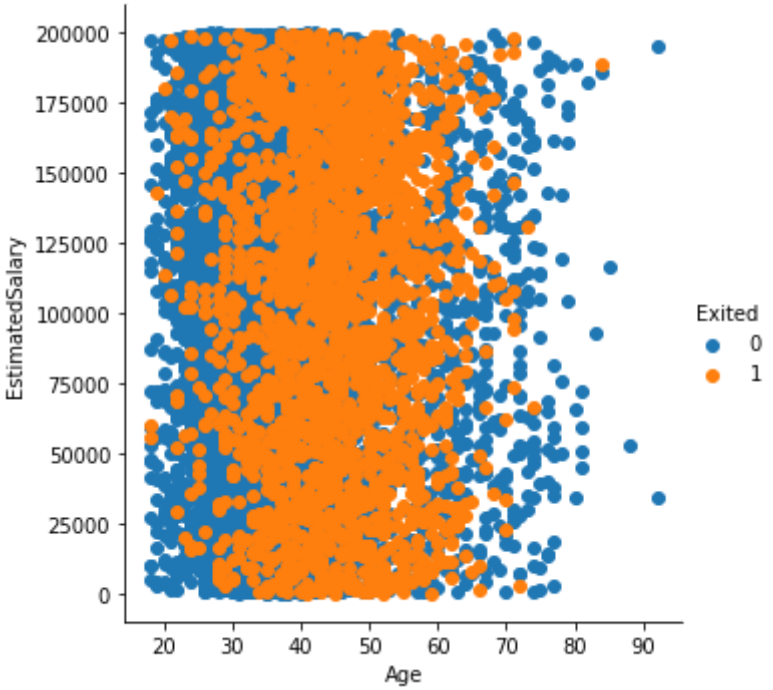


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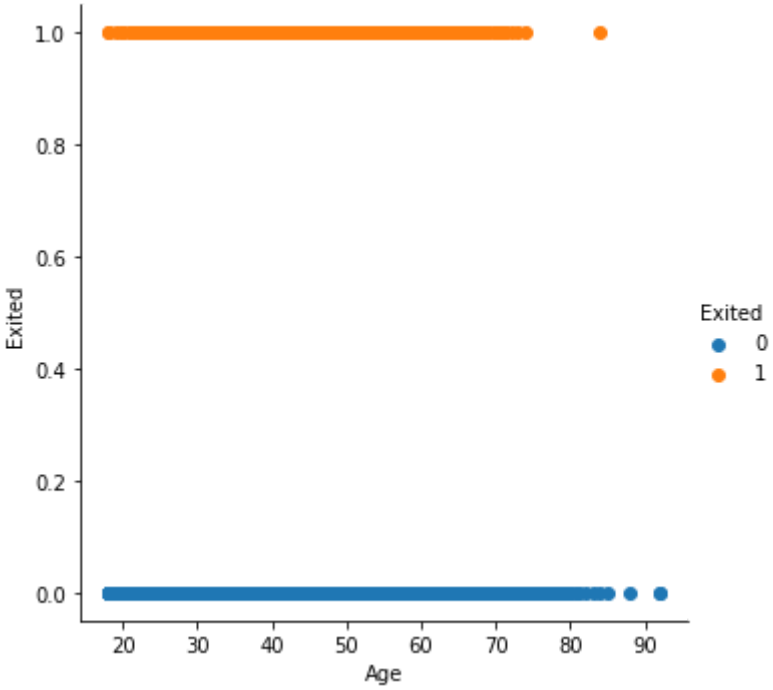


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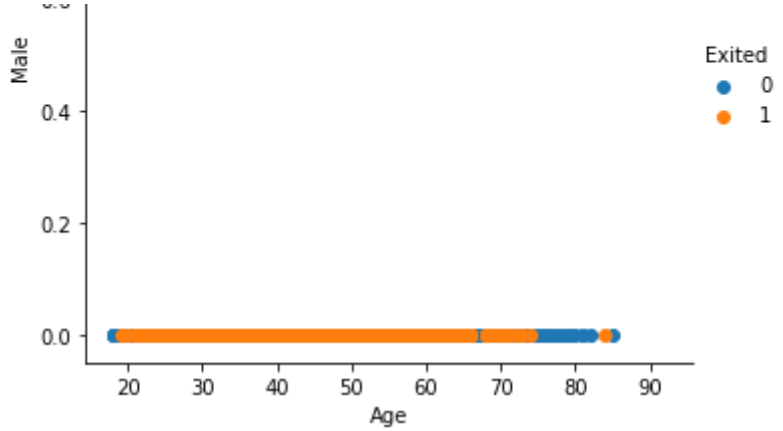


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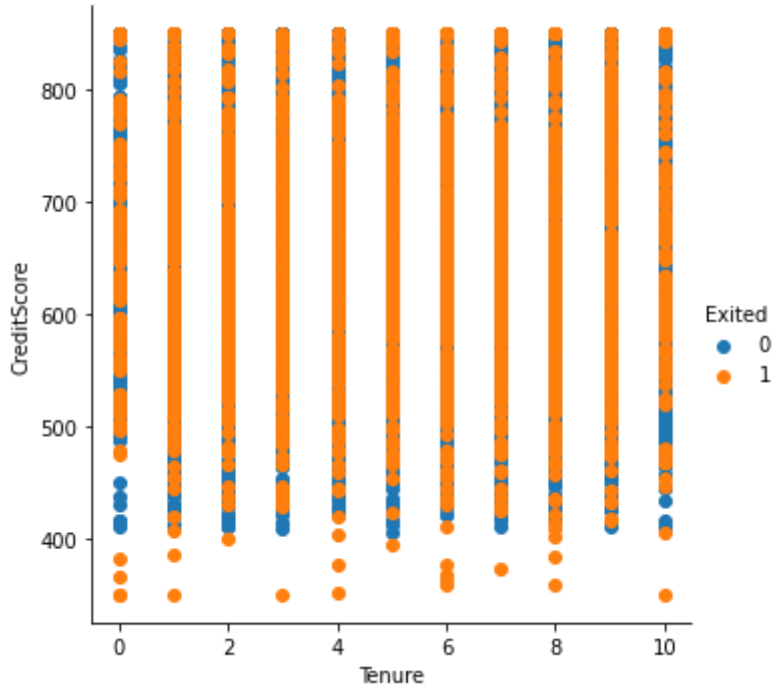


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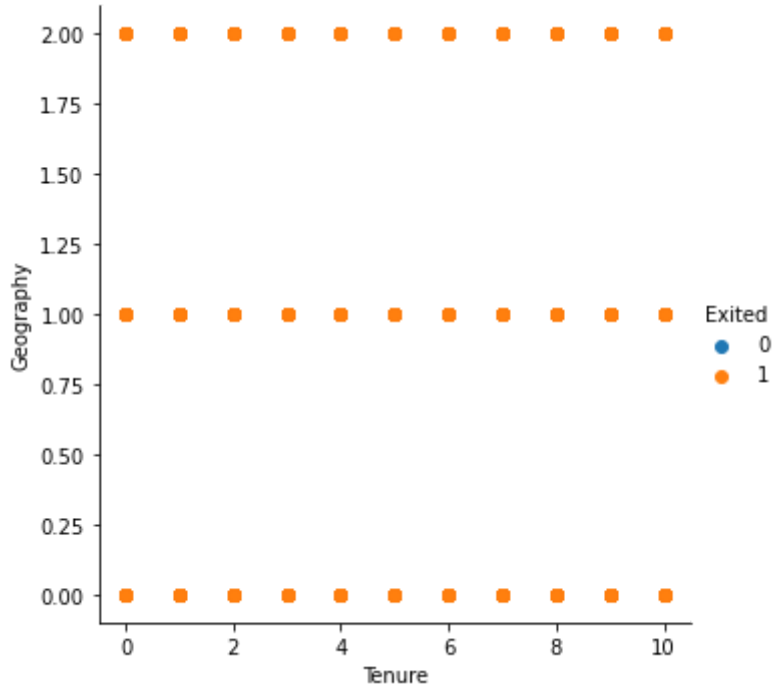


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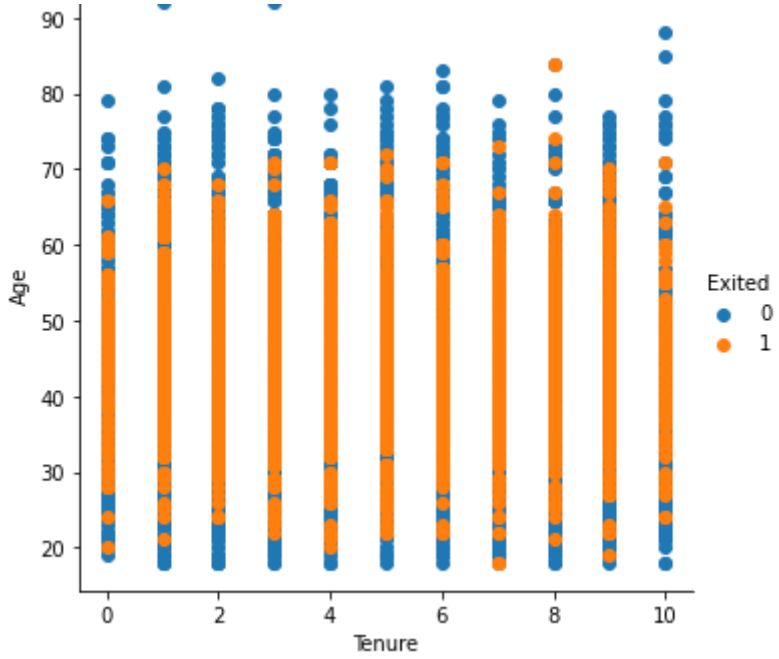


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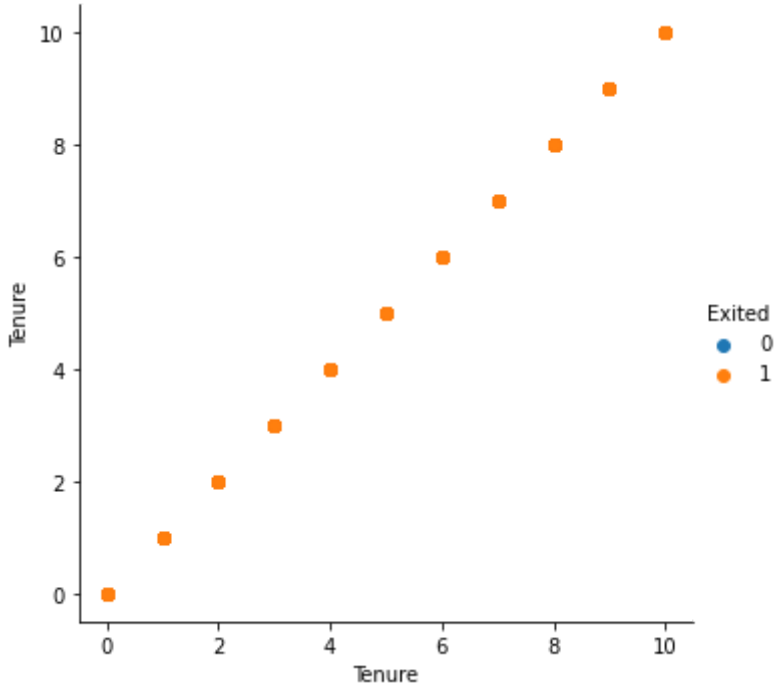


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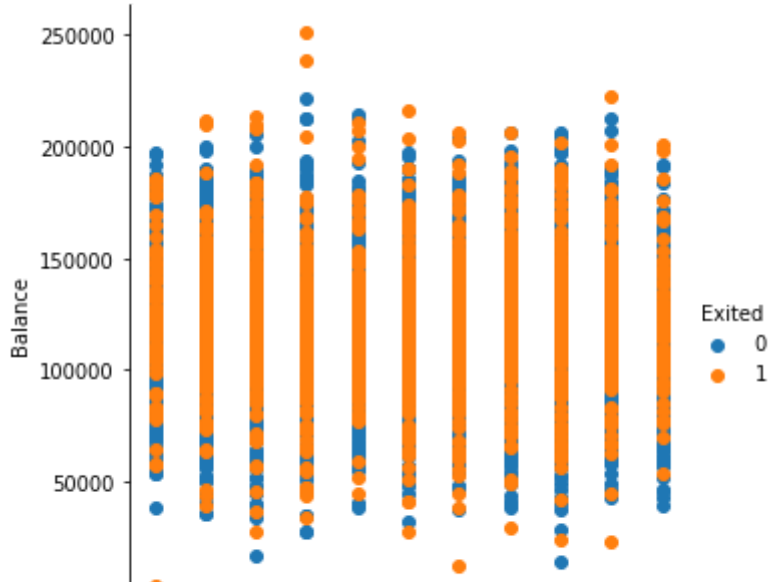

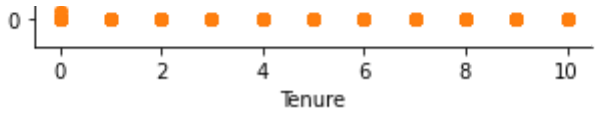


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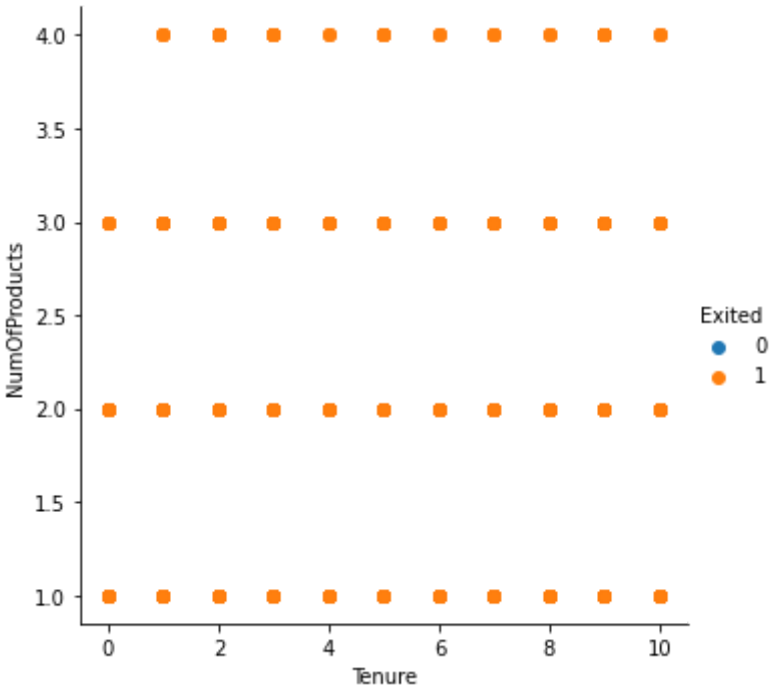


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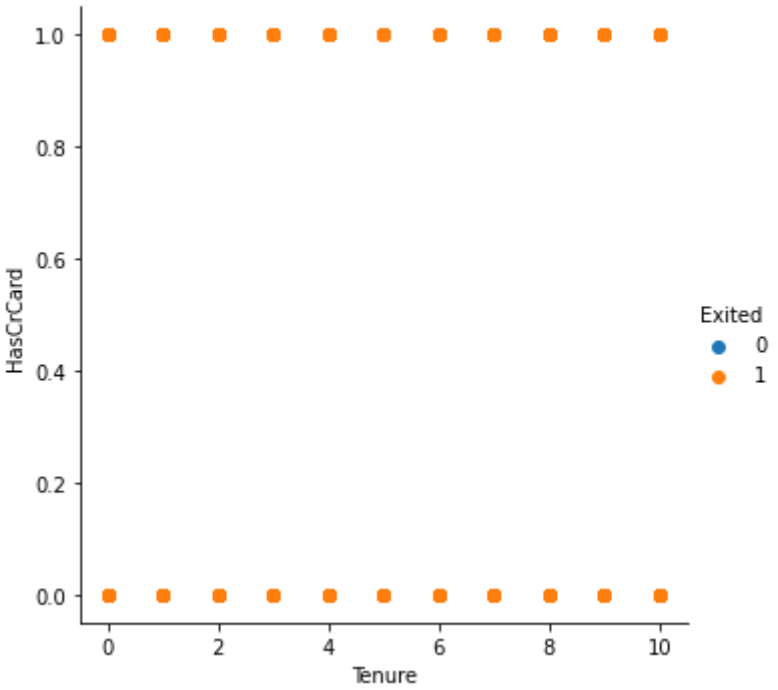


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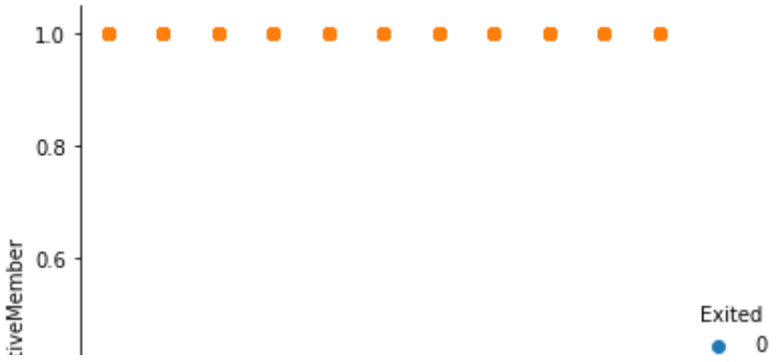

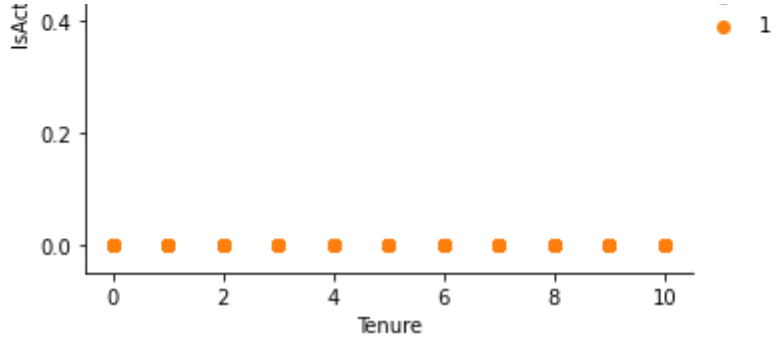


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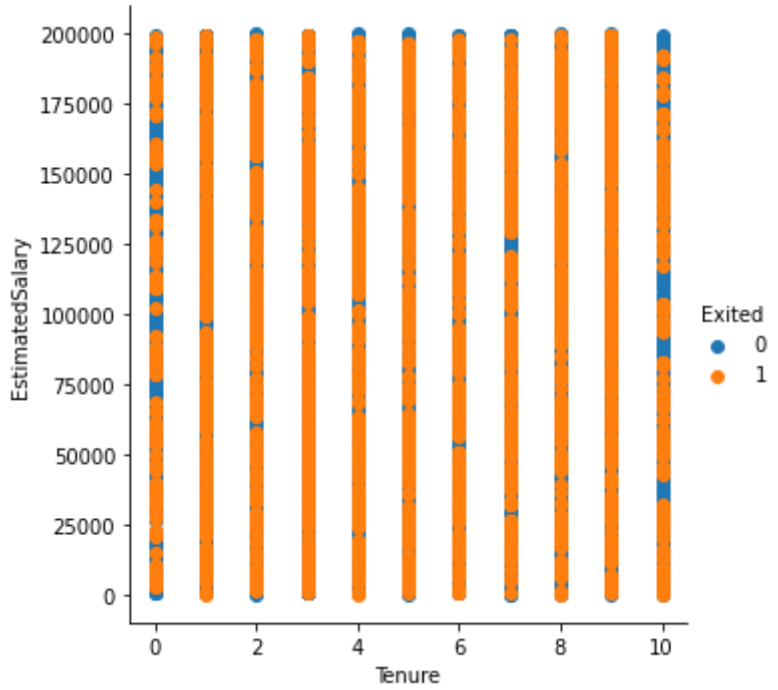


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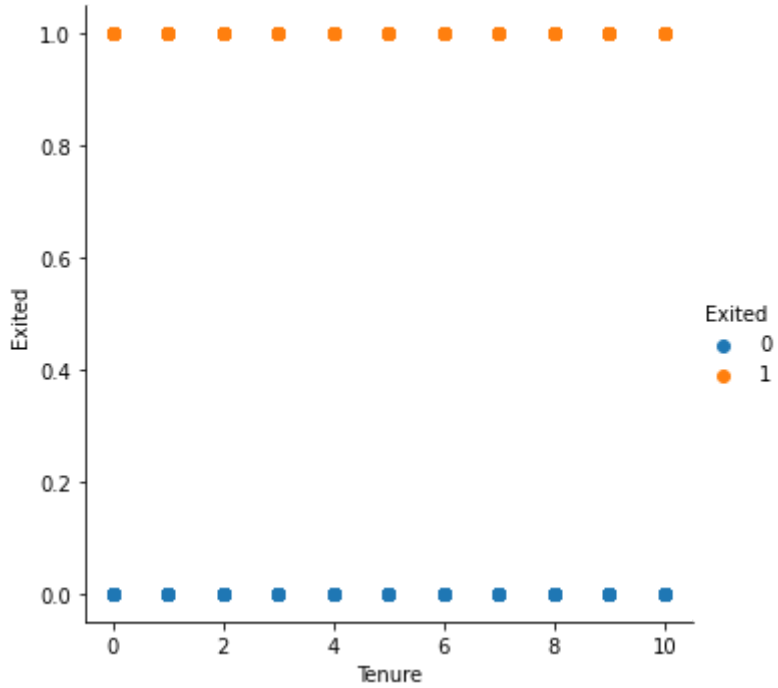


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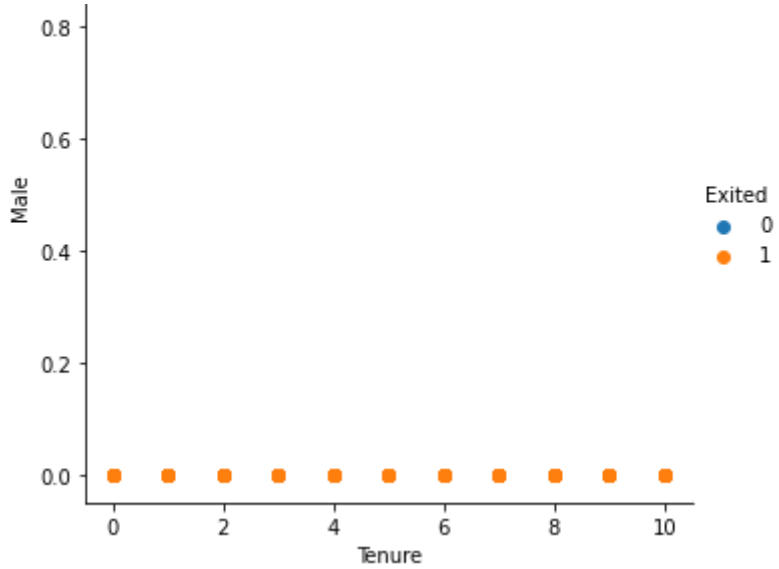


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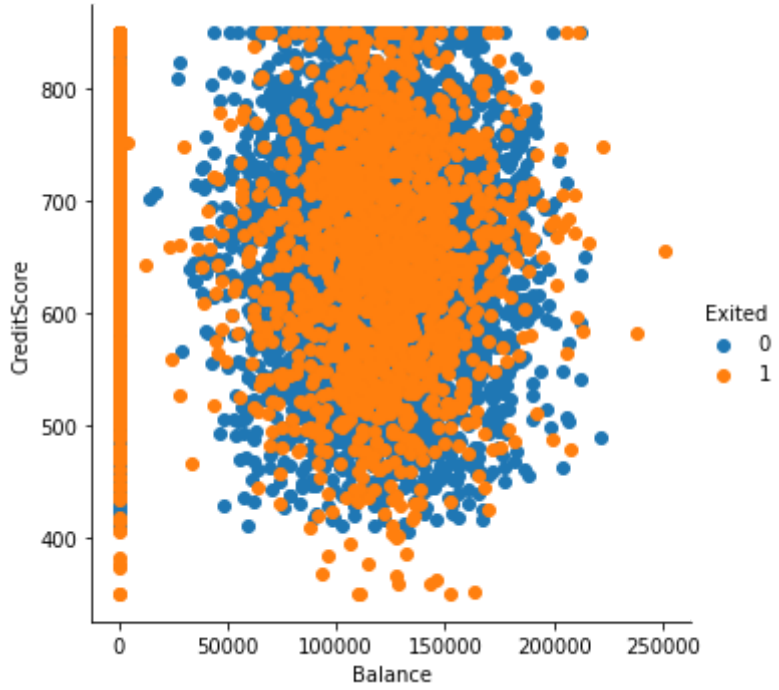


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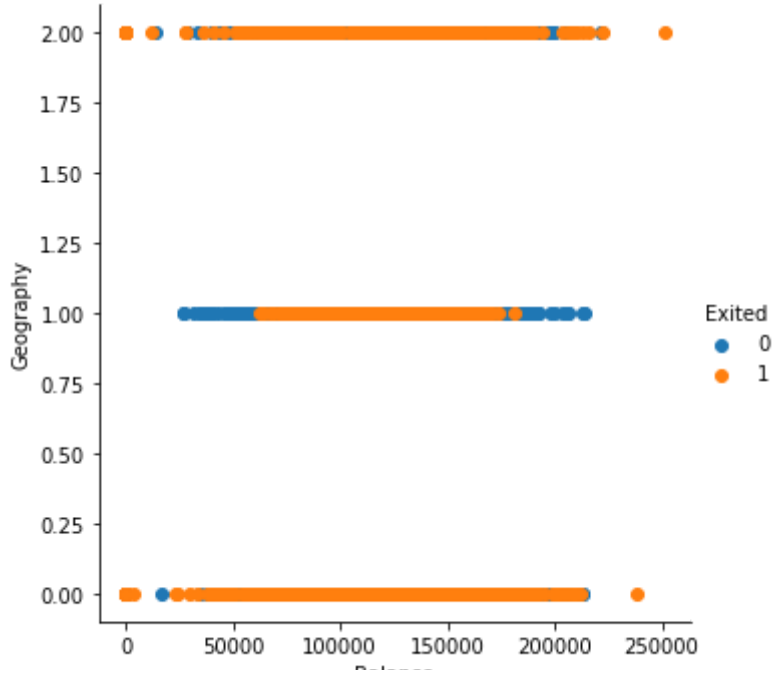

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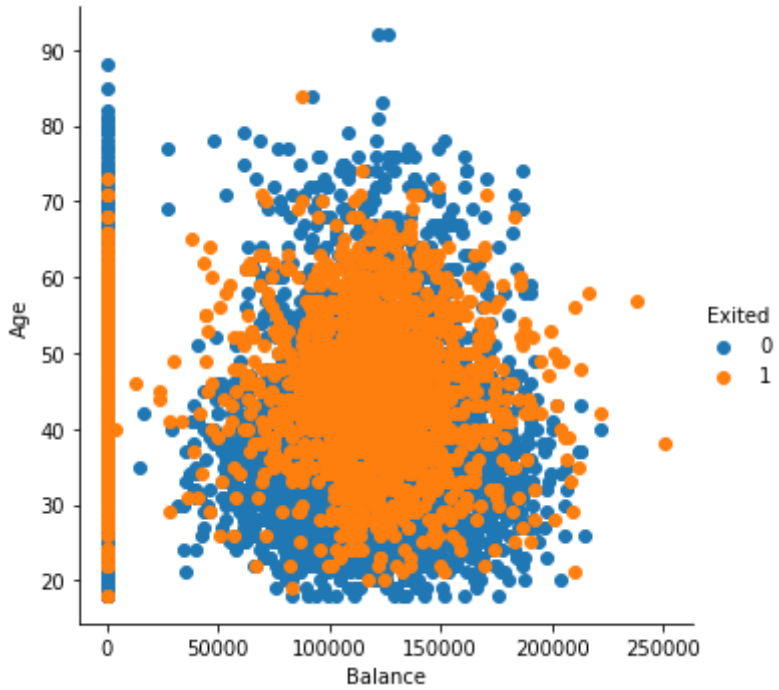


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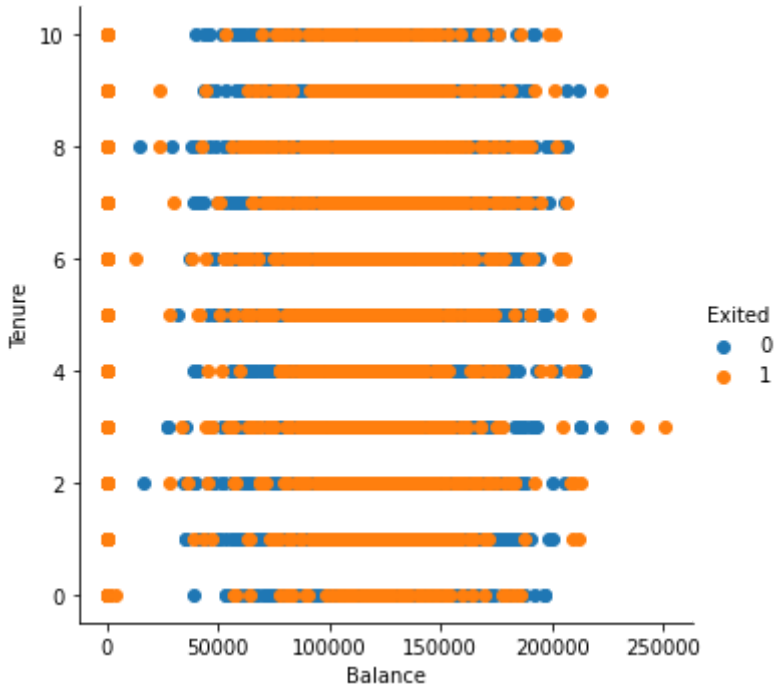


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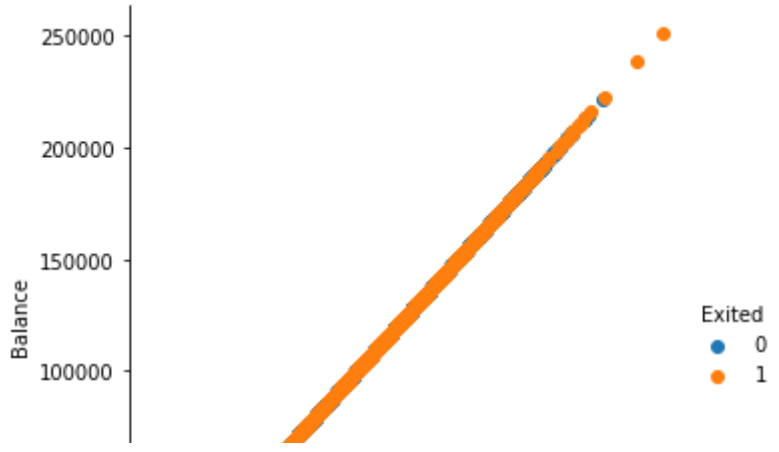

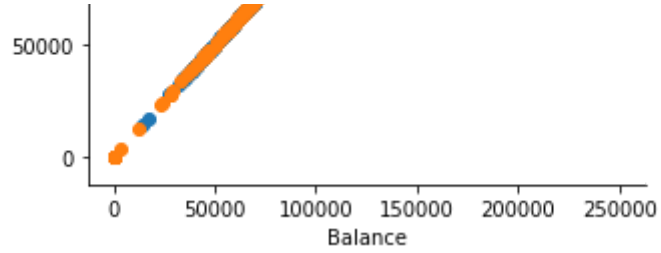


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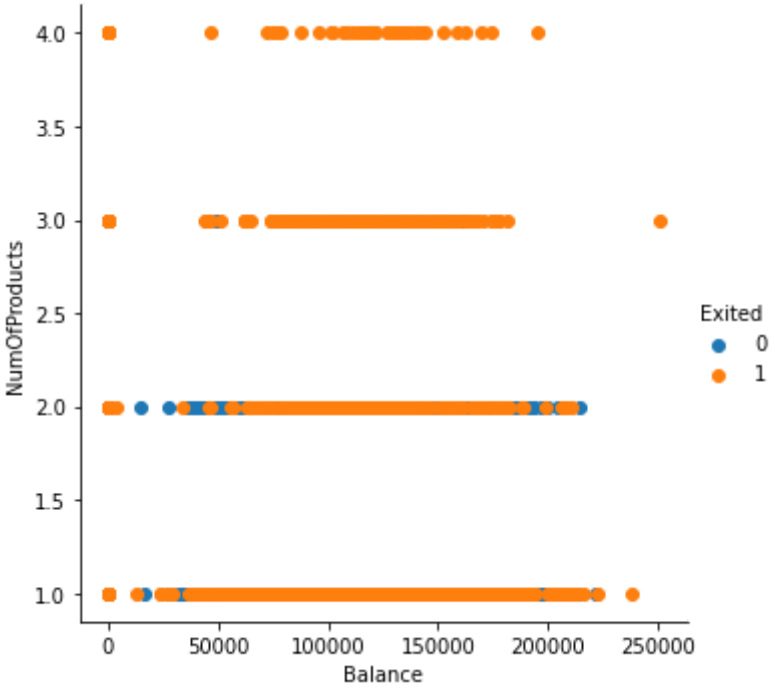


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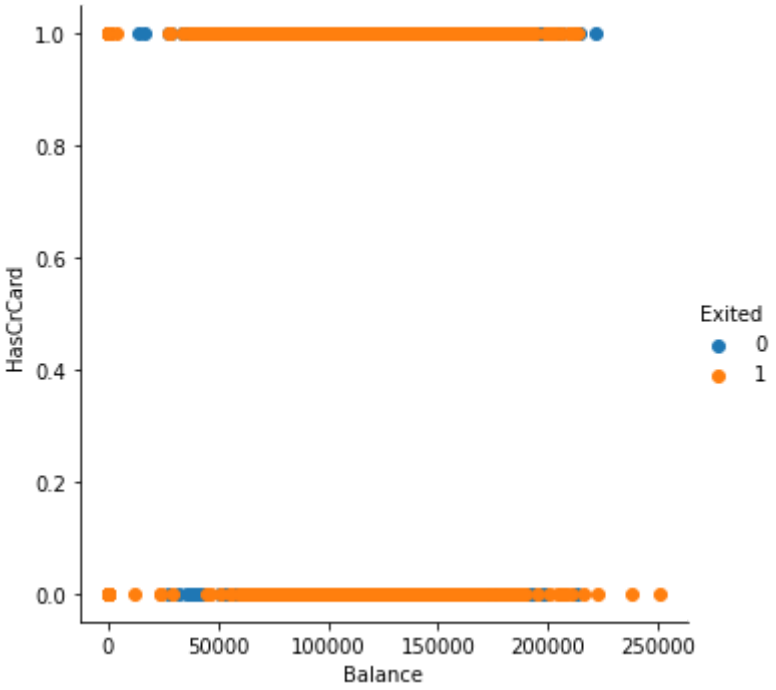


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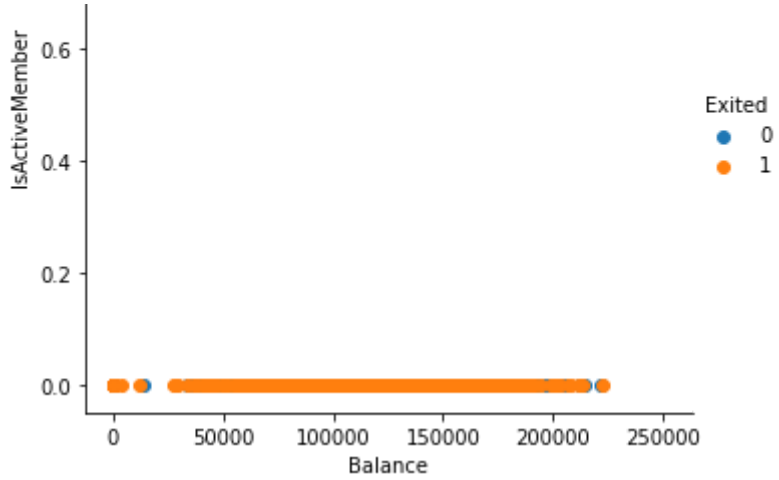


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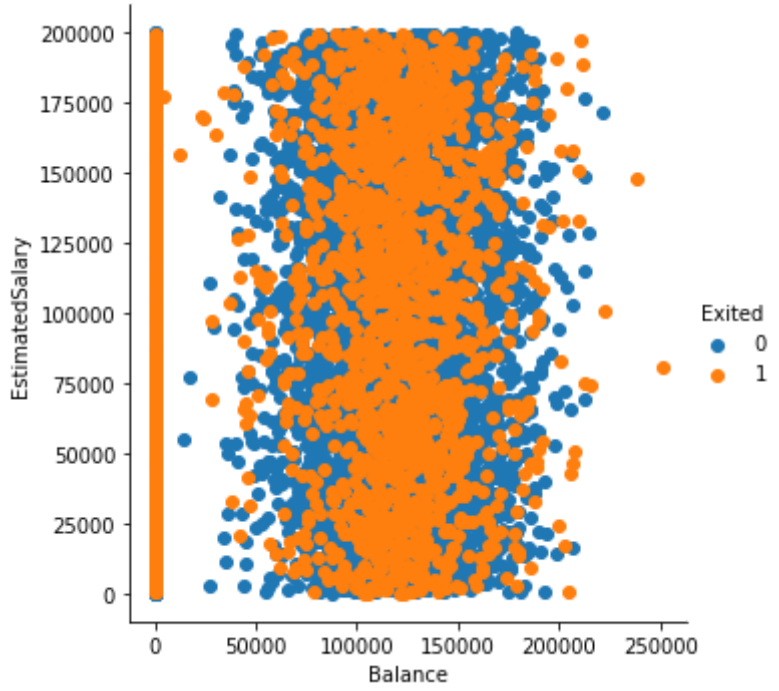


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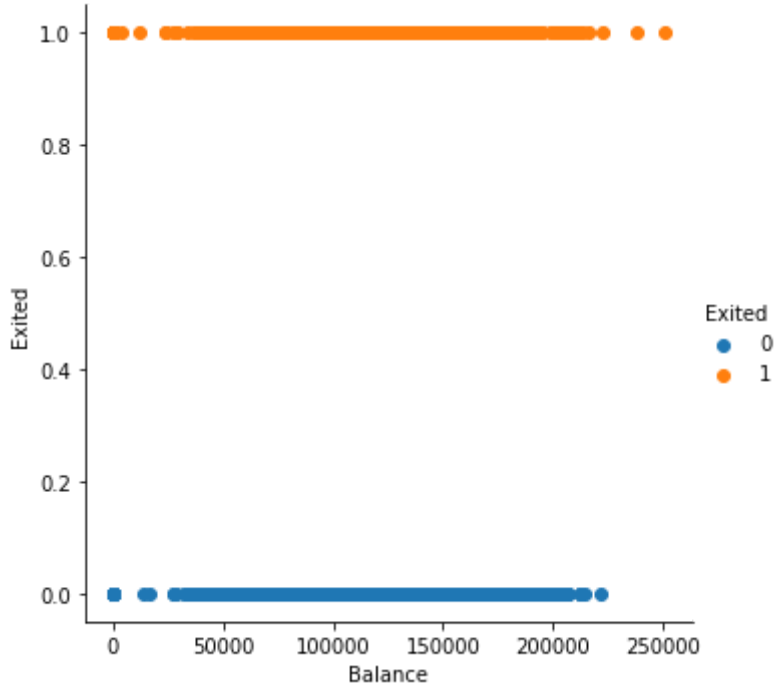


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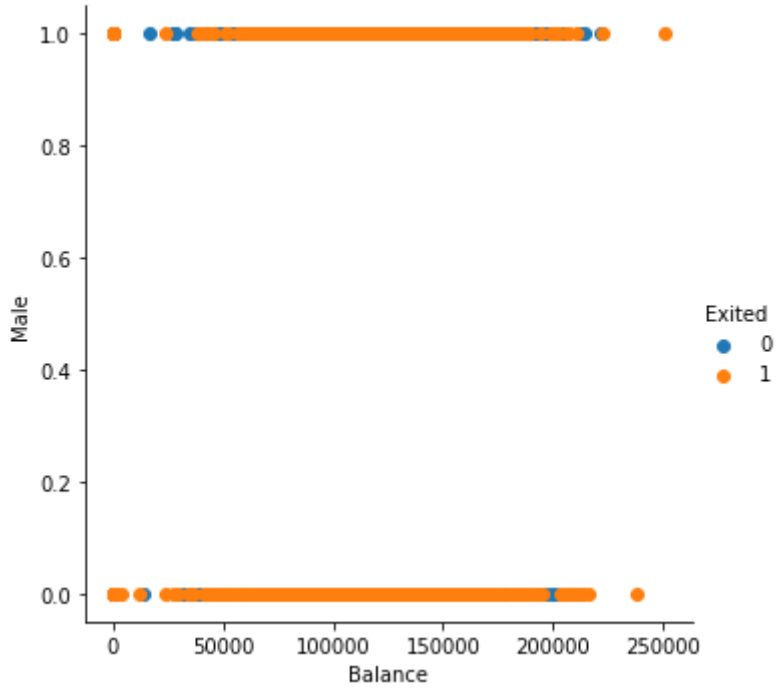


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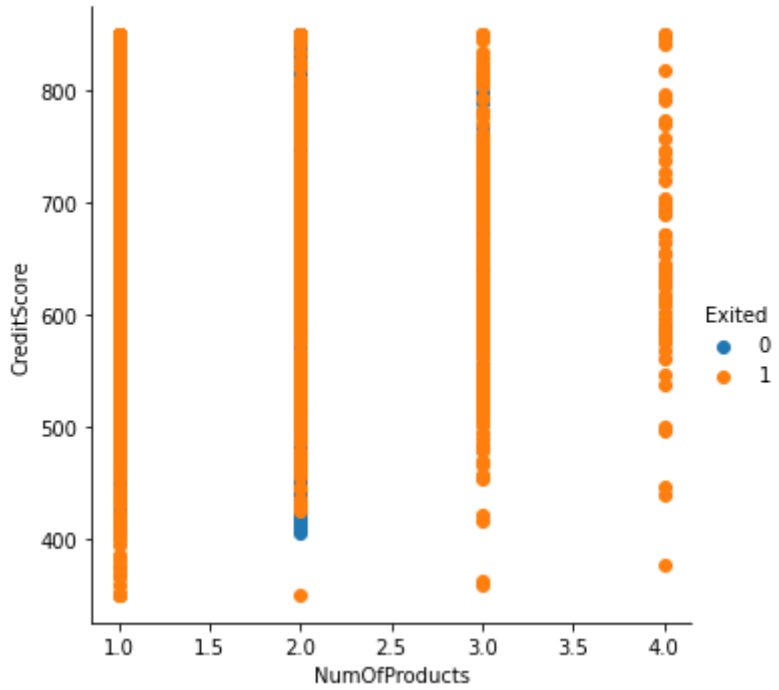


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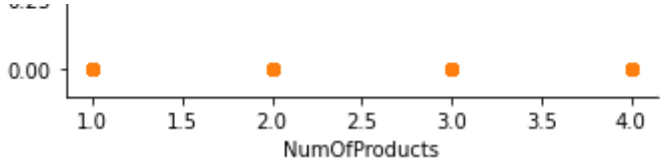


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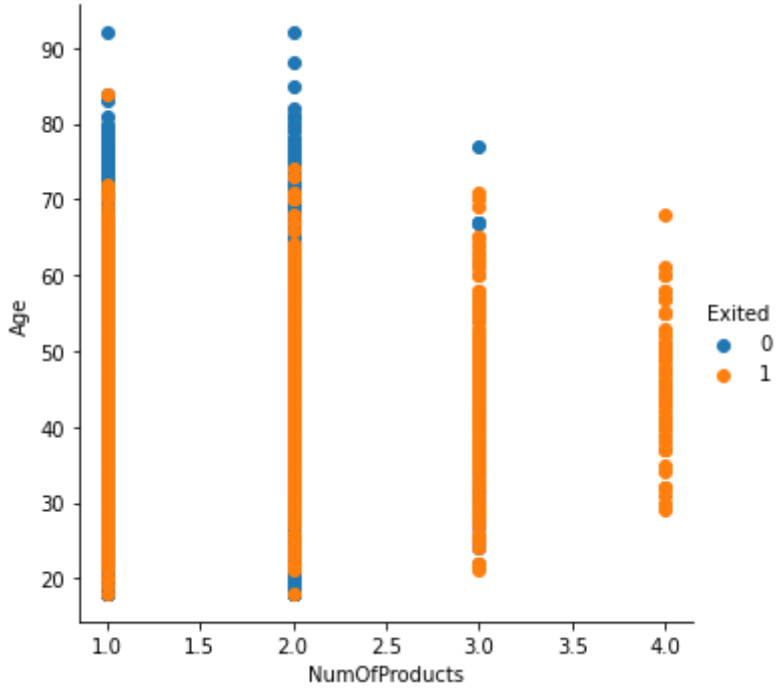


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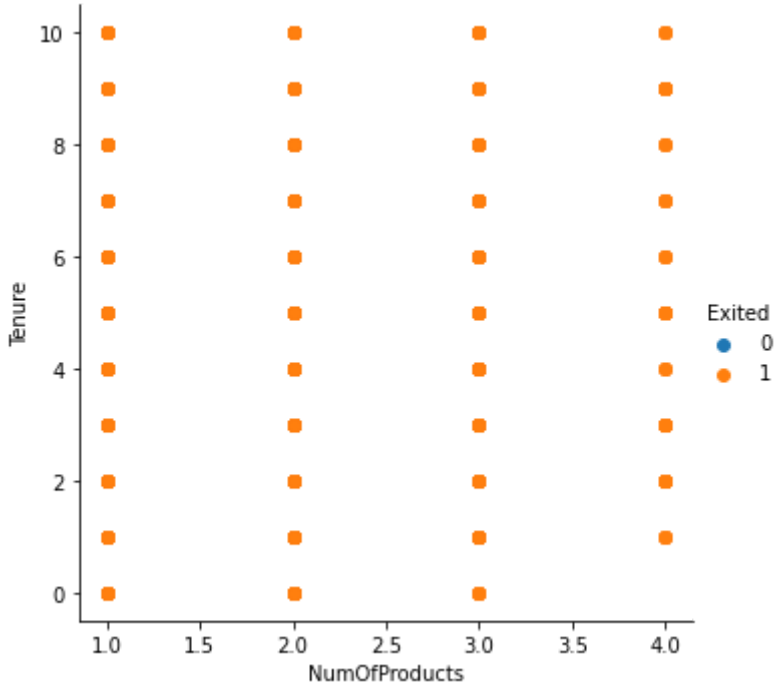


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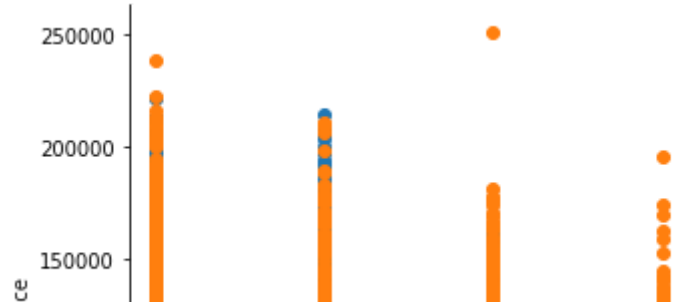

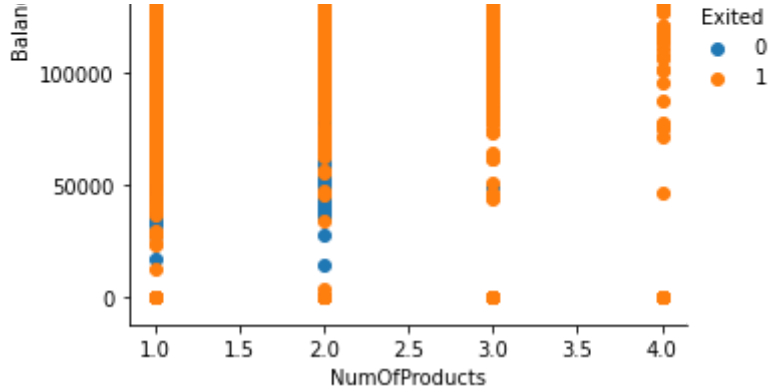


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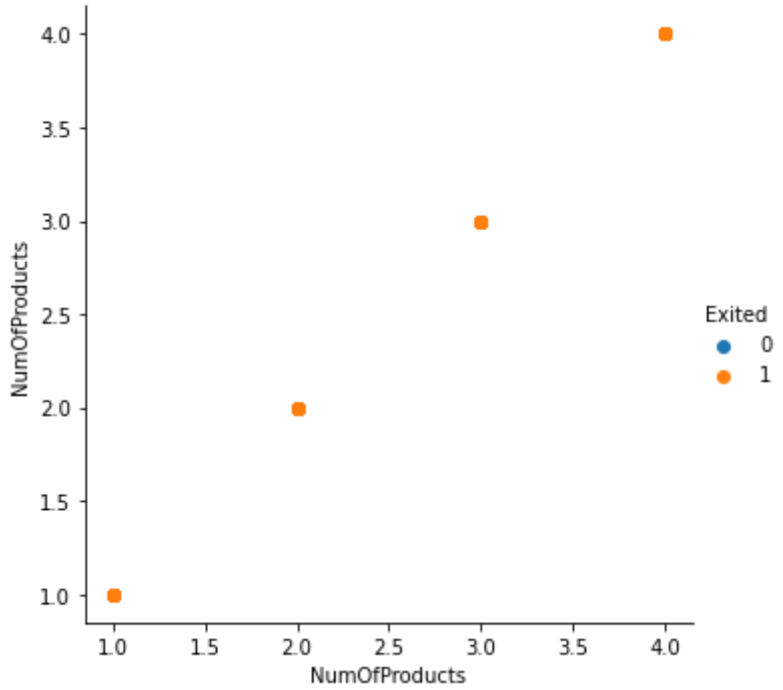


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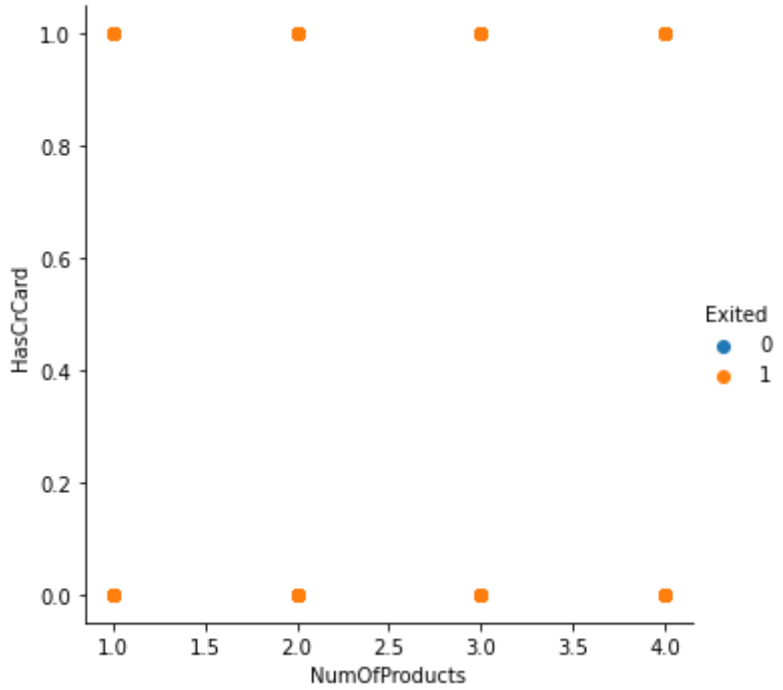


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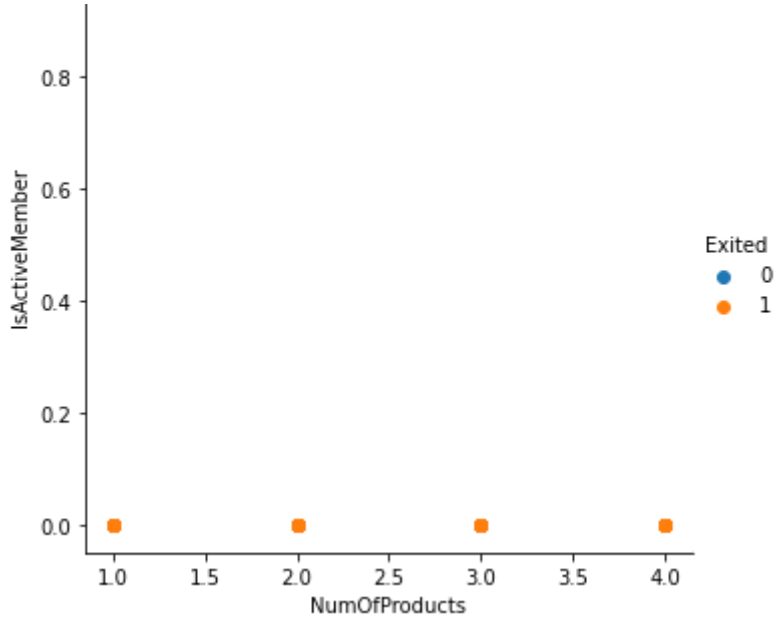


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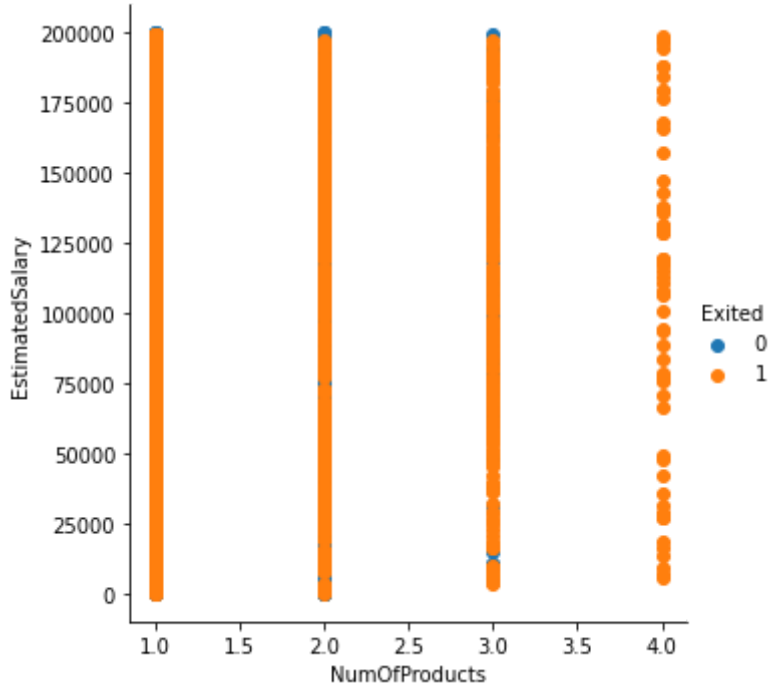


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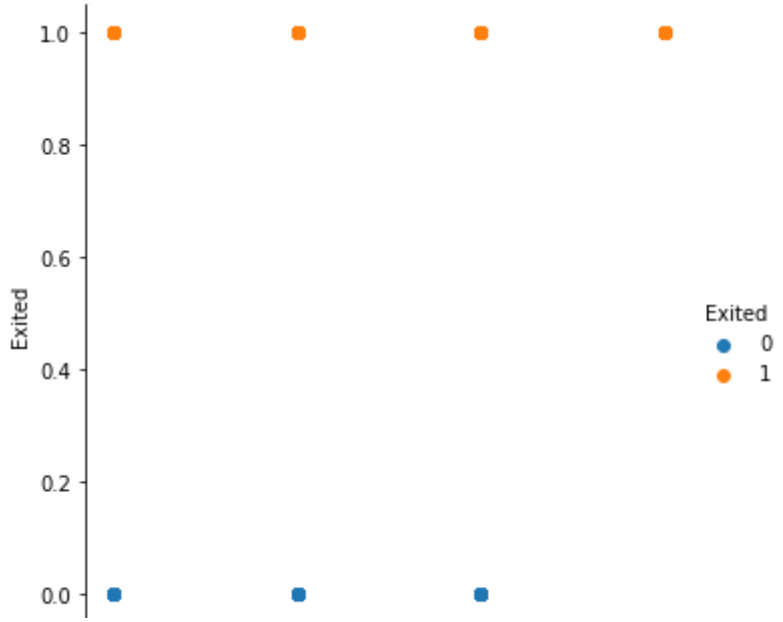

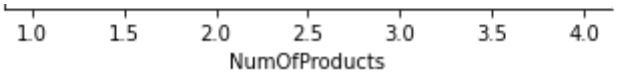


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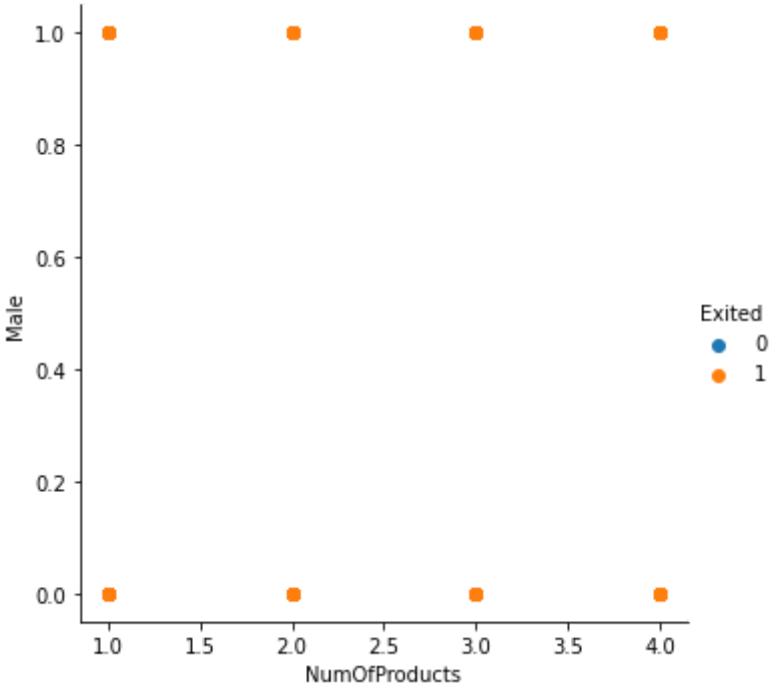


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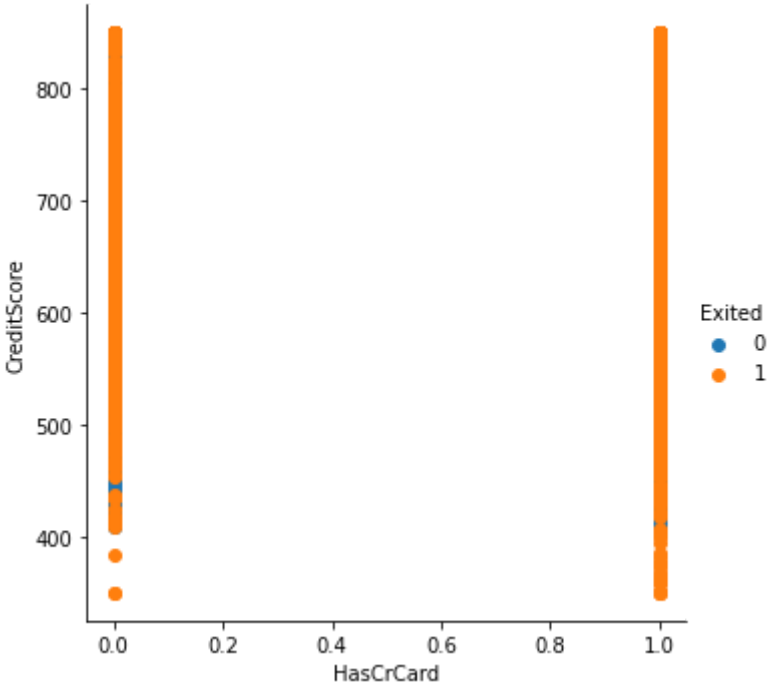


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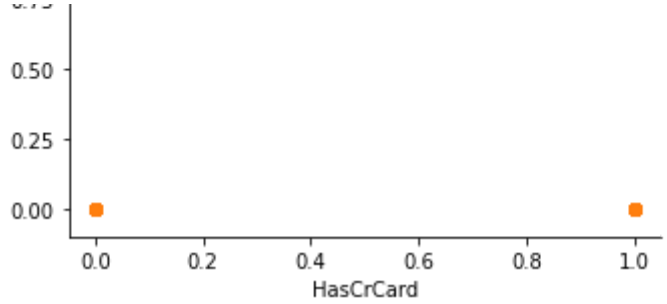


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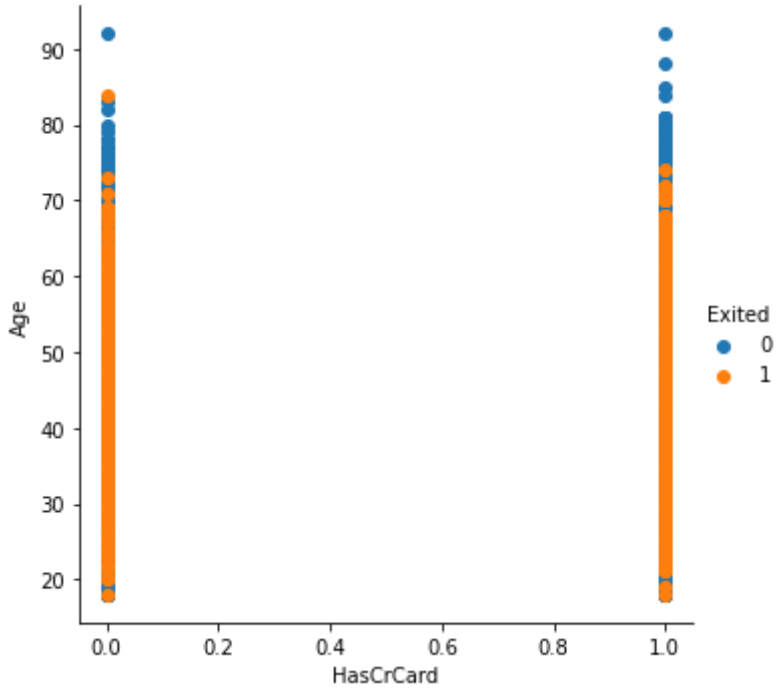


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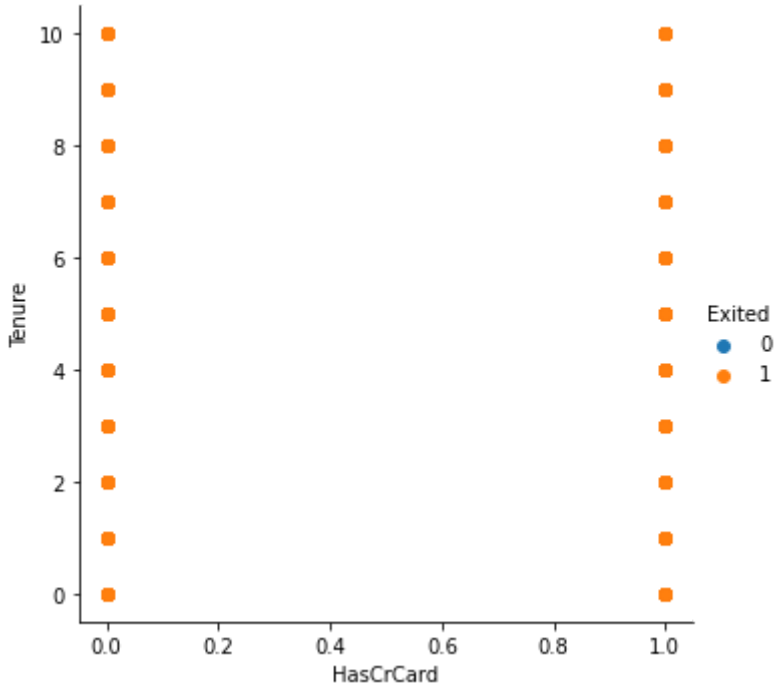


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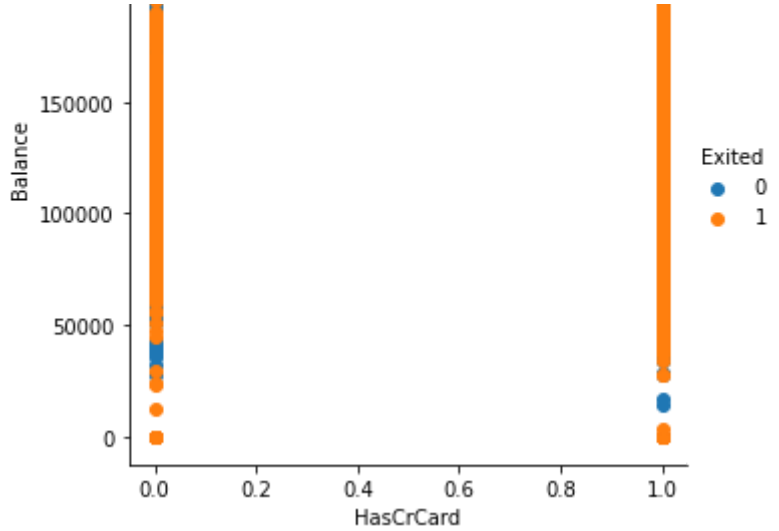


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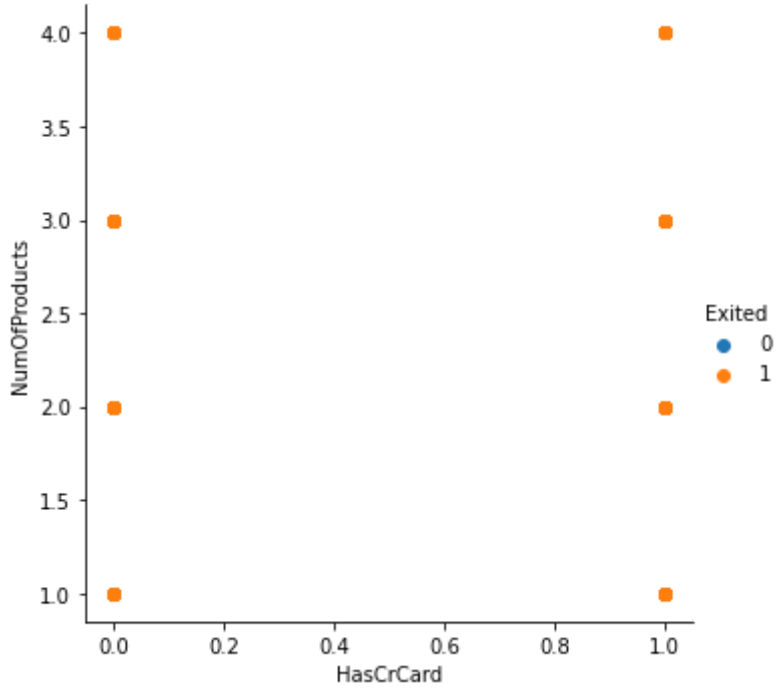


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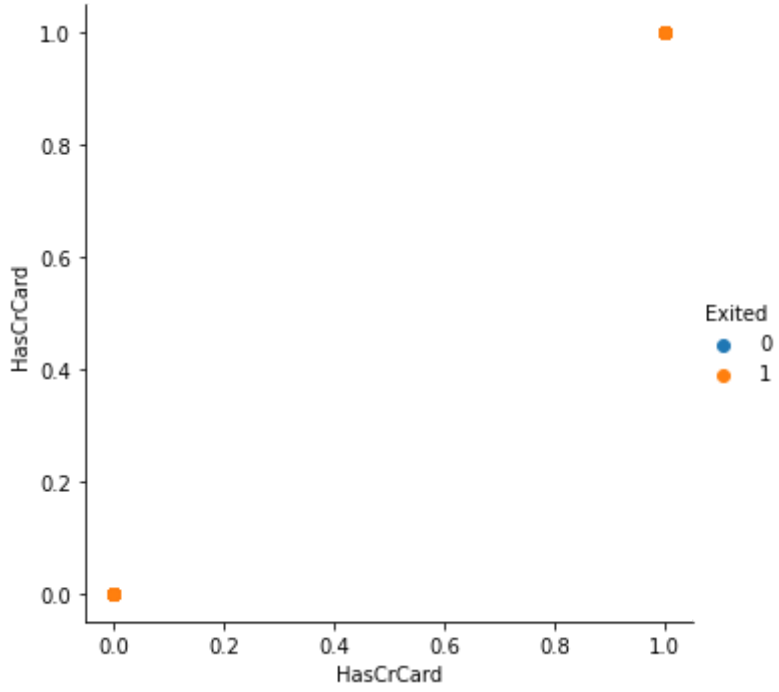

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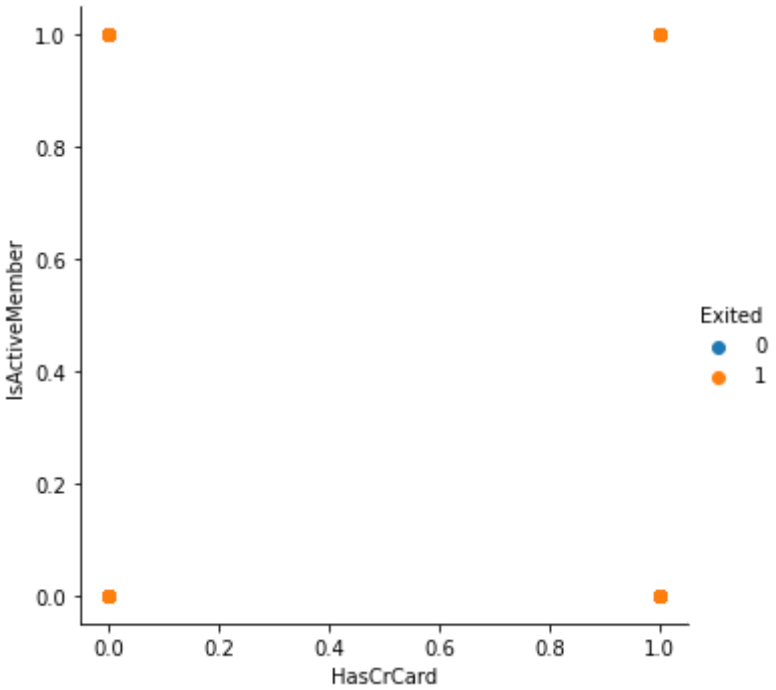


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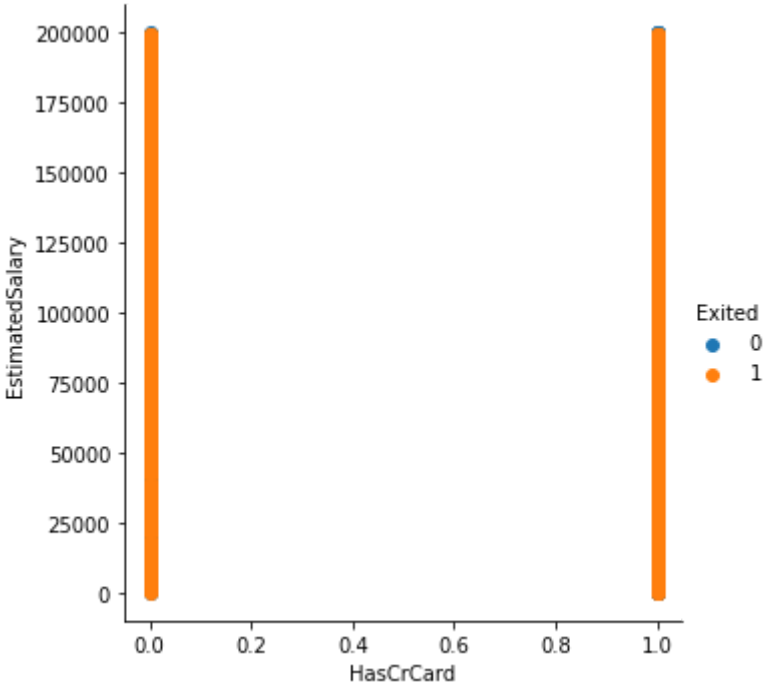


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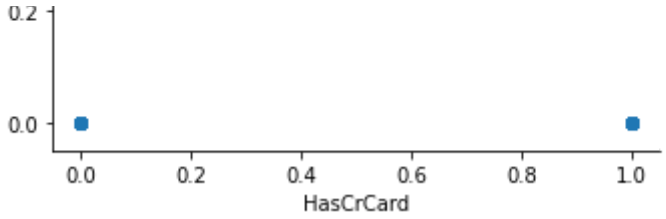


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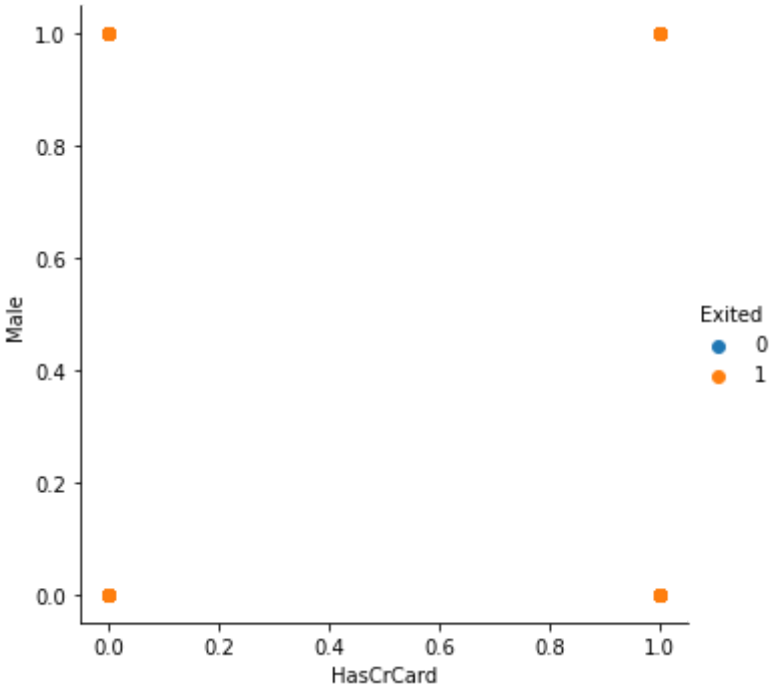


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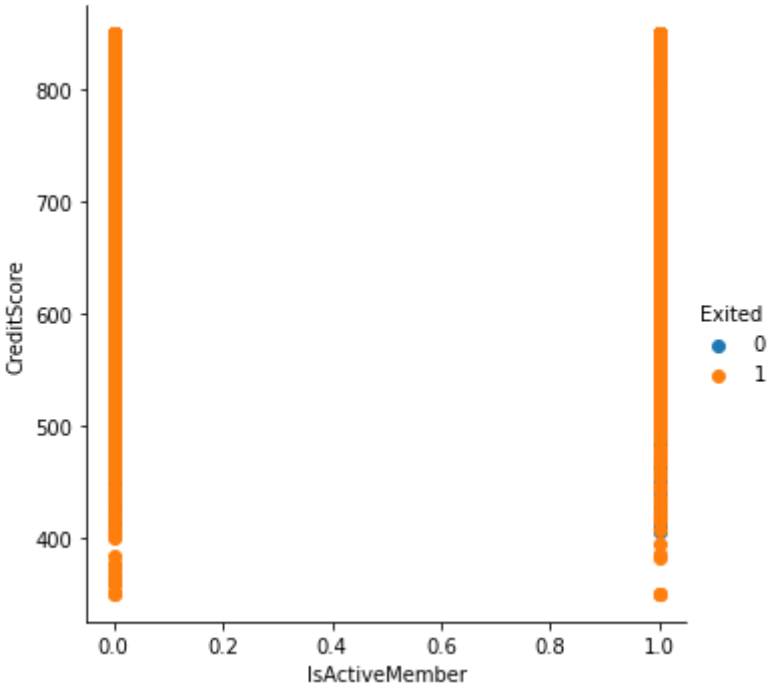


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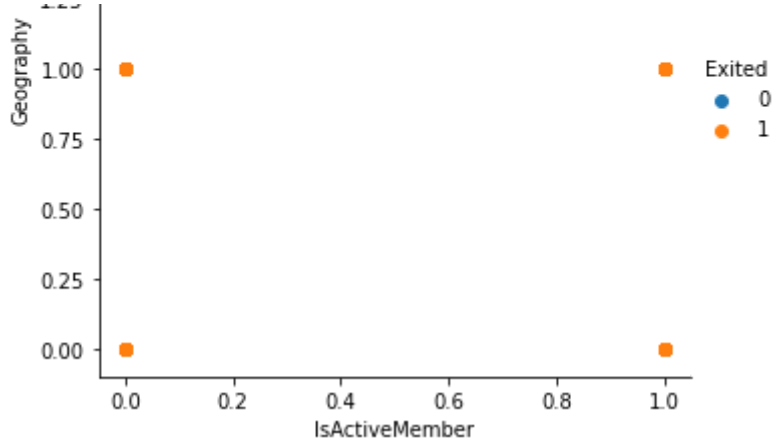


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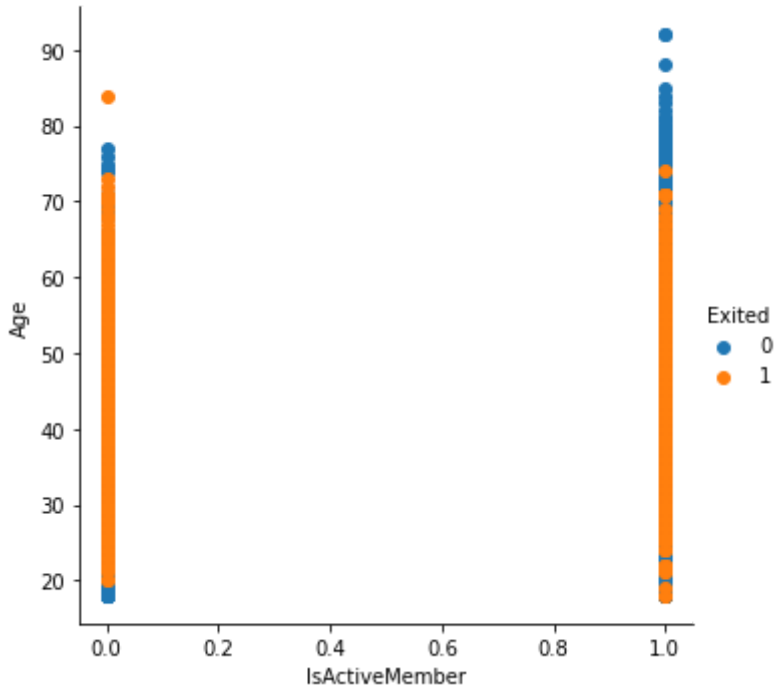


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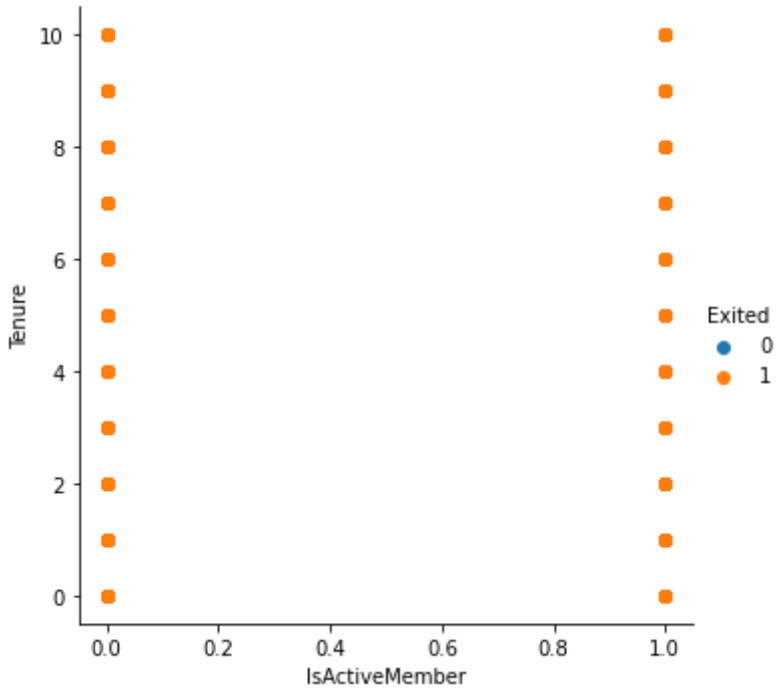


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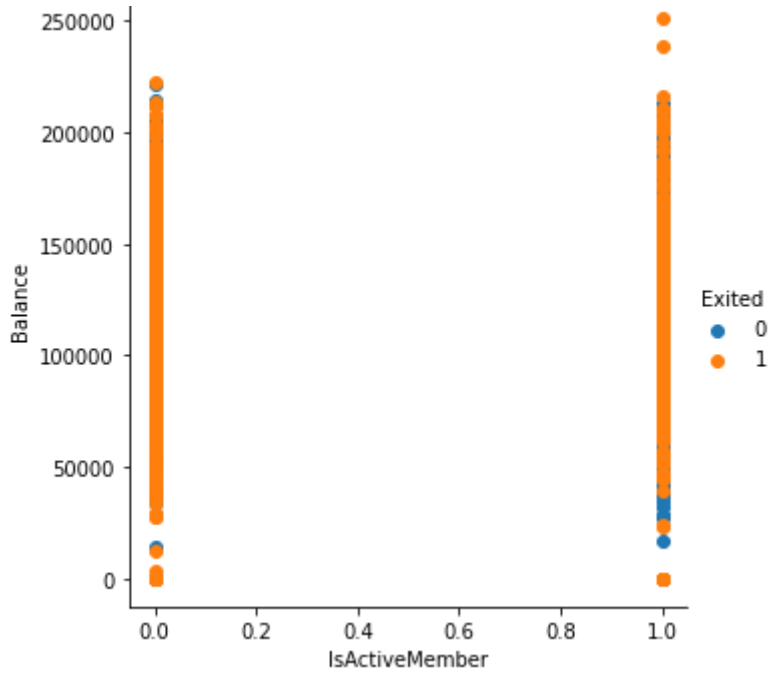


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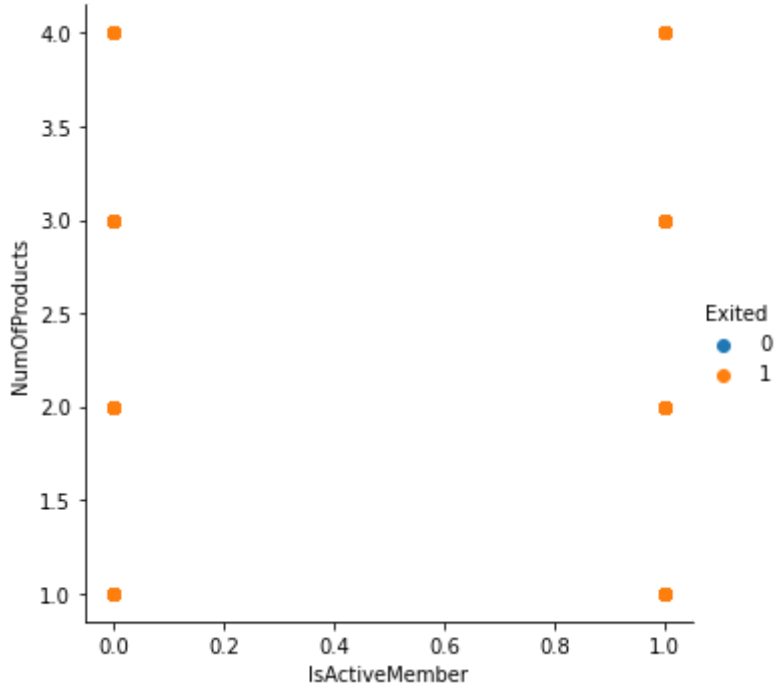


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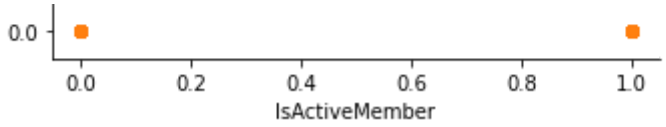


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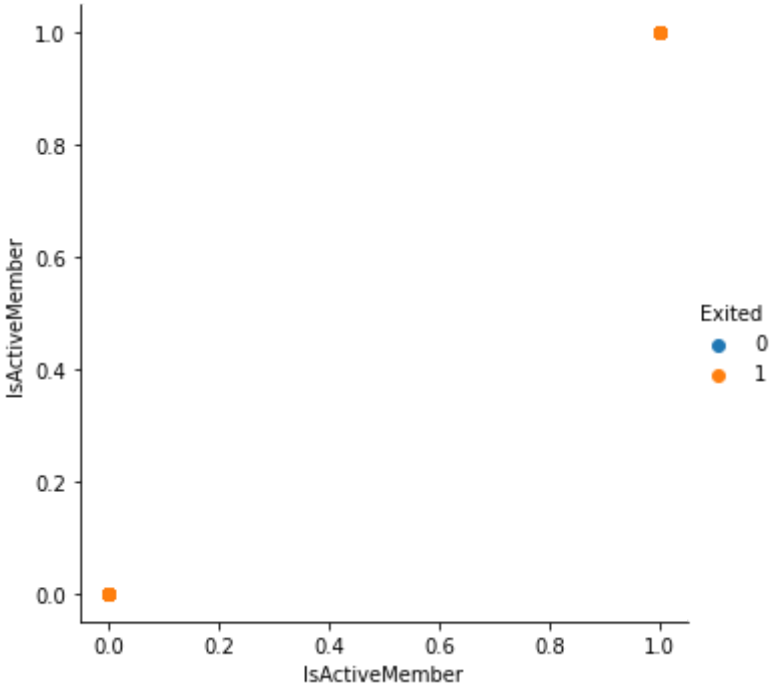


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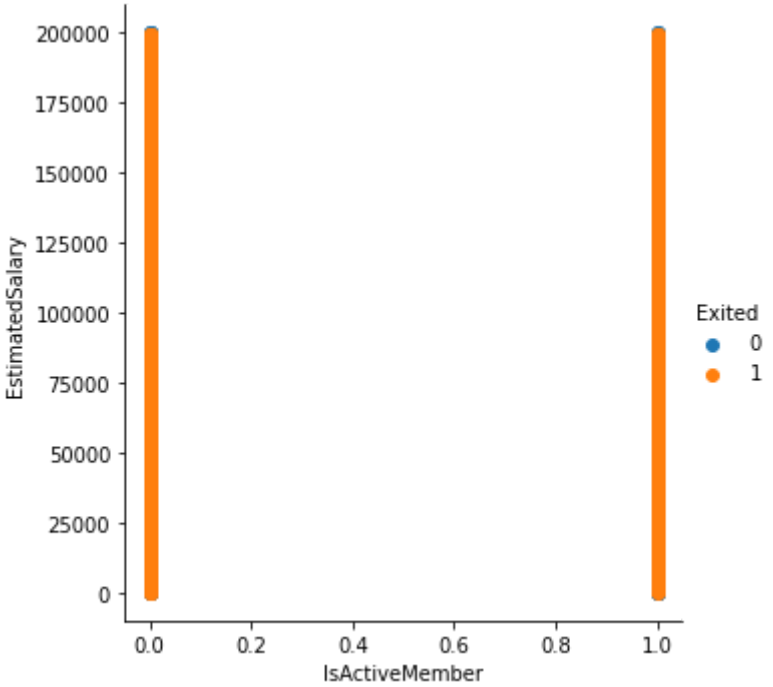


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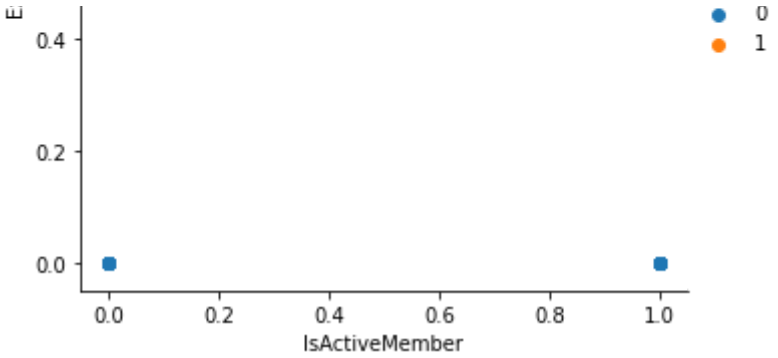


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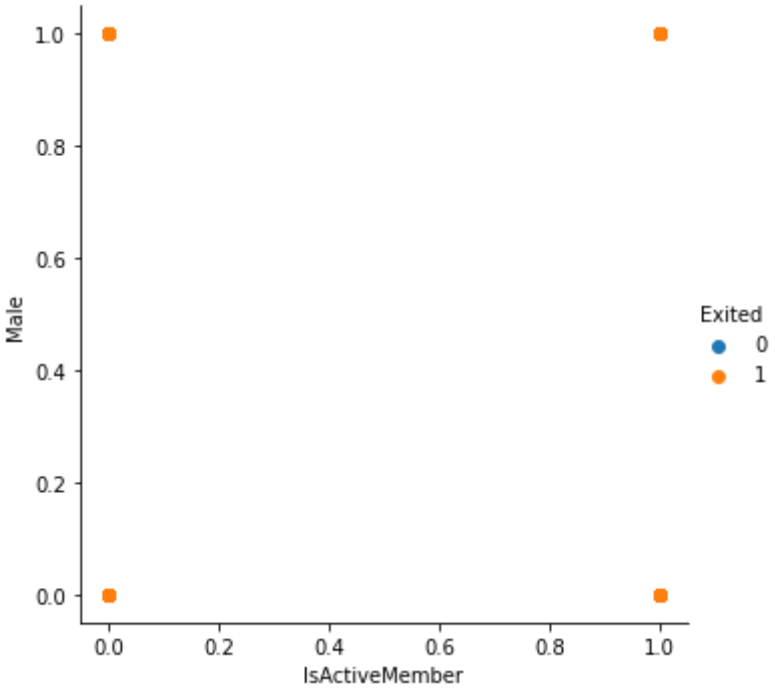


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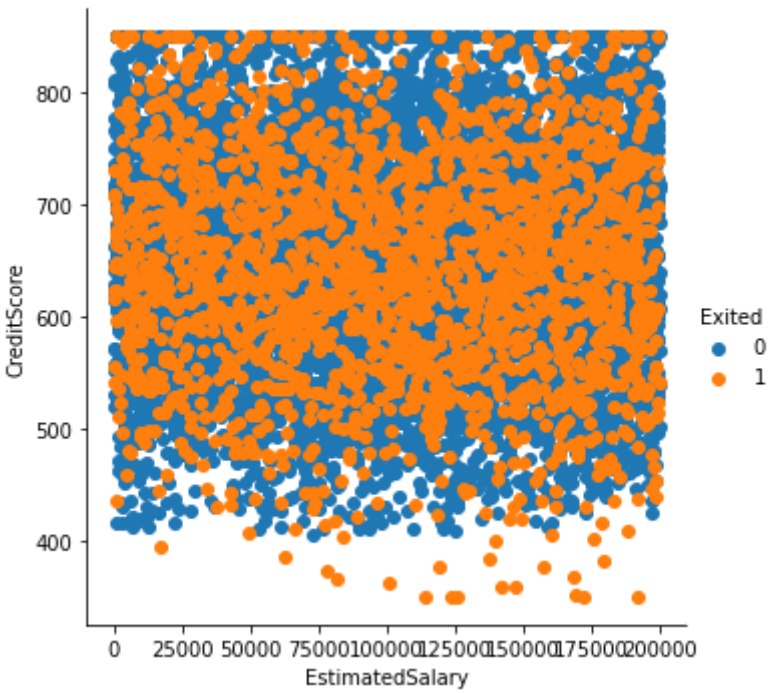


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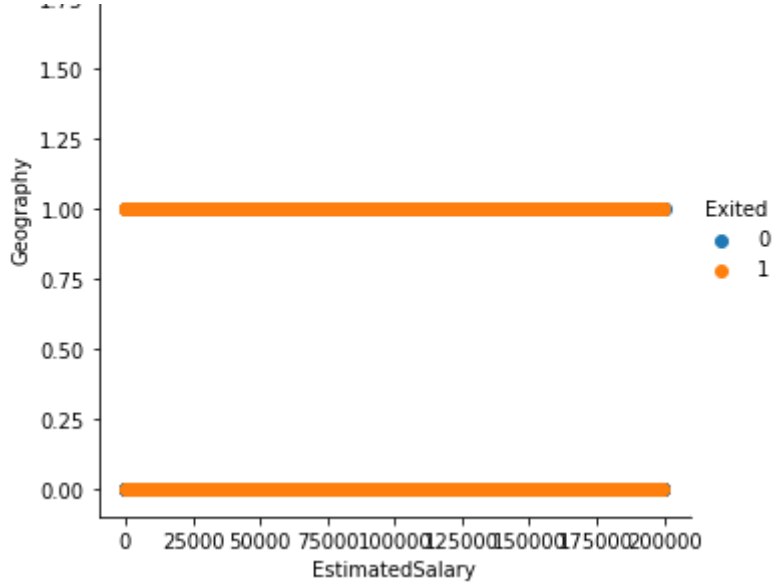


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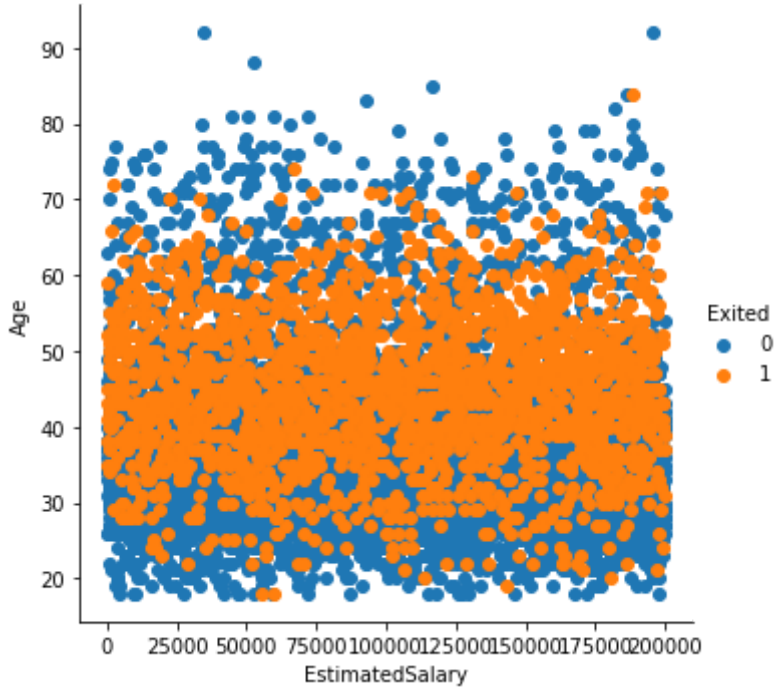


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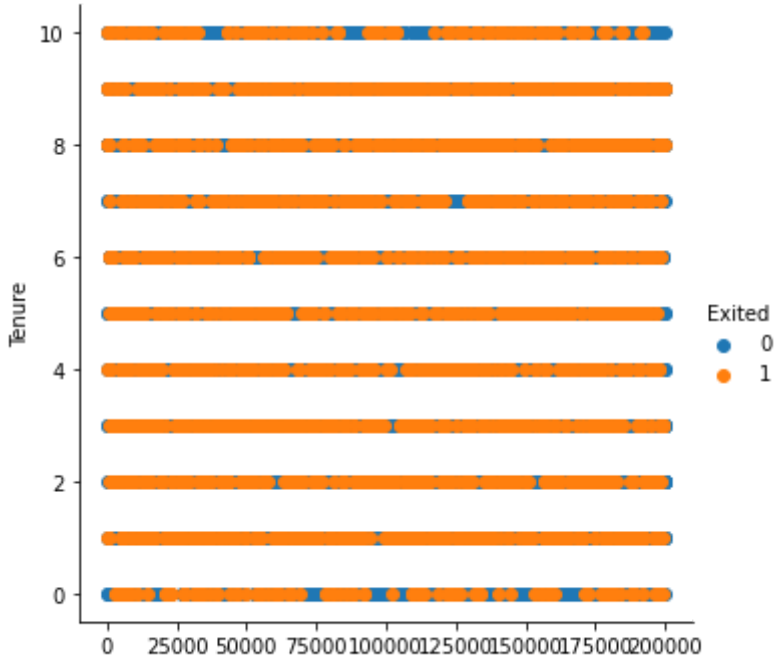

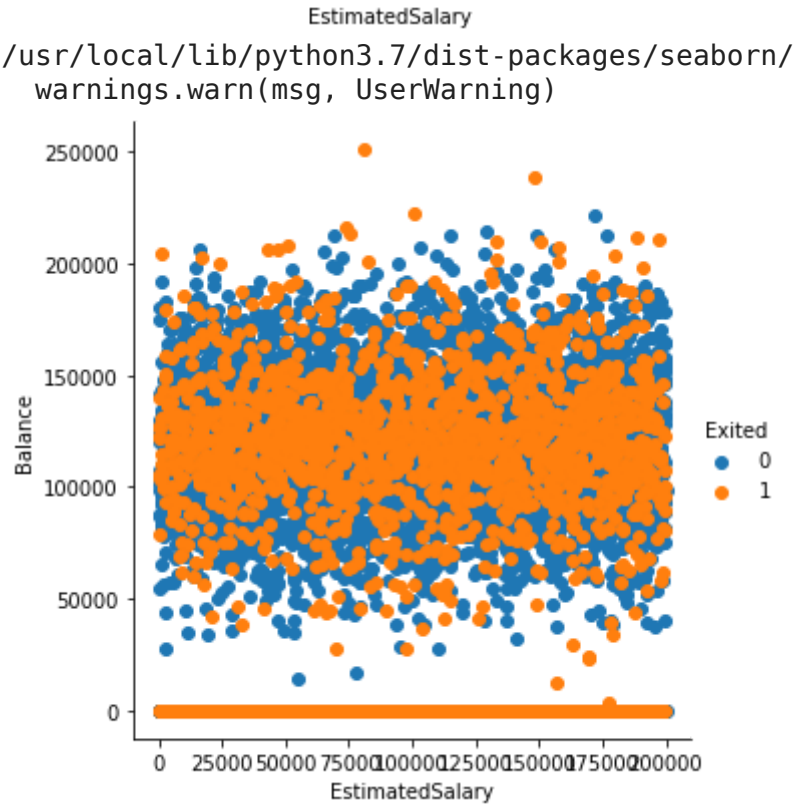


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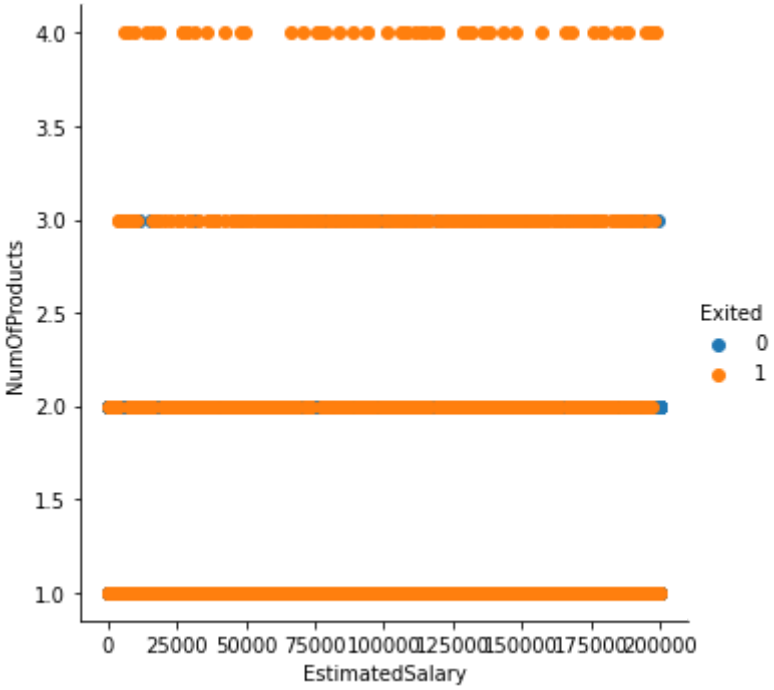


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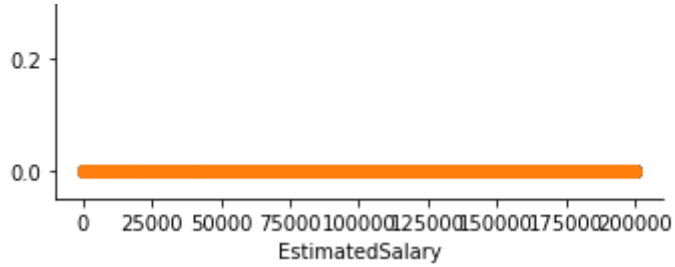


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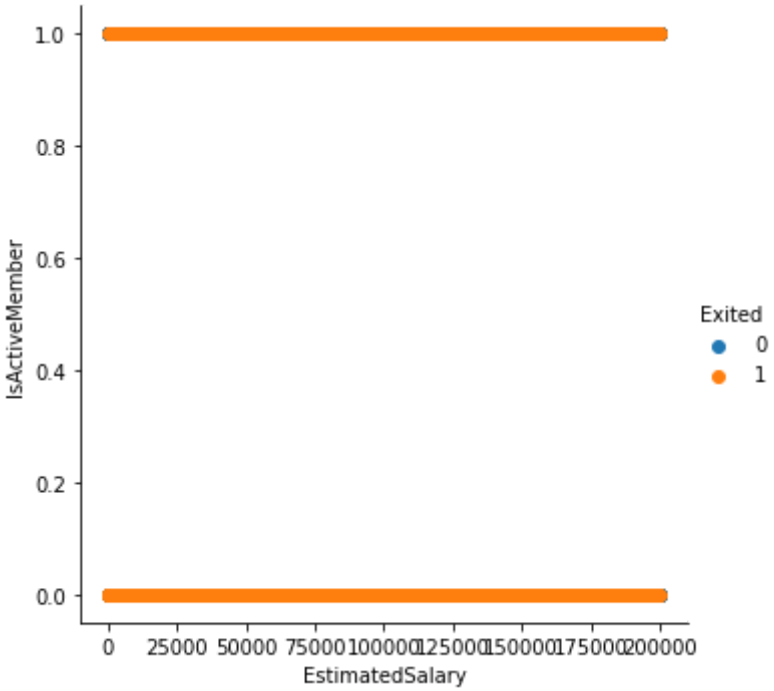


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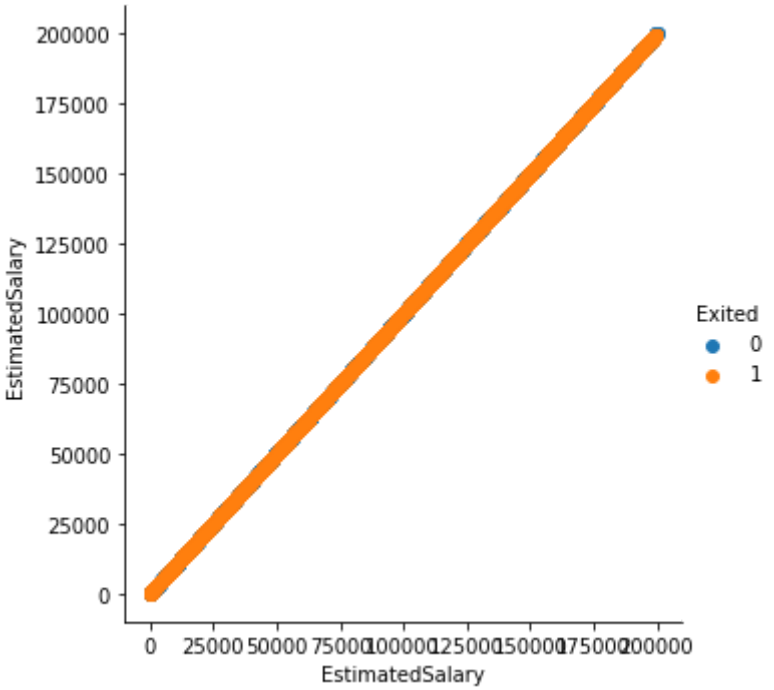


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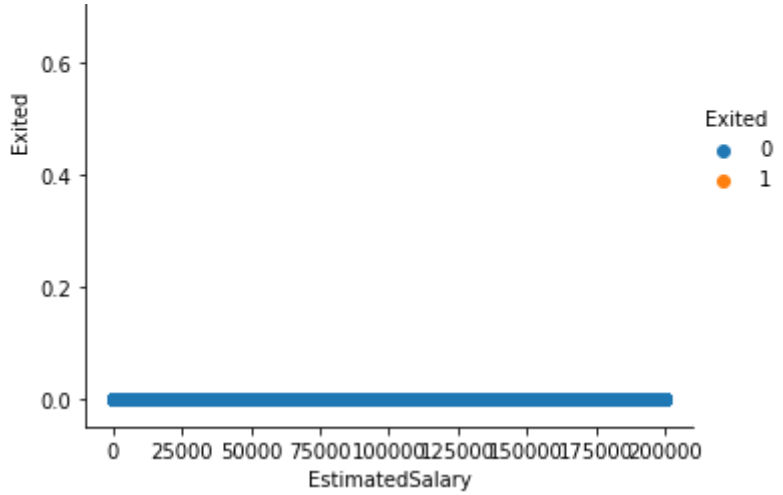


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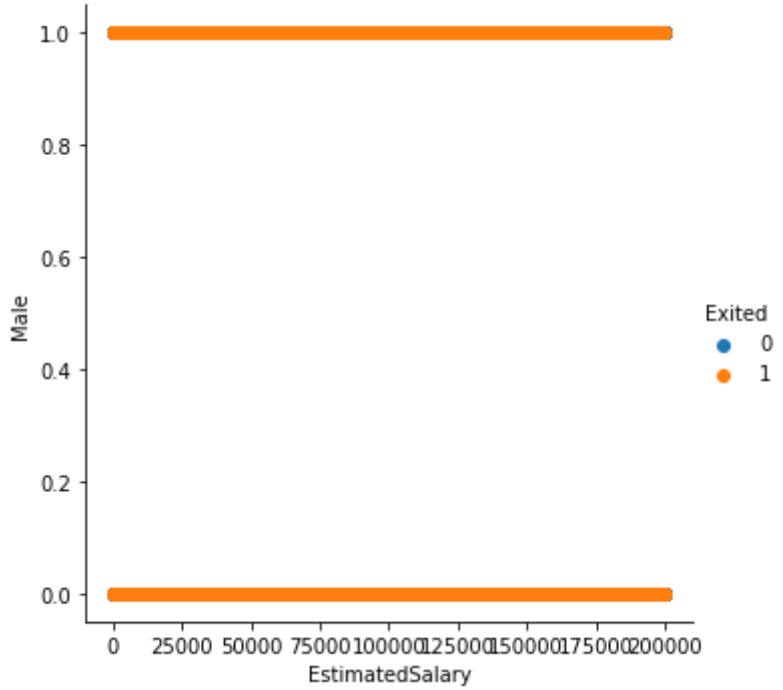


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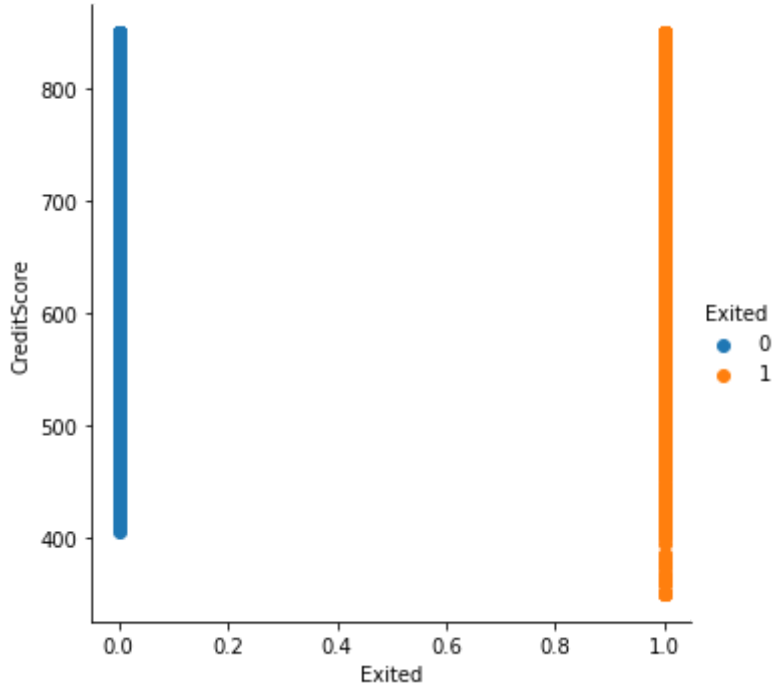


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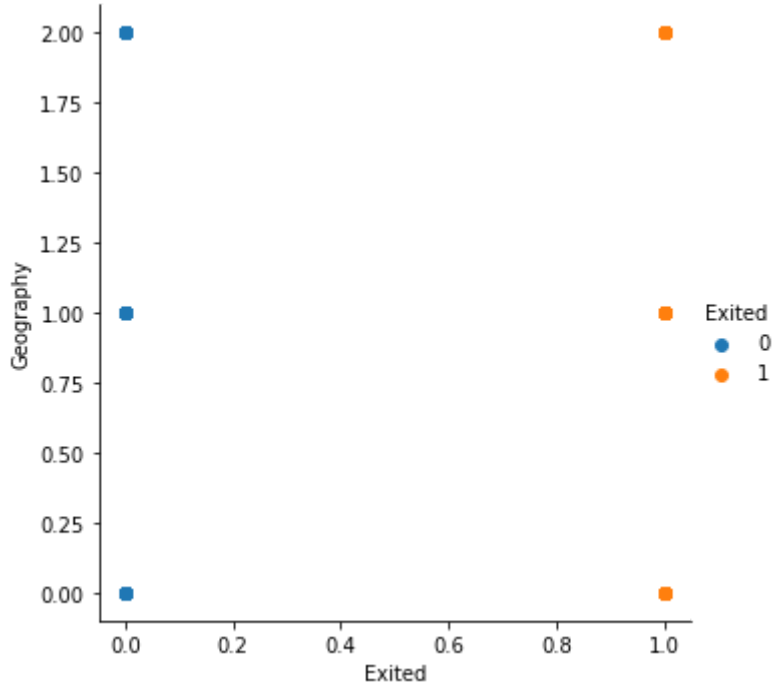


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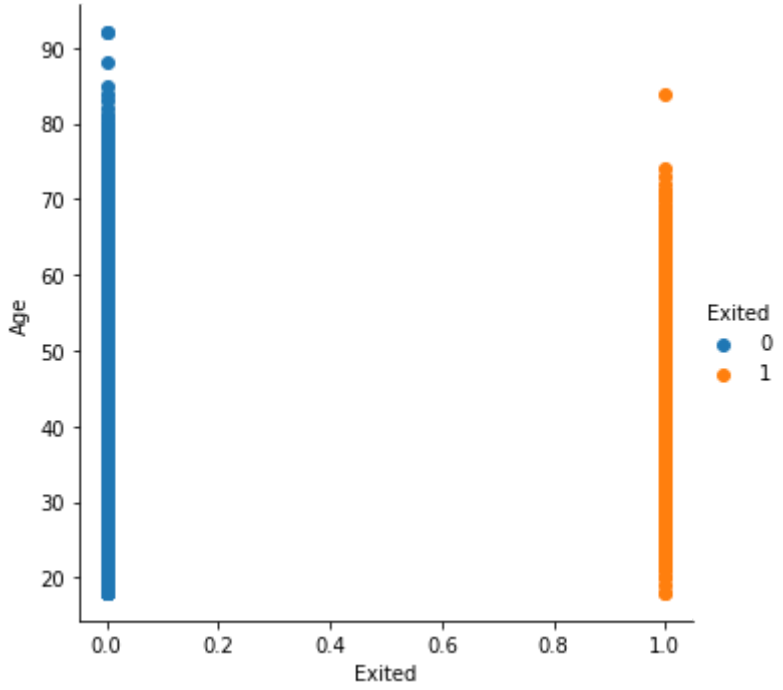


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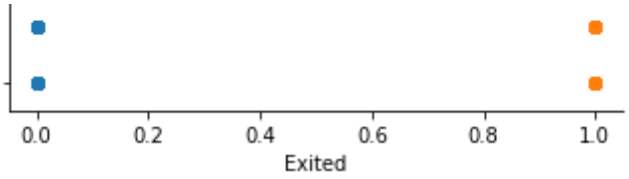


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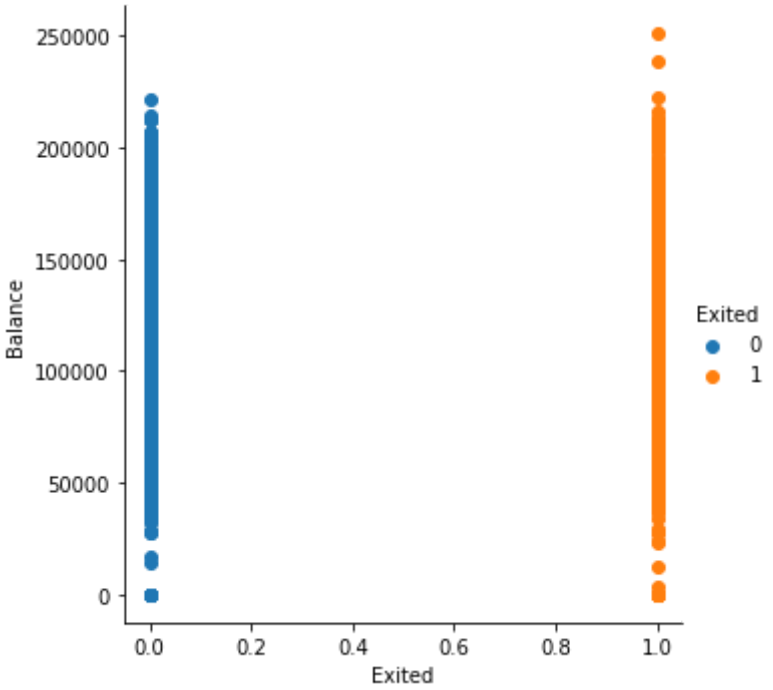


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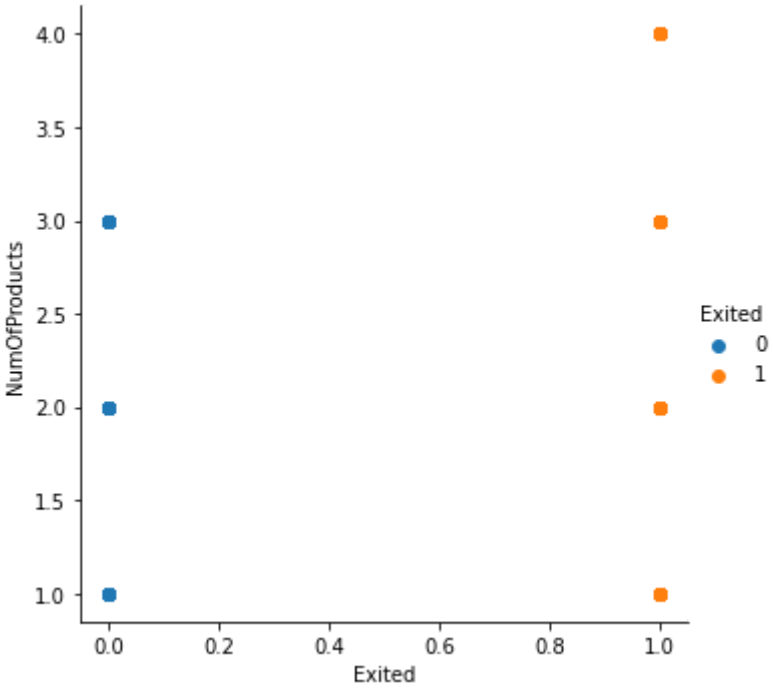


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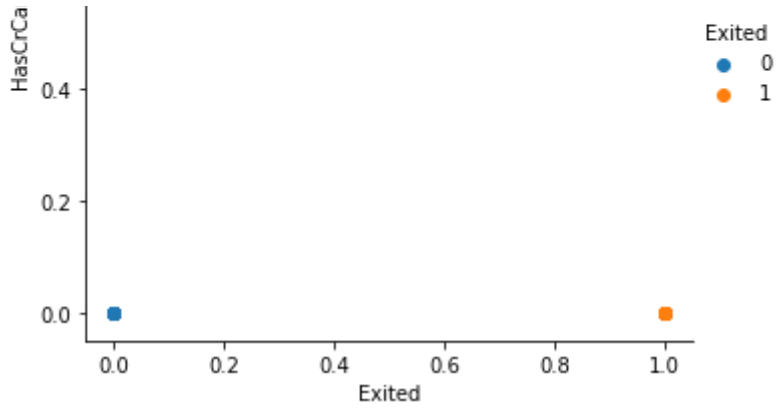


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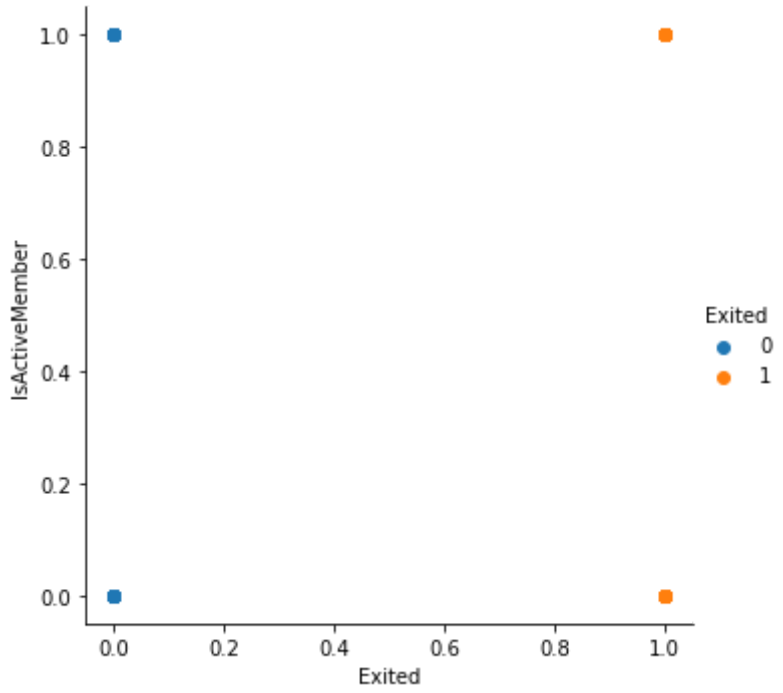


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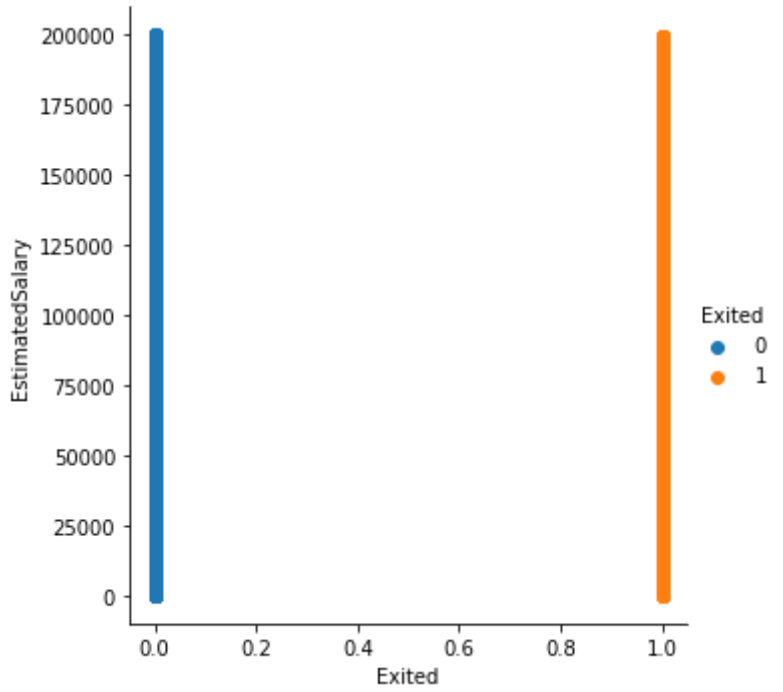


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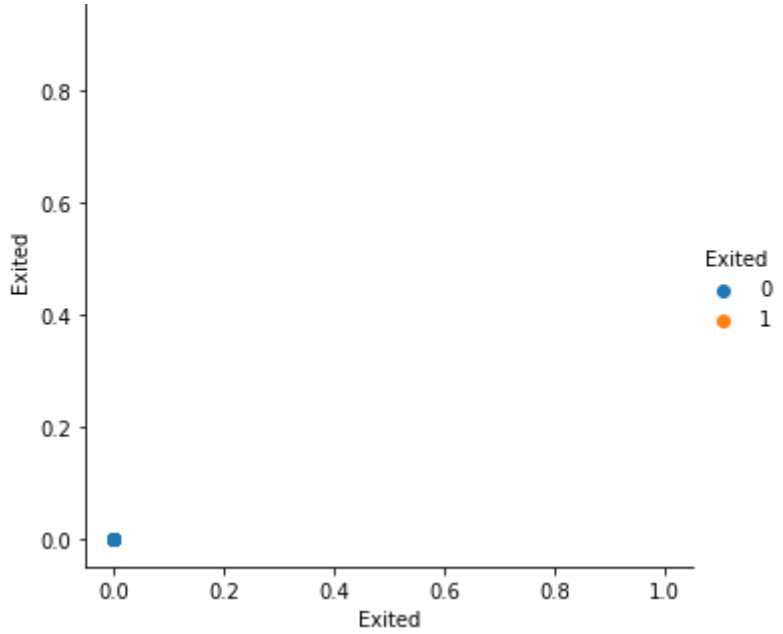


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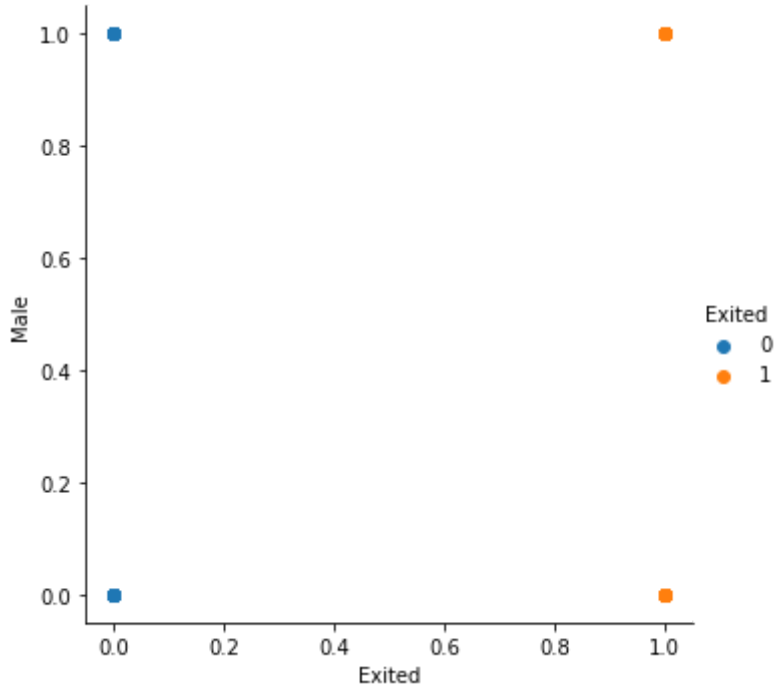


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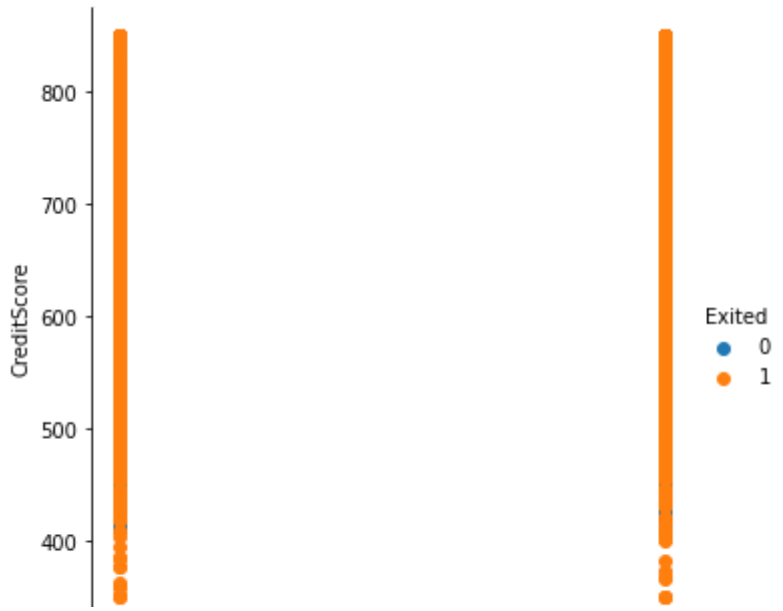

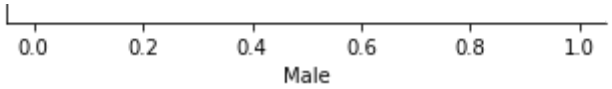


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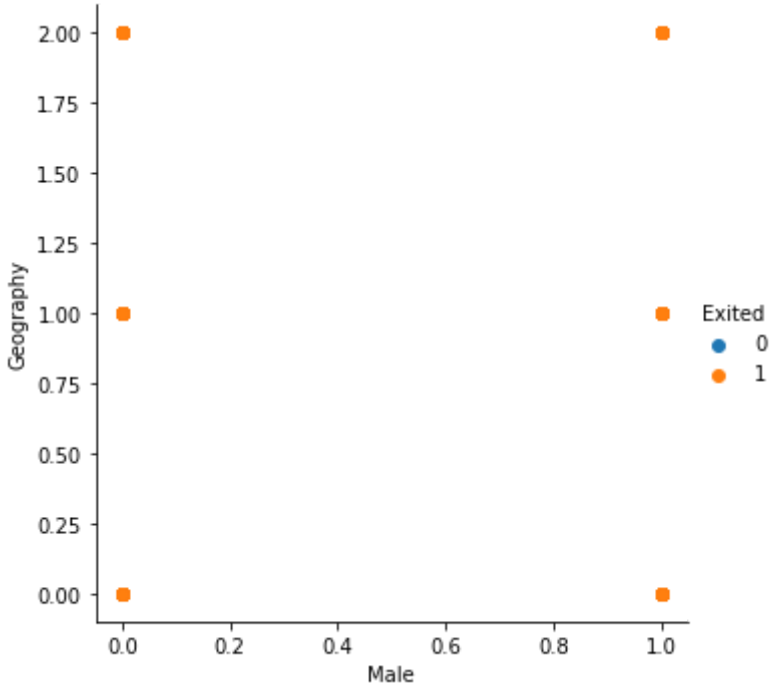


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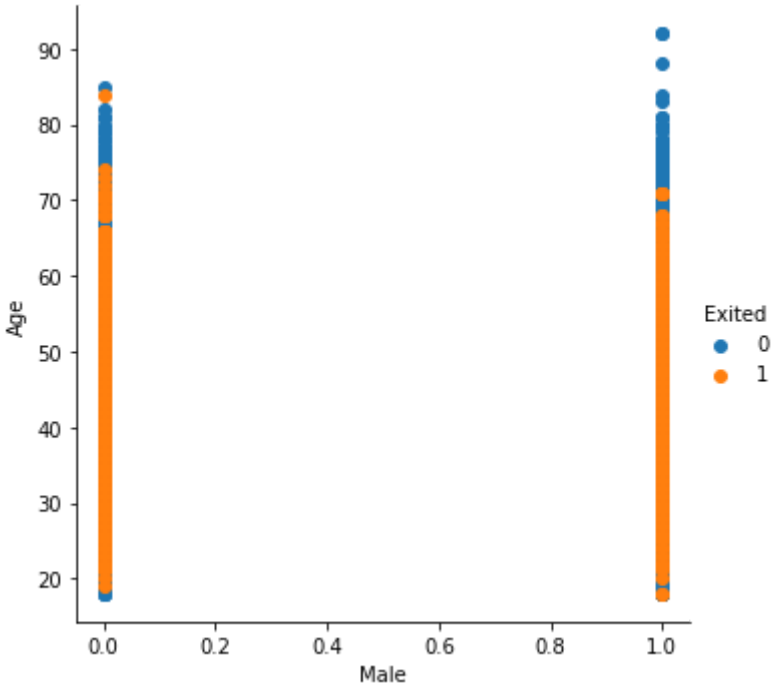


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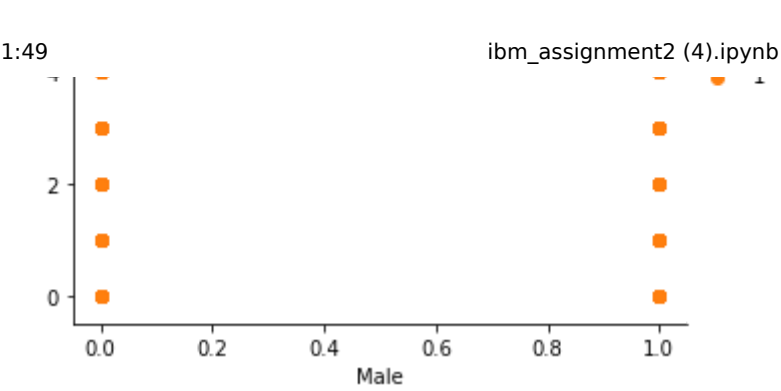


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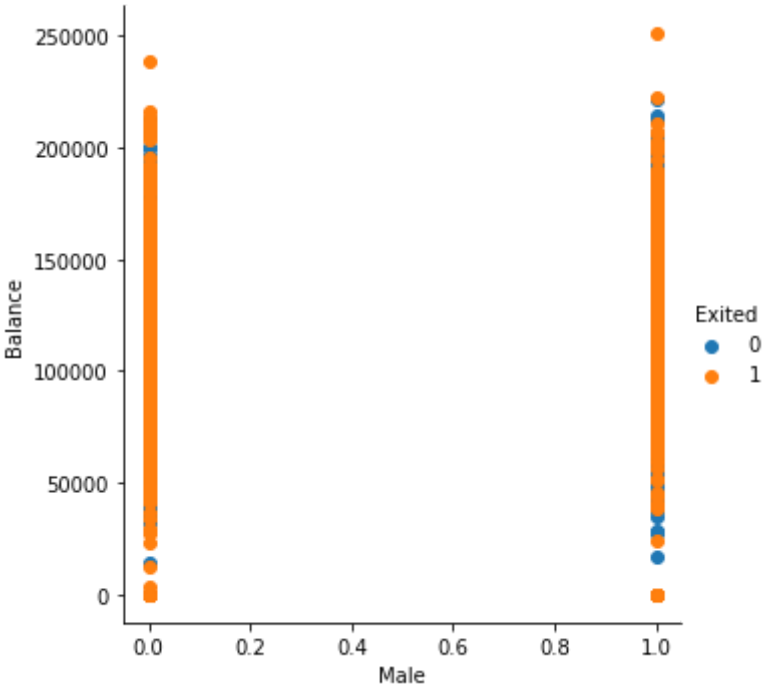
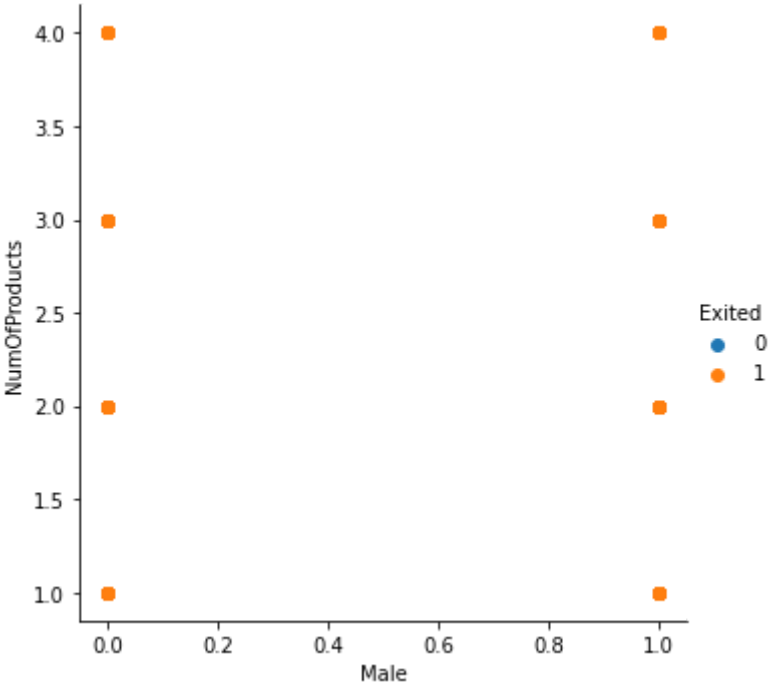
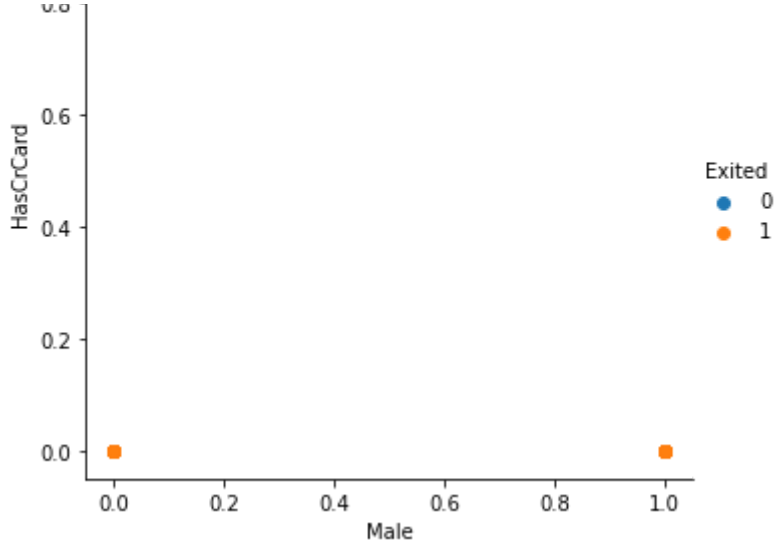
  warnings.warn(msg, UserWarning)
```



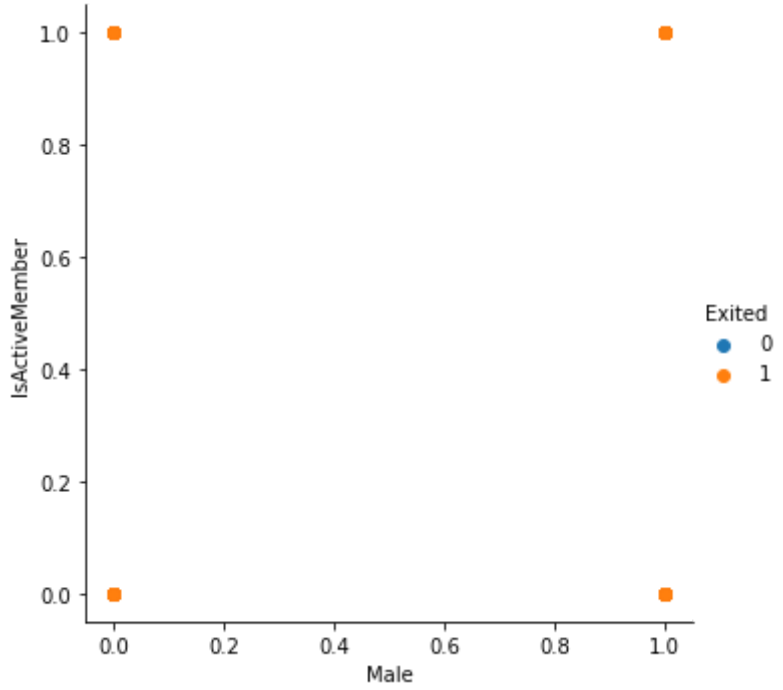

```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
  warnings.warn(msg, UserWarning)
```



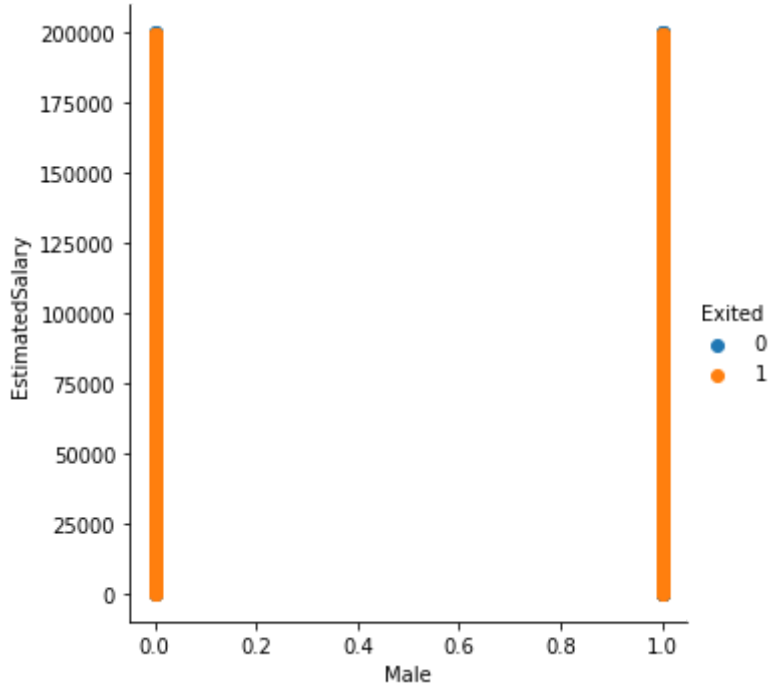

```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
  warnings.warn(msg, UserWarning)
```



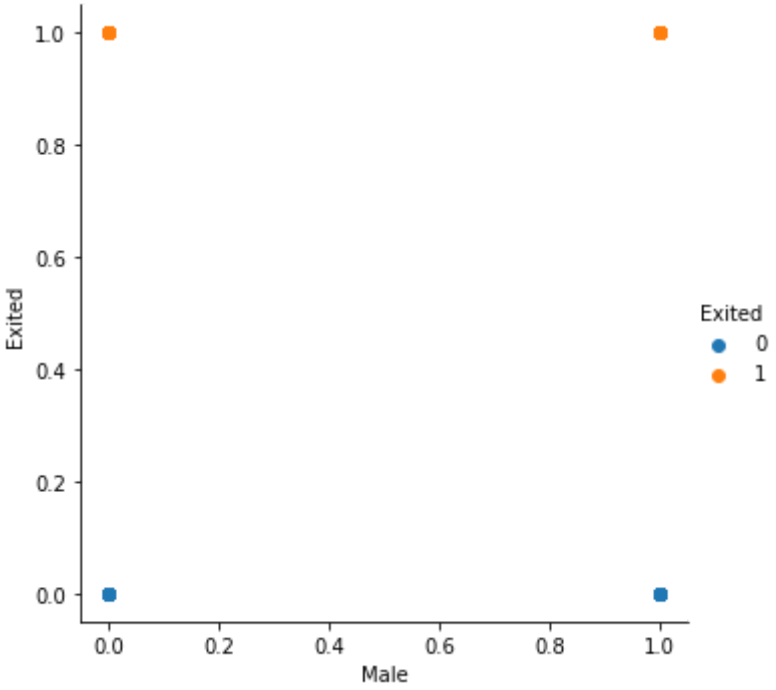

```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
  warnings.warn(msg, UserWarning)
```



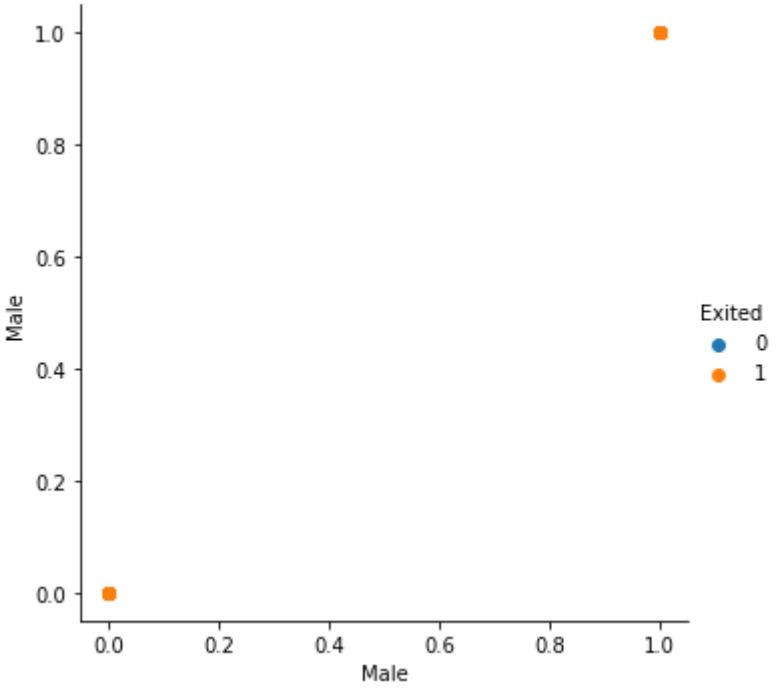

```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
  warnings.warn(msg, UserWarning)
```



```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
  warnings.warn(msg, UserWarning)
```

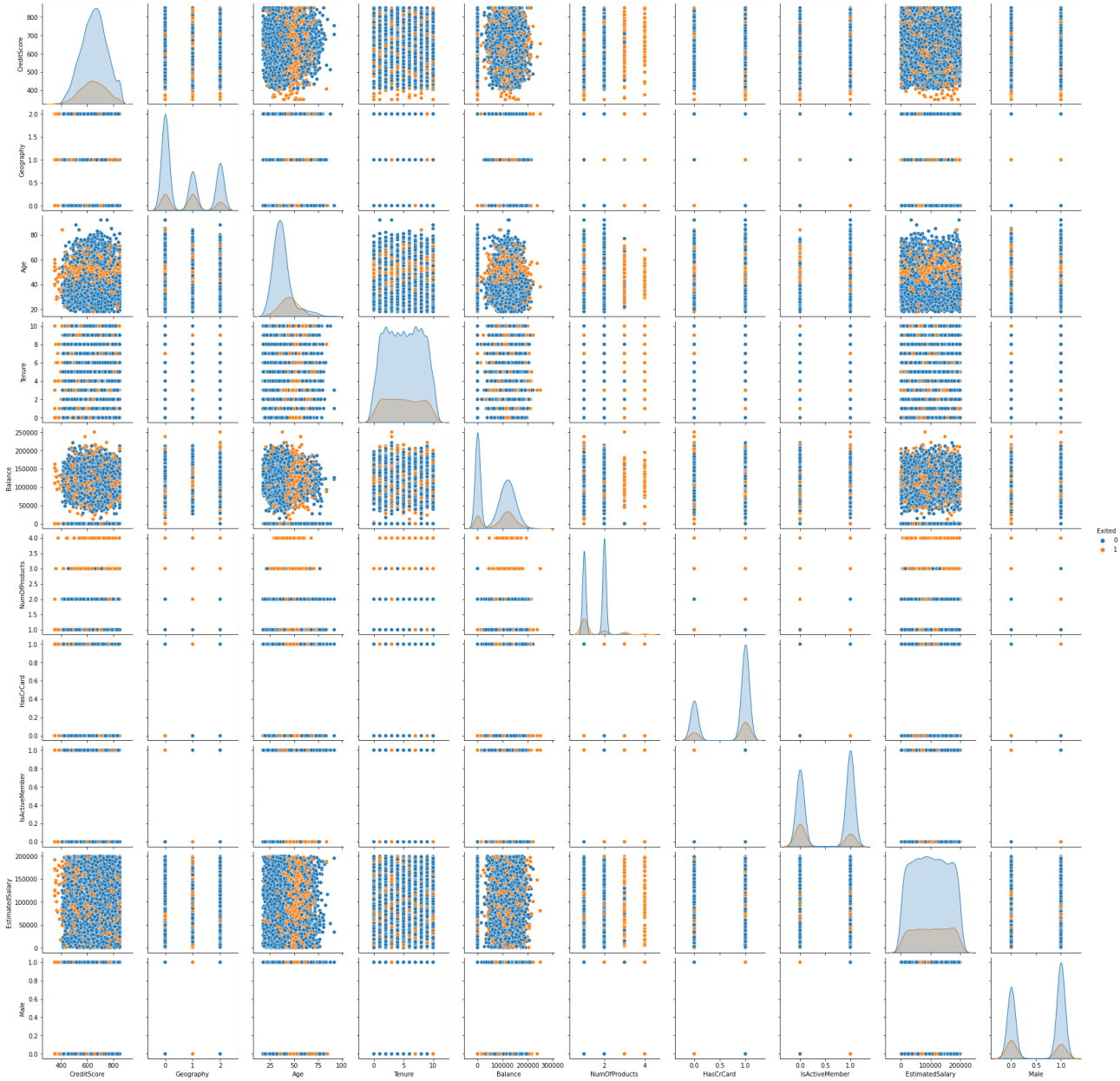



```
/usr/local/lib/python3.7/dist-packages/seaborn/axisgrid.py:337: UserWarning:
  warnings.warn(msg, UserWarning)
```




```
sns.pairplot(df,hue='Exited')
```

```
<seaborn.axisgrid.PairGrid at 0x7f0bcfc38350>
```



```
dict_1={}
for feature in df.columns:
  if df2[feature].dtype != 'O':
    quantile1, quantile3 = np.percentile(df[feature],[25,75])
    iqr_value = quantile3-quantile1
    lower_bound_value = quantile1-(1.5 * iqr_value)
    upper_bound_value = quantile3+(1.5 * iqr_value)
    dict_1.update({feature:{'lower':lower_bound_value,'upper':upper_bound_value}})
print(dict_1)
```

```
{'CreditScore': {'lower': 383.0, 'upper': 919.0}, 'Geography': {'lower': -1.5
```

```
df2 = df.copy()
for feature in df2.columns:
  try:
    if df2[feature].dtype != 'O' and feature not in ['Exited','Male']:
      df2 = df2.drop(df2[feature].loc[df2[feature] > dict_1[feature]['upper']].ind
      df2 = df2.drop(df2[feature].loc[df2[feature] < dict_1[feature]['lower']].ind
  except:
    pass
df2
```

	Surname	CreditScore	Geography	Age	Tenure	Balance	NumOfProducts	H

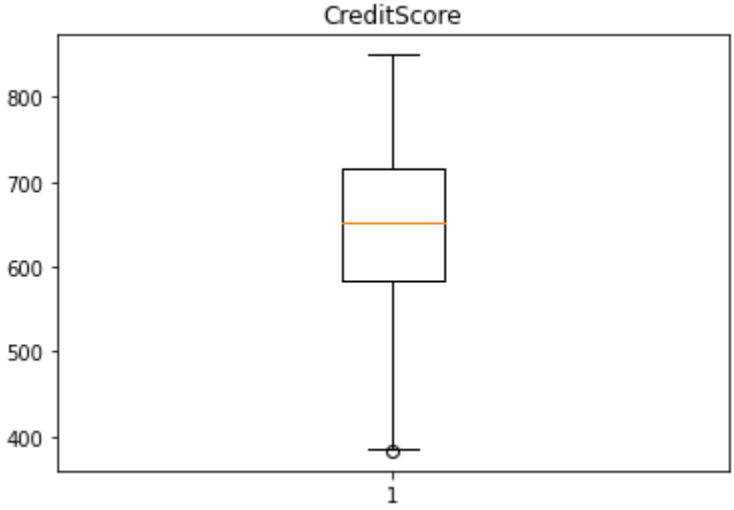
```
age_high = df2['Age'].loc[df2['Age']>dict_1['Age']['upper']].index
print(age_high)
df2.drop(df2['Age'].loc[df2['Age']>dict_1['Age']['upper']].index, axis=0)
```

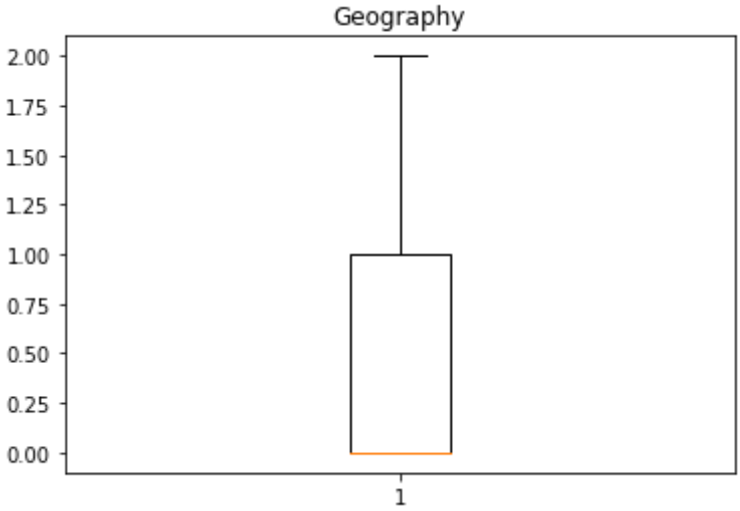
```
Int64Index([], dtype='int64')
```

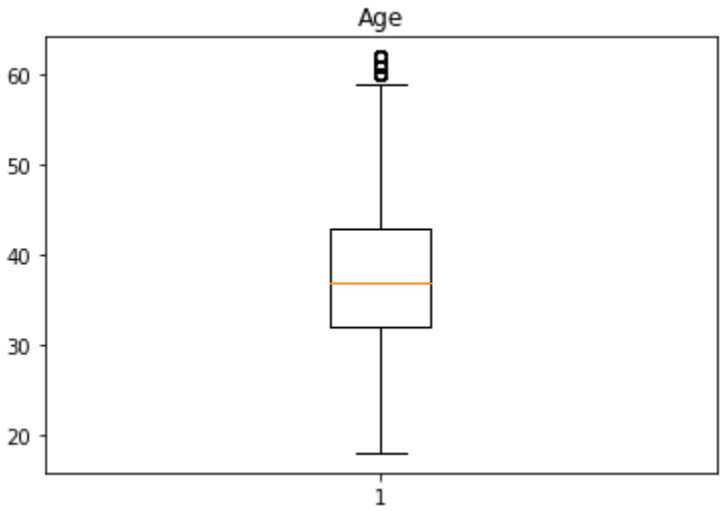
	Surname	CreditScore	Geography	Age	Tenure	Balance	NumOfProducts	H
0	Hargrave	619	0	42	2	0.00	1	
1	Hill	608	2	41	1	83807.86	1	
2	Onio	502	0	42	8	159660.80	3	
3	Boni	699	0	39	1	0.00	2	
4	Mitchell	850	2	43	2	125510.82	1	
...	...	...	...	...	...	...	...	...
9995	Obijiaku	771	0	39	5	0.00	2	
9996	Johnstone	516	0	35	10	57369.61	1	
9997	Liu	709	0	36	7	0.00	1	
9998	Sabbatini	772	1	42	3	75075.31	2	
9999	Walker	792	0	28	4	130142.79	1	

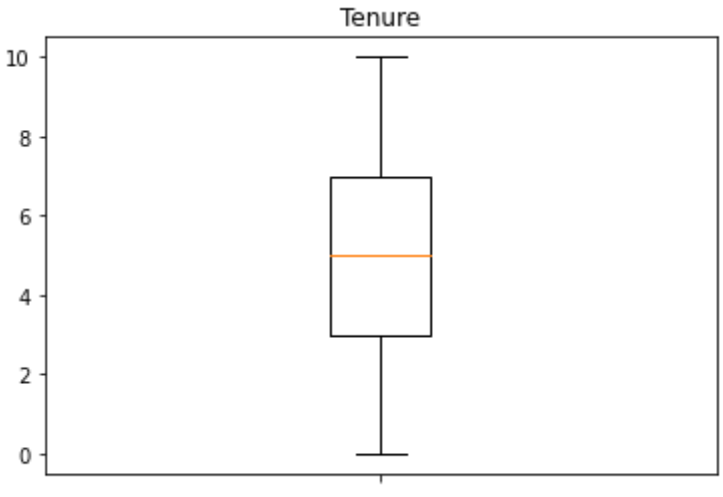
9568 rows × 11 columns

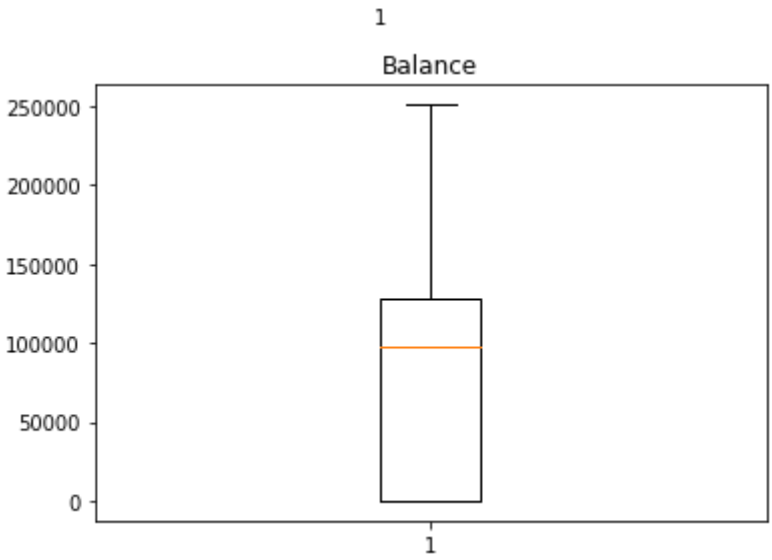
```
for sample in df2.columns:
  if df2[sample].dtype != 'O':
    plt.boxplot(df2[sample])
    plt.title(sample)
    plt.show()
```

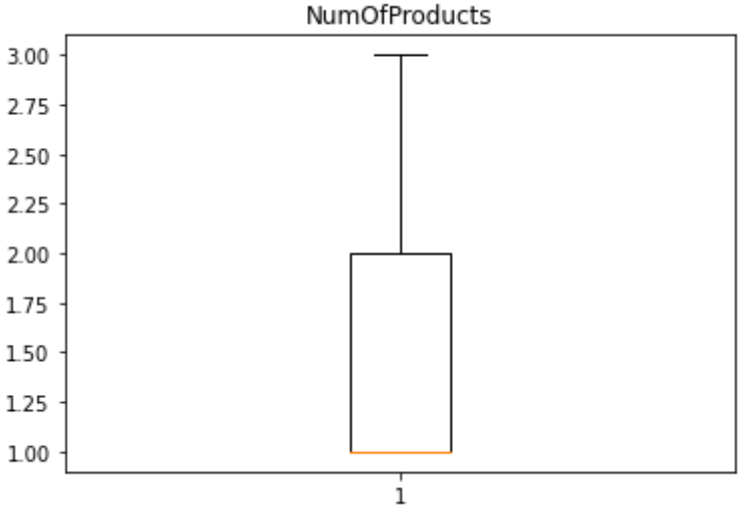

CreditScore
800
700
600
500
400
1

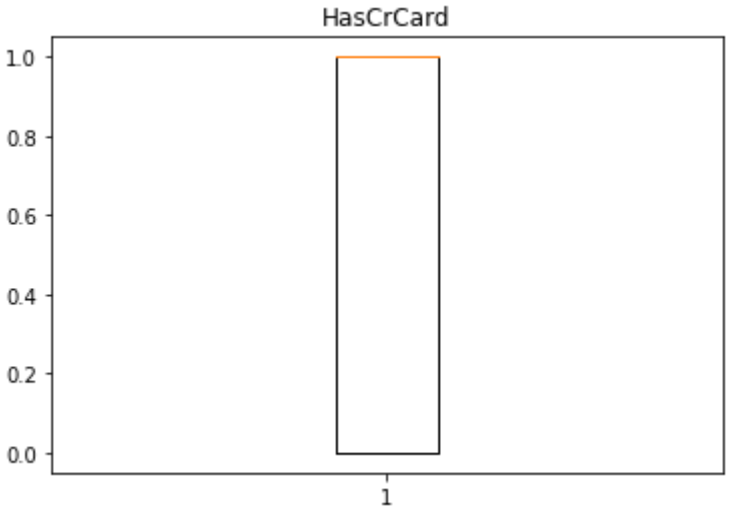

Geography
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
1

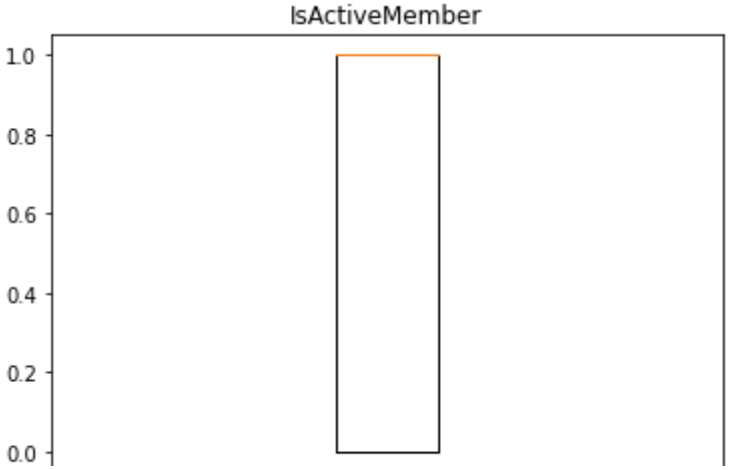

Age
60
50
40
30
20
1

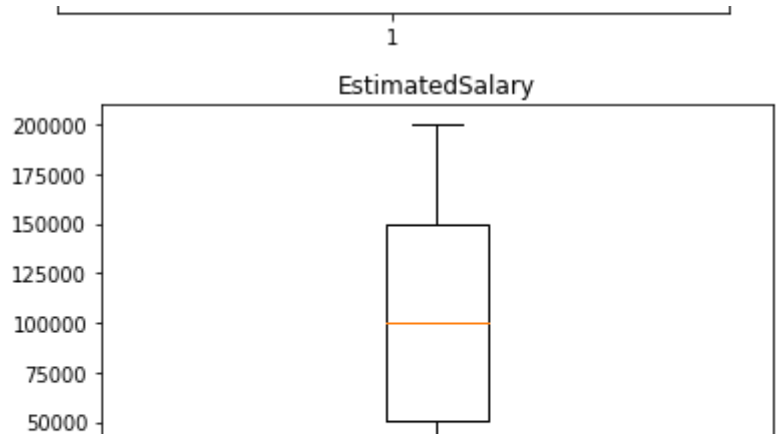

Tenure
10
8
6
4
2
0


1
Balance
250000
200000
150000
100000
50000
0
1


NumOfProducts
3.00
2.75
2.50
2.25
2.00
1.75
1.50
1.25
1.00
1


HasCrCard
1.0
0.8
0.6
0.4
0.2
0.0
1


IsActiveMember
1.0
0.8
0.6
0.4
0.2
0.0




```
df2['Age'].loc[df2['Age']>dict_1['Age']['upper']]
```

```
Series([], Name: Age, dtype: int64)
```

```
df2.head()
```

	Surname	CreditScore	Geography	Age	Tenure	Balance	NumOfProducts	HasC
0	Hargrave	619	0	42	2	0.00	1	
1	Hill	608	2	41	1	83807.86	1	
2	Onio	502	0	42	8	159660.80	3	
3	Boni	699	0	39	1	0.00	2	
4	Mitchell	850	2	43	2	125510.82	1	

```
x = df2.drop(['Exited','Surname'],axis='columns')
y = df2['Exited']
x
```

	CreditScore	Geography	Age	Tenure	Balance	NumOfProducts	HasCrCard
0	619	0	42	2	0.00	1	1

```
y
```

```
0       1
1       0
2       1
3       0
4       0
       ..
9995    0
9996    0
9997    1
9998    1
9999    0
Name: Exited, Length: 9568, dtype: int64
```

9998	772	1	42	3	75075.31	2	1

```
scaler = preprocessing.StandardScaler()
from sklearn.model_selection import train_test_split

x_train,x_test,y_train,y_test = train_test_split(x,y,test_size=0.25,random_state=4

x_test.count()
```

```
CreditScore        2392
Geography          2392
Age                2392
Tenure             2392
Balance            2392
NumOfProducts      2392
HasCrCard          2392
IsActiveMember     2392
EstimatedSalary    2392
dtype: int64
```

```
x_train
```

	CreditScore	Geography	Age	Tenure	Balance	NumOfProducts	HasCrCard
2142	690	0	35	6	112689.95	1	1
8398	767	1	45	7	132746.20	2	1
7954	743	0	30	7	77599.23	1	0

```
x_train_scaled = scaler.fit_transform(x_train)
x_train_scaled
```

```
array([[ 0.42023316, -0.90757135, -0.29774051, ...,  0.64970495,
        -0.99666109,  1.33516612],
       [ 1.2168678 ,  0.30184963,  0.84671603, ...,  0.64970495,
        -0.99666109, -1.28100658],
       [ 0.9685661 , -0.90757135, -0.86996879, ..., -1.53916019,
        -0.99666109,  0.76862512],
       ...,
       [ 1.08237104, -0.90757135,  0.04559645, ..., -1.53916019,
        -0.99666109, -1.68307651],
       [-2.21797246,  0.30184963, -0.64107748, ...,  0.64970495,
         1.00335009, -1.64161652],
       [ 1.49620722,  1.51127062, -0.86996879, ..., -1.53916019,
         1.00335009,  0.98374312]])
```

```
x_test_scaled = scaler.transform(x_test)
x_test_scaled
```

```
array([[ 1.16513828,  1.51127062, -0.29774051, ..., -1.53916019,
        -0.99666109,  0.86285844],
       [-0.85231308,  0.30184963,  0.96116169, ...,  0.64970495,
         1.00335009,  0.1624185 ],
       [-0.14879158, -0.90757135, -0.52663182, ...,  0.64970495,
        -0.99666109,  0.39521358],
       ...,
       [ 1.80658435, -0.90757135, -0.86996879, ...,  0.64970495,
         1.00335009,  1.07572334],
       [-1.78344447,  0.30184963, -0.41218617, ...,  0.64970495,
         1.00335009,  1.55989324],
       [ 1.43413179, -0.90757135, -0.64107748, ..., -1.53916019,
        -0.99666109, -0.18918079]])
```

Colab paid products - Cancel contracts here

✓ 0s completed at 11:48