

In [1]:

```
import networkx as nx
import matplotlib.pyplot as plt
from matplotlib.pyplot import figure
import pandas as pd
import collections
import itertools
```

In [2]:

```
data_file = "/Users/Chao/Downloads/Edinburgh_Export.xlsx"

df_trans = pd.read_excel(data_file, sheet_name='transactions')
df_users = pd.read_excel(data_file, sheet_name='users')
df_payees = pd.read_excel(data_file, sheet_name='payees')

# As there is no unique identification for transfer payees, we add another c
# account number and sort code to identify payees.
df_trans['createdAt'] = pd.to_datetime(df_trans['createdAt'])

df_payees['account_full'] = df_payees['Receiver accountNumber'].astype(str)

df_users = df_users.rename(columns={"_id": "customerId"}, errors="raise")
df_users['dateOfBirth'] = df_users['dateOfBirth'].str[:4]
df_users['dateOfBirth'] = df_users['dateOfBirth'].astype('float')
df_users['createdAt'] = pd.to_datetime(df_users['createdAt'])
```

In [5]:

```
# First we create a graph that link transaction id and category to analysis
# emission
#T = nx.from_pandas_edgelist(df_trans, '_id', 'externalParty.transactionCategory')
#                                ['transactionFootPrint.carbonEmissionInGrams','a
#                                'externalParty.merchantCategoryCode','transacti
#                                'transactionType.direction'])
```

In [6]:

```
# we can get category list: ['OTHER', 'SHOPPING', 'TRAVEL', nan, 'GROCERIES',
cat_list = []
trans_count = 0
for cat in pd.Series(df_trans['externalParty.transactionCategory']).unique():
    if not pd.isnull(cat):
        cat_list.append((cat, T.degree(cat)))
        trans_count += T.degree(cat)

cat_list.append(('null', df_trans.shape[0] - trans_count))
print(cat_list)

# there is 62167 transactions in total
```

```
[('OTHER', 41336), ('SHOPPING', 3557), ('TRAVEL', 4178), ('GROCERIES', 6108),
('LIFESTYLE', 5907), ('SUBSCRIPTION', 104), ('FUEL', 10), ('null', 967)]
```

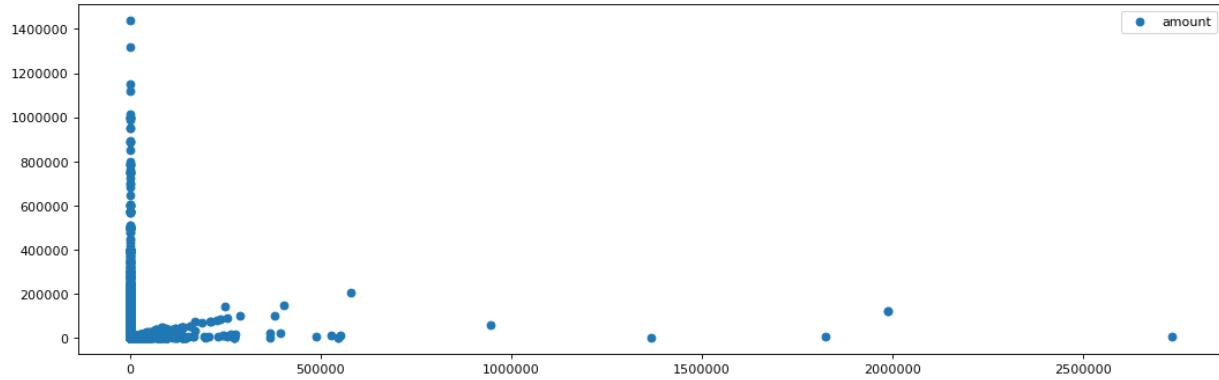
In [7]:

```
# To futher analysis the 'OTHER'category, we can analysis the merchant category
df = df_trans[df_trans['externalParty.transactionCategory'] == 'OTHER']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts().head(30)
print(top_mcc)
sum(top_mcc.values)
# we could notice that top 5 cover 29% of 'OTHER', top 10 cover 39% of 'OTHER'
# we would like to focus on mcc that appear more than 100 times cover unless
# according to the table, is top 5 mcc
```

```
6011.0    1614
4814.0     195
8398.0     183
8999.0     153
4900.0     112
9402.0      79
9399.0      72
6012.0      72
8220.0      70
7311.0      70
5969.0      62
5967.0      60
7399.0      51
4816.0      49
6211.0      42
4899.0      38
6300.0      38
5968.0      30
7299.0      27
8641.0      21
8699.0      19
4812.0      19
8299.0      15
4215.0      14
7523.0      12
5065.0      11
8043.0      10
5965.0       9
8021.0       9
8062.0       9
Name: externalParty.merchantCategoryCode, dtype: int64
```

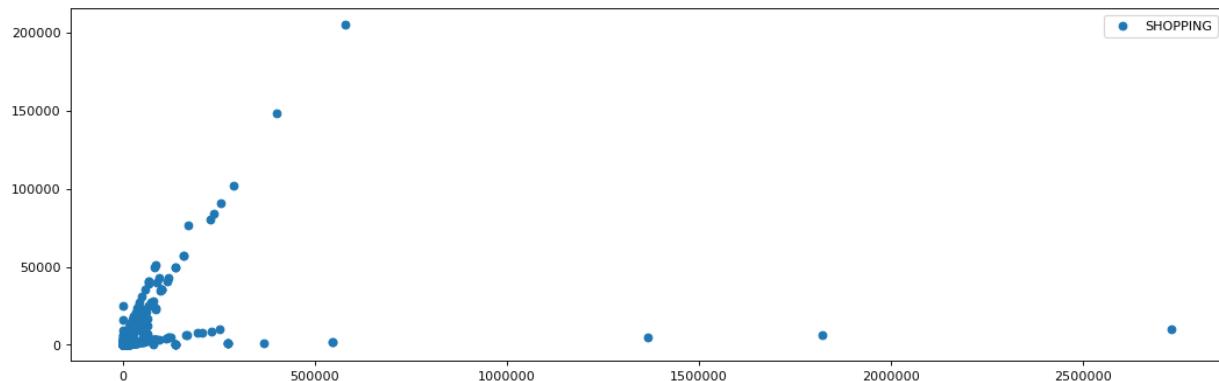
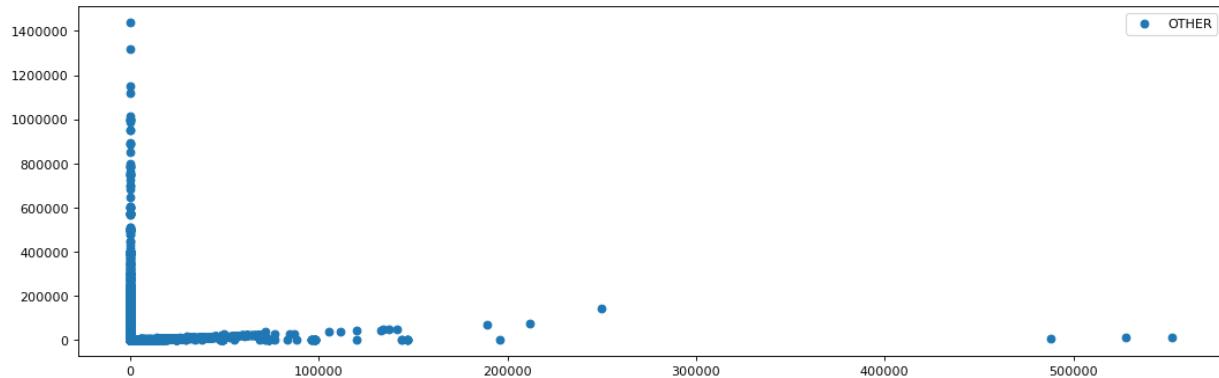
Out[7]:

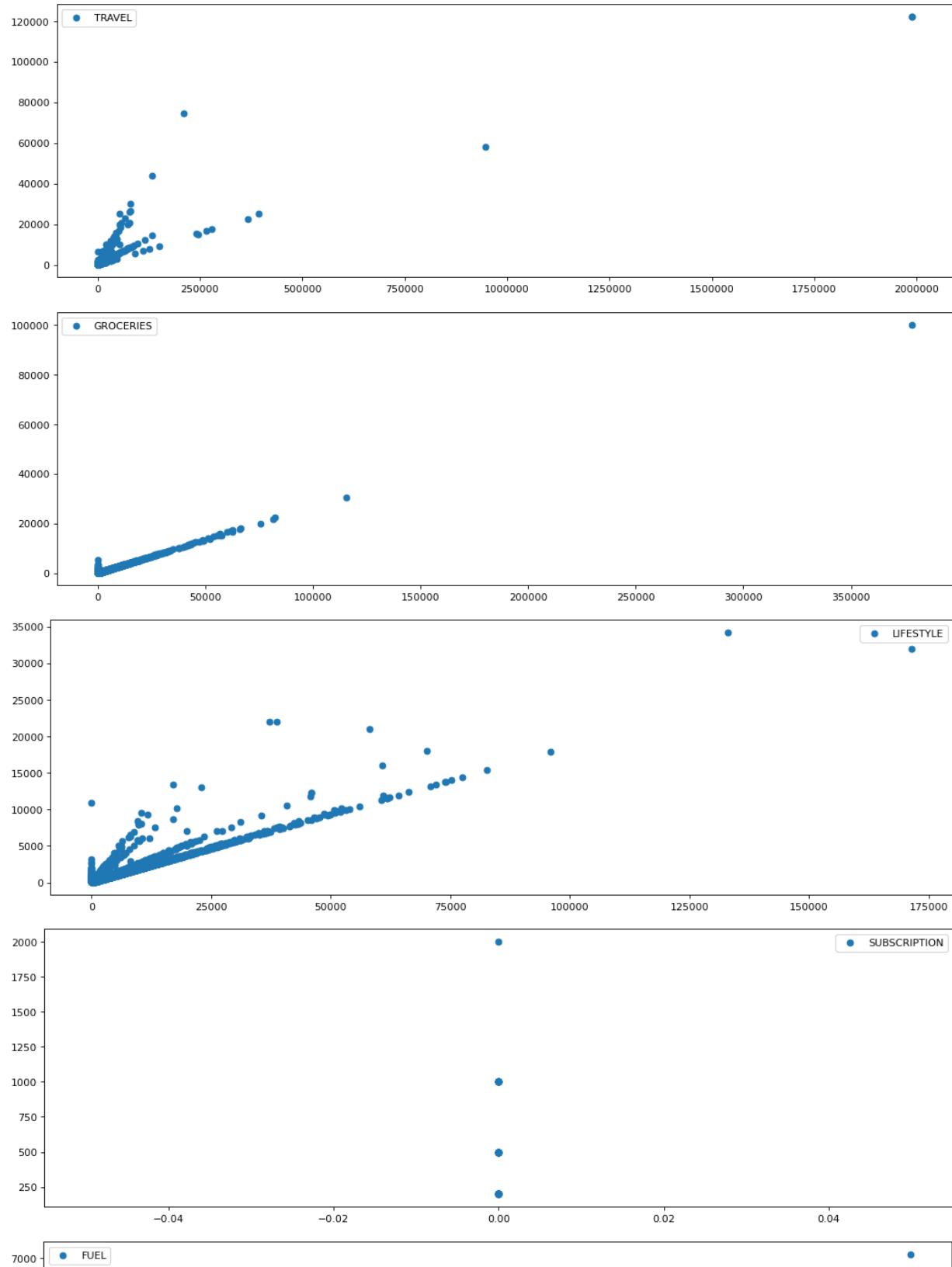
```
# next is analysis the relationship between carbon emission and category/amount
figure(figsize=(16, 5), dpi=80)
plt.scatter(df_trans['transactionFootPrint.carbonEmissionInGrams'], df_trans['externalParty.merchantCategoryCode'])
plt.legend(loc='best')
plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
plt.xticks(rotation=90)
plt.show()
```



In [8]:

```
for cat in cat_list[:-1]:
    figure(figsize=(16, 5), dpi=80)
    df = df_trans[df_trans['externalParty.transactionCategory'] == cat[0]]
    plt.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount'],
    plt.legend(loc='best')
    #plt.title('Clustering Coefficient')
    plt.ticklabel_format(style='plain')
    #plt.xticks(rotation=90)
    plt.show()
```

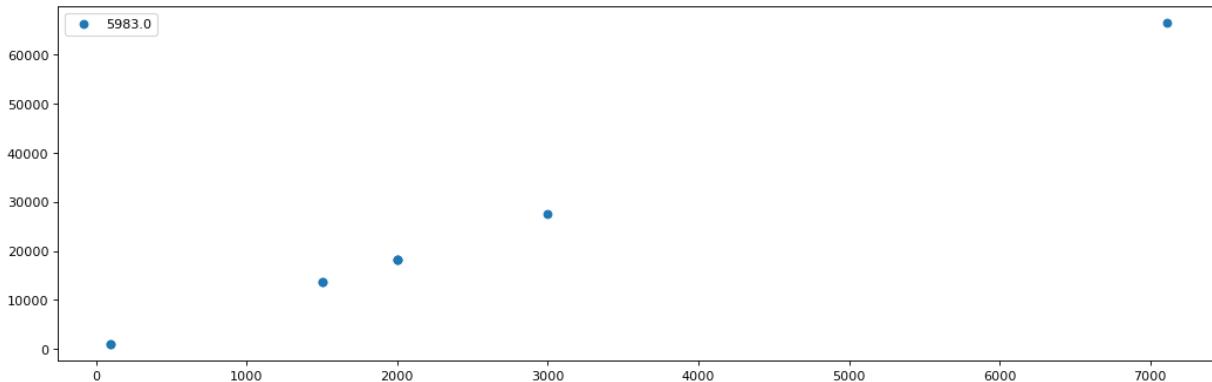




In [198...]

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'FUEL']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # ('FUEL',
print(top_mcc)
ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc):
    df = df_trans[df_trans['externalParty.merchantCategoryCode'] == mcc]
    ax.scatter(df['amount.value'], df['transactionFootPrint.carbonEmissionInG
    df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]
    print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissio
plt.legend(loc='best')
#plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
#plt.xticks(rotation=90)
plt.show()
```

```
5983.0      10
Name: externalParty.merchantCategoryCode, dtype: int64
[ 4.5674 456.74  ]
/Users/chao/opt/anaconda3/envs/gt/lib/python3.9/site-packages/IPython/core/in
teractiveshell.py:3444: RankWarning: Polyfit may be poorly conditioned
  exec(code_obj, self.user_global_ns, self.user_ns)
```

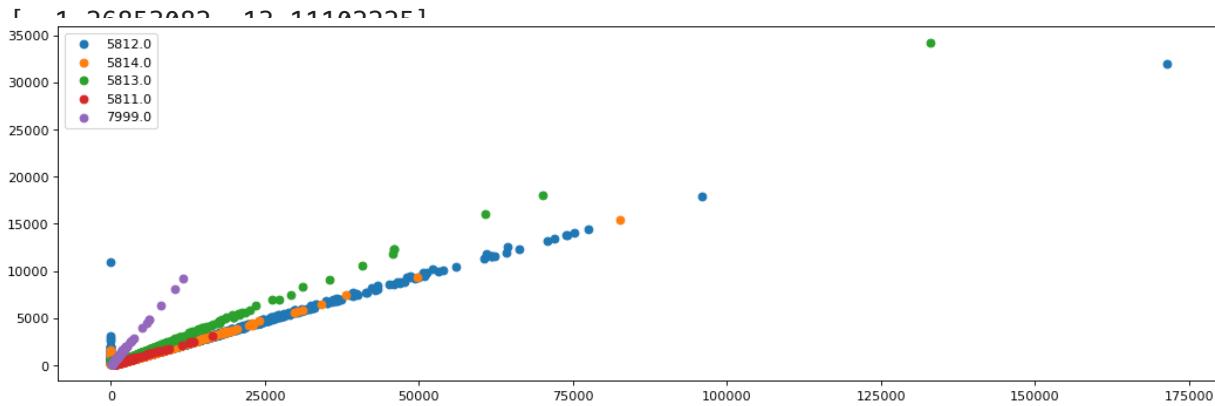


In [189...]

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'LIFESTYLE']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # ('LIFESTYL
print(top_mcc.head(10))
ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(5)):
    df = df_trans[df_trans['externalParty.merchantCategoryCode'] == mcc]
    ax.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount.v
    df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]
    print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissio
plt.legend(loc='best')
#plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
#plt.xticks(rotation=90)
plt.show()
```

```
5812.0      2762
5814.0      1408
5813.0      965
5811.0      189
7999.0      105
5921.0      92
7230.0      78
```

```
7997.0      68
5993.0      42
7832.0      41
Name: externalParty.merchantCategoryCode, dtype: int64
[ 4.05368089 833.94510666]
[5.27501569 0.37927706]
[3.83547874 7.46907995]
[ 5.29502963 -8.65307132]
```



In [216...]

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'LIFESTYLE']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # ('LIFESTYLE')
print(top_mcc.head(10))
#ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(5)):
    df = df.drop(df[df['externalParty.merchantCategoryCode'] == mcc].index)
figure(figsize=(16, 5), dpi=80)
plt.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount.value'])
df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]

print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'], 1))
plt.legend(loc='best')
#plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
#plt.xticks(rotation=90)
plt.show()
```

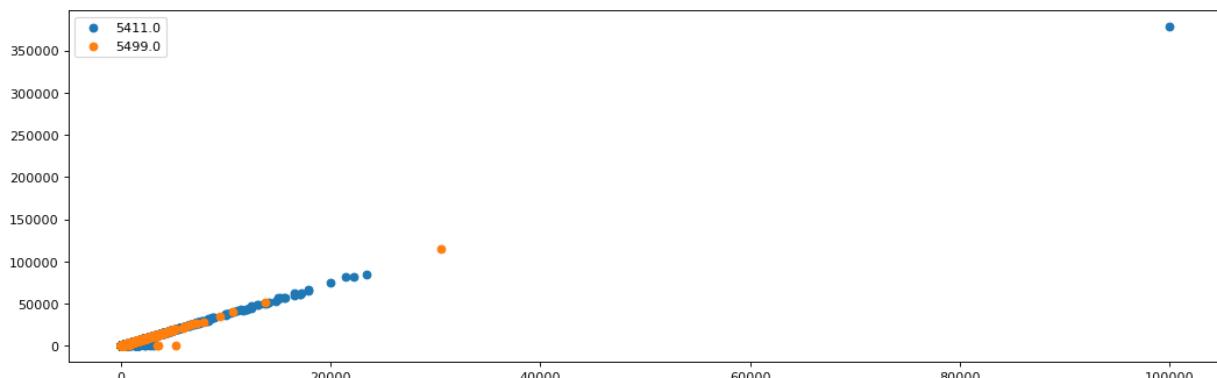
```
5812.0      2762
5814.0      1408
5813.0      965
5811.0      189
7999.0      105
5921.0       92
7230.0       78
7997.0       68
5993.0       42
7832.0       41
Name: externalParty.merchantCategoryCode, dtype: int64
[ 1.36120842 599.18613823]
```



In [188]:

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'GROCERIES']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # ('GROCERIES')
print(top_mcc.head(10))
ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(2)):
    df = df_trans[df_trans['externalParty.merchantCategoryCode'] == mcc]
    ax.scatter(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'])
    df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]
    print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'], 1))
    plt.legend(loc='best')
# plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
# plt.xticks(rotation=90)
plt.show()
```

```
5411.0      4514
5499.0      1319
5441.0       110
5462.0       102
5451.0        41
5422.0        22
Name: externalParty.merchantCategoryCode, dtype: int64
[ 3.62883546 33.55188651]
[ 3.34347475 196.46268261]
```

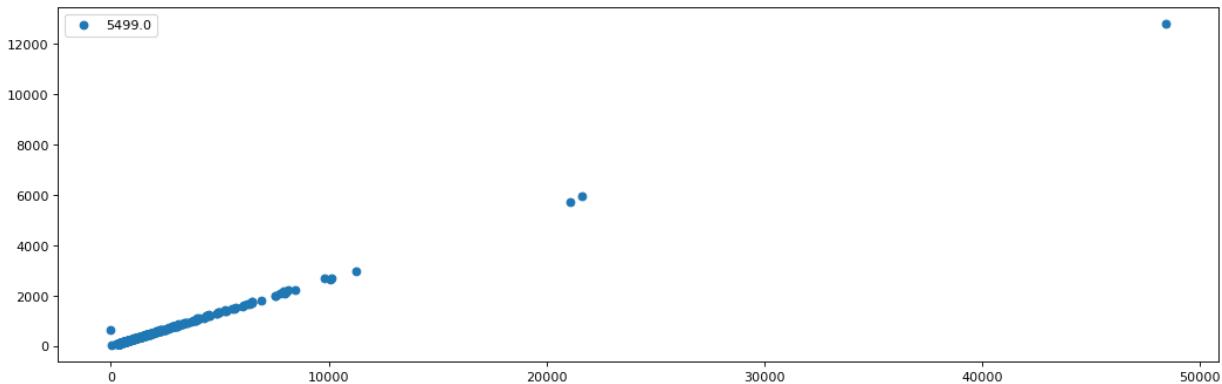


In [215...]

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'GROCERIES']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # ('GROCERIES')
print(top_mcc.head(10))
#ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(2)):
    df = df.drop(df[df['externalParty.merchantCategoryCode'] == mcc].index)
figure(figsize=(16, 5), dpi=80)
plt.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount.value'])
df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]

print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'], 1))
plt.legend(loc='best')
#plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
# plt.xticks(rotation=90)
plt.show()
```

```
5411.0    4514
5499.0    1319
5441.0    110
5462.0    102
5451.0    41
5422.0    22
Name: externalParty.merchantCategoryCode, dtype: int64
[ 3.73229381 -4.3871232 ]
```

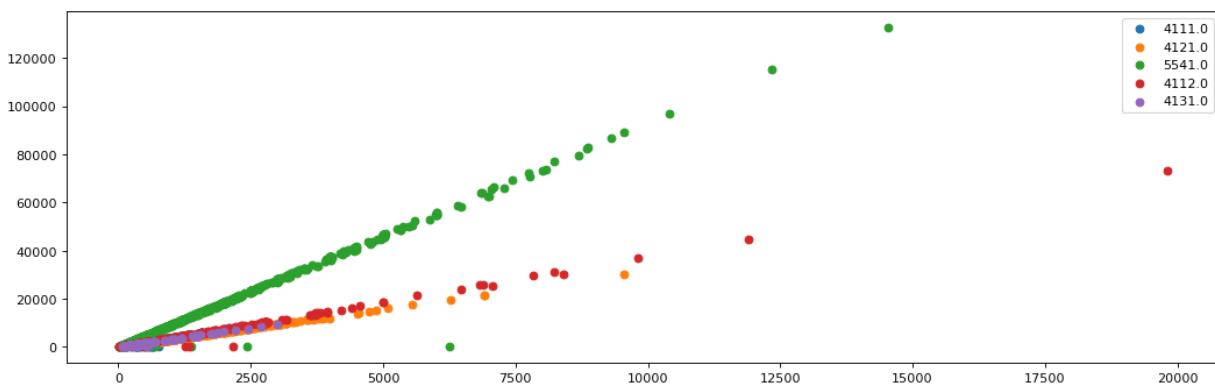


In [186...]

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'TRAVEL']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # 'TRAVEL'
print(top_mcc.head(6))
ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(5)):
    df = df_trans[df_trans['externalParty.merchantCategoryCode'] == mcc]
    ax.scatter(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'])
    df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]
    print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'], 1))
    plt.legend(loc='best')
    #plt.title('Clustering Coefficient')
    plt.ticklabel_format(style='plain')
    #plt.xticks(rotation=90)
    plt.show()
```

```
4111.0    1279
4121.0    950
5541.0    724
```

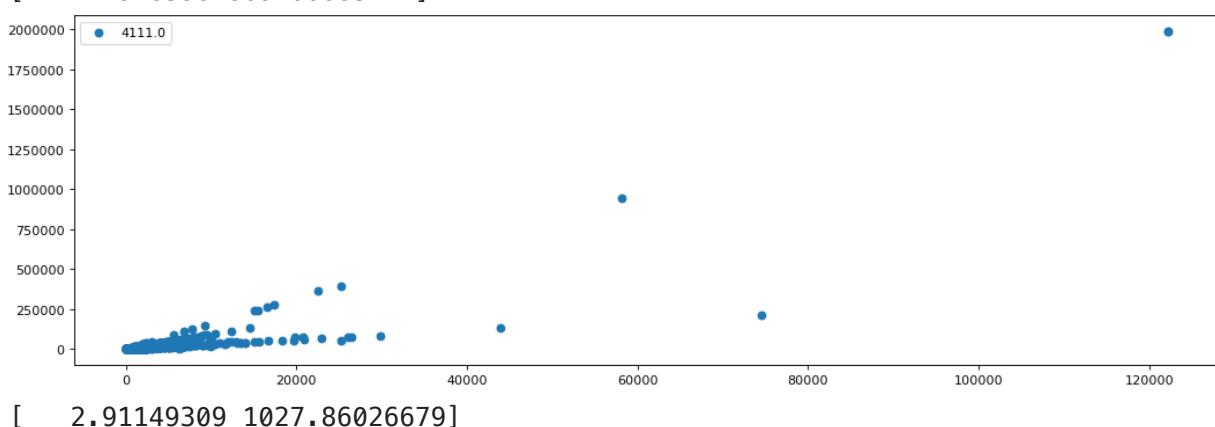
```
4112.0      302
4131.0      297
7523.0      236
Name: externalParty.merchantCategoryCode, dtype: int64
[ 3.69937973 -24.40273621]
[ 3.12641457 -4.50430101]
[ 3.49432547 2653.85638504]
[3.57420994 9.53590787]
```



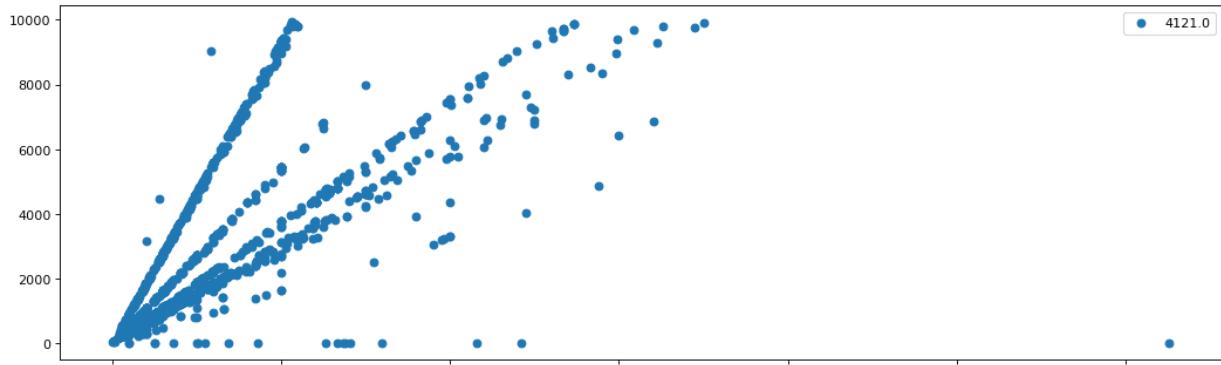
In [207]:

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'TRAVEL']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # 'TRAVEL',
print(top_mcc.head(6))
#ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(5)):
    figure(figsize=(16, 5), dpi=80)
    df = df.drop(df[df['externalParty.merchantCategoryCode'] == mcc].index)
    plt.scatter(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'])
    df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]
    print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'], 1))
    plt.legend(loc='best')
    #plt.title('Clustering Coefficient')
    plt.ticklabel_format(style='plain')
    #plt.xticks(rotation=90)
    plt.show()
```

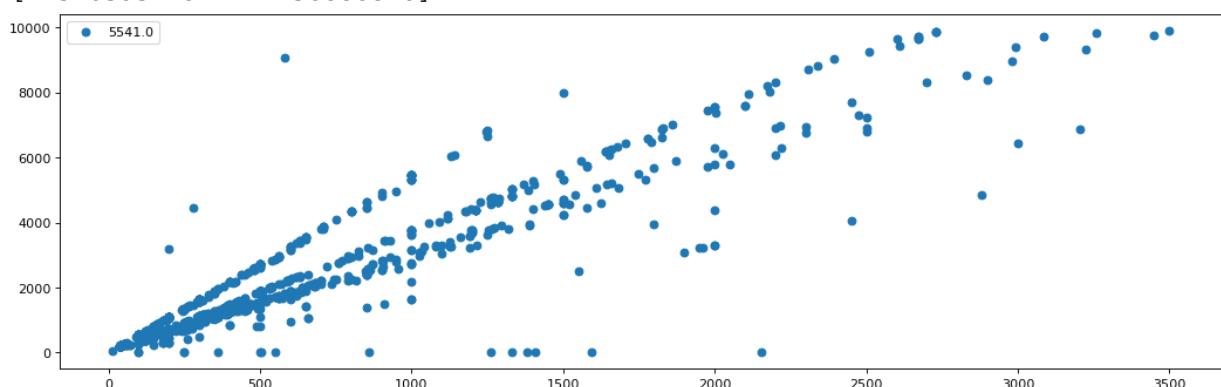
```
4111.0      1279
4121.0      950
5541.0      724
4112.0      302
4131.0      297
7523.0      236
Name: externalParty.merchantCategoryCode, dtype: int64
[ 2.77948598 869.06083427]
```



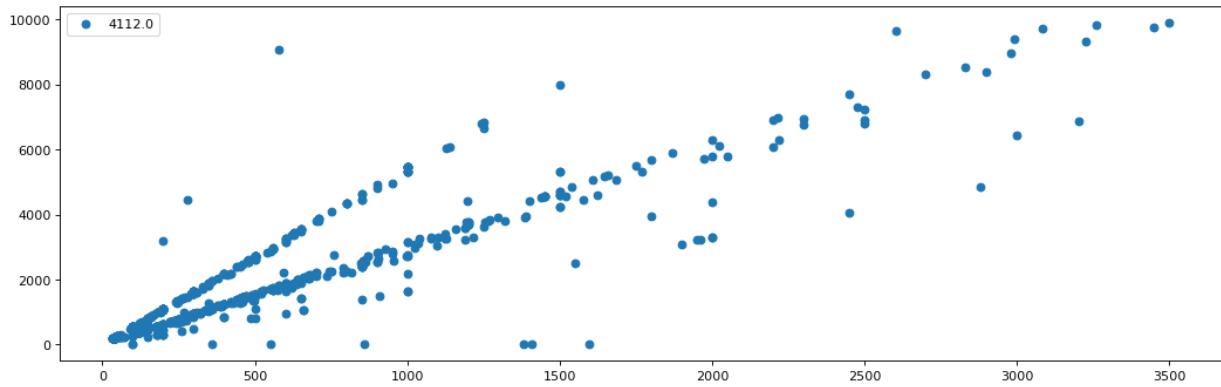
```
[ 2.91149309 1027.86026679]
```



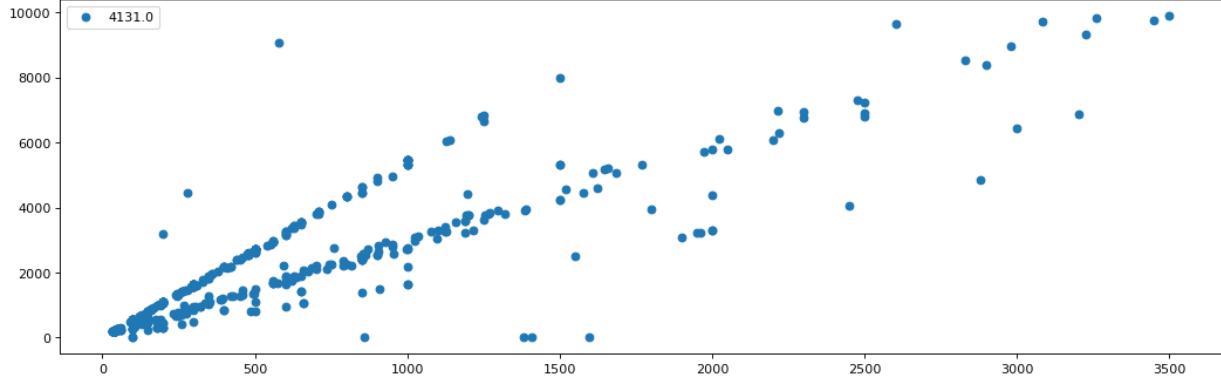
[3.03932794 274.56886846]



[2.76151575 364.25727105]



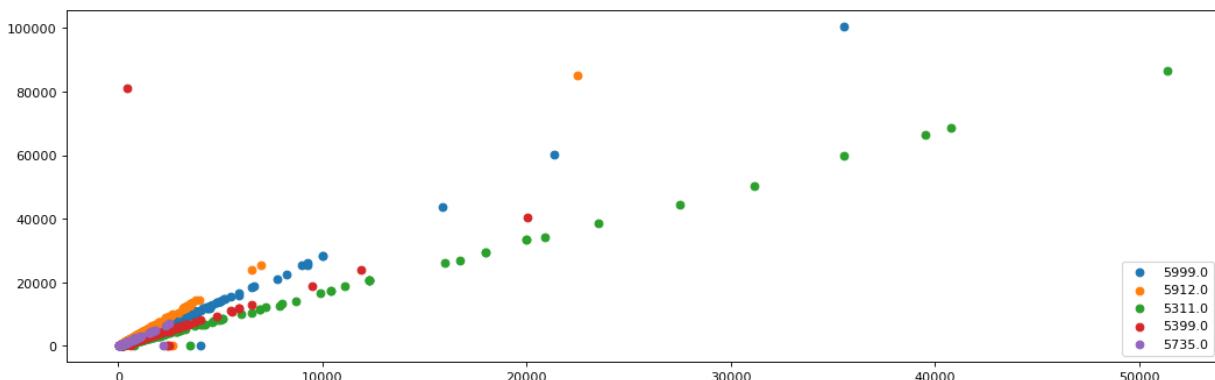
[2.62269506 570.19953935]



In [203]:

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'SHOPPING']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # 3557
print(top_mcc)
ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(5)):
    df = df_trans[df_trans['externalParty.merchantCategoryCode'] == mcc]
    ax.scatter(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'])
    df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]
    print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'], 1))
    plt.legend(loc='best')
# plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
# plt.xticks(rotation=90)
plt.show()
```

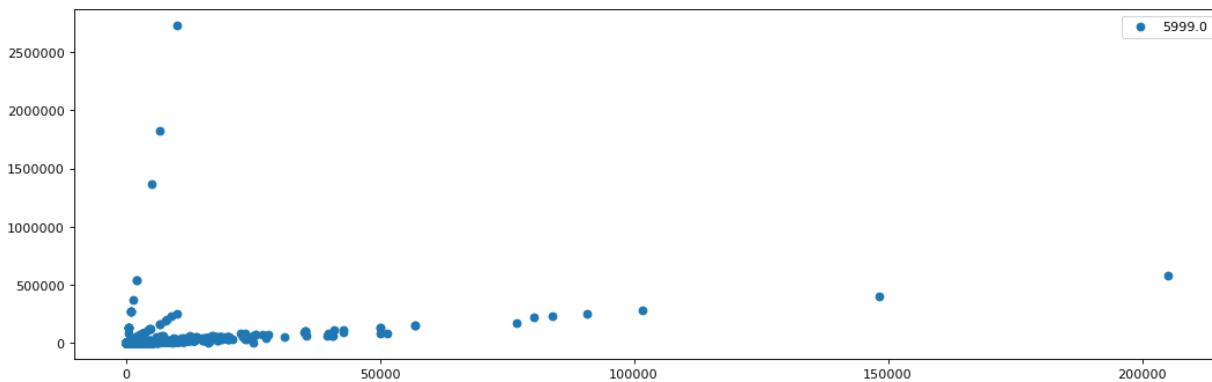
```
5999.0      417
5912.0      339
5311.0      271
5399.0      180
5735.0      153
...
5946.0      1
7622.0      1
7221.0      1
5733.0      1
5300.0      1
Name: externalParty.merchantCategoryCode, Length: 97, dtype: int64
[ 2.63611784 155.0278324 ]
[ 3.4123363 178.03494186]
[ 1.6096959 24.27376614]
[1.95453722 9.81821757]
[ 2.47581971 91.71898397]
```



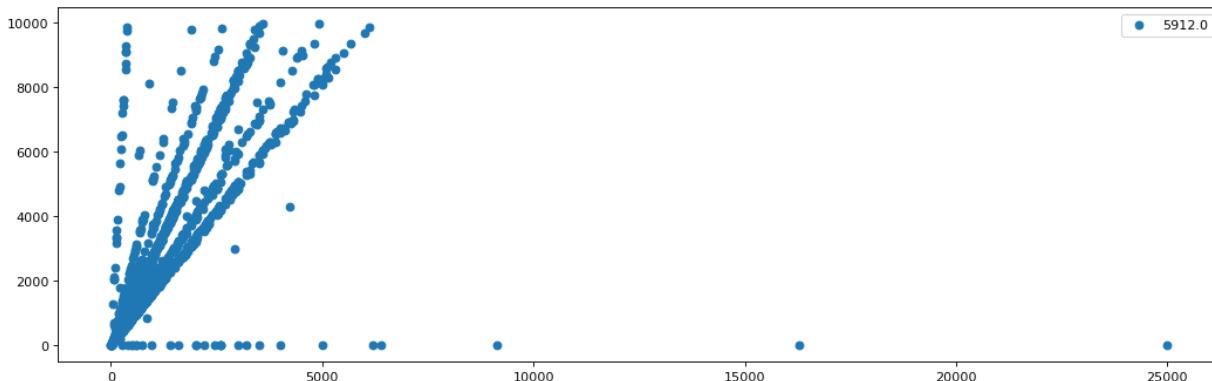
In [204]:

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'SHOPPING']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() # 3557
print(top_mcc)
#ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(5)):
    figure(figsize=(16, 5), dpi=80)
    df = df.drop(df[df['externalParty.merchantCategoryCode'] == mcc].index)
    plt.scatter(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'])
    df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]
    print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'], 1))
    plt.legend(loc='best')
    #plt.title('Clustering Coefficient')
    plt.ticklabel_format(style='plain')
    #plt.xticks(rotation=90)
    plt.show()
```

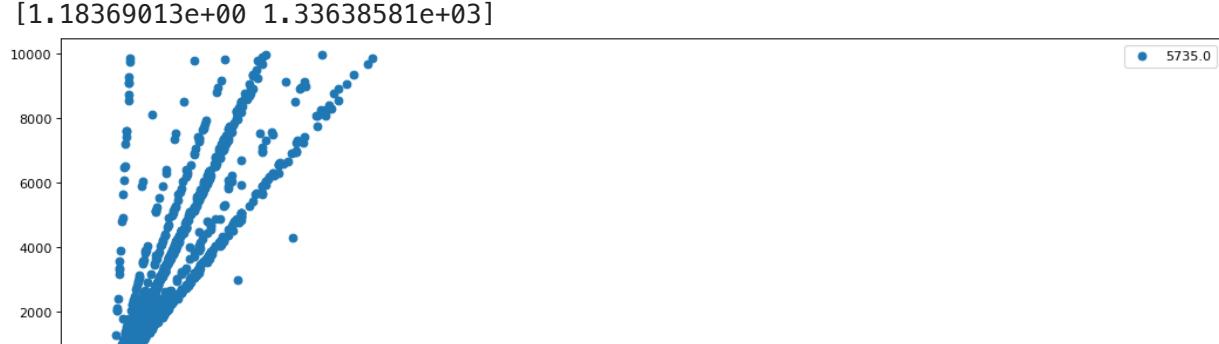
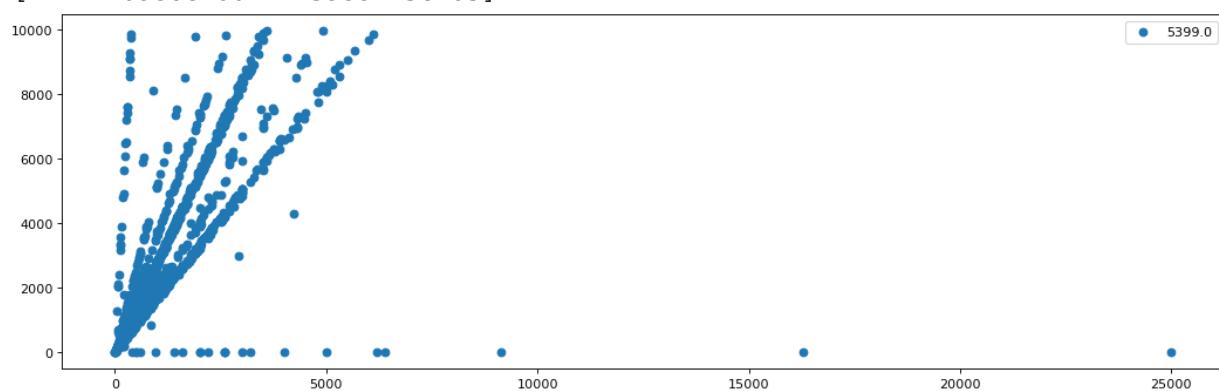
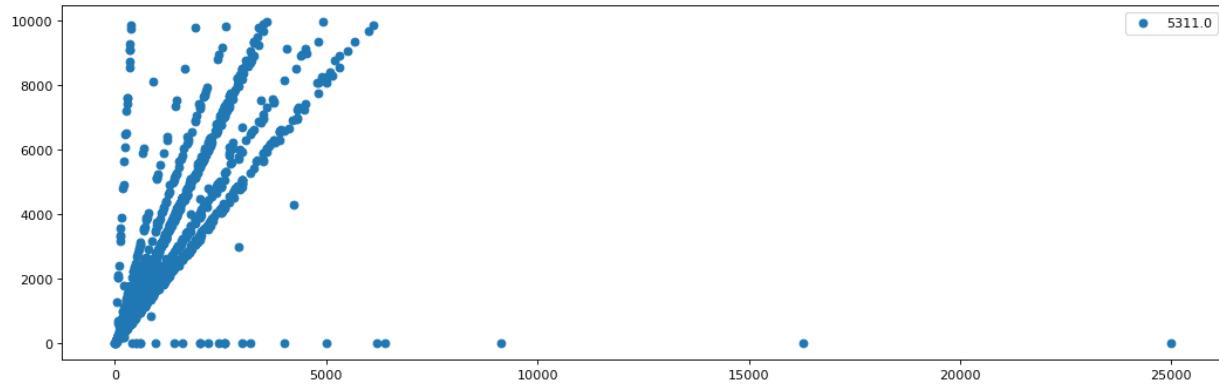
```
5999.0      417
5912.0      339
5311.0      271
5399.0      180
5735.0      153
...
5946.0       1
7622.0       1
7221.0       1
5733.0       1
5300.0       1
Name: externalParty.merchantCategoryCode, Length: 97, dtype: int64
[ 1.33955526 1099.30872345]
```



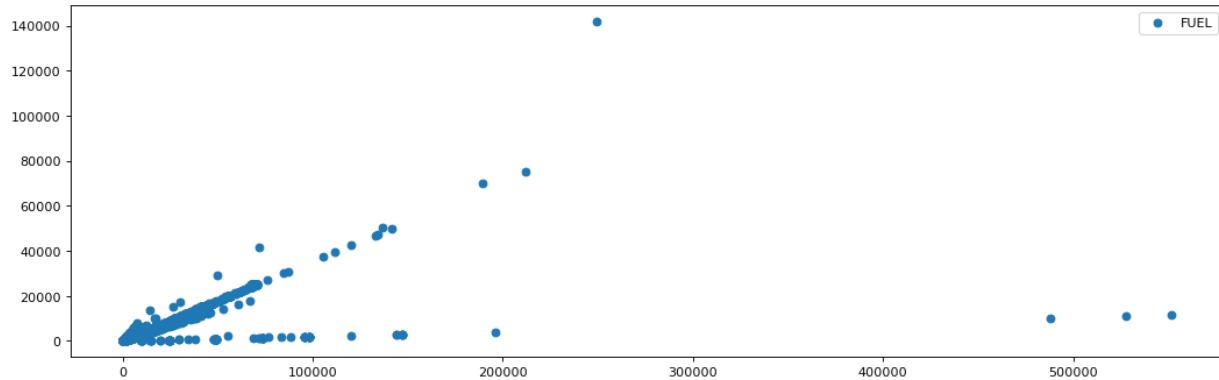
```
[ 1.28616154 1057.05339349]
```



```
[ 1.26018146 1161.58573351]
```



```
In [10]:  
figure(figsize=(16, 5), dpi=80)  
df = df_trans[(df_trans['externalParty.transactionCategory'] == 'OTHER') & (df_trans['transactionFootPrint.carbonEmissionInGrams'] > 0)]  
plt.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount.value'])  
plt.legend(loc='best')  
#plt.title('Clustering Coefficient')  
plt.ticklabel_format(style='plain')  
#plt.xticks(rotation=90)  
plt.show()
```



In [199]:

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'OTHER']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() #41336
print(top_mcc.head(10))
ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(10)):
    df = df_trans[df_trans['externalParty.merchantCategoryCode'] == mcc]
    ax.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount.value'])
    df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]
    print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmiss
plt.legend(loc='best')
#plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
#plt.xticks(rotation=90)
plt.show()
```

```
6011.0    1614
4814.0     195
8398.0     183
8999.0     153
4900.0     112
9402.0      79
9399.0      72
6012.0      72
8220.0      70
7311.0      70
Name: externalParty.merchantCategoryCode, dtype: int64
[ 2.28747657 896.90660857]
[ 3.73005811 15.94148991]
[ 1.72172696 -21.86645893]
[ 2.47757366 167.95775934]
[48.96977851 -6.67954341]
[ 1.69756307 17.07779157]
[1.74069887 4.75757732]
[ 2.76791016 -54.48447287]
[ 1.73695393 -12.56893042]
[ 2.66339616 -22.62042236]
```

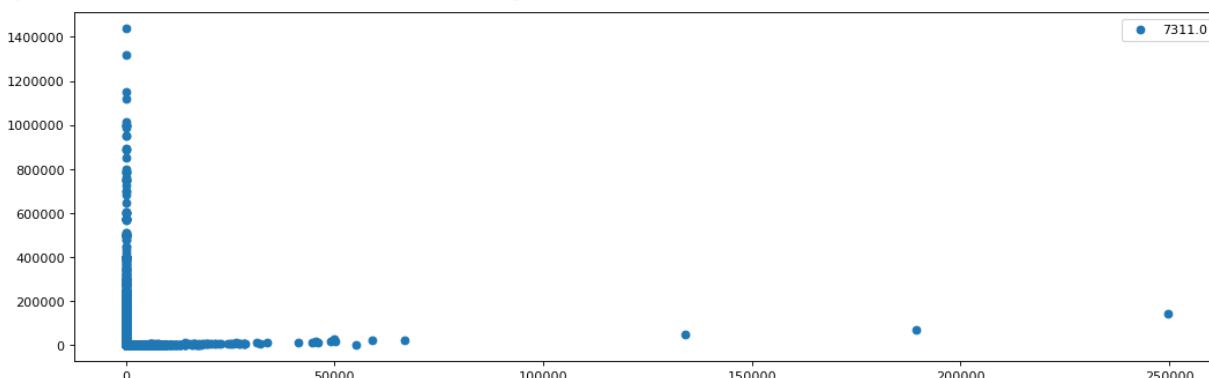


In [213...]

```
df = df_trans[df_trans['externalParty.transactionCategory'] == 'OTHER']
top_mcc = df['externalParty.merchantCategoryCode'].value_counts() #41336
print(top_mcc.head(10))
#ax = figure(figsize=(16, 5), dpi=80).add_subplot()
for mcc in dict(top_mcc.head(10)):
    df = df.drop(df[df['externalParty.merchantCategoryCode'] == mcc].index)
figure(figsize=(16, 5), dpi=80)
plt.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount.value'])
df = df[df['transactionFootPrint.carbonEmissionInGrams'] <= 10000]

print(np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'], 1))
plt.legend(loc='best')
#plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
#plt.xticks(rotation=90)
plt.show()
```

```
6011.0      1614
4814.0       195
8398.0       183
8999.0       153
4900.0       112
9402.0        79
9399.0        72
6012.0        72
8220.0        70
7311.0        70
Name: externalParty.merchantCategoryCode, dtype: int64
[-2.73187572e-04  4.25899759e+01]
```



In [211...]

```
df_trans[(df_trans['externalParty.transactionCategory'] == 'OTHER') & (df_trans['amount.value'] > 10000)]
```

Out [211...]

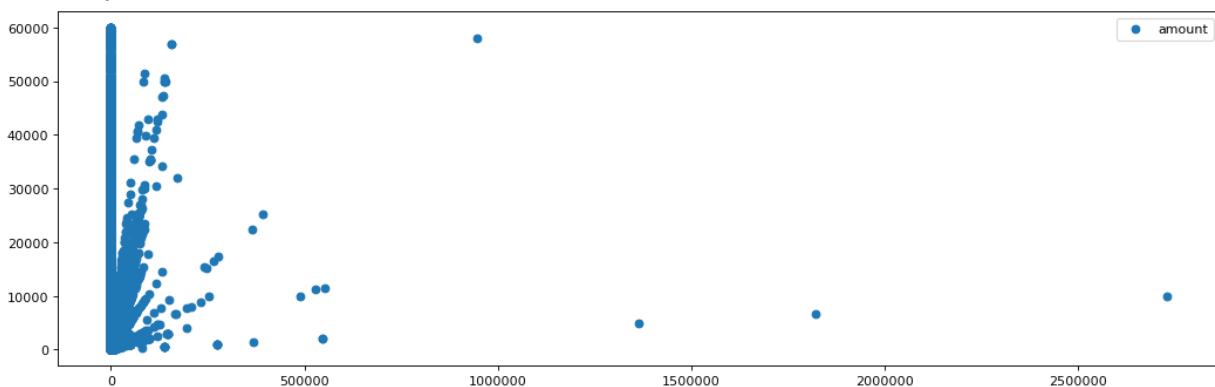
	_id	accountId	customerId
0	6184758b97f95307088aea85	6178590764f48e00089a06ac	3253926e-9c0d-4fd9-8248-eb7c2f457b99
5	6187ed7b97f9530708cf6042	6178590764f48e00089a06ac	3253926e-9c0d-4fd9-8248-eb7c2f457b99
3080	62228a90f8ed260011324f8e	620a5a68ebacb80011deda94	e31a7e0-c83a-4f5d-a461-061ec98ba0a6

	<u>_id</u>	<u>accountId</u>	<u>customerId</u>
3284	6225e36ce566ff91673afdf1	620a5a68ebacb80011deda94	2e31a7e0-c83a-4f5d-a461-061ec98ba0a6 1
3287	6225e5c6e566ff91673b3679	620a5a68ebacb80011deda94	2e31a7e0-c83a-4f5d-a461-061ec98ba0a6
...
62151	62e277b69e67676e2e1b8c49	628498e5f2bc4c00113c3e99	b4e6a655-0586-46c6-8c6e-9bfc1d91d940 1
62156	62e27adb9e67676e2e1bd4ef	628d0436755d000011e9988a	e0489c24-35d2-402a-a794-38d9e5dfa812 1
62162	62e2827a9e67676e2e1c861d	628e4b5d9effed0011312e66	565fb0a0-27c8-493e-9468-b3176e814efe 1
62165	62e283819e67676e2e1ca018	624c2d30832f7100114cdf52	a6b9ad7d-5434-48d9-b564-cfdc16405039 1
62166	62e283ae9e67676e2e1ca420	628953b4823336001190951d	0e798a9e-4bb9-47be-a7b7-f895beafaca1

In [134]:

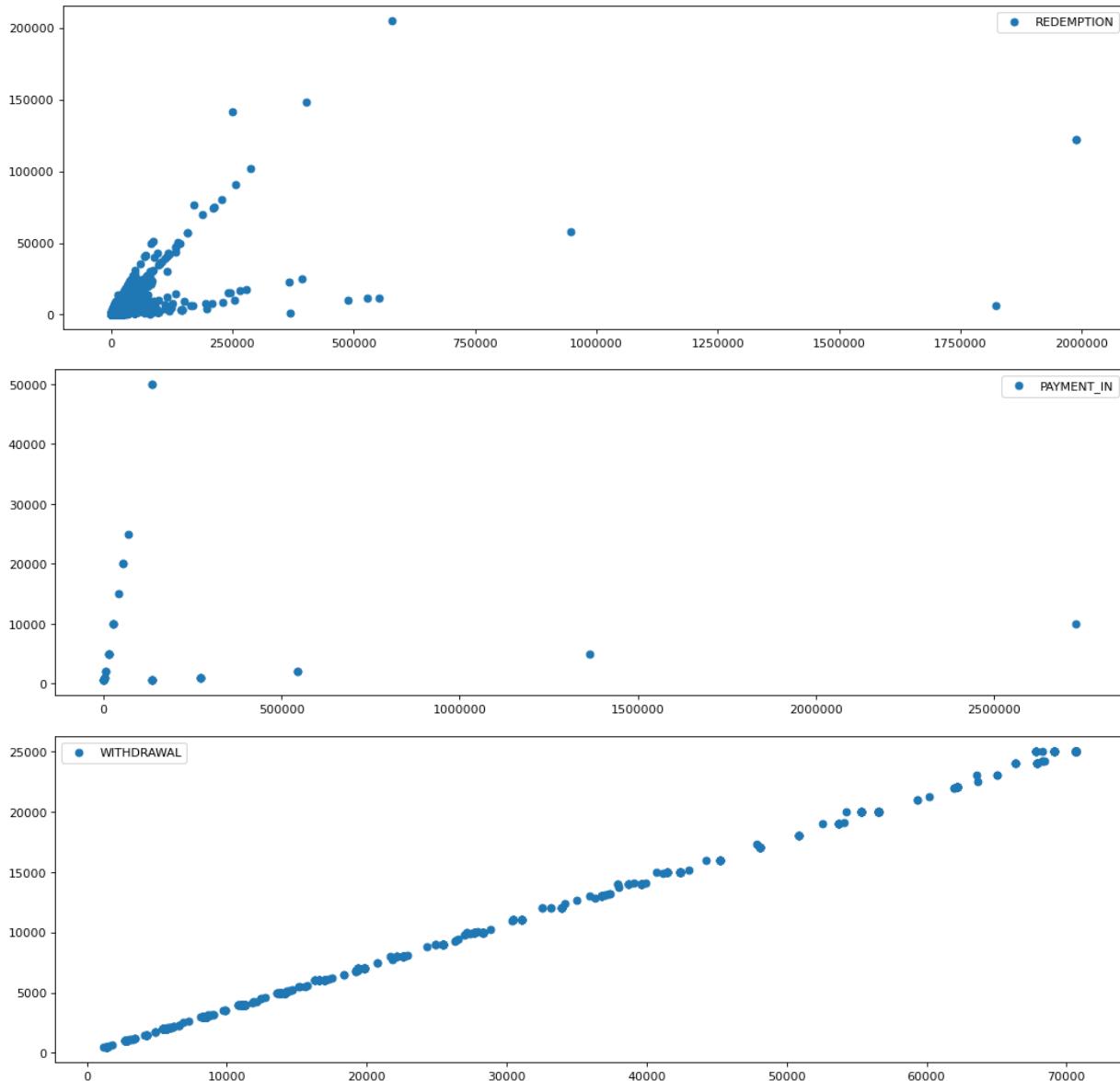
```
figure(figsize=(16, 5), dpi=80)
#df = df_trans[df_trans['transactionFootPrint.carbonEmissionInGrams'] <= 6000]
df = df_trans[df_trans['amount.value'] < 60000]
print(df_trans.shape)
print(df.shape)
plt.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount.value'])
plt.legend(loc='best')
#plt.title('Clustering Coefficient')
plt.ticklabel_format(style='plain')
#plt.xticks(rotation=90)
plt.show()
```

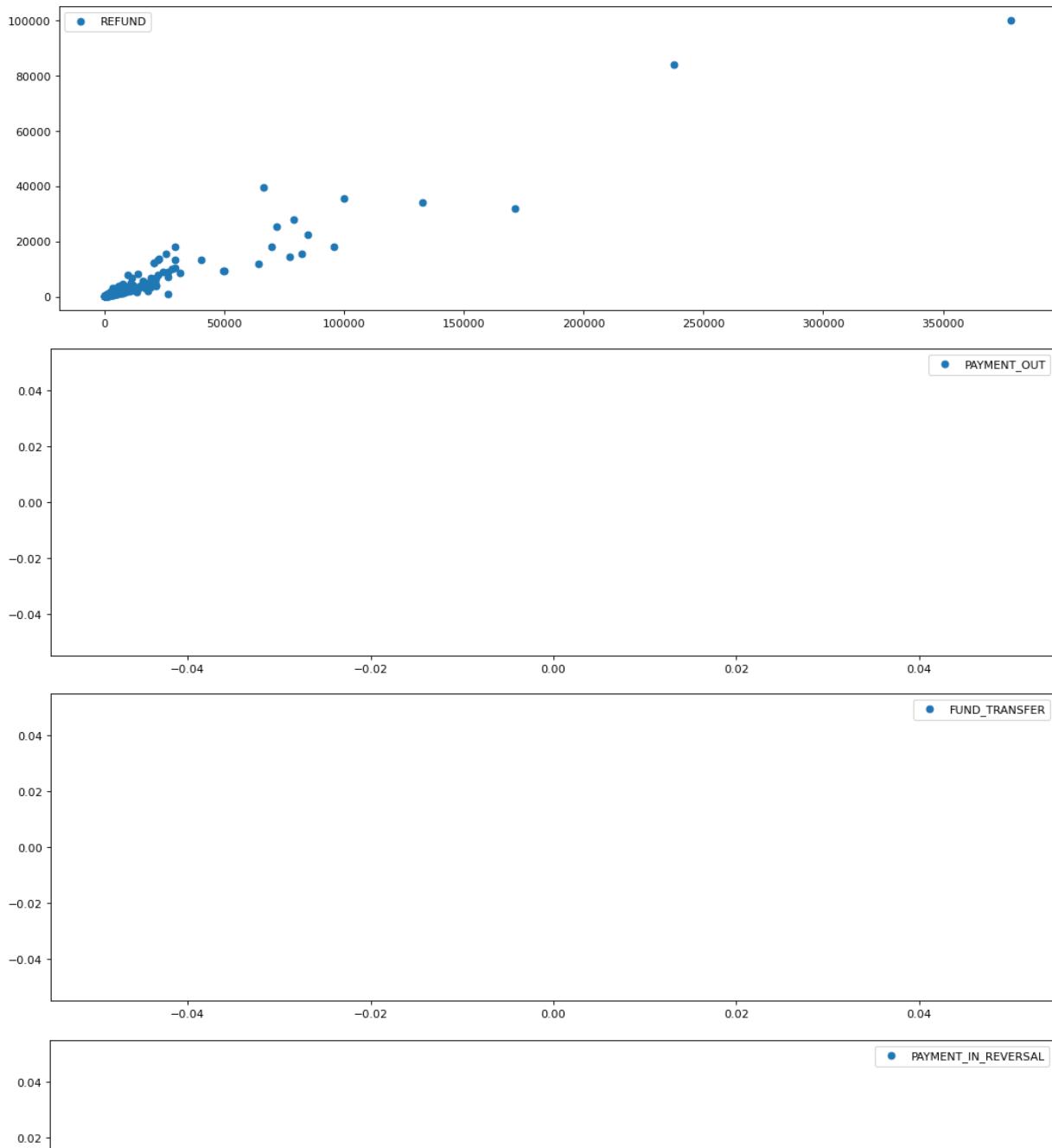
(62167, 12)
(59208, 12)



In [287]:

```
#df = df_trans[df_trans['transactionFootPrint.carbonEmissionInGrams'] > 0]
trans_type = pd.Series(df_trans['transactionType.code']).unique()
for trans_ty in trans_type:
    figure(figsize=(16, 5), dpi=80)
    df = df_trans[(df_trans['transactionType.code'] == trans_ty) & (df_trans['transactionFootPrint.carbonEmissionInGrams'] > 0)]
    plt.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount'])
    plt.legend(loc='best')
    #plt.title('Clustering Coefficient')
    plt.ticklabel_format(style='plain')
    #plt.xticks(rotation=90)
    plt.show()
df_trans['transactionType.code'].value_counts()
```



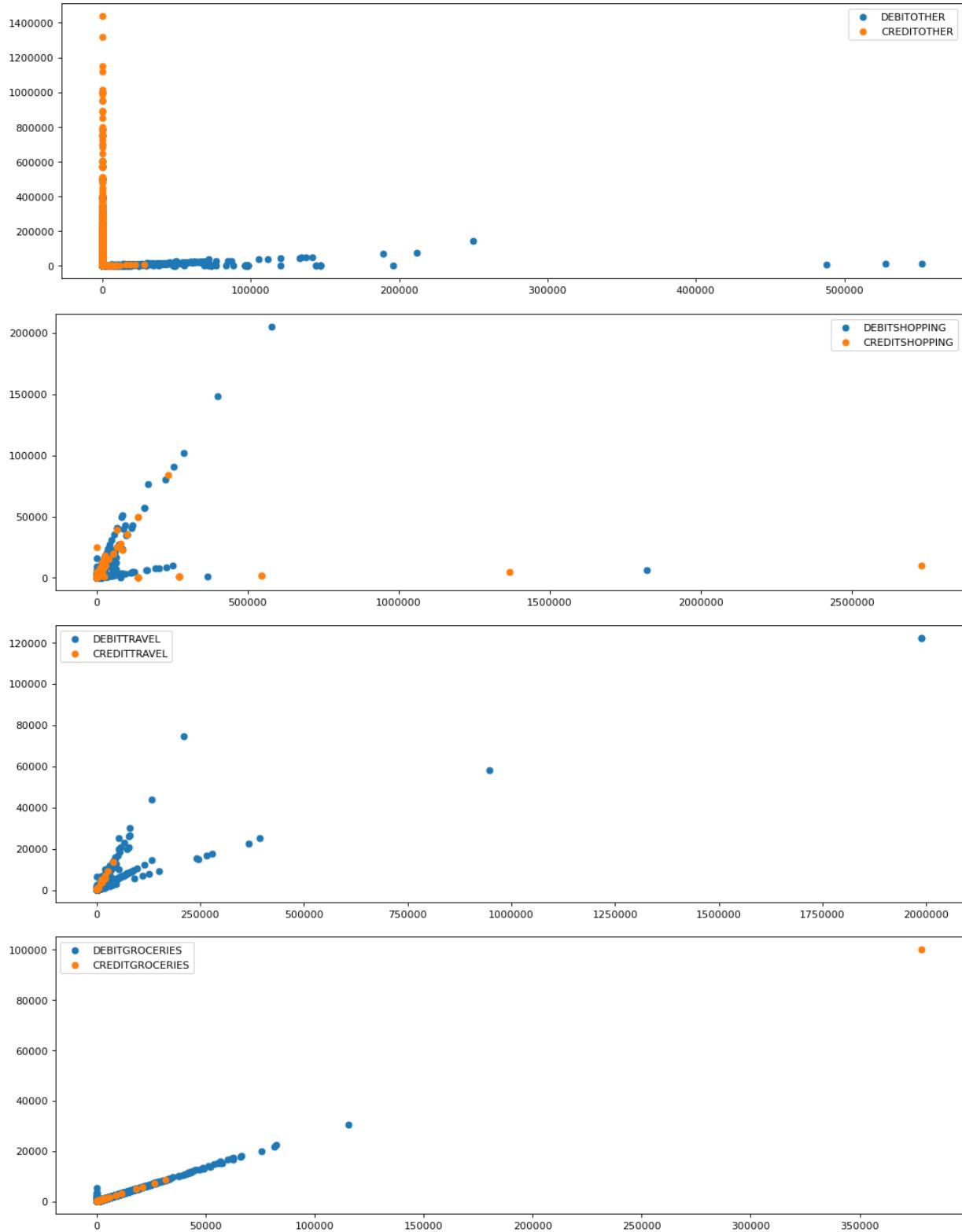


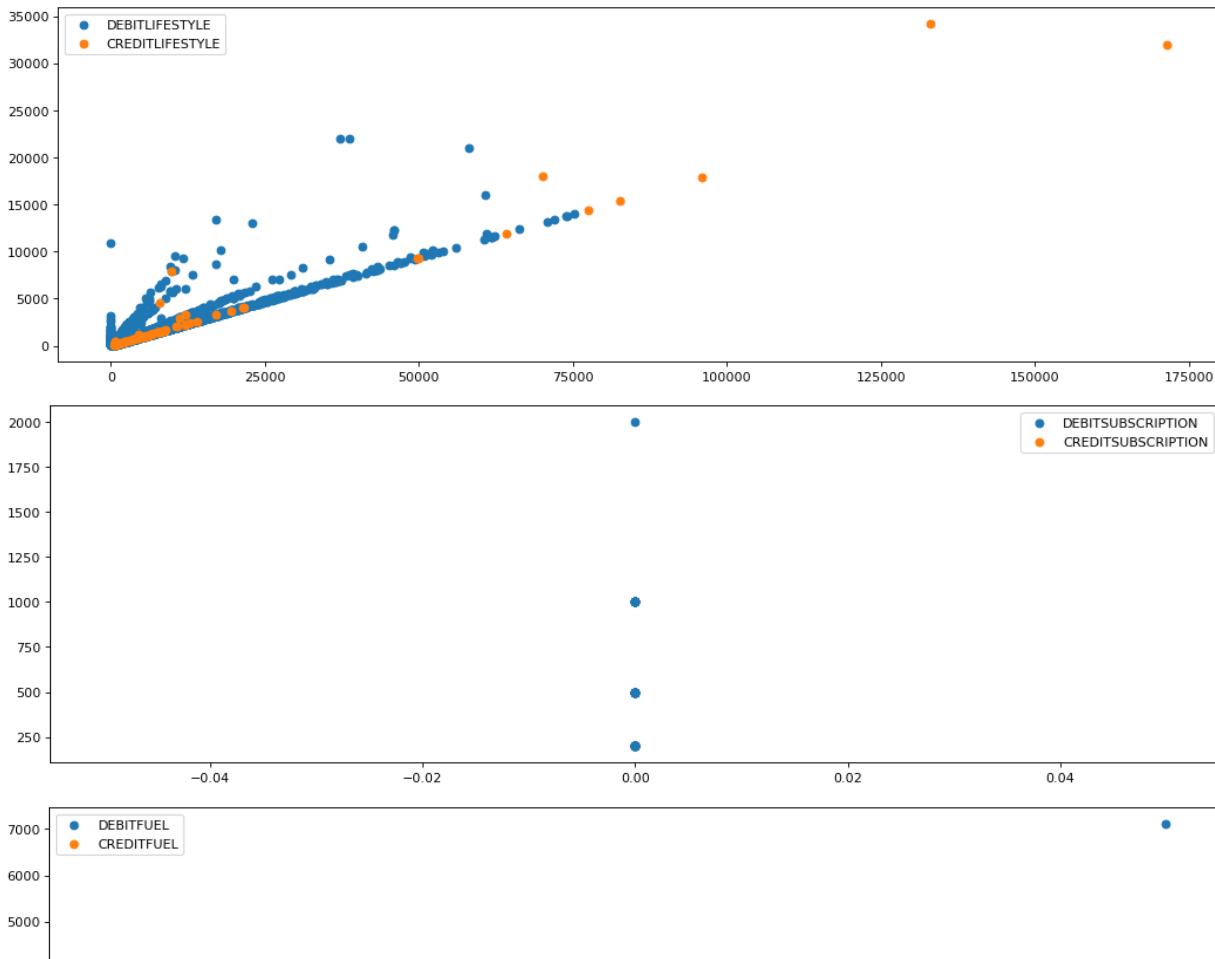
In [13]:

```
trans_dir = pd.Series(df_trans['transactionType.direction']).unique()
df = df_trans[df_trans['externalParty.transactionCategory'] == 'OTHER']

for cat in cat_list[:-1]:
    ax = figure(figsize=(16, 5), dpi=80).add_subplot()
    for dirc in trans_dir:
        df = df_trans[(df_trans['transactionType.direction'] == dirc) & (df_trans['transactionFootPrint.carbonEmissionInGrams'] > 0)]
        ax.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount'], c=df['amount'])
    plt.legend(loc='best')
    #plt.title('Clustering Coefficient')
    plt.ticklabel_format(style='plain')
    #plt.xticks(rotation=90)
    plt.show()

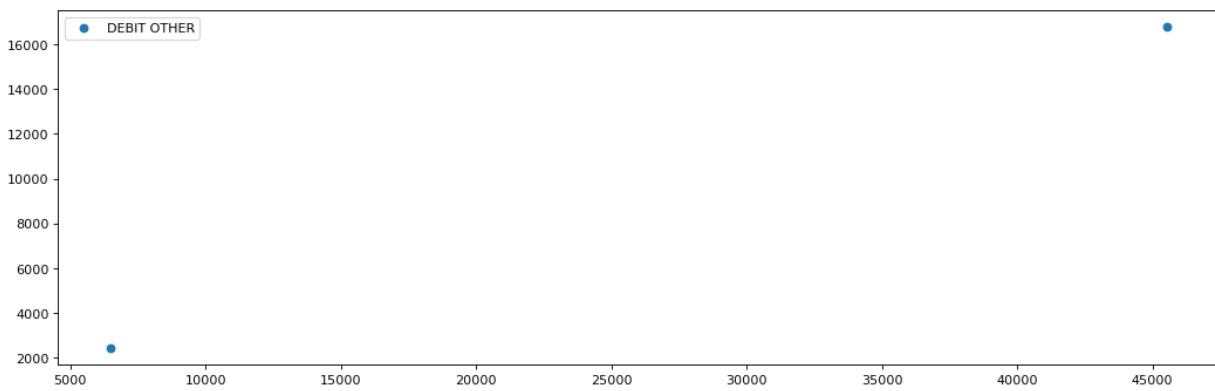
df_trans['transactionType.direction'].value_counts()
```

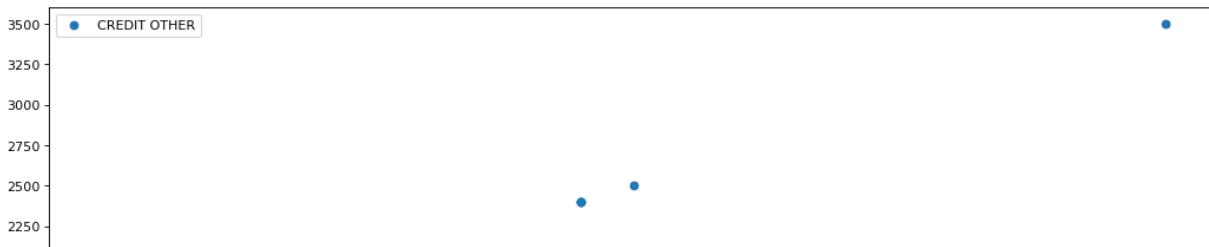




In [25]:

```
for dirc in trans_dir:
    figure(figsize=(16, 5), dpi=80)
    df = df_trans[(df_trans['transactionType.direction'] == dirc) & (df_trans['externalParty.merchantCategoryCode'] == 5965)]
    plt.scatter(df['transactionFootPrint.carbonEmissionInGrams'], df['amount'])
    plt.legend(loc='best')
    #plt.title('Clustering Coefficient')
    plt.ticklabel_format(style='plain')
    #plt.xticks(rotation=90)
    plt.show()
```





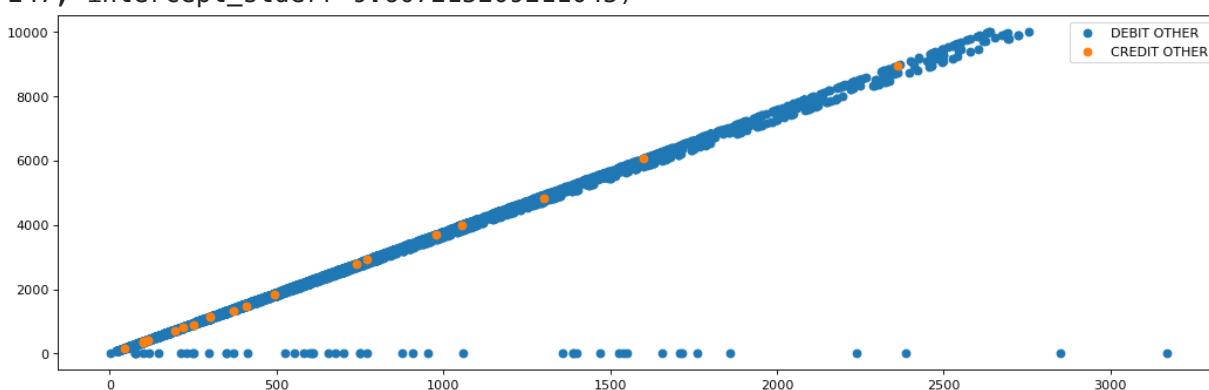
```
In [26]: df_trans[(df_trans['transactionType.code'] == 'REDEMPTION') & (df_trans['exte
```

```
Out[26]: 4814.0    194  
8398.0    182  
8999.0    152  
4900.0    112  
9402.0     79  
...  
1799.0      1  
7349.0      1  
8734.0      1  
8675.0      1  
7221.0      1
```

Name: externalParty.merchantCategoryCode, Length: 64, dtype: int64

```
In [105... ax = figure(figsize=(16, 5), dpi=80).add_subplot()  
#for trans_ty in ['REDEMPTION', 'REFUND']:  
for dirc in trans_dir:  
    df = df_trans[(df_trans['transactionType.direction'] == dirc) & (df_trans['transactionFootPrint.carbonEmissionInGrams'] <= 10000)]  
    df.dropna()  
    ax.scatter(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'])  
    fit = stats.linregress(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams'])  
    print(fit)  
plt.legend(loc='best')  
#plt.title('Clustering Coefficient')  
plt.ticklabel_format(style='plain')  
#plt.xticks(rotation=90)  
plt.show()
```

```
LinregressResult(slope=3.6281188654733674, intercept=33.84670572388313, rvalue=0.97425210716869, pvalue=0.0, stderr=0.013136699766246712, intercept_stderr=11.879525115099446)  
LinregressResult(slope=3.7829315375215193, intercept=-16.3700989445897, rvalue=0.9999168329764553, pvalue=1.8070717330719503e-35, stderr=0.011500319257730247, intercept_stderr=9.607215209211045)
```



In [103]:

```
import math
from sklearn.linear_model import LinearRegression

reg = LinearRegression().fit(df['transactionFootPrint.carbonEmissionInGrams'])

print(reg)
for num in list_1:
    list_3.append(math.sqrt(num))

fit = stats.linregress(df['amount.value'], df['transactionFootPrint.carbonEmi
print(fit)
np.polyfit(df['amount.value'], df['transactionFootPrint.carbonEmissionInGrams
#fit = stats.linregress([1,2,3,4], [1,2,3,4])
#fit
```

```
LinearRegression()
LinregressResult(slope=3.7829315375215193, intercept=-16.3700989445897, rvalu
e=0.9999168329764553, pvalue=1.8070717330719503e-35, stderr=0.011500319257730
247, intercept_stderr=9.607215209211045)
array([ 3.78293154, -16.37009894])
```

Out[103]:

In [59]:

```
df_test = df_trans.groupby(['transactionType.code', 'externalParty.merchantCa
df_test = df_test.to_frame(name = 'size').reset_index()
#len(pd.Series(df_test['externalParty.merchantCategoryCode']).unique()) # 213
print(df_test[df_test['externalParty.merchantCategoryCode'] == 5211])
df_test[df_test.duplicated(subset='externalParty.merchantCategoryCode')]
```

	transactionType.code	externalParty.merchantCategoryCode	size
57	REDEMPTION		5211.0 19
217	REFUND		5211.0 1

Out[59]:

	transactionType.code	externalParty.merchantCategoryCode	size
211	REFUND		4111.0 2
212	REFUND		4112.0 7
213	REFUND		4121.0 5
214	REFUND		4215.0 1
215	REFUND		4814.0 1
216	REFUND		5045.0 1
217	REFUND		5211.0 1
218	REFUND		5310.0 4
219	REFUND		5311.0 12
220	REFUND		5399.0 4
221	REFUND		5411.0 27
222	REFUND		5451.0 5
223	REFUND		5499.0 4
224	REFUND		5611.0 1
225	REFUND		5621.0 6

	transactionType.code	externalParty.merchantCategoryCode	size
226	REFUND	5651.0	6
227	REFUND	5655.0	1
228	REFUND	5661.0	1
229	REFUND	5691.0	8
230	REFUND	5719.0	1
231	REFUND	5732.0	2
232	REFUND	5734.0	3
233	REFUND	5735.0	4
234	REFUND	5812.0	35
235	REFUND	5813.0	4
236	REFUND	5814.0	23
237	REFUND	5817.0	3
238	REFUND	5912.0	4
239	REFUND	5941.0	3
240	REFUND	5944.0	1
241	REFUND	5947.0	1
242	REFUND	5965.0	7
243	REFUND	5968.0	1
244	REFUND	5969.0	1
245	REFUND	5983.0	3
246	REFUND	5992.0	1
247	REFUND	5994.0	1
248	REFUND	5999.0	8
249	REFUND	6012.0	1
250	REFUND	6300.0	3
252	REFUND	7011.0	2
253	REFUND	7230.0	4
254	REFUND	7278.0	1
255	REFUND	7298.0	1
256	REFUND	7311.0	1
257	REFUND	7372.0	1
258	REFUND	7399.0	2
259	REFUND	7538.0	1
260	REFUND	7994.0	2
261	REFUND	7997.0	1

	transactionType.code	externalParty.merchantCategoryCode	size
262	REFUND	7999.0	1
263	REFUND	8099.0	1
264	REFUND	8220.0	1
--	--	--	--

In [40]:	pd.Series(df_trans['externalParty.merchantCategoryCode']).unique()
----------	--

Out[40]:	array([8398., 6532., 7399., 5712., 5940., 5399., 7221., 5732., 7922., 5411., 5541., 4111., 6011., 5812., 5999., 5912., 5977., 5651., 7230., 5969., 5261., 5422., 5331., 5462., 5945., 5813., 4112., 5814., 5811., 4121., 7929., 7523., 5714., 5499., nan, 5921., 5965., 5311., 5970., 5699., 5942., 5944., 9402., 5947., 5441., 8999., 5251., 5734., 5309., 5994., 5310., 5941., 5044., 5691., 5661., 5968., 5735., 4215., 8062., 5817., 6012., 8641., 5971., 7999., 7011., 8021., 7997., 5621., 5200., 5943., 5641., 8299., 5992., 7216., 7542., 5211., 8699., 4722., 5631., 3509., 8220., 5655., 3245., 7278., 7032., 5995., 8043., 3811., 6513., 5192., 5199., 5816., 3615., 7994., 5818., 4789., 4900., 5111., 7941., 5967., 5815., 4899., 4131., 5169., 7033., 9399., 5719., 5451., 5946., 7996., 4511., 7991., 7311., 7832., 4814., 5993., 5611., 5521., 7549., 7395., 742., 3246., 7299., 7932., 5931., 3294., 5948., 8099., 5231., 6300., 5193., 4214., 8661., 7333., 5533., 8675., 5733., 4816., 7372., 8734., 7992., 5045., 5964., 7321., 4784., 7538., 3005., 780., 7349., 7993., 3029., 7622., 5047., 3504., 5932., 5599., 7392., 5949., 8111., 5099., 9222., 4812., 5713., 7394., 1799., 5698., 7699., 7298., 7210., 5065., 7211., 5933., 5137., 8351., 7998., 3503., 5172., 5997., 7631., 5722., 7933., 8041., 3640., 3043., 7379., 3548., 5983., 5039., 7519., 6211., 5511., 7512., 3389., 5198., 4458., 4821., 1711., 5697., 7641., 5139., 3026., 7829., 5046., 9311., 7911., 5973., 4011., 1520., 7531., 6533., 7251., 5300., 4582., 5532.])
----------	---

In [727]:	#df_users = df_users.rename(columns={"_id": "customerId"}, errors="raise") df_users['createdAt'] = pd.to_datetime(df_users['createdAt']) df_trans['createdAt'] = pd.to_datetime(df_trans['createdAt']) df = pd.merge(df_trans, df_users, on='customerId', how='inner') #for uid in top_users: # df = df.drop(df[df['customerId'] == uid].index, inplace=False) df.head(10)
-----------	---

	_id	accountId	customerId	create
0	6184758b97f95307088aea85	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-2021-00:06:35.175000+0000
1	6186865597f9530708b3c553	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-2021-13:42:45.390000+0000
2	6187ed7b97f9530708cf6042	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-2021-15:15:07.865000+0000

	<u>_id</u>		<u>accountId</u>	<u>customerId</u>	<u>create</u>
3	6188ce1e97f9530708e0a386	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-	2021-07:13:34.264000+
4	618bd2bb97f95307081c387c	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-	2021-14:10:03.063000+
5	618cd67297f9530708303d35	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-	2021-08:38:10.464000+
6	618d151d0e663c0011e25a08	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-	2021-13:05:33.041000+
7	618d1c1d9fc7c800121f8c53	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-	2021-13:35:25.108000+
8	619a57fe97f95307083a6765	6178590764f48e00089a06ac	9c0d-4fd9-8248-eb7c2f457b99	3253926e-	2021-14:30:22.214000+

In [567]:

df_users.dtypes

```
Out[567]:
```

customerId	object
address.country	object
address.postcode	object
address.townOrCity	object
createdAt	object
dateOfBirth	float64
nationality	object
dtype:	object

In [23]:

df_trans['customerId'].value_counts().mean() # 139 16

Out[23]:

16.520595269731597

In [24]:

len(pd.Series(df_trans['customerId']).unique())

Out[24]:

3763

In [12]:

df_users['dateOfBirth'].value_counts(bins=4) #11956 12988

Out[12]:

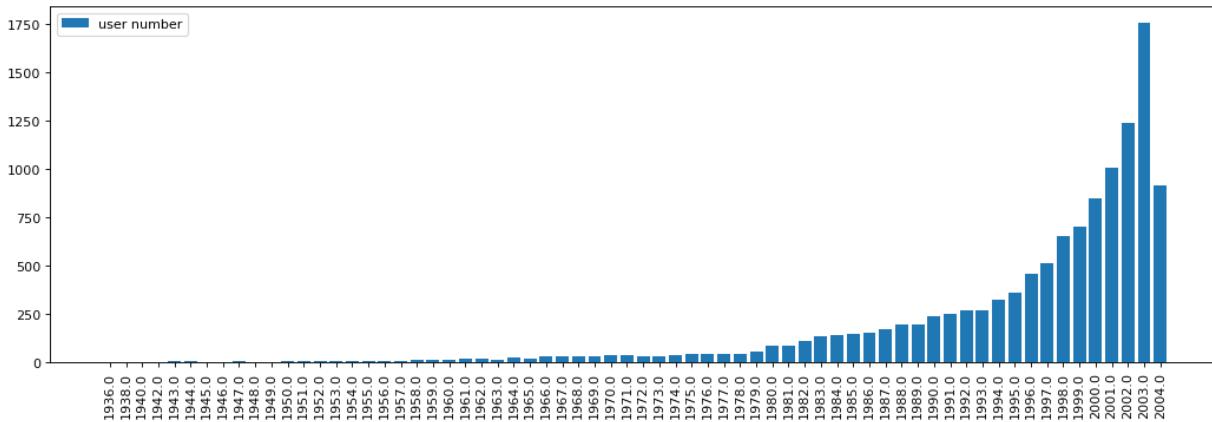
(1987.0, 2004.0]	10184
(1970.0, 1987.0]	1401
(1953.0, 1970.0]	317
(1935.931, 1953.0]	54
Name: dateOfBirth, dtype:	int64

In [3]:

```
#df.shape # outer 71392 inner 62167 -> have all customer info 12988 user
age_group = df['dateOfBirth'].value_counts()
age_group = dict(age_group)
age_group = collections.OrderedDict(sorted(age_group.items()))
figure(figsize=(16, 5), dpi=80)

plt.bar(range(len(age_group)), list(age_group.values()), align='center', label='user number')
plt.xticks(range(len(age_group)), list(age_group.keys()), rotation=90)

plt.legend(loc='best')
plt.show()
```

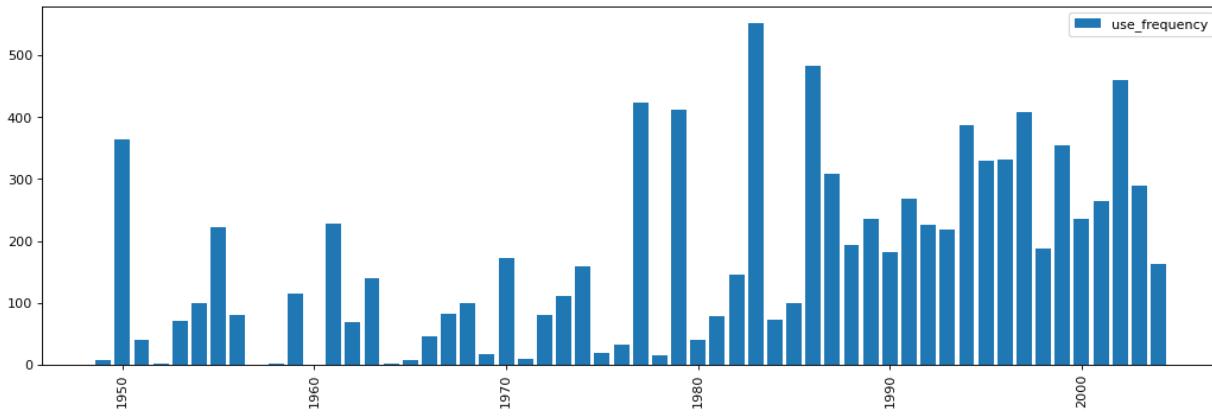


In [572...]

```
user_frequency = df['customerId'].value_counts()
user_frequency = dict(user_frequency)
year = []
for freq in user_frequency:
    year.append(df.loc[df['customerId'] == freq, 'dateOfBirth'].iloc[0])

figure(figsize=(16, 5), dpi=80)
plt.bar(year, list(user_frequency.values()), align='center', label='use_frequency')
plt.xticks(rotation=90)

plt.legend(loc='best')
plt.show()
```



In [438...]

```
#df.groupby('dateOfBirth').size()
```

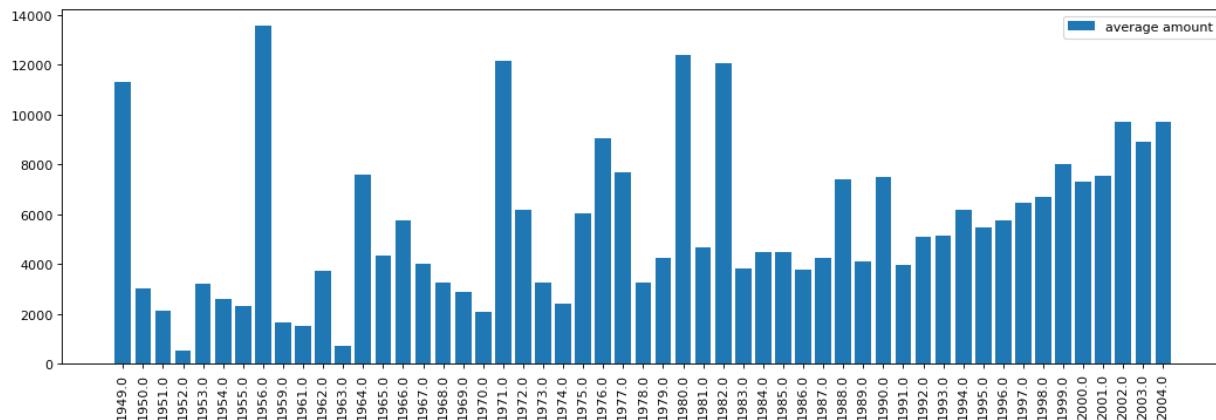
```
Out[438]:
```

2003.0	6921
2002.0	5382
2001.0	4270
2000.0	4094
1998.0	4045
1999.0	3679
1997.0	3654
1996.0	3202
1995.0	2481
1992.0	1958
2004.0	1920
1993.0	1817
1994.0	1698
1986.0	1517
1989.0	1511
1987.0	1353
1991.0	1298
1988.0	1214
1990.0	966
1983.0	914
1985.0	812
1982.0	726
1984.0	643
1977.0	560
1981.0	494
1979.0	460
1970.0	395
1950.0	365
1974.0	339
1973.0	300
1961.0	289
1955.0	242
1980.0	210
1968.0	188
1963.0	153
1976.0	151
1967.0	146
1959.0	143
1972.0	126
1962.0	120
1956.0	110
1954.0	102
1975.0	86
1966.0	83
1971.0	73
1953.0	71
1951.0	51
1969.0	40
1978.0	31
1965.0	30
1949.0	8
1964.0	4
1958.0	3
1952.0	2

Name: dateOfBirth, dtype: int64

In [503...]

```
amount_by_year = df.groupby('dateOfBirth')['amount.value'].mean()
#df['customerId'].value_counts().mode() # mean 16, median 6, mode 2, std 37.3
amount_by_year = dict(amount_by_year)
amount_by_year.pop(1958.0)
draw_dict(amount_by_year, 'average amount')
```

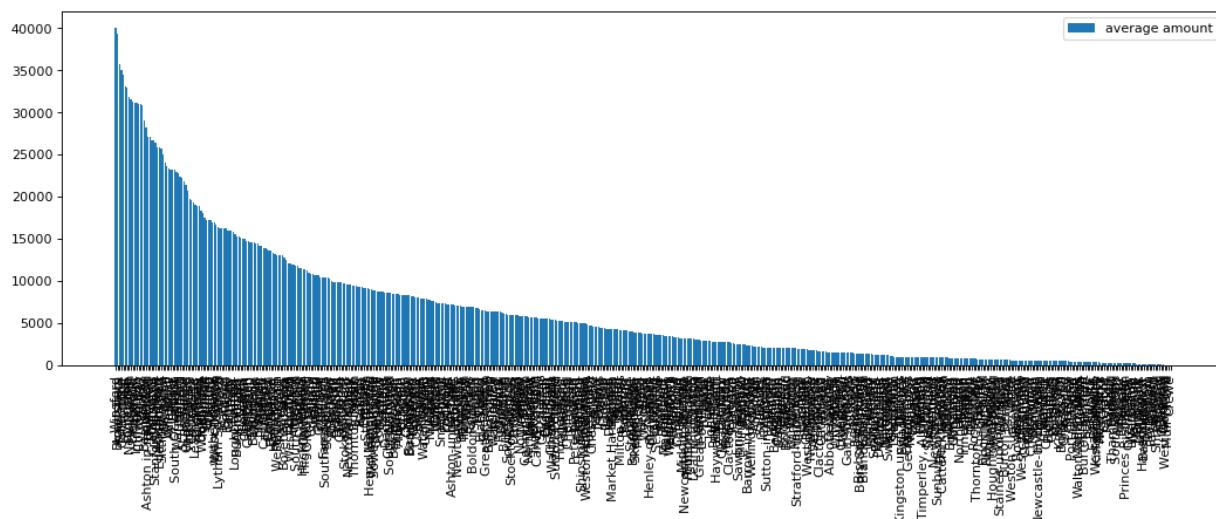


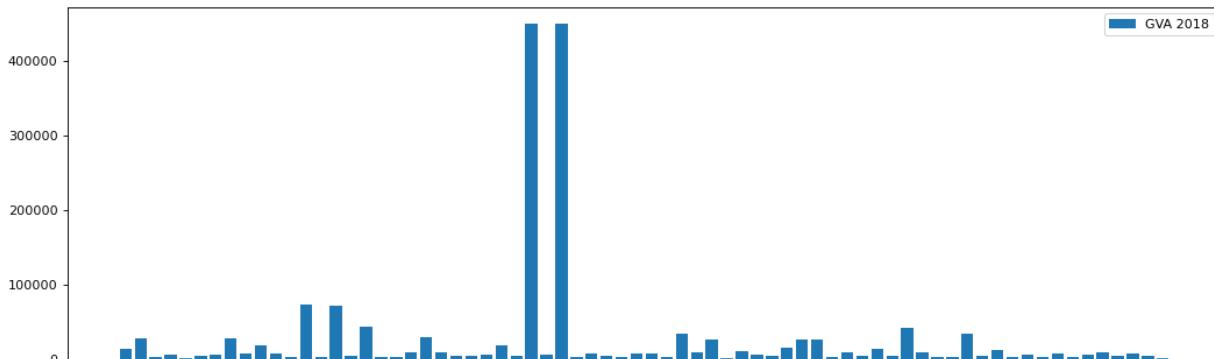
In [562...]

```
# address
#data_file_GVA = "/Users/Chao/Downloads/regionalgrossdomesticproductgdpcityre
#df_GVA = pd.read_excel(data_file_GVA, sheet_name='gva')

town_group = df.groupby('address.townOrCity')['amount.value'].mean().sort_val
#town_group = df.groupby('address.townOrCity')['amount.value'].mean()
town_group = dict(town_group)
gva_group = {}
for town in town_group:
    if list(df_GVA.loc[df_GVA['Area name'].str.contains(town, na=False), '201
        gva_group[town] = list(df_GVA.loc[df_GVA['Area name'].str.contains(to

draw_dict(town_group, 'average amount')
draw_dict(gva_group, 'GVA 2018')
```





In [657...]

```
print(df_trans['amount.value'].mean())
print(df_trans['amount.value'].mode())
print(df_trans['amount.value'].std())
print(df['amount.value'].mean())
print(df['amount.value'].mode())
print(df['amount.value'].std())

print(10798 + 35686)
top_users = dict(df.groupby('customerId')['amount.value'].mean().sort_values()
top_users
```

```
10798.588978075184
0    1000
dtype: int64
35686.24550617364
10798.588978075184
0    1000
dtype: int64
35686.24550617318
46484
```

Out[657...]

```
{'a837dbed-7257-4f6e-8191-9039a701d3c2': 785544.0,
 'ce039da2-61fd-4f52-9d8a-d2f857b685e5': 746666.666666666666,
 'ad09ed7b-7f8d-4835-9905-a937b0b12ab6': 744476.5,
 '90ddd7d0-f83e-46bf-8470-b14cc7d2055f': 500166.6666666667,
 'f9232864-c430-4da2-8bad-018616977c3b': 450000.0,
 '0621273e-3816-422f-a7ef-69cdea6f741d': 447550.0,
 'f96b57b9-be29-4038-ad6b-b04d6ec9d5b8': 402001.8333333333,
 '8e733c96-60a7-4cf0-a7ce-4befaf280613': 377525.0,
 '717842a0-95c0-4df4-bc4a-42b961e0117b': 372704.0,
 'c3dc3f9a-9e96-457c-9c0a-dff8c623caa8': 332500.0,
 'e455a61b-f117-4b97-b763-5f18f6165952': 308600.0,
 '8d856b48-2457-4066-bdf6-80dafcbee555': 286209.0,
 '1dc537f1-910e-4ef5-a391-1da3a81c2453': 280562.5,
 '320e9d4f-adee-4baa-bc53-0edd2799bd06': 266533.3333333333,
 '8537bc3f-829c-4dc4-a643-464f52b72ce2': 261991.6,
 'af1df29e-a19f-4f1d-9bed-62b525419eba': 245888.53846153847,
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```

In [658]:

```
df_trans.groupby('customerId')['amount.value'].mean().sort_values(ascending=False)
```

Out[658]:

customerId	amount.value
a837dbed-7257-4f6e-8191-9039a701d3c2	785544.000000
ce039da2-61fd-4f52-9d8a-d2f857b685e5	746666.666667
ad09ed7b-7f8d-4835-9905-a937b0b12ab6	744476.500000
90ddd7d0-f83e-46bf-8470-b14cc7d2055f	500166.666667
f9232864-c430-4da2-8bad-018616977c3b	450000.000000

```
b6ea4b34-3bb2-4b9e-b0af-70ead3af2813      ...
a35fa169-e0fd-4376-830c-dc77b3fce70b      1.000000
389ca924-a93b-4184-a43c-2c23a5dec7f5      1.000000
10e3bb59-6b47-4fe9-b729-c0a9dda34cd7      1.000000
29ecab60-957a-41ee-aab1-0c3f84a8a4b2      1.000000
Name: amount.value, length: 3763, dtype: float64
```

```
In [659]: df_trans.groupby('externalParty.transactionCategory')['amount.value'].mean()
```

```
Out[659]: externalParty.transactionCategory
OTHER           15352.643047
SHOPPING        2590.887546
FUEL            2231.300000
TRAVEL          1320.843705
LIFESTYLE        1289.568817
GROCERIES       968.574165
SUBSCRIPTION    437.461538
Name: amount.value, dtype: float64
```

```
In [469]: df.groupby('address.townOrCity')['amount.value'].agg(['mean', 'count']).sort_
```

address.townOrCity	mean	count
Redlodge	746666.666667	3
Bury St. Edmunds	447550.000000	2
Rushden	165318.000000	1
Cradley Heath	117526.419355	31
Halstead	104235.764706	17
Sandbach	94600.000000	6
Camberley	94136.322581	31
Chessington	90118.750000	16
Potters Bar	89673.333333	3
Stamford	84784.285714	35
Lancaster	81675.240000	25
Brackley	80000.000000	2
Saltcoats	70447.666667	6
Askam-in-Furness	67477.722222	18
Prescot	65251.000000	2
Oldbury	64875.000000	4
Hitchin	64193.565217	23
Barton on sea	63585.428571	7
Prestatyn	62865.000000	16
Holyhead	62302.406250	64

	mean	count
address.townOrCity		
Crewe	62270.714286	7
Dunfermline	61495.181818	33
Castleford	60381.312500	32
Hove	59182.000000	11
Oxford	54264.551402	107
Arbroath	53910.555556	9
Newtownards	53682.625000	16
Houghton le Spring	53163.500000	8
Staines-upon-Thames	52717.769231	26
Paisley	51779.052632	19
Honiton	50333.333333	6
Port Talbot	50077.500000	4
Shifnal	48853.833333	18
Rotherham	48501.267606	71
Ammanford	47833.333333	3
Daventry	47822.222222	9
Leven	47106.125000	8
Shrewsbury	45216.294118	17
Margate	44681.000000	13
Mirfield	43973.000000	3
Baldock	42025.000000	4
Aylesbury	41964.080000	25
Willenhall	40918.134328	67
Dewsbury	40429.125000	16
Carmarthen	40427.272727	11
Winsford	40041.142857	7
Broadstairs	39343.333333	3
Alloa	38614.714286	56
Glanford	38470.877778	10

In [113...]

```
# trans every month
df_21_11 = df_trans[(df_trans['createdAt'] > '2021-10-31') & (df_trans['creat
df_21_12 = df_trans[(df_trans['createdAt'] > '2021-11-30') & (df_trans['creat
df_22_1 = df_trans[(df_trans['createdAt'] > '2021-12-31') & (df_trans['create
df_22_2 = df_trans[(df_trans['createdAt'] > '2022-01-31') & (df_trans['create
df_22_3 = df_trans[(df_trans['createdAt'] > '2022-02-28') & (df_trans['create
df_22_4 = df_trans[(df_trans['createdAt'] > '2022-03-31') & (df_trans['create
df_22_5 = df_trans[(df_trans['createdAt'] > '2022-04-30') & (df_trans['create
df_22_6 = df_trans[(df_trans['createdAt'] > '2022-05-31') & (df_trans['create
df_22_7 = df_trans[(df_trans['createdAt'] > '2022-06-30') & (df_trans['create
```

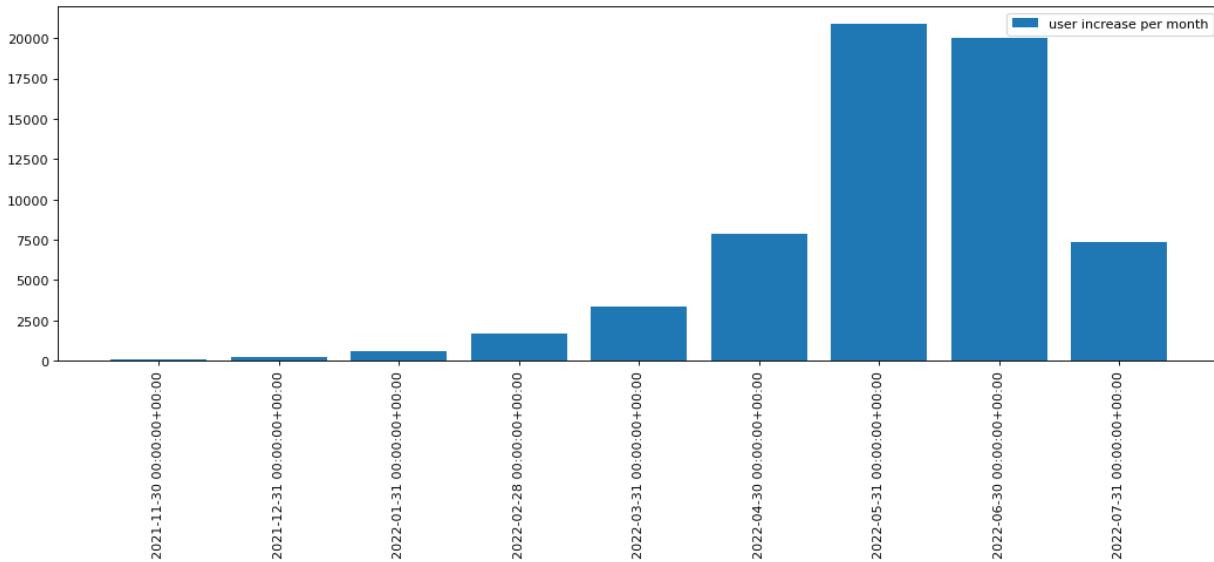
In [114...]

```
trans_month = [df_21_11, df_21_12, df_22_1, df_22_2, df_22_3, df_22_4, df_22_
for month in trans_month:
    print(month.shape)
```

```
(107, 12)
(240, 12)
(582, 12)
(1737, 12)
(3456, 12)
(7981, 12)
(21633, 12)
(20900, 12)
(7832, 12)
```

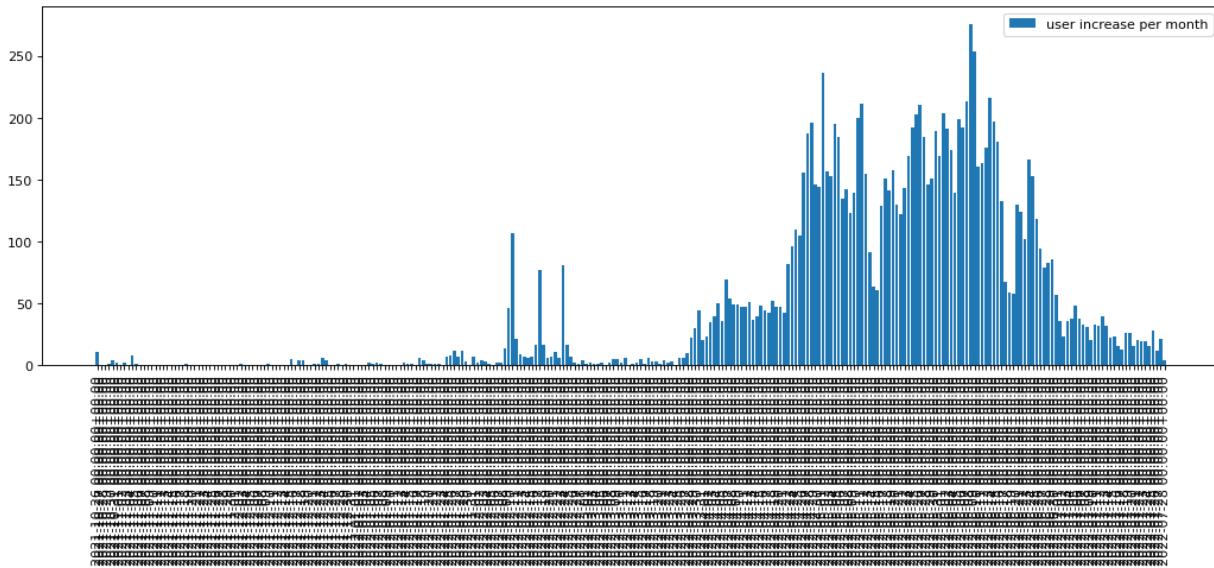
In [730...]

```
trans_increase = df.groupby(pd.Grouper(key='createdAt_x', axis=0, freq='M')).
trans_increase = dict(trans_increase)
draw_dict(trans_increase, 'user increase per month')
```



In [178...]

```
# user number increase
#user_increase = df_trans.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
#user_increase = dict(user_increase)
#draw_dict(user_increase, 'user increase per month')
user_increase = df_users.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
user_increase = dict(user_increase)
draw_dict(user_increase, 'user increase per month')
```



In [654...]

```
# user frequency and create time
user_frequency_time = df.groupby([pd.Grouper(key='createdAt_x', axis=0, freq='M'),
user_frequency_time = pd.DataFrame(user_frequency_time)
```

In [655...]

```
#print(user_frequency_time.groupby('createdAt_y').sum())
user_frequency_month = {9:0, 8:0, 7:0, 6:0, 5:0, 4:0, 3:0, 2:0, 1:0, 0:0}
index = 0
end = 9
for i, row in user_frequency_time.iloc[::-1].iterrows():
    user_frequency_month[index] += row.values[0]
    if index == end:
        index = 0
        end -= 1
    else:
        index += 1
print(user_frequency_month)

user_frequency_time
```

```
{9: 142, 8: 226, 7: 490, 6: 734, 5: 1689, 4: 2016, 3: 3904, 2: 7644, 1: 2143
2, 0: 23890}
```

Out[655...]

createdAt_x	createdAt_y	0
2021-11-30 00:00:00+00:00	2021-10-31 00:00:00+00:00	99
	2021-11-30 00:00:00+00:00	8

		0
	createdAt_x	createdAt_y
	2021-12-31 00:00:00+00:00	2021-10-31 00:00:00+00:00
		154
		2021-11-30 00:00:00+00:00
		56
		2021-12-31 00:00:00+00:00
		25
	2022-01-31 00:00:00+00:00	2021-10-31 00:00:00+00:00
		214
		2021-11-30 00:00:00+00:00
		111
		2021-12-31 00:00:00+00:00
		169
		2022-01-31 00:00:00+00:00
		75
	2022-02-28 00:00:00+00:00	2021-10-31 00:00:00+00:00
		322
		2021-11-30 00:00:00+00:00
		104
		2021-12-31 00:00:00+00:00
		195
		2022-01-31 00:00:00+00:00
		201
		2022-02-28 00:00:00+00:00
		892
	2022-03-31 00:00:00+00:00	2021-10-31 00:00:00+00:00
		308
		2021-11-30 00:00:00+00:00
		181
		2021-12-31 00:00:00+00:00
		205
		2022-01-31 00:00:00+00:00
		396
		2022-02-28 00:00:00+00:00
		2060
		2022-03-31 00:00:00+00:00
		192
	2022-04-30 00:00:00+00:00	2021-10-31 00:00:00+00:00
		193
		2021-11-30 00:00:00+00:00
		190
		2021-12-31 00:00:00+00:00
		176
		2022-01-31 00:00:00+00:00
		313
		2022-02-28 00:00:00+00:00
		1389
		2022-03-31 00:00:00+00:00
		658
		2022-04-30 00:00:00+00:00
		4955
	2022-05-31 00:00:00+00:00	2021-10-31 00:00:00+00:00
		156
		2021-11-30 00:00:00+00:00
		134
		2021-12-31 00:00:00+00:00
		117
		2022-01-31 00:00:00+00:00
		283
		2022-02-28 00:00:00+00:00
		1393
		2022-03-31 00:00:00+00:00
		619
		2022-04-30 00:00:00+00:00
		7531
		2022-05-31 00:00:00+00:00
		10693
	2022-06-30 00:00:00+00:00	2021-10-31 00:00:00+00:00
		126

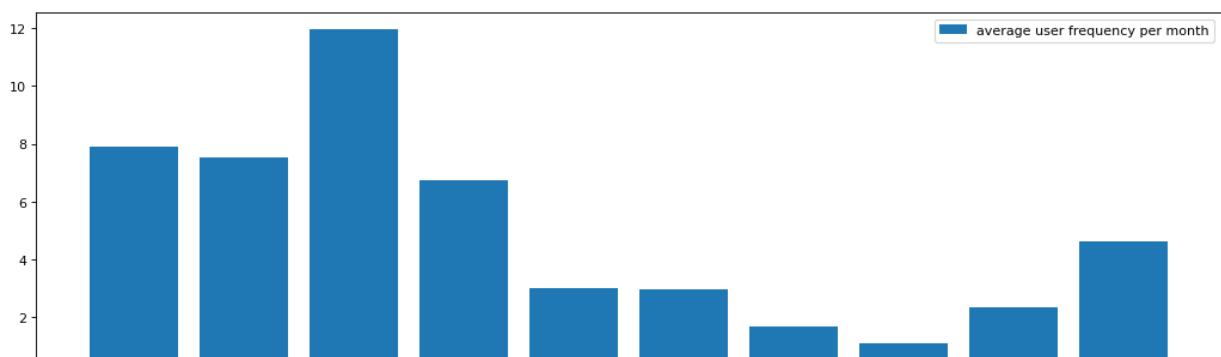
0

createdAt_x	createdAt_y
2021-11-30 00:00:00+00:00	131
2021-12-31 00:00:00+00:00	164
2022-01-31 00:00:00+00:00	248
2022-02-28 00:00:00+00:00	947
2022-03-31 00:00:00+00:00	284
2022-04-30 00:00:00+00:00	3481
2022-05-31 00:00:00+00:00	8184
2022-06-30 00:00:00+00:00	6452
2022-07-31 00:00:00+00:00	2021-10-31 00:00:00+00:00
	142
	2021-11-30 00:00:00+00:00
	100
	2021-12-31 00:00:00+00:00
	203
	2022-01-31 00:00:00+00:00
	243
	2022-02-28 00:00:00+00:00
	826
	2022-03-31 00:00:00+00:00
	107

In [656]:

```
users_month = []
pre = 0
for num in user_increase.values():
    users_month.append(num + pre)
    pre = num

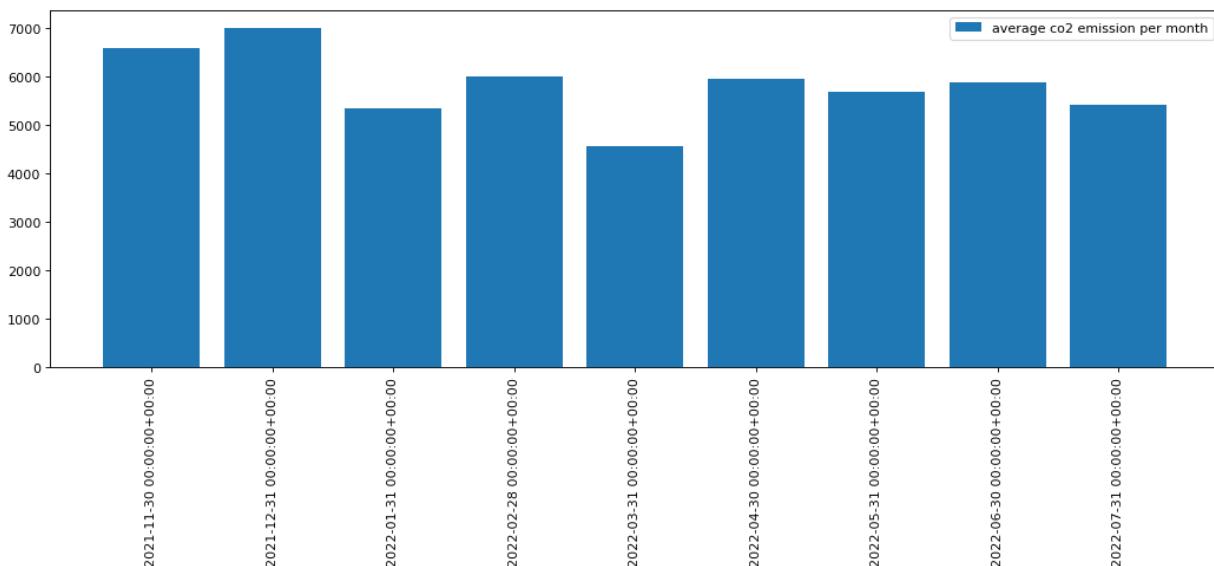
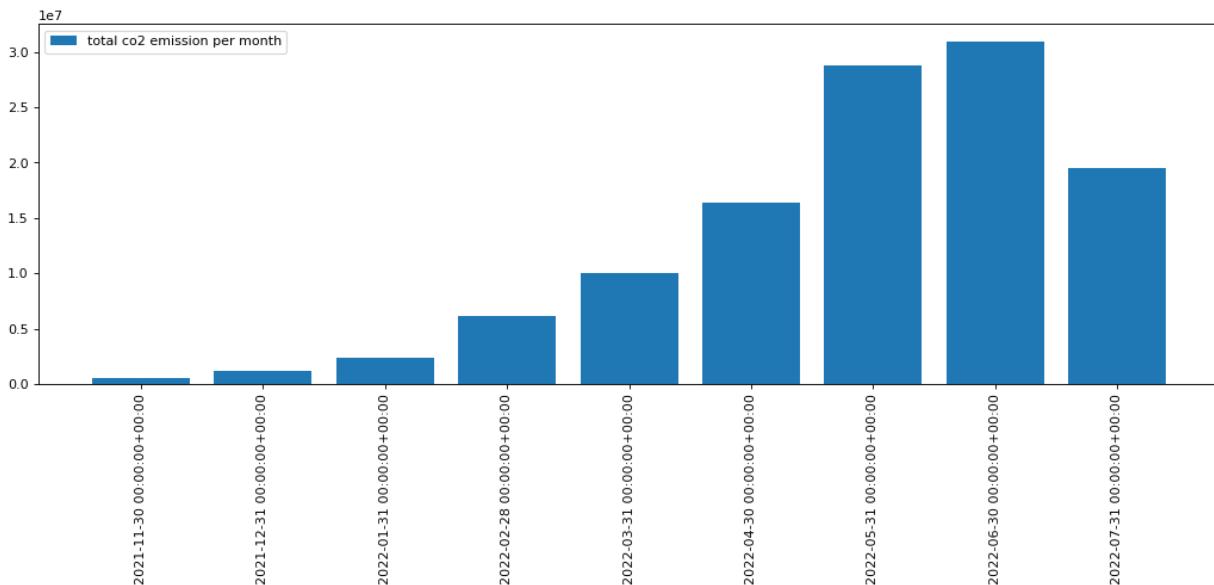
user_frequency_month_avg = {9:0, 8:0, 7:0, 6:0, 5:0, 4:0, 3:0, 2:0, 1:0, 0:0}
for i, month in enumerate(user_frequency_month):
    user_frequency_month_avg[month] = user_frequency_month[month] / users_month[i]
draw_dict(user_frequency_month_avg, 'average user frequency per month')
print(users_month)
```



```
[18, 30, 41, 109, 564, 680, 2367, 7004, 9277, 5165]
```

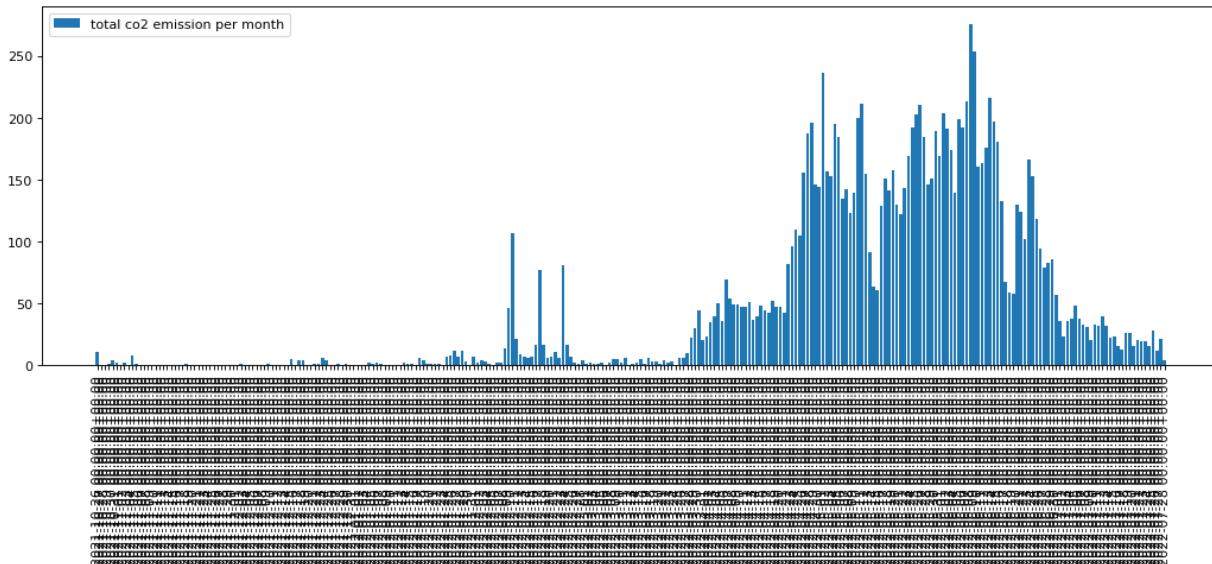
In [713...]

```
df_co2 = df_trans[(df_trans['transactionFootPrint.carbonEmissionInGrams'] > 0)
co2_month_sum = df_co2.groupby(pd.Grouper(key='createdAt', axis=0, freq='M'))
draw_dict(dict(co2_month_sum), 'total co2 emission per month')
co2_month_avg = df_co2.groupby(pd.Grouper(key='createdAt', axis=0, freq='M'))
draw_dict(dict(co2_month_avg), 'average co2 emission per month')
```



In [223...]

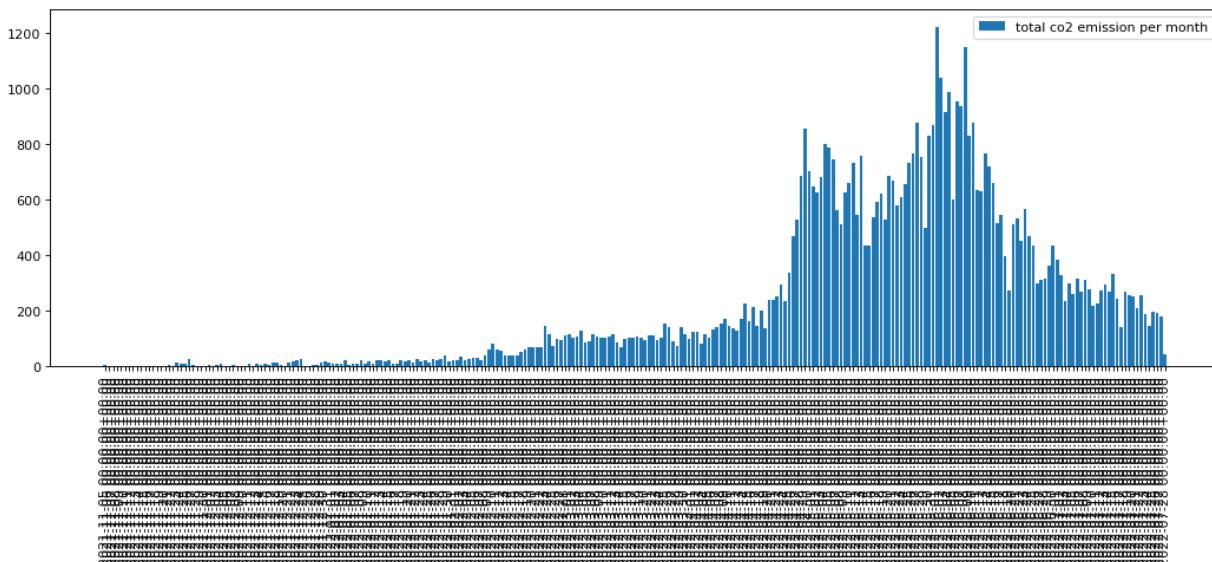
```
#df_co2 = df_trans[(df_trans['transactionFootPrint.carbonEmissionInGrams'] <
co2_month_sum = df_users.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
draw_dict(dict(co2_month_sum), 'total co2 emission per month')
```



In [221...]

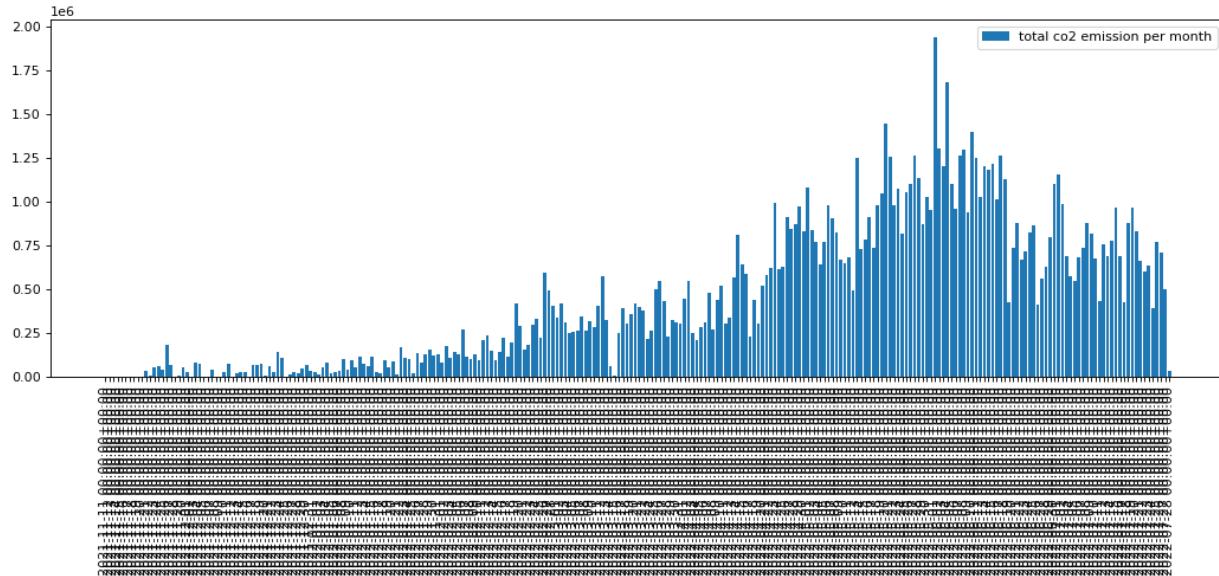
```
df_co2 = df_trans[(df_trans['transactionFootPrint.carbonEmissionInGrams'] < 6

co2_month_sum = df_co2.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
draw_dict(dict(co2_month_sum), 'total co2 emission per month')
#co2_month_avg = df_co2.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
#draw_dict(dict(co2_month_avg), 'average co2 emission per month')
```



In [220...]

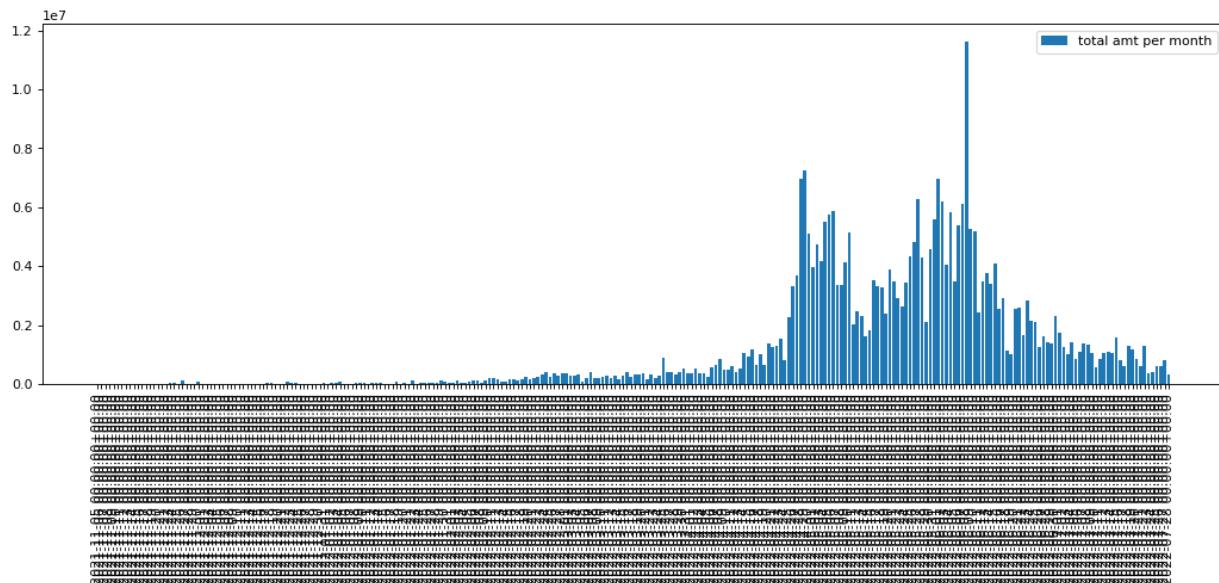
```
df_co2 = df_trans[(df_trans['transactionFootPrint.carbonEmissionInGrams'] > 0
co2_month_sum = df_co2.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
draw_dict(dict(co2_month_sum), 'total co2 emission per month')
```



In []:

In [136]:

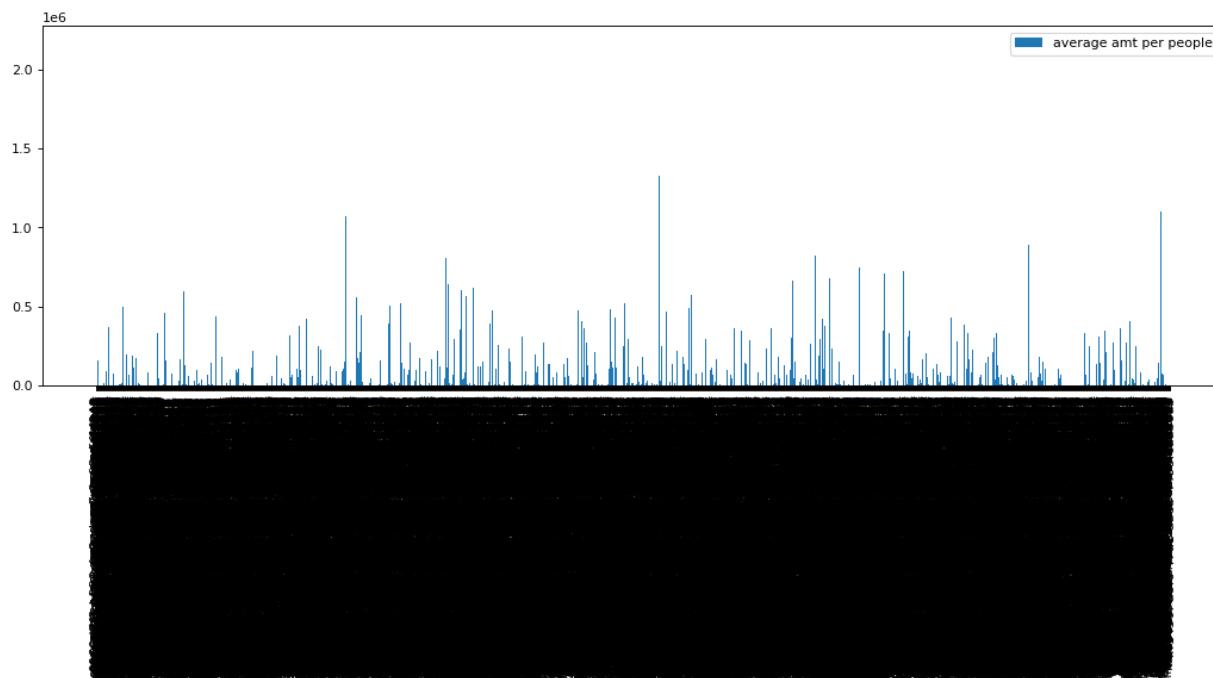
```
df_amt = df_trans[df_trans['amount.value'] < 60000]
amt_month_sum = df_amt.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
draw_dict(dict(amt_month_sum), 'total amt per month')
amt_month_avg = df_amt.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
draw_dict(dict(amt_month_avg), 'average amt per month')
```





In [168...]

```
amt_month_avg = df_amt.groupby('customerId')['amount.value'].sum()
draw_dict(dict(amt_month_avg), 'total amt per people')
```



In [170...]

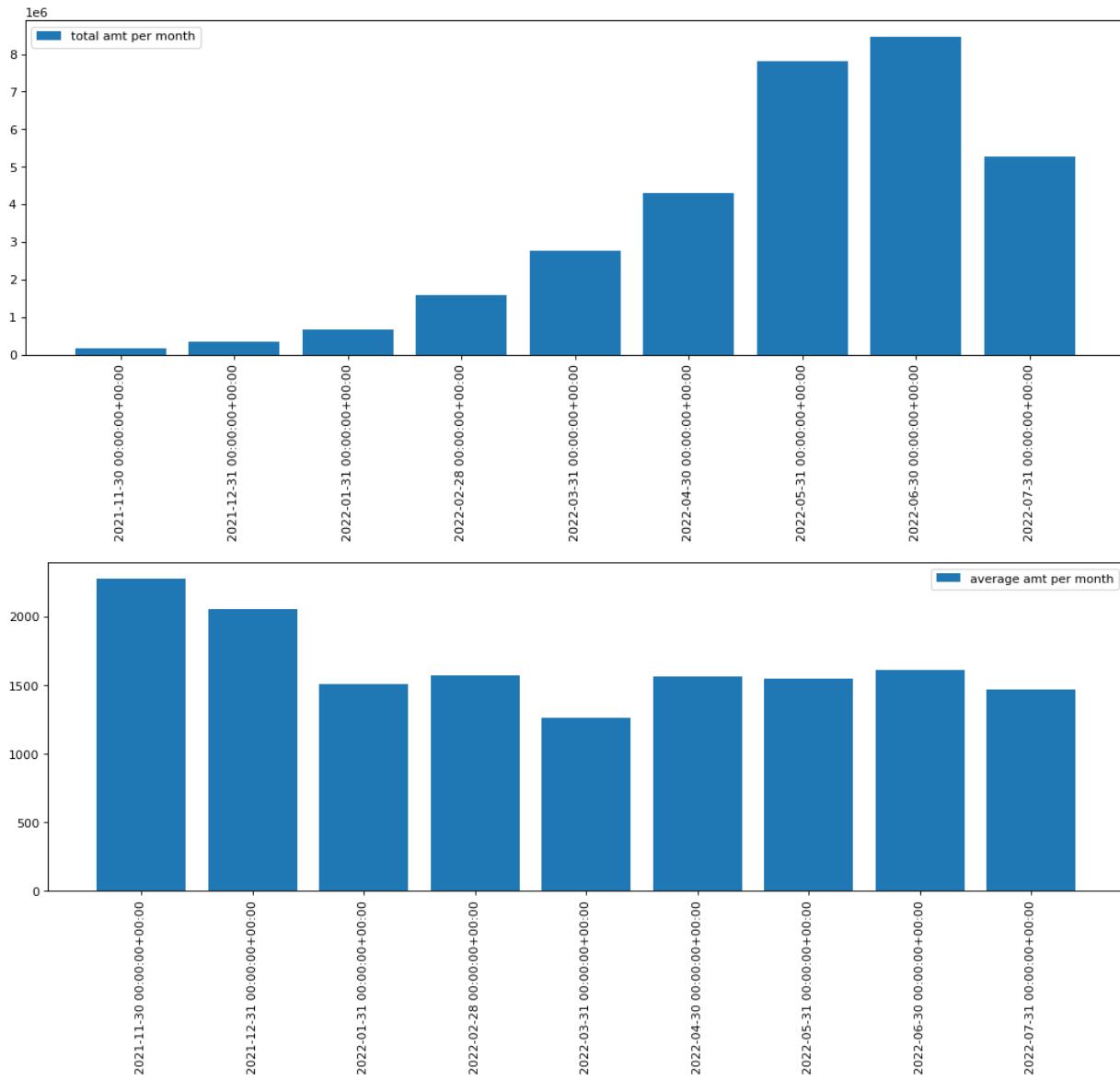
```
amt_month_avg.mean()
```

Out[170...]

```
85895.75163043478
```

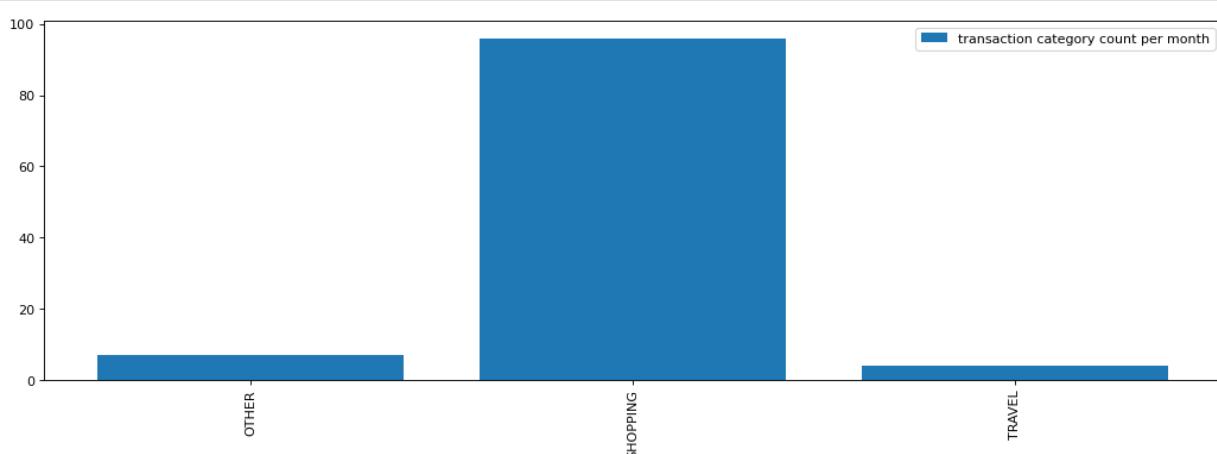
In [111...]

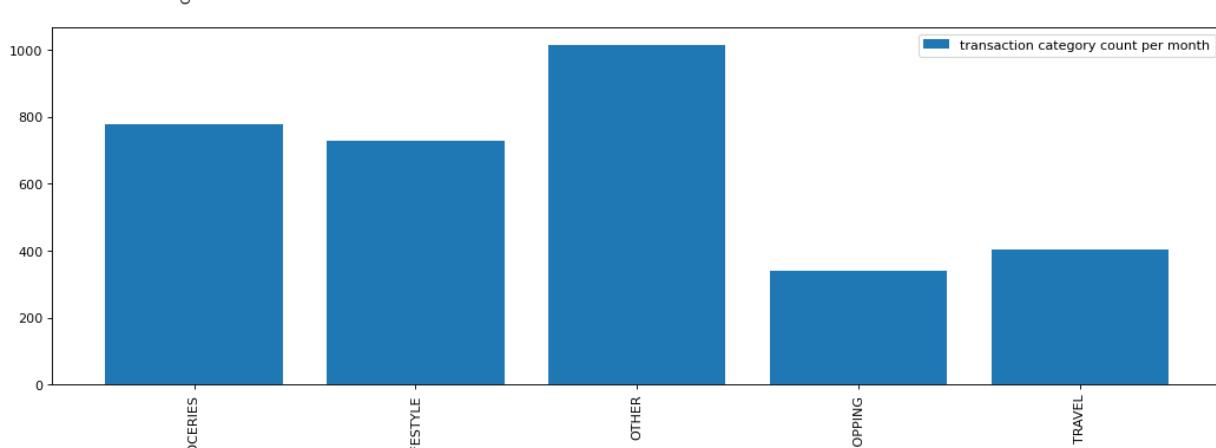
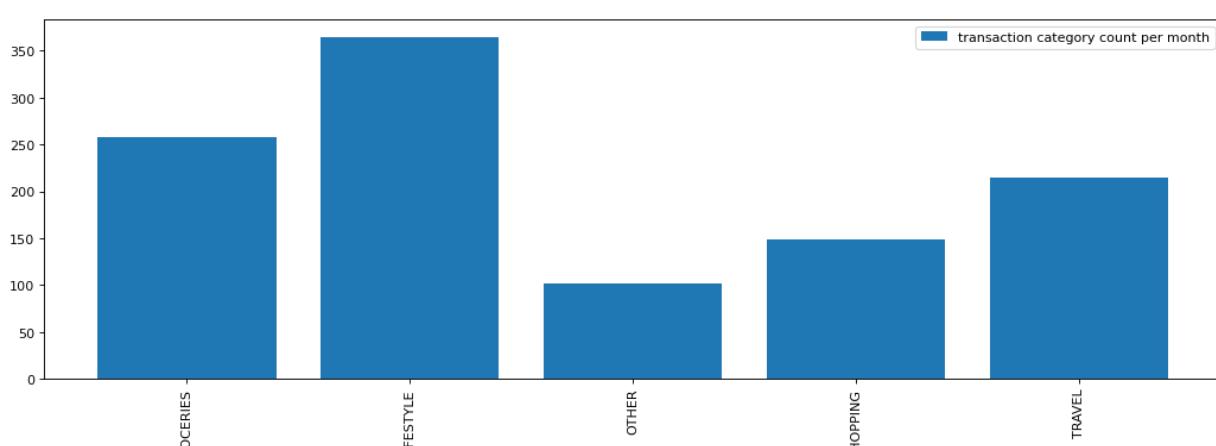
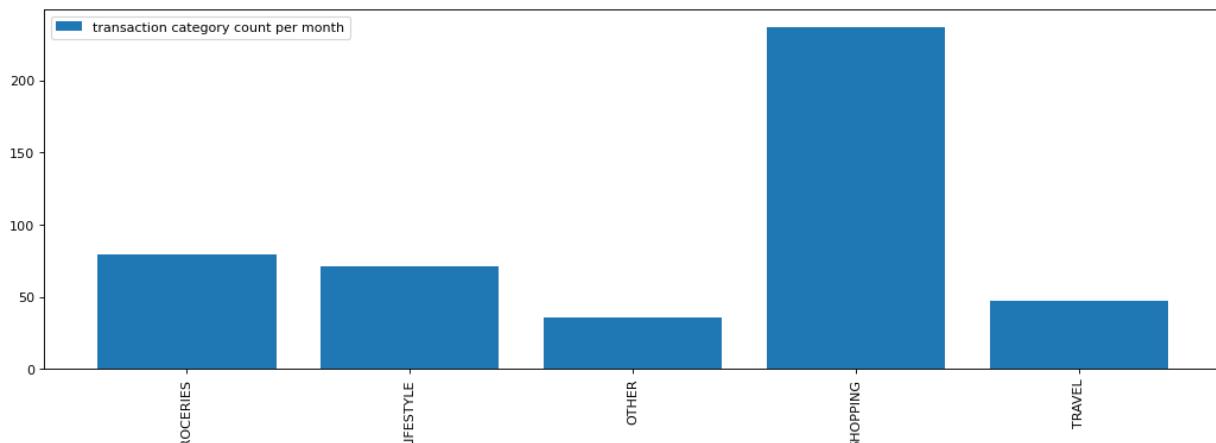
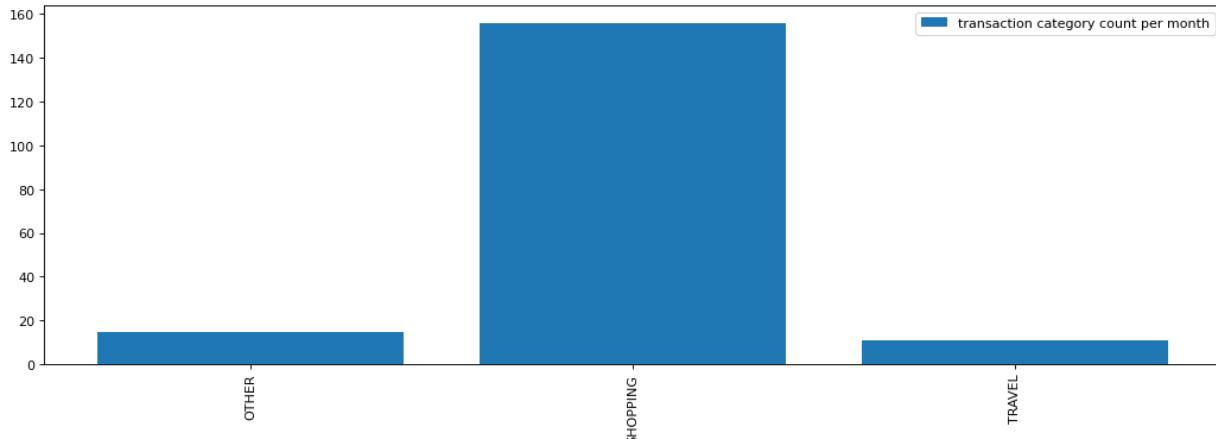
```
df_amt = df_trans[(df_trans['transactionFootPrint.carbonEmissionInGrams'] > 0)
amt_month_sum = df_amt.groupby(pd.Grouper(key='createdAt', axis=0, freq='M'))
draw_dict(dict(amt_month_sum), 'total amt per month')
amt_month_avg = df_amt.groupby(pd.Grouper(key='createdAt', axis=0, freq='M'))
draw_dict(dict(amt_month_avg), 'average amt per month')
```

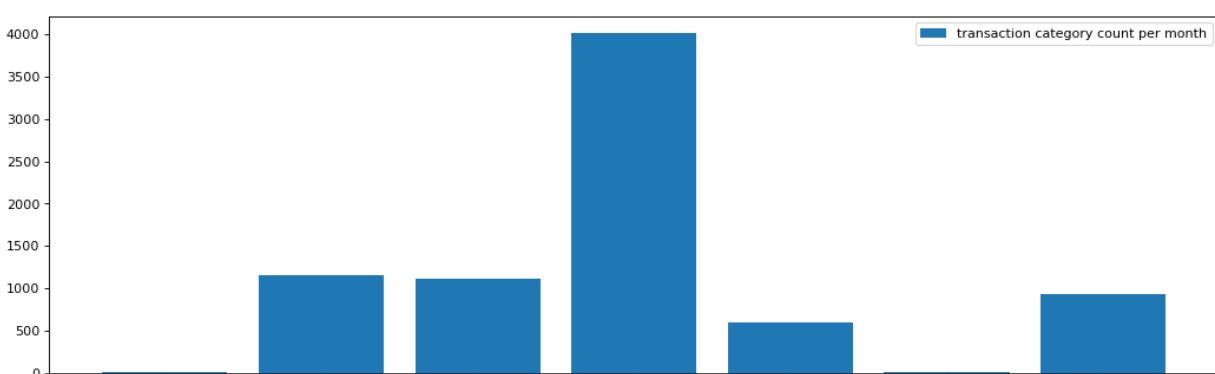
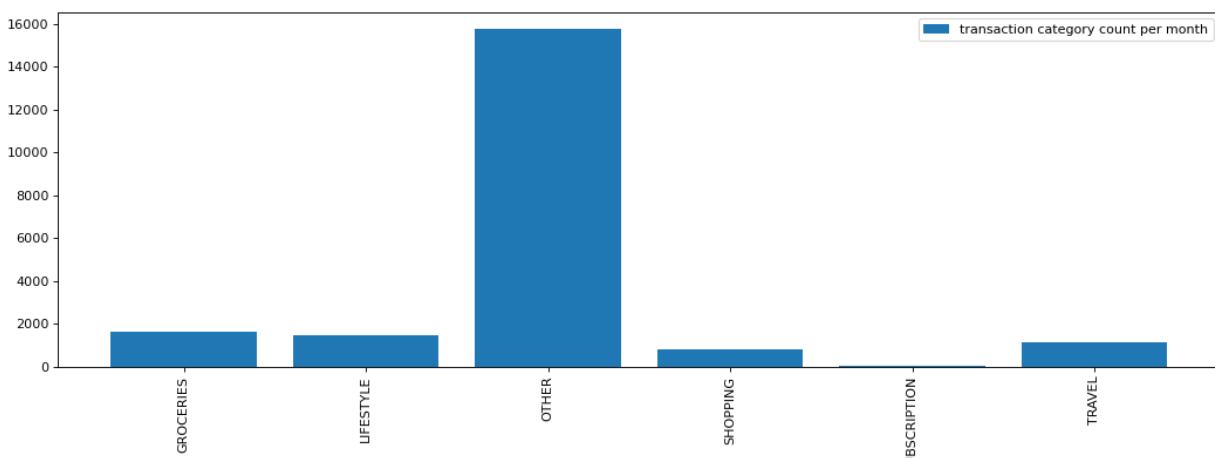
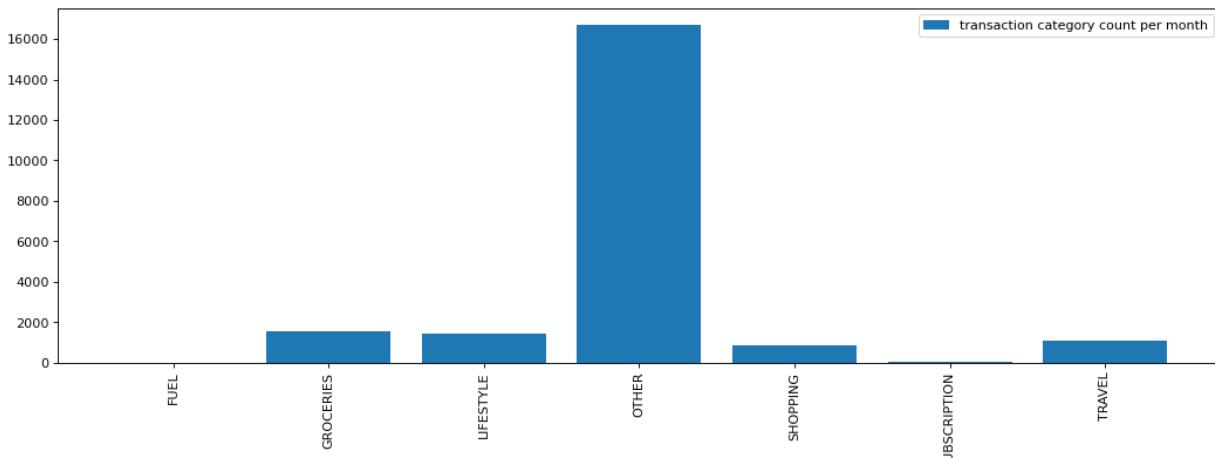
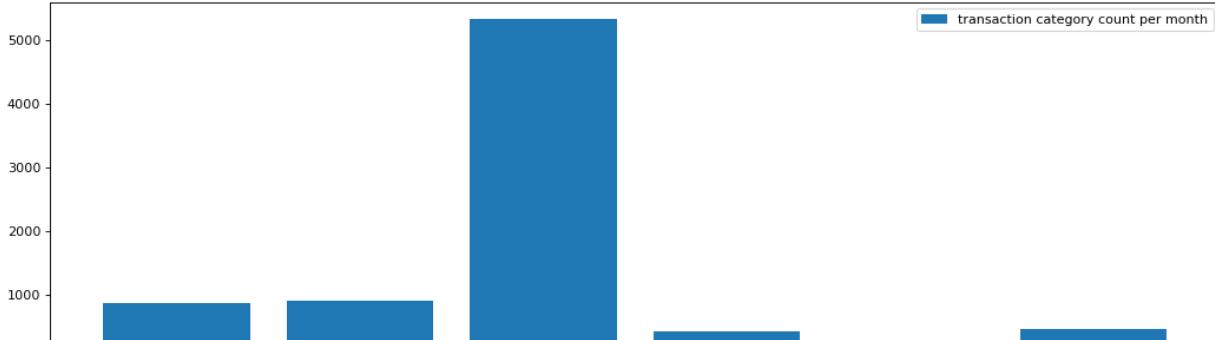


In [737]:

```
#cat_monthly = df.groupby([pd.Grouper(key='createdAt_X', axis=0, freq='M')],  
for month in trans_month:  
    cat_monthly = month.groupby('externalParty.transactionCategory').size()  
    draw_dict(dict(cat_monthly), 'transaction category count per month')
```







In [770...]

```
df_test = df.groupby(['customerId', 'externalParty.transactionCategory']).size()
df_test = df_test.to_frame(name = 'size').reset_index()
print(df_test.shape)
print(df_trans['customerId'].value_counts())
df_test['externalParty.transactionCategory'].value_counts() # 3763
```

```
(5823, 3)
b1bf1119-cdce-46de-b296-f3f733ee2779      552
2aa2a980-470d-470a-8379-ec51e5036ee4      483
34f30c26-4ab6-4b64-94f2-ccdf4cd0b1c1      460
3253926e-9c0d-4fd9-8248-eb7c2f457b99      424
e1090e22-632f-45e4-a480-b9206b3a573d      412
...
5bd90ae4-dd59-4875-bca2-59c07300173c      1
2d09d861-ead0-4bae-be8f-3a9916bac9bd      1
57e600dc-5cce-4d4f-848a-f6608eef5185      1
297a2225-c415-4448-872b-4e3291e12174      1
b6387ce7-7cf7-44f6-aae6-e89641327175      1
Name: customerId, Length: 3763, dtype: int64
OTHER          3604
GROCERIES      587
LIFESTYLE       566
TRAVEL          507
SHOPPING         494
SUBSCRIPTION    60
FUEL             5
Name: externalParty.transactionCategory, dtype: int64
```

Out [770...]

```
df_21_11.groupby('customerId')['transactionFootPrint.carbonEmissionInGrams'].
```

Out [676...]

customerId	mean	sum	count
e1090e22-632f-45e4-a480-b9206b3a573d	2.731292e+06	2731292.44	1
e047d168-451f-484a-908a-857d556e0a8f	1.365646e+06	1365646.22	1
533e1809-b98a-4455-bbf2-8d8780507002	5.462585e+05	546258.49	1
437d909b-d630-4ec9-922c-480c4cfab527	2.731292e+05	273129.24	1
af7c2018-56a5-4338-afb4-25e35fe2f427	2.731292e+05	273129.24	1
b3ec512b-ffff-4d83-baa3-ecd8374a398b	1.823138e+05	1093882.62	6
ffcf3506-a7d8-48a0-ba54-d4d54d15ee78	1.365646e+05	136564.62	1
3253926e-9c0d-4fd9-8248-eb7c2f457b99	6.733646e+04	2895467.57	43
5ec14a71-9089-43e4-b4c9-82db1fed11a2	5.462585e+04	54625.85	1
2aa2a980-470d-470a-8379-ec51e5036ee4	2.708719e+04	325046.27	12
478dd3bf-b586-425b-8a96-a0430fb72b1b	1.812723e+04	145017.83	8
ce3d4f74-f5ea-4d78-8ba8-ceca45235edb	1.732371e+04	329150.41	19
99d40295-a201-4e6b-b2ab-23eb43603364	8.601182e+03	51607.09	6
0c922076-e434-411a-8a3e-1c06b00979f4	5.462580e+03	5462.58	1

		mean	sum	count
customerId				
	cb737080-1b02-43c5-9623-67da9f54a512	2.729925e+03	5459.85	2
	40145ab5-241c-47c5-bb6a-3a05374b28a9	1.365650e+03	1365.65	1
In [677...]	df_21_12.groupby('customerId')[['transactionFootPrint.carbonEmissionInGrams']].			
Out [677...]		mean	sum	count
customerId				
	3253926e-9c0d-4fd9-8248-eb7c2f457b99	11998.882877	875918.45	73
	e1090e22-632f-45e4-a480-b9206b3a573d	8374.948947	159124.03	19
	2aa2a980-470d-470a-8379-ec51e5036ee4	6322.197209	271854.48	43
	99d40295-a201-4e6b-b2ab-23eb43603364	5934.994286	41544.96	7
	437d909b-d630-4ec9-922c-480c4cfab527	3469.120000	48567.68	14
	ffcf3506-a7d8-48a0-ba54-d4d54d15ee78	3405.865833	40870.39	12
	0c922076-e434-411a-8a3e-1c06b00979f4	2888.553529	49105.41	17
	06736825-4170-45cf-aef9-75e449ea19e7	2299.906000	11499.53	5
	af7c2018-56a5-4338-afb4-25e35fe2f427	2106.618750	16852.95	8
	b3ec512b-ffff-4d83-baa3-ecd8374a398b	1641.947500	6567.79	4
	ce3d4f74-f5ea-4d78-8ba8-ceca45235edb	1368.456250	21895.30	16
	fd654d64-f795-401d-a5fe-76cf2cfa01a	897.970000	2693.91	3
	4dd438c3-69e1-4520-9fb0-00c43c6fe02f	630.930000	1892.79	3
	addc05de-2f8c-493c-9c66-7c4ffd8052e8	0.000000	0.00	1
	42924ae1-ddea-40c2-8e55-72c3089aef44	0.000000	0.00	1
	b0c0181f-e9e0-489d-866d-71560c55d48d	0.000000	0.00	1
	b3b91b2d-5dbf-4c56-8a74-8b04cbab5f7c	0.000000	0.00	1
	44a1a125-9052-49dc-a9f9-d449ebad3d14	0.000000	0.00	1
	4ec3aa2c-1dcd-47a7-b20c-ce7083ddbab8	0.000000	0.00	1
	c23a9d75-e238-4fcf-8855-595697b9ce84	0.000000	0.00	1
	c3924705-b945-49a4-8cf0-00ac0e28b4ff	0.000000	0.00	1
	996daa66-632a-4fed-af68-d79e6ad64533	0.000000	0.00	1
	d63381bf-7ea4-4205-8d8b-007b683ebc4b	0.000000	0.00	1
	dff827bc-d6bb-4fd0-ae3d-d82786f9e5ad	0.000000	0.00	1
	e065da2d-f8d5-4ebf-b3ae-c5b1f7010ac8	0.000000	0.00	1
	3bf452bc-b5a1-415c-8942-1a3b7887e8b4	0.000000	0.00	1
	e624772c-e68d-461d-9b1b-c10e7330787c	0.000000	0.00	1

	mean	sum	count
customerId			

```
In [27]: def draw_dict(dict_value, label):
    figure(figsize=(16, 5), dpi=80)

    plt.bar(range(len(dict_value)), list(dict_value.values()), align='center')
    plt.xticks(range(len(dict_value)), list(dict_value.keys()), rotation=90)

    plt.legend(loc='best')
    plt.show()
```

.....

trans_id – category weight:carbon emission, amount, mmc, trans type, direction
to see the relation between the carbon emission amount and the trans cat

more specific graph of the above graph, can be used in deeply analysis eg: for
and the mmc cost the most

find the relationship between amount and the carbon emission for all cat
to ensure eg: that normally high amount means high carbon emission etc.

find the relationship between trans type and direction, get the portion of each
to ensure eg: there is no evidence that trans type and direction would affect

users

trans_id – customerid weight:carbon emission, amount, cat, trans type, direction
analysis user address and age affect the transaction amount, carbon emission,

payees

.....

```
#trans_1 = df_trans.head(10)
#trans_1
```

```
payees_1 = df_payees.head(10)
```

```
payees_1
```

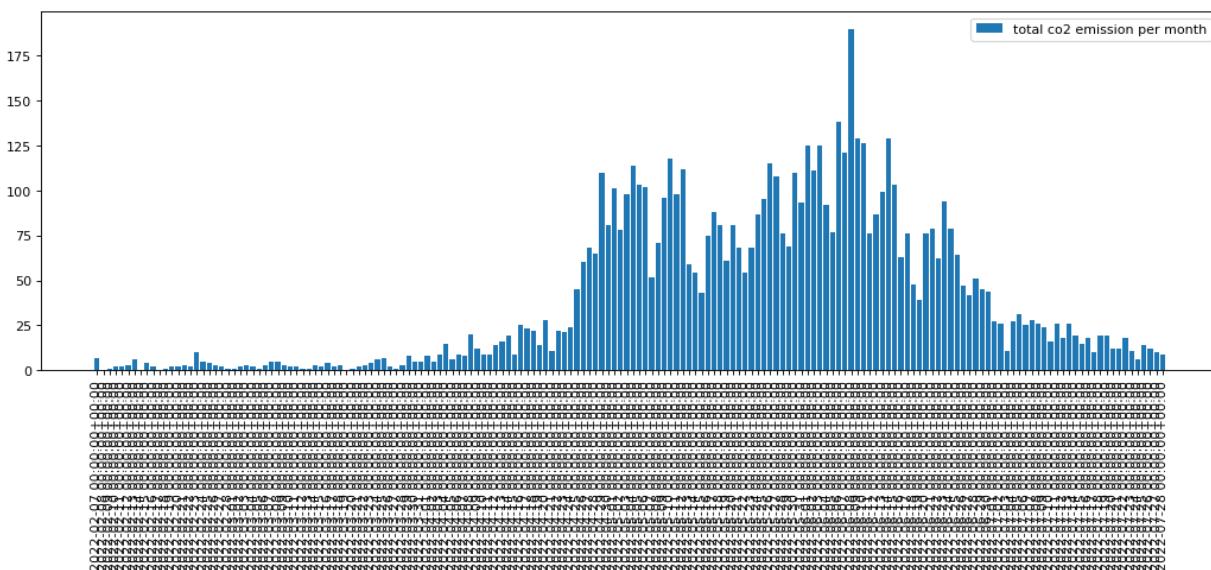
Out[239...]

	_id	createdAt	SenderId	customerId	Sender is an ekko user
0	6201245fbe7e0d00104d05d7	2022-02-07 13:53:35.103000+00:00	ce3d4f74-f5ea-4d78-8ba8-ceca45235edb		True
1	6201253ebe7e0d00104d05e0	2022-02-07 13:57:18.050000+00:00	ffcf3506-a7d8-48a0-ba54-d4d54d15ee78		True
2	62012600be7e0d00104d05ed	2022-02-07 14:00:32.740000+00:00	2aa2a980-470d-470a-8379-ec51e5036ee4		True
3	6201267cbe7e0d00104d05f6	2022-02-07 14:02:36.428000+00:00	ffcf3506-a7d8-48a0-ba54-d4d54d15ee78		True

	<u>_id</u>	<u>createdAt</u>	<u>SenderId customerId</u>	<u>Sender is an ekko user</u>
4	620126f9be7e0d00104d0607	2022-02-07 14:04:41.508000+00:00	2aa2a980-470d-470a-8379-ec51e5036ee4	True
5	620147481ad11a0011ca4cdc	2022-02-07 16:22:32.676000+00:00	749ca4ea-26cb-4163-83f1-f5a2fcfa3a16a	True
6	620180638f785400106f17ed	2022-02-07 20:26:11.792000+00:00	3253926e-9c0d-4fd9-8248-eb7c2f457b99	True
7	620385b03ce99a00119aa17e	2022-02-09 09:13:20.413000+00:00	c0cdb5dc-ac39-4265-b66a-51faf326aed8	True

In [29]:

```
#len(pd.Series(df_trans['customerId']).unique()) # 3763
df_payees['createdAt'] = pd.to_datetime(df_payees['createdAt'])
co2_month_sum = df_payees.groupby(pd.Grouper(key='createdAt', axis=0, freq='D'))
draw_dict(dict(co2_month_sum), 'total co2 emission per month')
```



In [230]:

```
G = nx.DiGraph()
G = nx.from_pandas_edgelist(df_payees, 'SenderId customerId', 'account_full',
df_payees['createdAt'] = pd.to_datetime(df_payees['createdAt']))
```

In [247]:

```
df_22_2 = df_payees[(df_payees['createdAt'] > '2022-01-31') & (df_payees['cre
df_22_3 = df_payees[(df_payees['createdAt'] > '2022-02-28') & (df_payees['cre
df_22_4 = df_payees[(df_payees['createdAt'] > '2022-03-31') & (df_payees['cre
df_22_5 = df_payees[(df_payees['createdAt'] > '2022-04-30') & (df_payees['cre
df_22_6 = df_payees[(df_payees['createdAt'] > '2022-05-31') & (df_payees['cre
df_22_7 = df_payees[(df_payees['createdAt'] > '2022-06-30') & (df_payees['cre
df_p = [df_22_2, df_22_3, df_22_4, df_22_5, df_22_6, df_22_7]
```

In [311]:

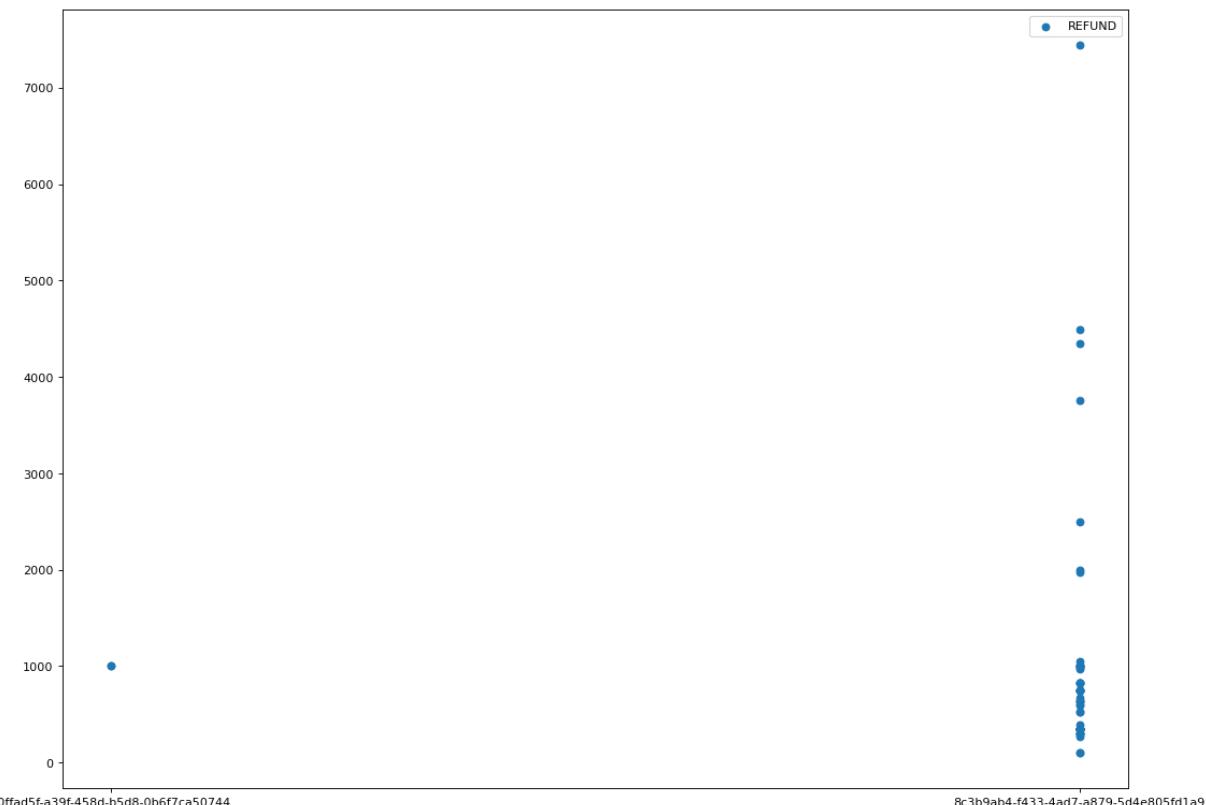
```
for month in df_p:
    M = nx.from_pandas_edgelist(month, 'Sender customerId', 'accconut_full',
    M2 = nx.Graph()
    d = dict(M.in_degree())
    received_trans = [x for x in d if d[x] >= 2]

    community_list = []
    node_color = []
    for acc in received_trans:
        payees = nx.ancestors(M, acc)
        community_list[acc] = payees
        M2.add_node(acc)
        node_color.append('tab:red')
        num = M2.number_of_nodes()
        M2.add_nodes_from(payees)
        num = M2.number_of_nodes() - num
        node_color.extend(['tab:blue']*num)
        M2.add_edges_from(map(lambda e: (e, acc), payees))

    if received_trans:
        figure(figsize=(16, 12), dpi=80)
        plt.title('month ')
        nx.draw(M2, node_size=100, node_color=node_color)
    for nodes in community_list:
        df = pd.DataFrame()
        for node in community_list[nodes]:
            df = df.append(df_trans[df_trans['customerId'] == node])
        figure(figsize=(16, 5), dpi=80)
        plt.scatter(df['customerId'], df['amount.value'], label=trans_ty)
        plt.legend(loc='best')
        #plt.title('Clustering Coefficient')
        #plt.ticklabel_format(style='plain')
        #plt.xticks(rotation=90)
        plt.show()
        print(df['externalParty.transactionCategory'].value_counts())
print(community_list)

{}
```

month



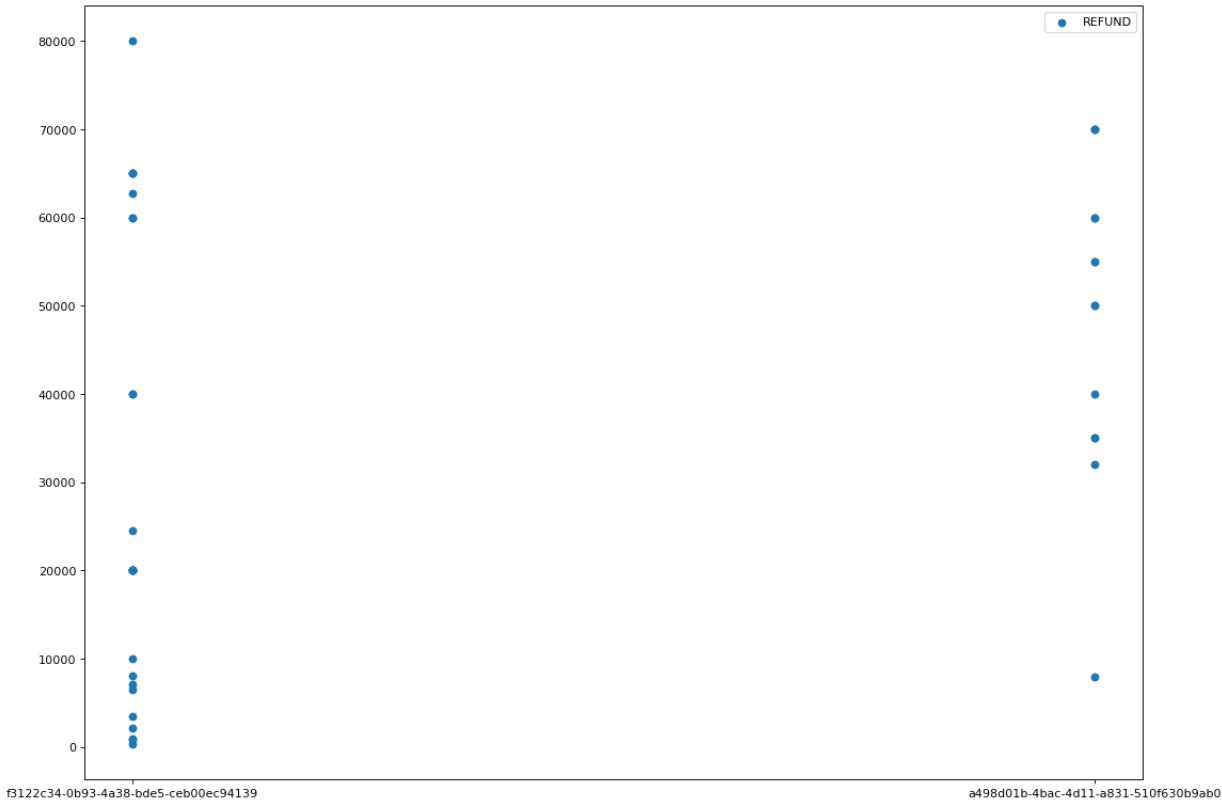
LIFESTYLE 21

GROCERIES 19

OTHER 8

TRAVEL 1

Name: externalParty.transactionCategory, dtype: int64

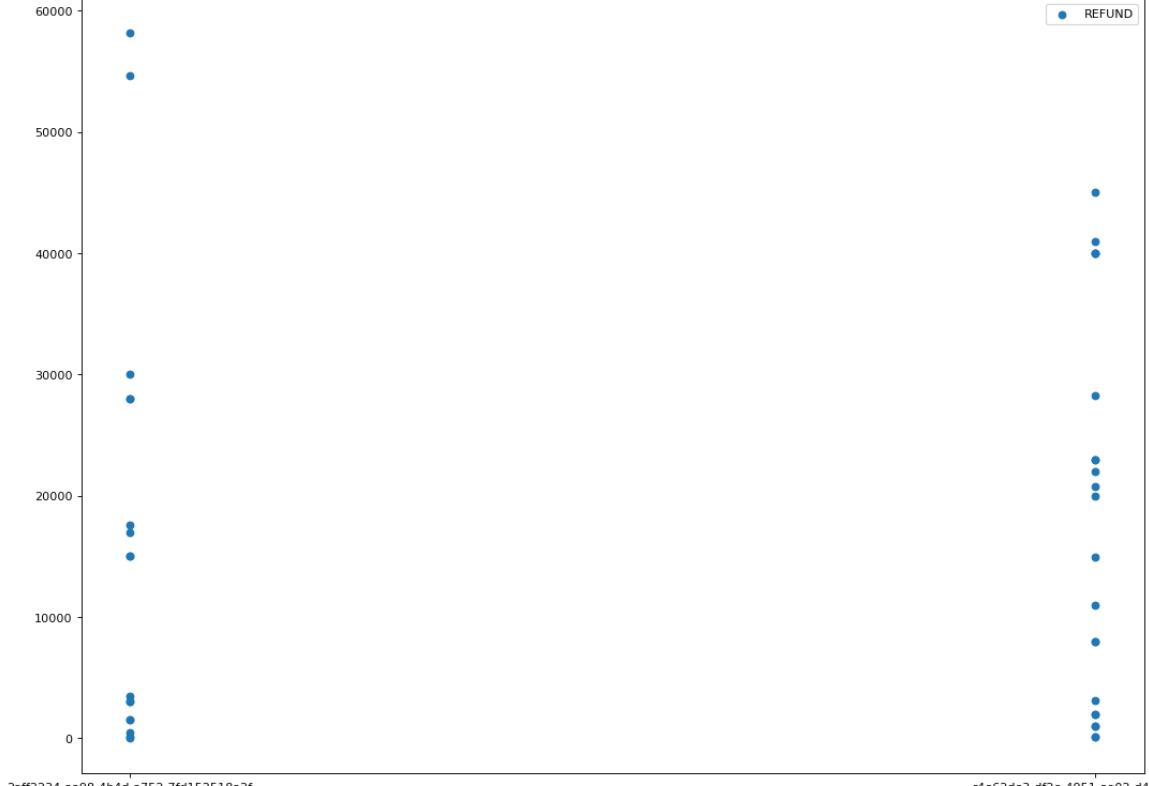


f3122c34-0b93-4a38-bde5-ceb00ec94139

a498d01b-4bac-4d11-a831-510f630b9ab0

OTHER 37
SHOPPING 2
LIFESTYLE 1

Name: externalParty.transactionCategory, dtype: int64



2aff2234-aa98-4b4d-a752-7fd152518a2f

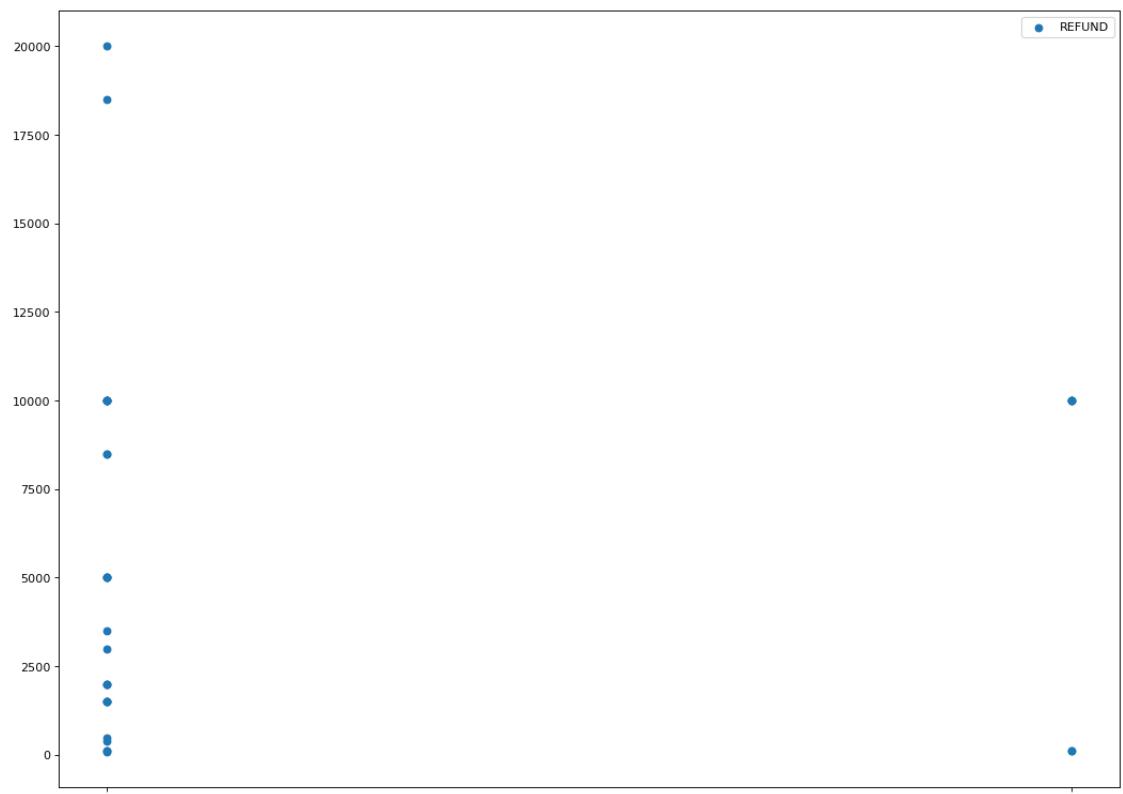
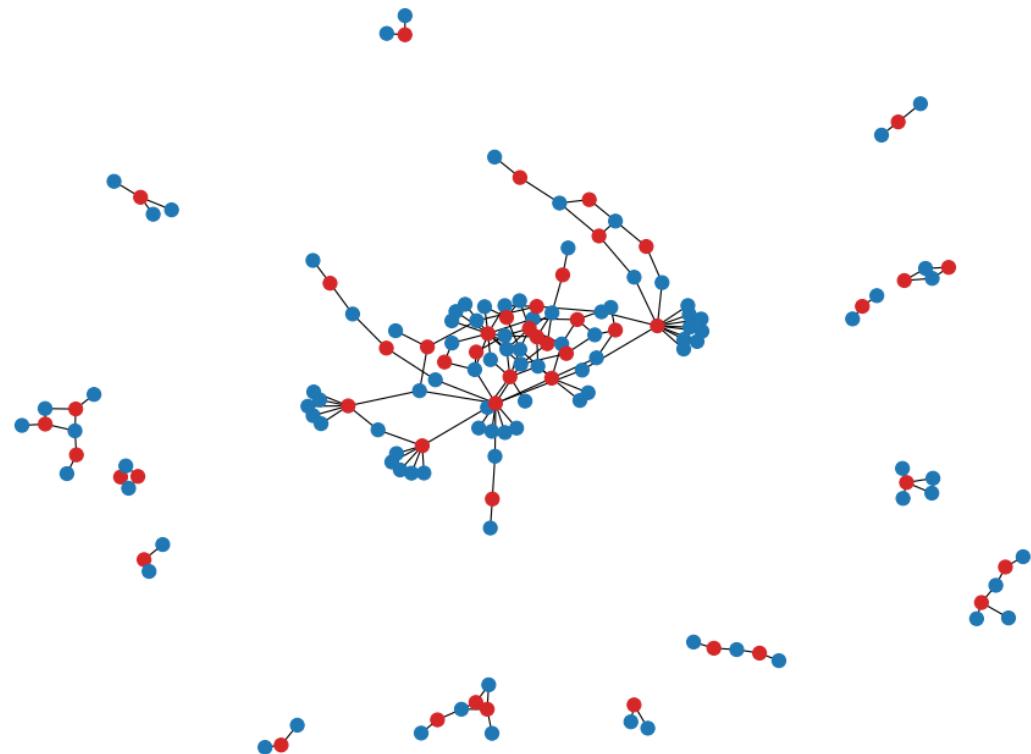
c4e62de3-df2e-4951-aa02-d4fe17c87ba3

OTHER 35
SHOPPING 2
TRAVEL 2

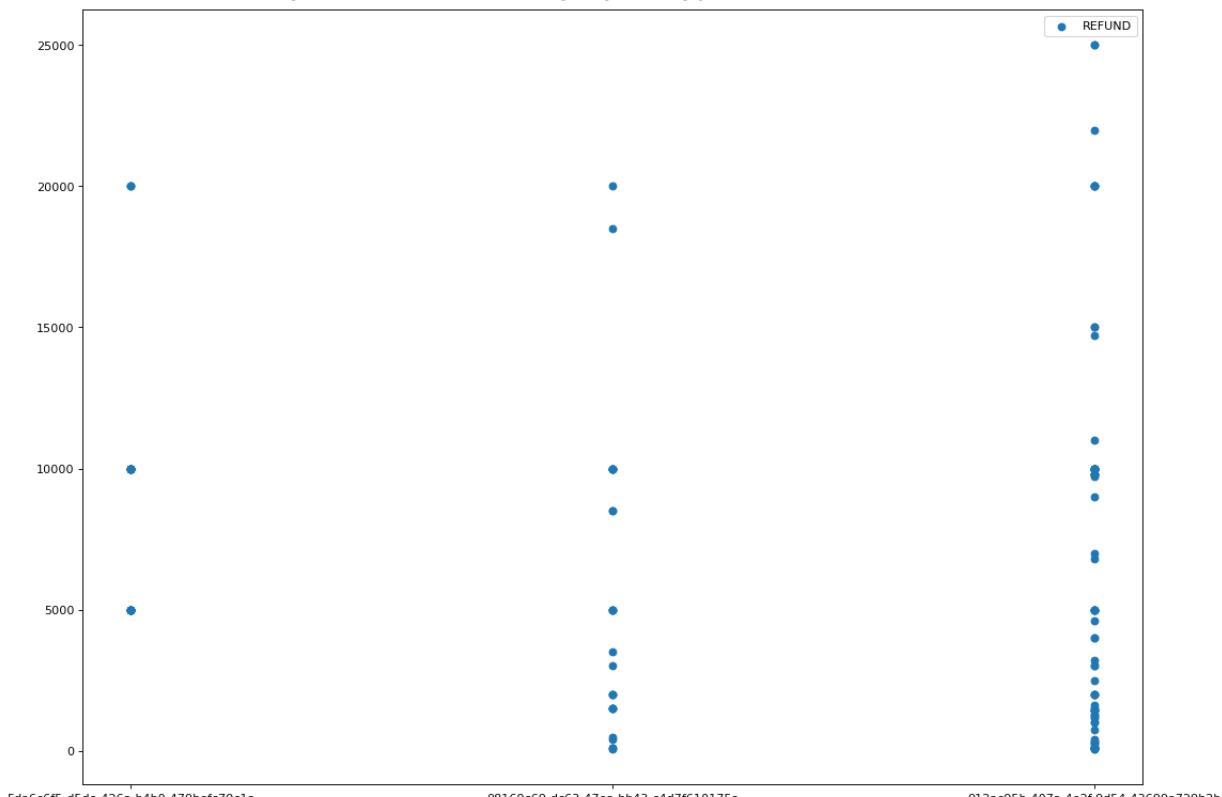
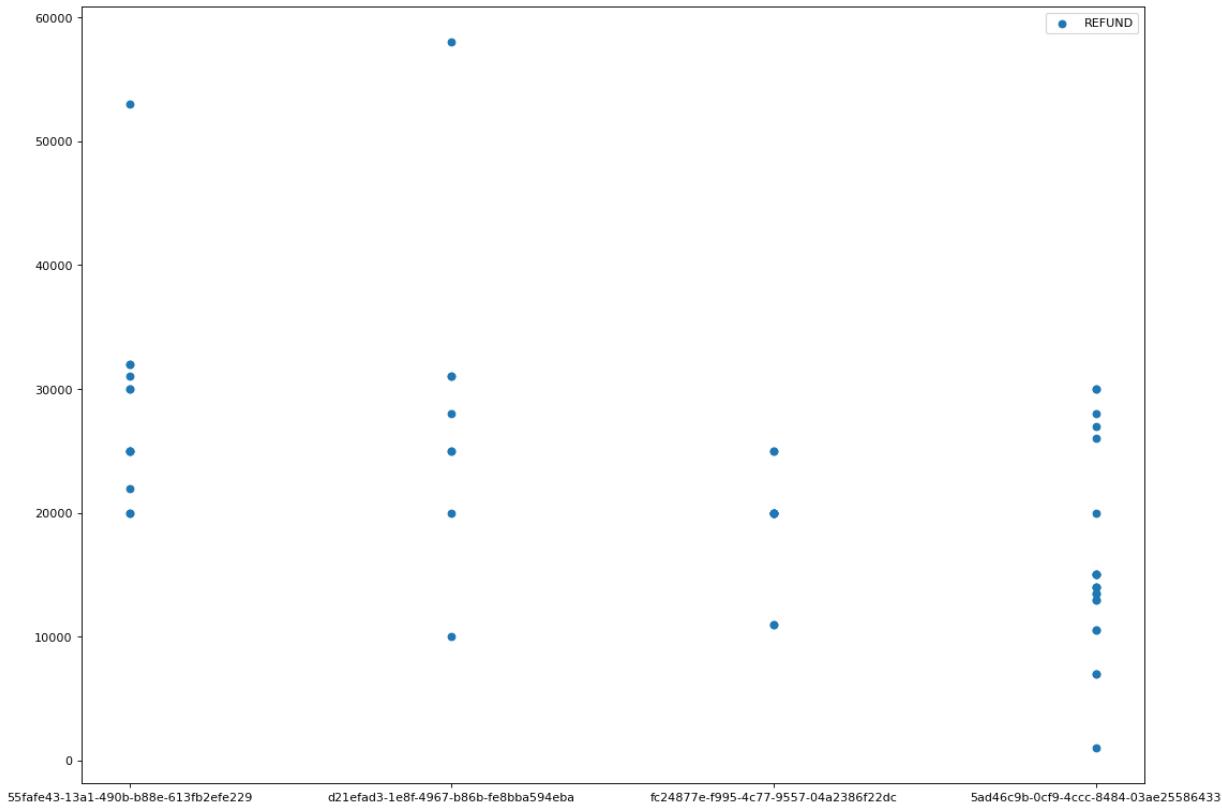
Name: externalParty.transactionCategory, dtype: int64

```
{'29450271_236972': {'c0ffad5f-a39f-458d-b5d8-0b6f7ca50744': '8c3b9ab4-f433-4ad7-a879-5d4e805fd1a9'}, '33684400_90129': {'f3122c34-0b93-4a38-bde5-ceb00ec94139', 'a498d01b-4bac-4d11-a831-510f630b9ab0'}, '6215934_300248': {'2aff2234-
```

month

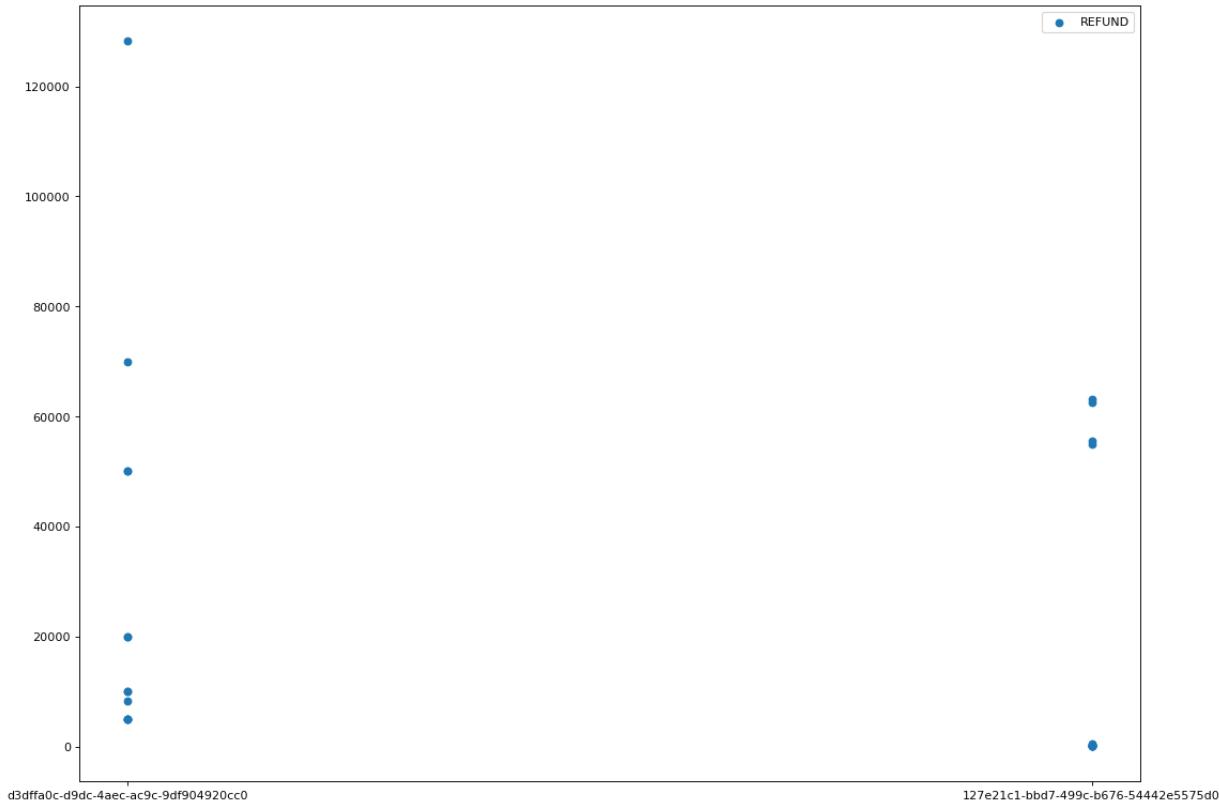


```
08169c69-dc63-47ea-bb43-c4d7f610175a  
OTHER 34  
Name: externalParty.transactionCategory, dtype: int64
```



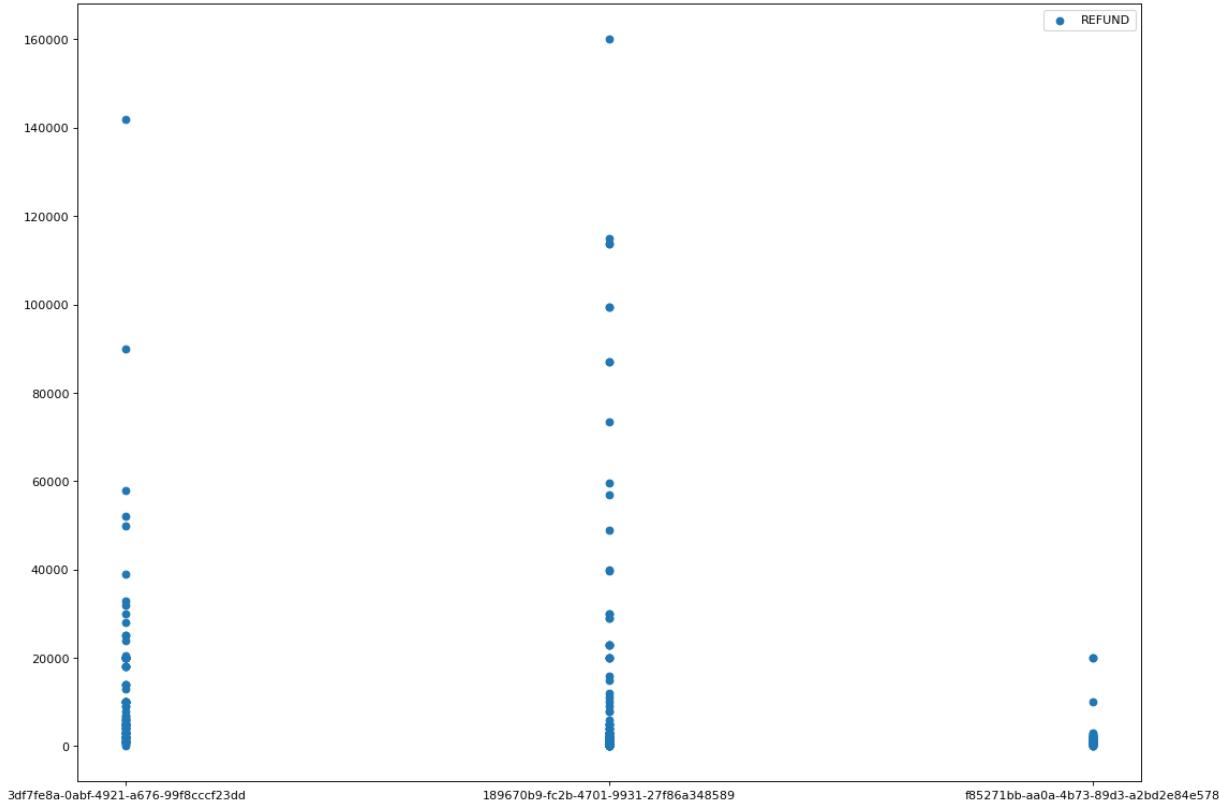
OTHER	132
LIFESTYLE	9
GROCERIES	4
TRAVEL	2
SHOPPING	1

Name: externalParty.transactionCategory, dtype: int64

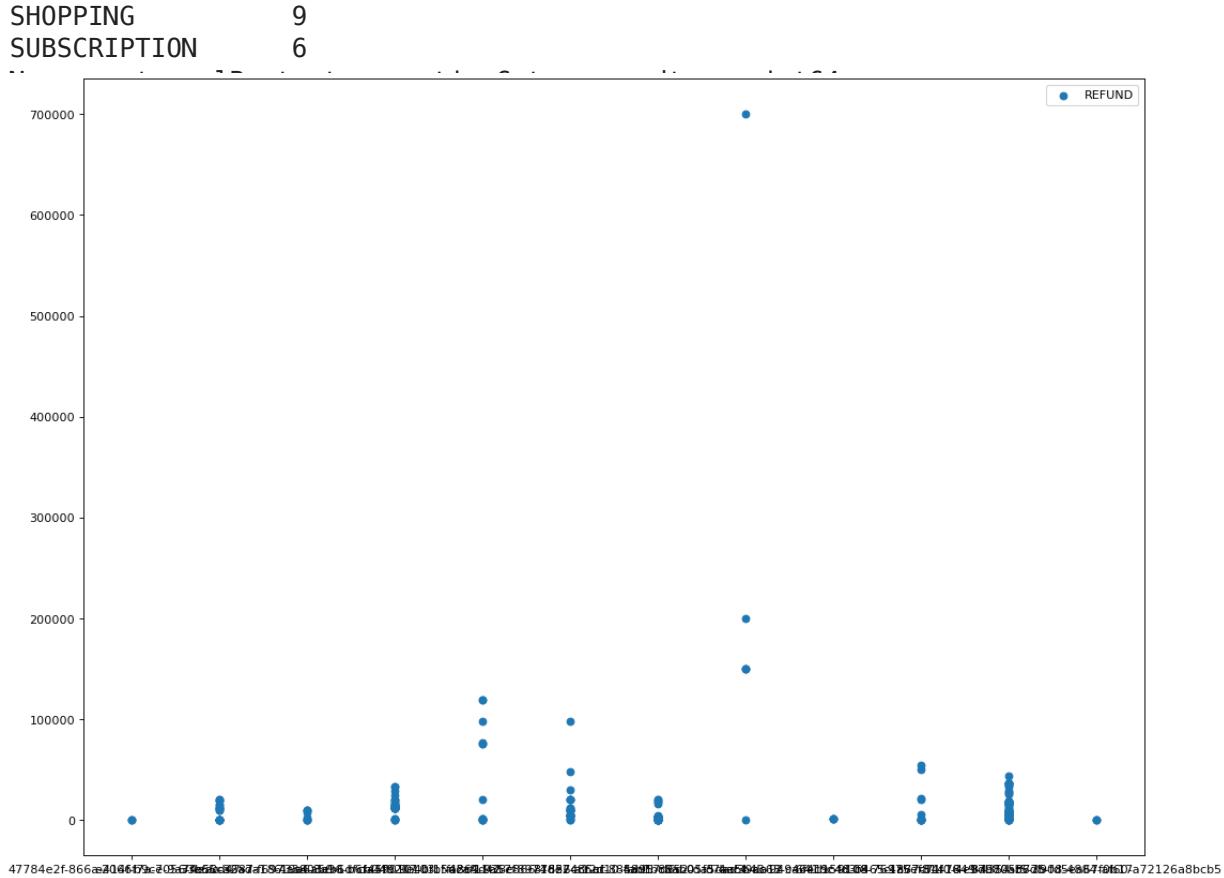


OTHER 23
SHOPPING 2
SUBSCRIPTION 1

Name: externalParty.transactionCategory, dtype: int64



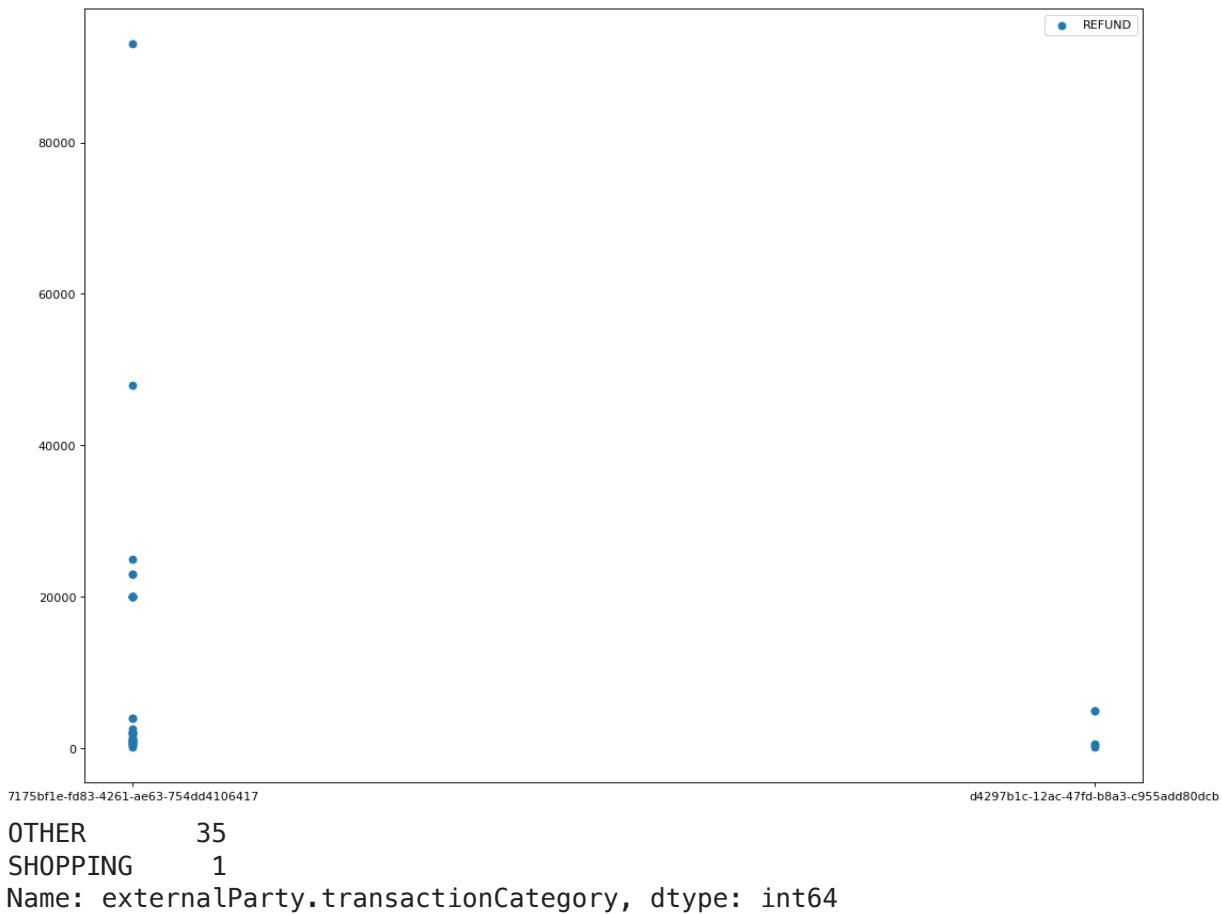
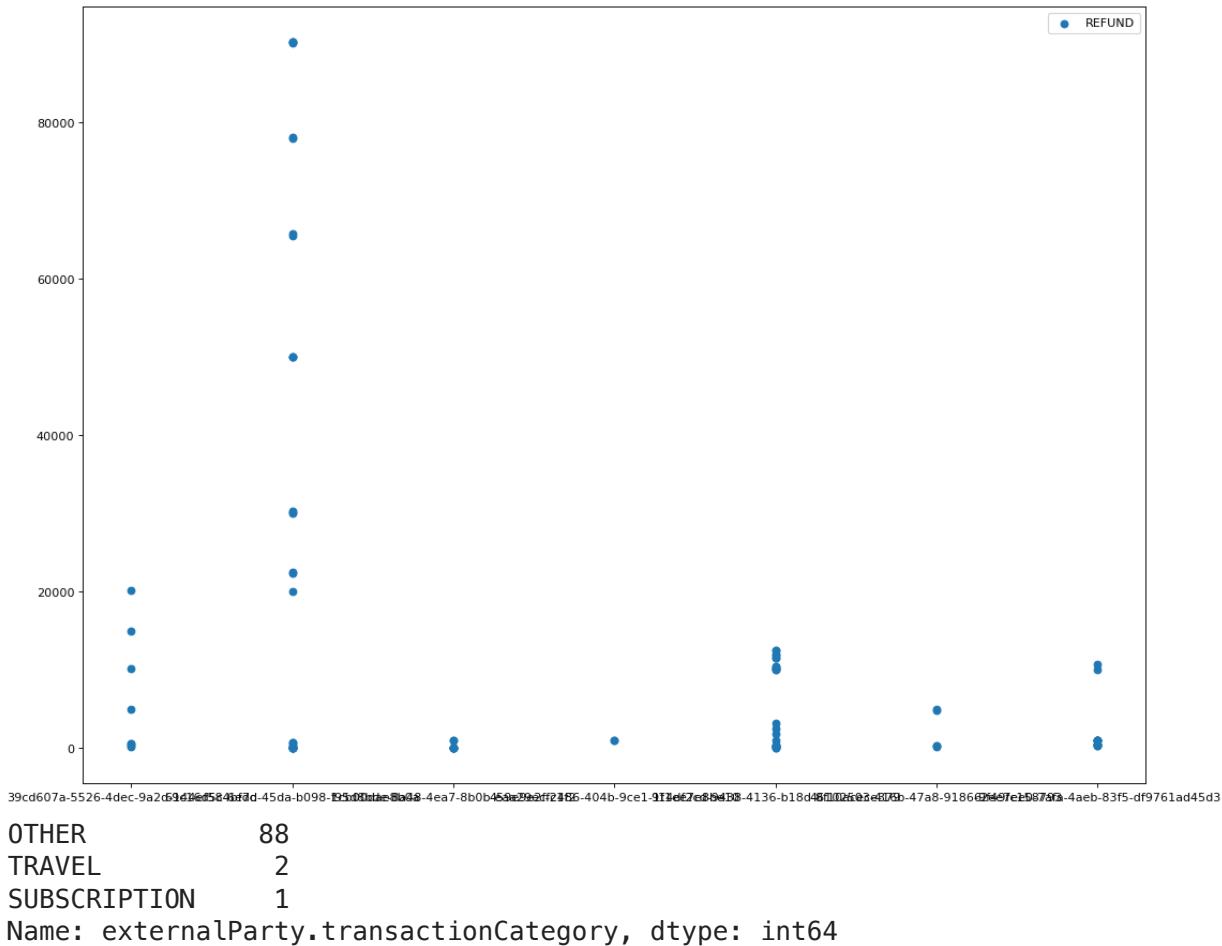
OTHER 215
GROCERIES 24
LIFESTYLE 13
TRAVEL 9

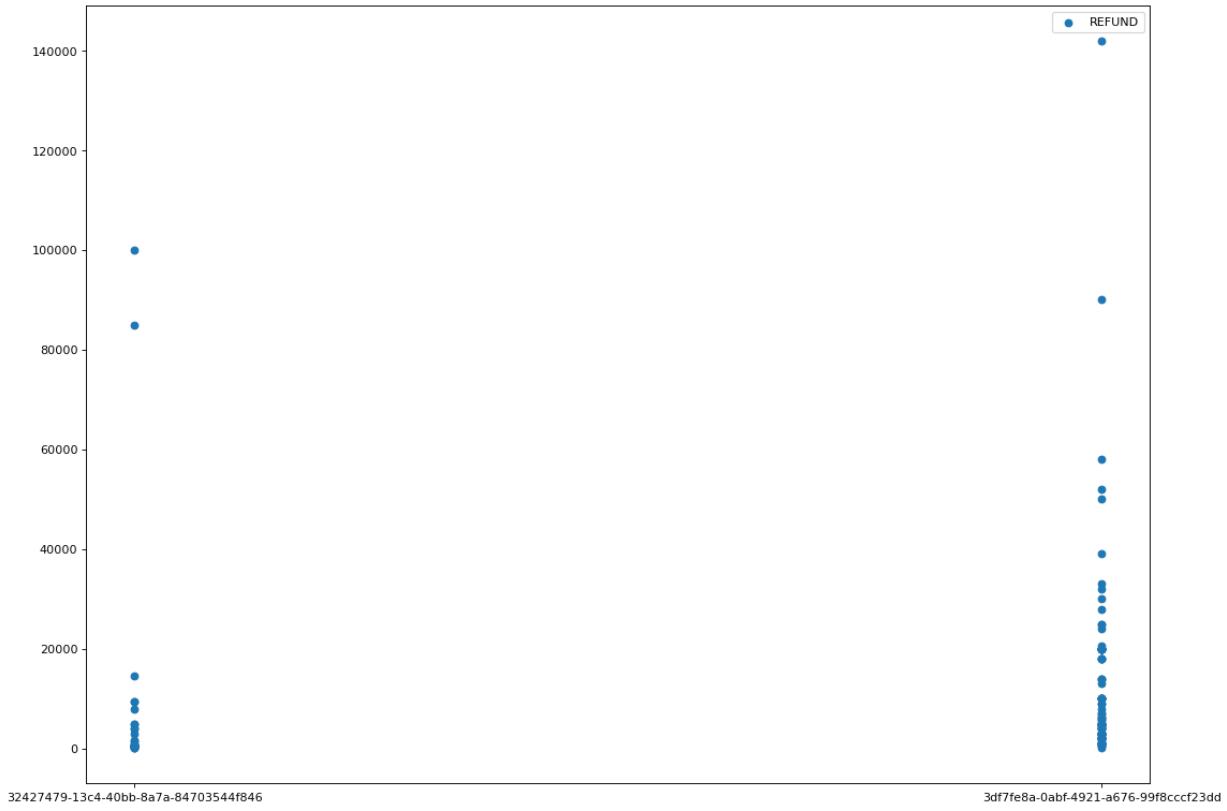


```
OTHER          243  
GROCERIES      1  
Name: externalParty.transactionCategory, dtype: int64
```



OTHER 41
Name: externalParty.transactionCategory, dtype: int64





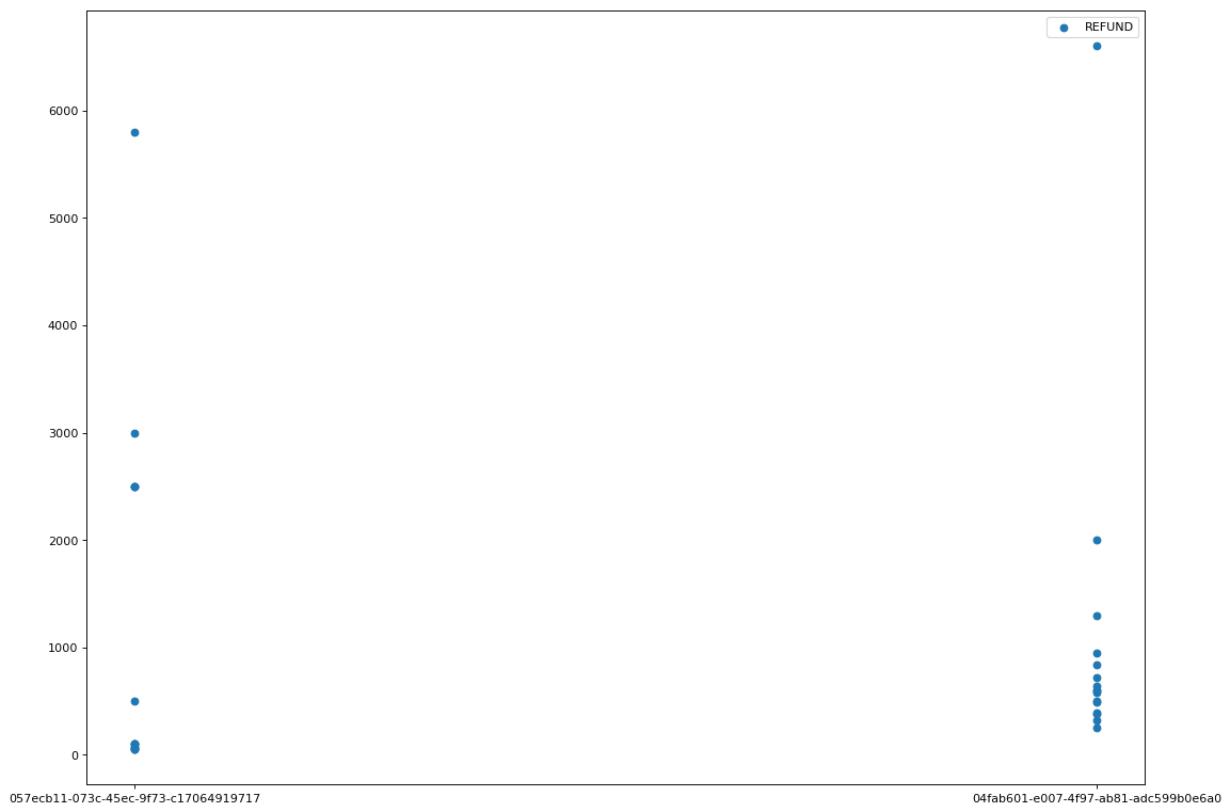
OTHER	104
LIFESTYLE	6
GROCERIES	5
SUBSCRIPTION	5
TRAVEL	4
SHOPPING	2

Name: externalParty.transactionCategory, dtype: int64



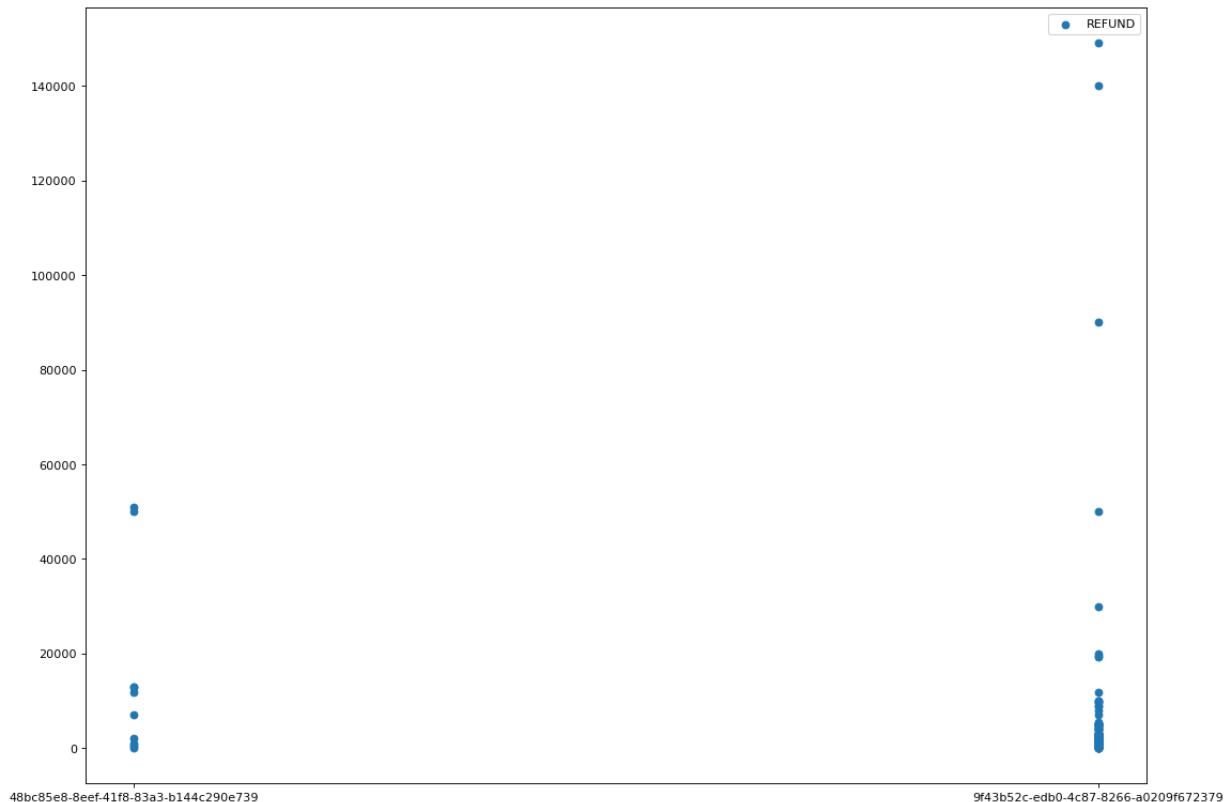
OTHER 80

LIFESTYLE 8
TRAVEL 5



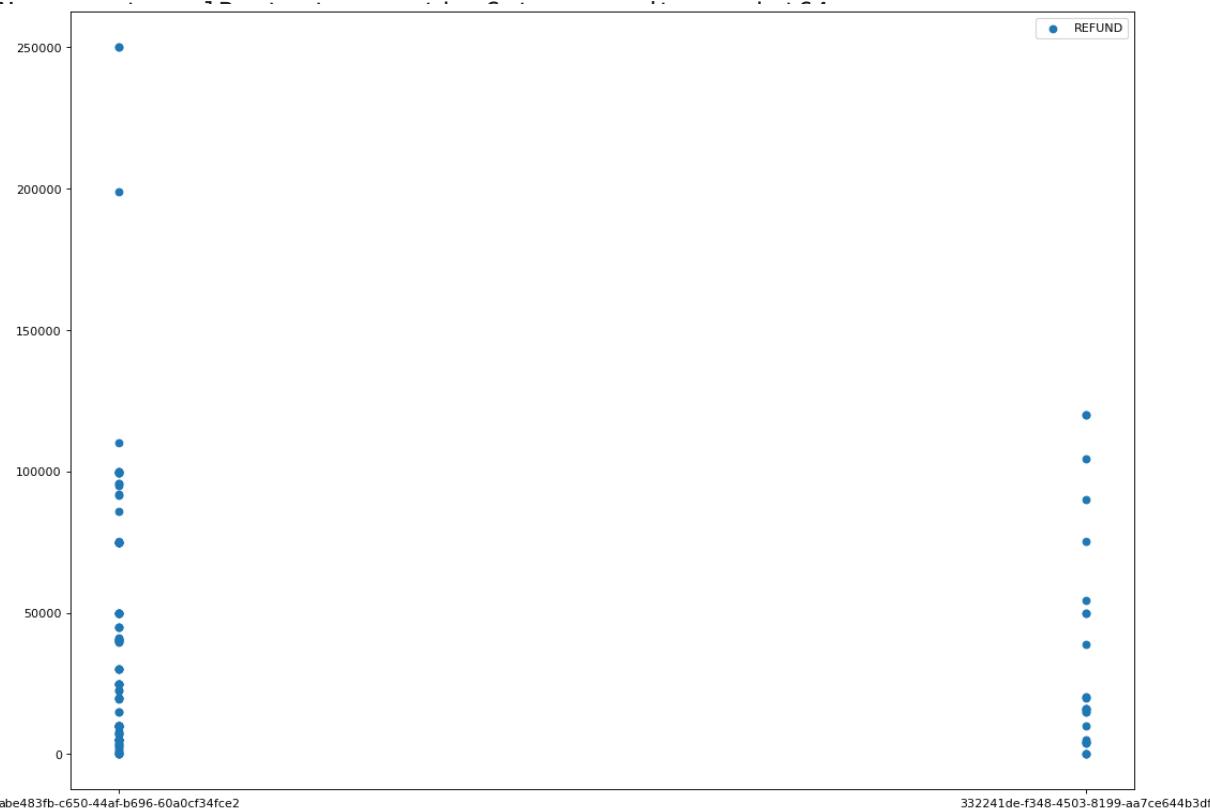
OTHER 16
SHOPPING 14

Name: externalParty.transactionCategory, dtype: int64



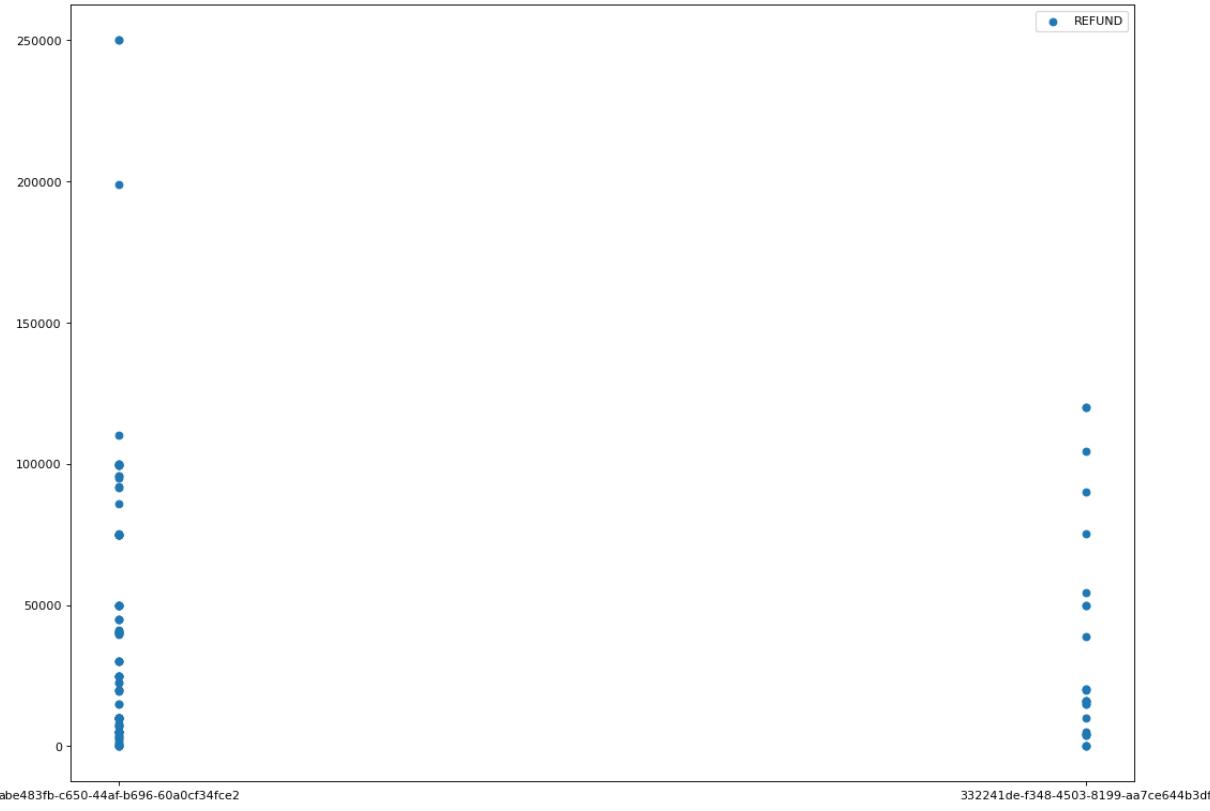
OTHER 92
GROCERIES 19
SHOPPING 17

LIFESTYLE 11
TRAVEL 8
SUBSCRIPTION 1



OTHER 130
TRAVEL 1

Name: externalParty.transactionCategory, dtype: int64

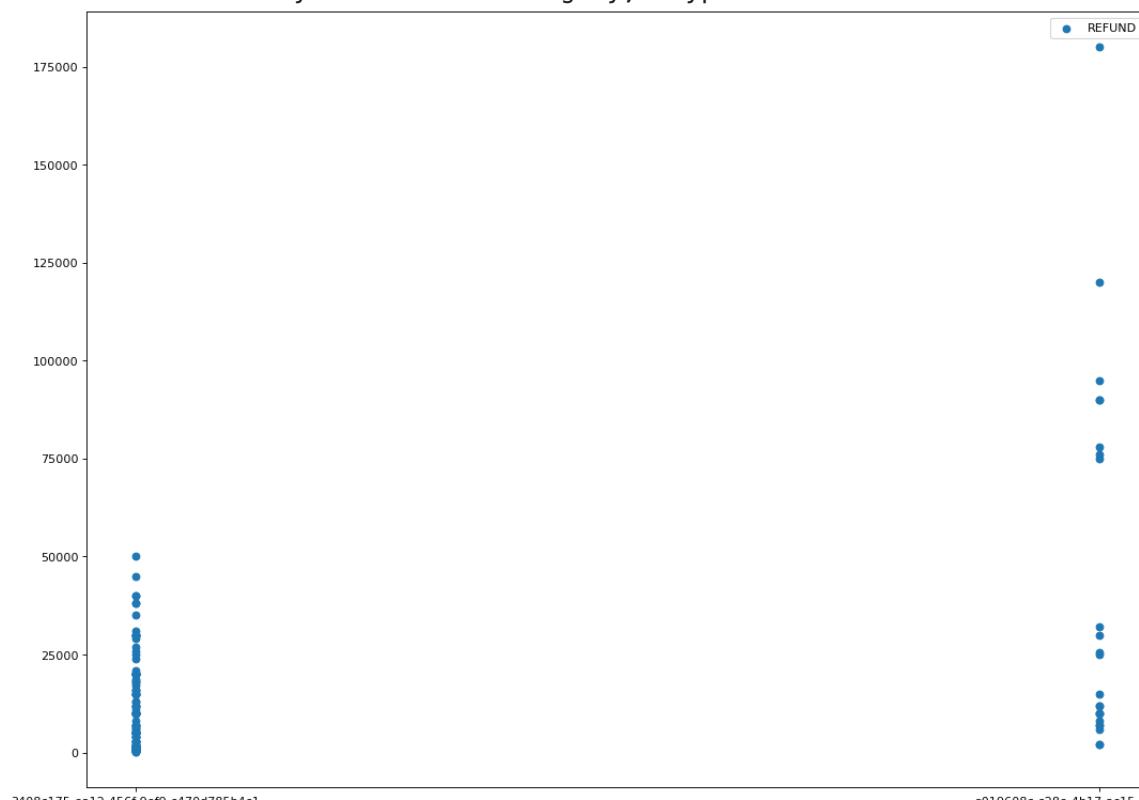


OTHER 130
TRAVEL 1



OTHER	195
GROCERIES	14
LIFESTYLE	9
TRAVEL	8
SUBSCRIPTION	5
SHOPPING	3

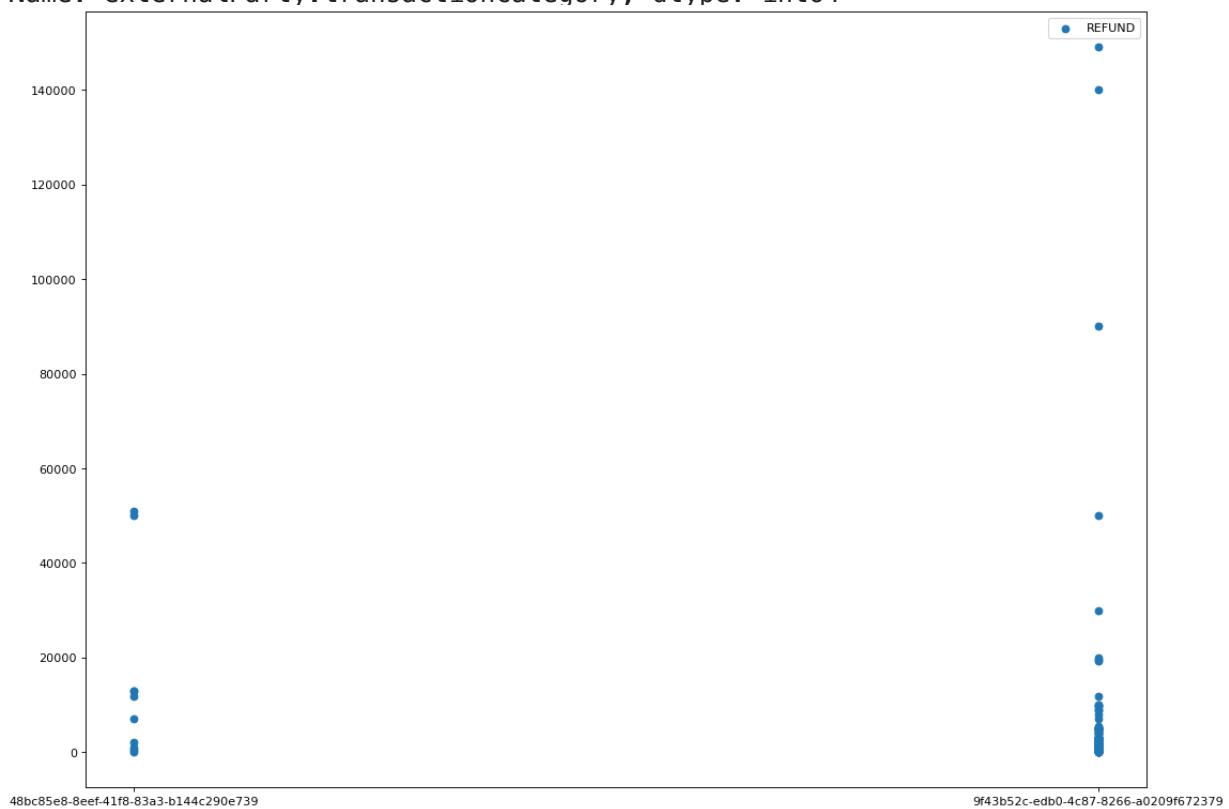
Name: externalParty.transactionCategory, dtype: int64



OTHER	104
-------	-----

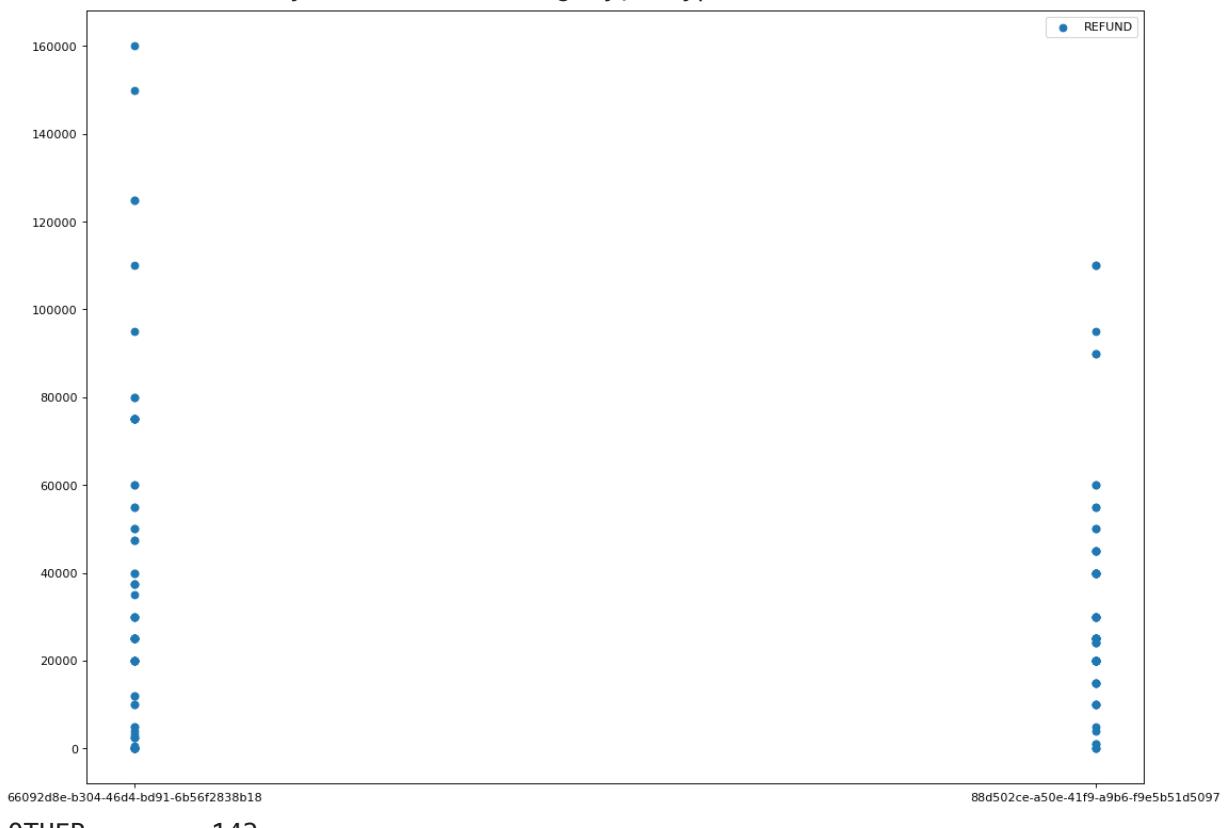
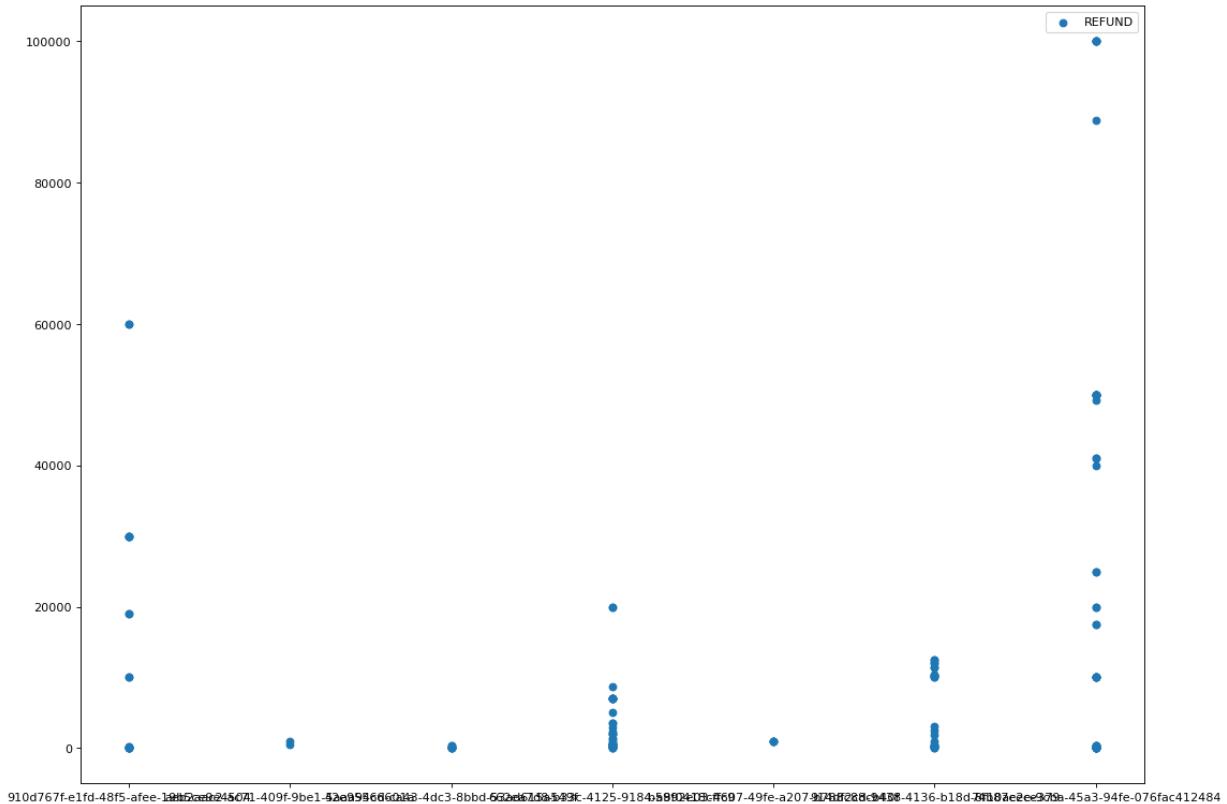
SHOPPING 18
TRAVEL 14
LIFESTYLE 11

Name: externalParty.transactionCategory, dtype: int64

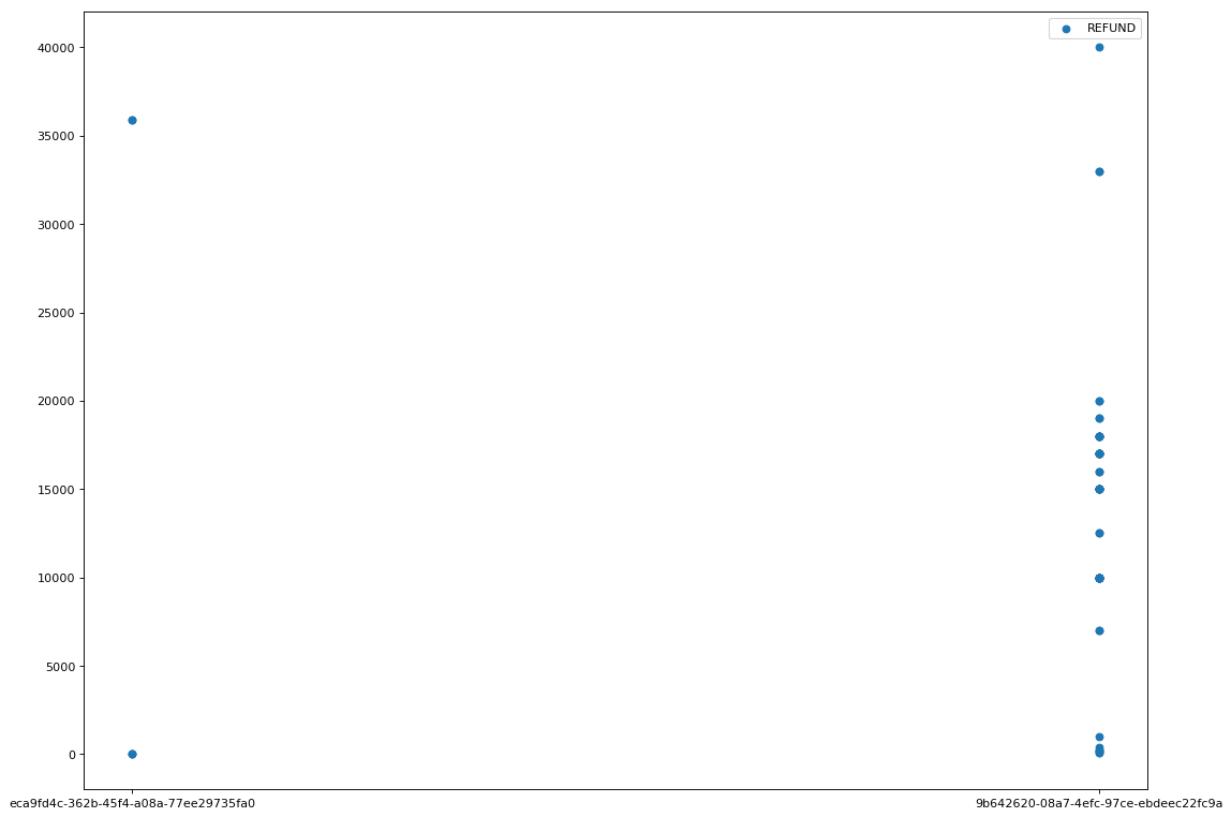


OTHER 92
GROCERIES 19
SHOPPING 17
LIFESTYLE 11
TRAVEL 8
SUBSCRIPTION 1

Name: externalParty.transactionCategory, dtype: int64

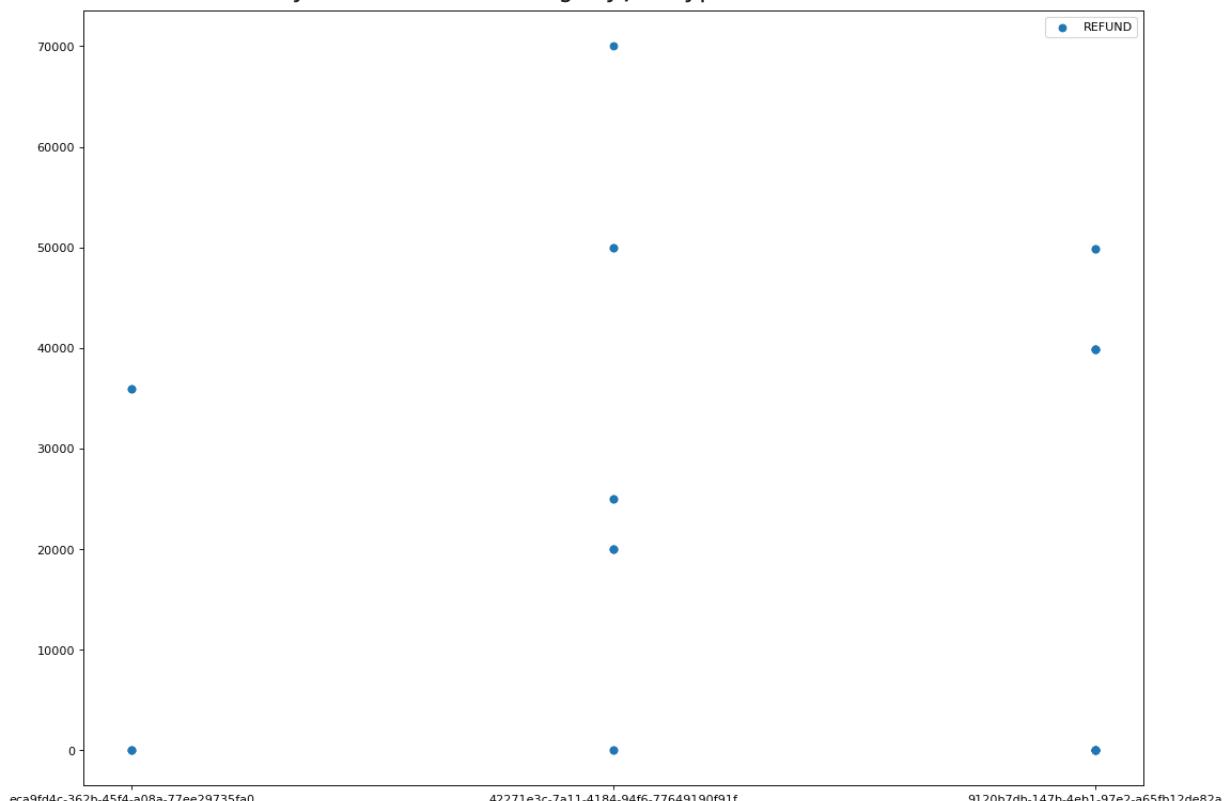


LIFESTYLE 1
TRAVEL 1



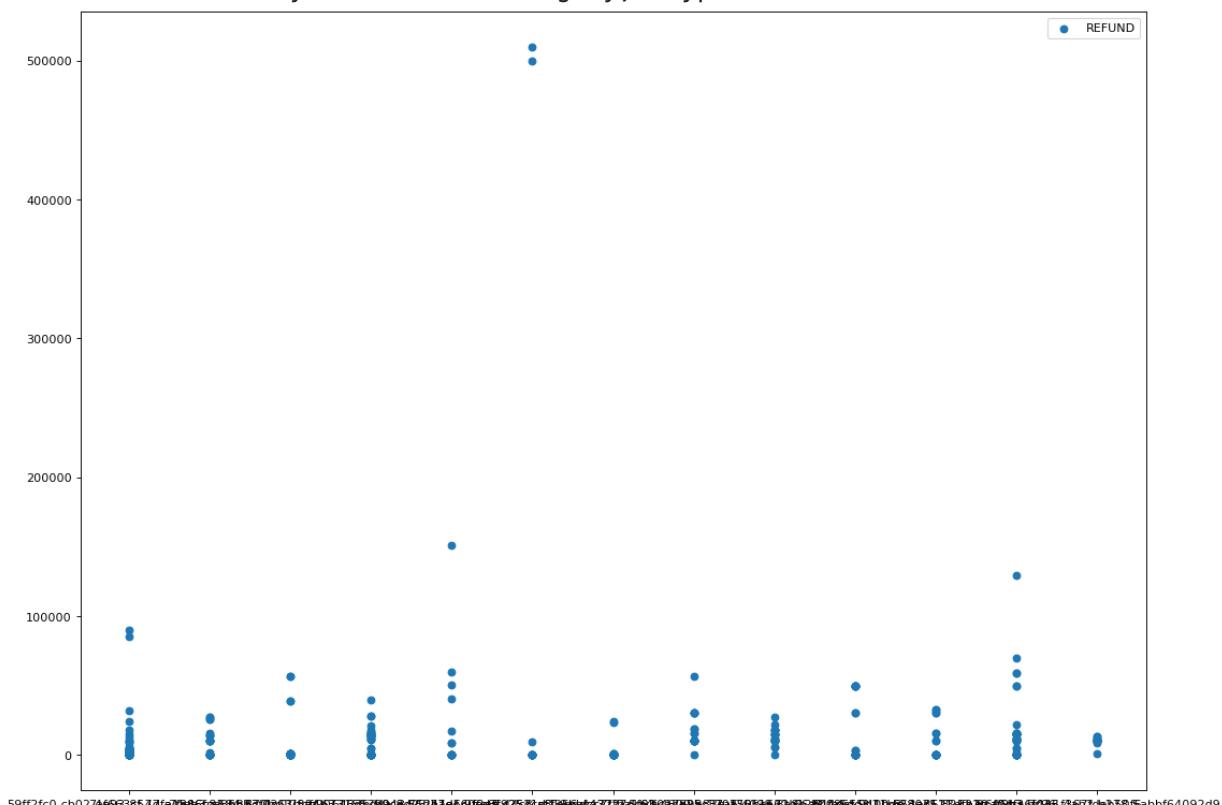
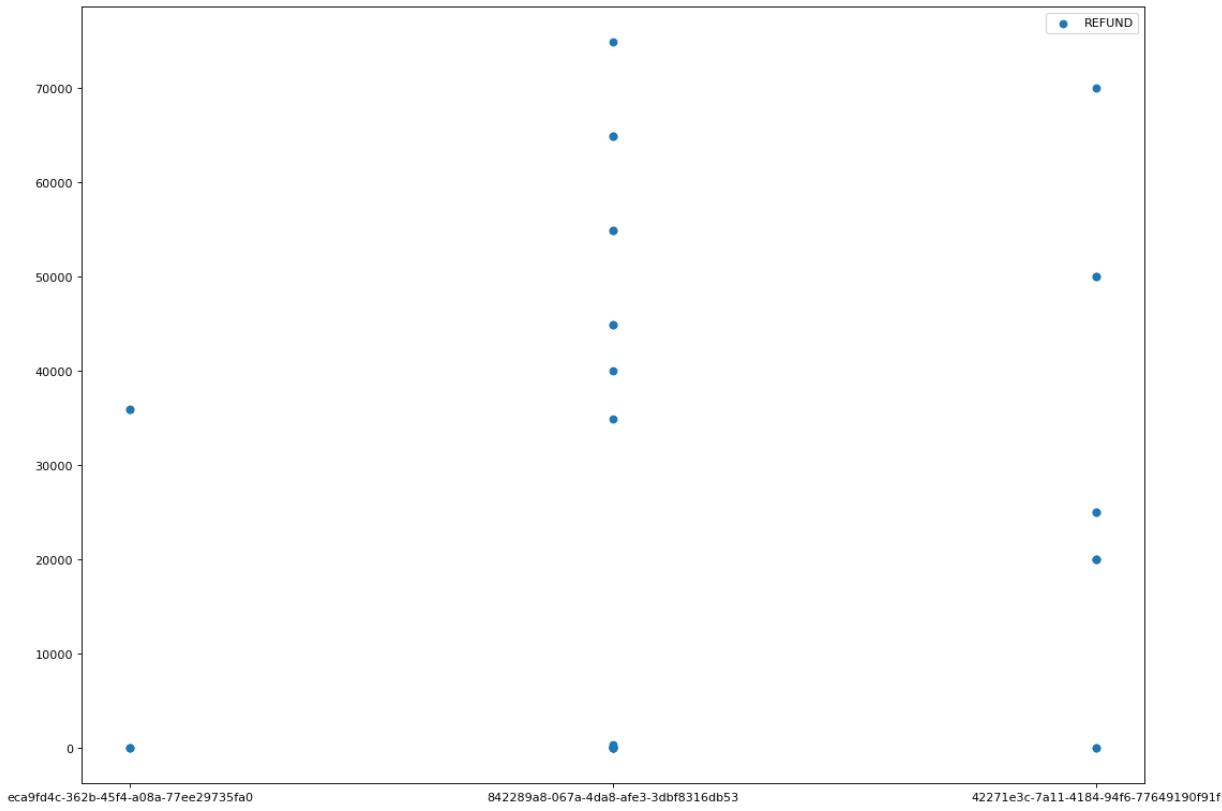
OTHER 65

Name: externalParty.transactionCategory, dtype: int64



OTHER 28

Name: externalParty.transactionCategory, dtype: int64



OTHER 319

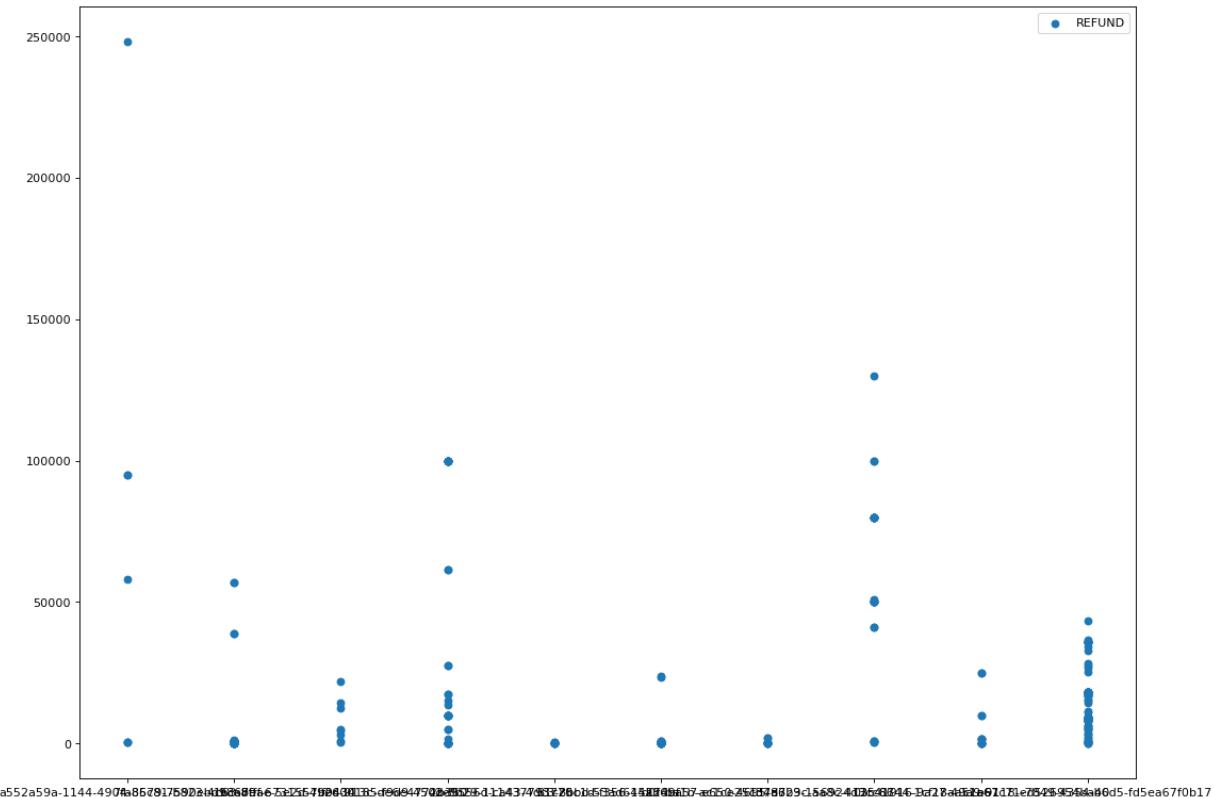
GROCERIES 25

TRAVEL 15

SHOPPING 10

LIFESTYLE 1

Name: externalParty.transactionCategory, dtype: int64

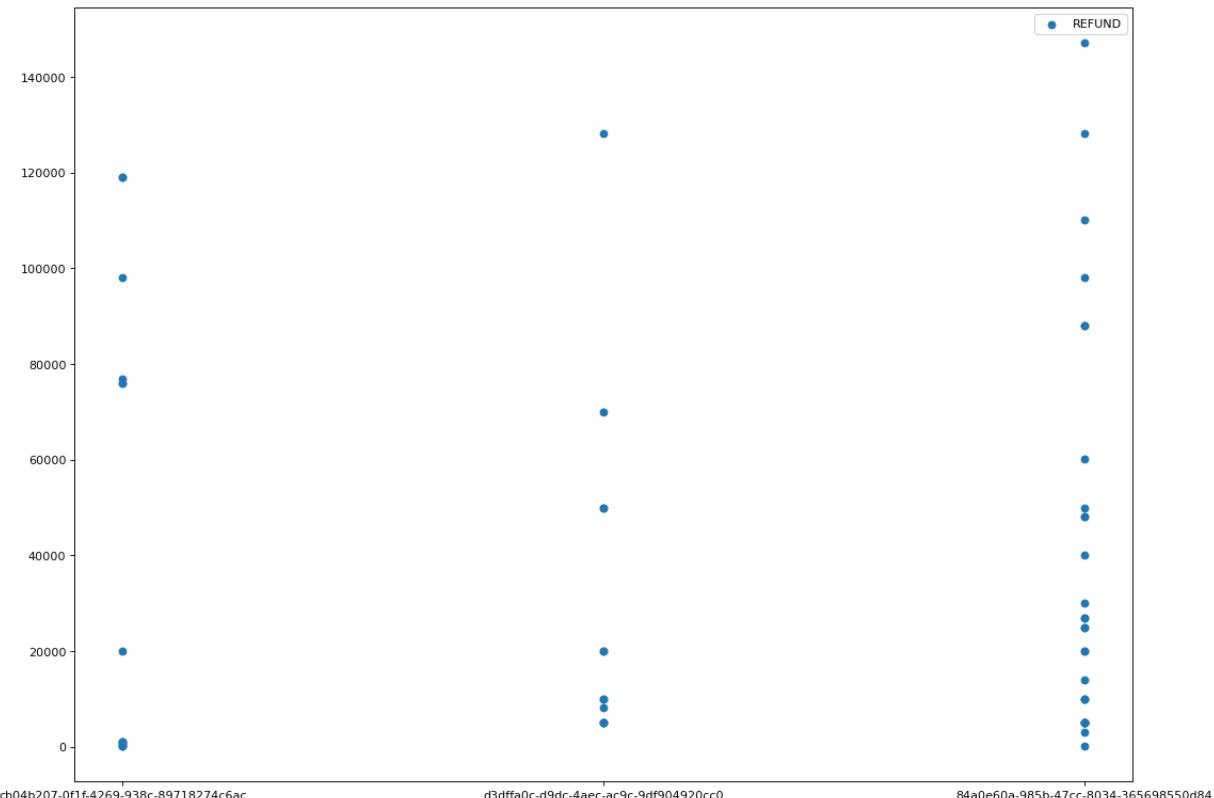


OTHER 245

SHOPPING 2

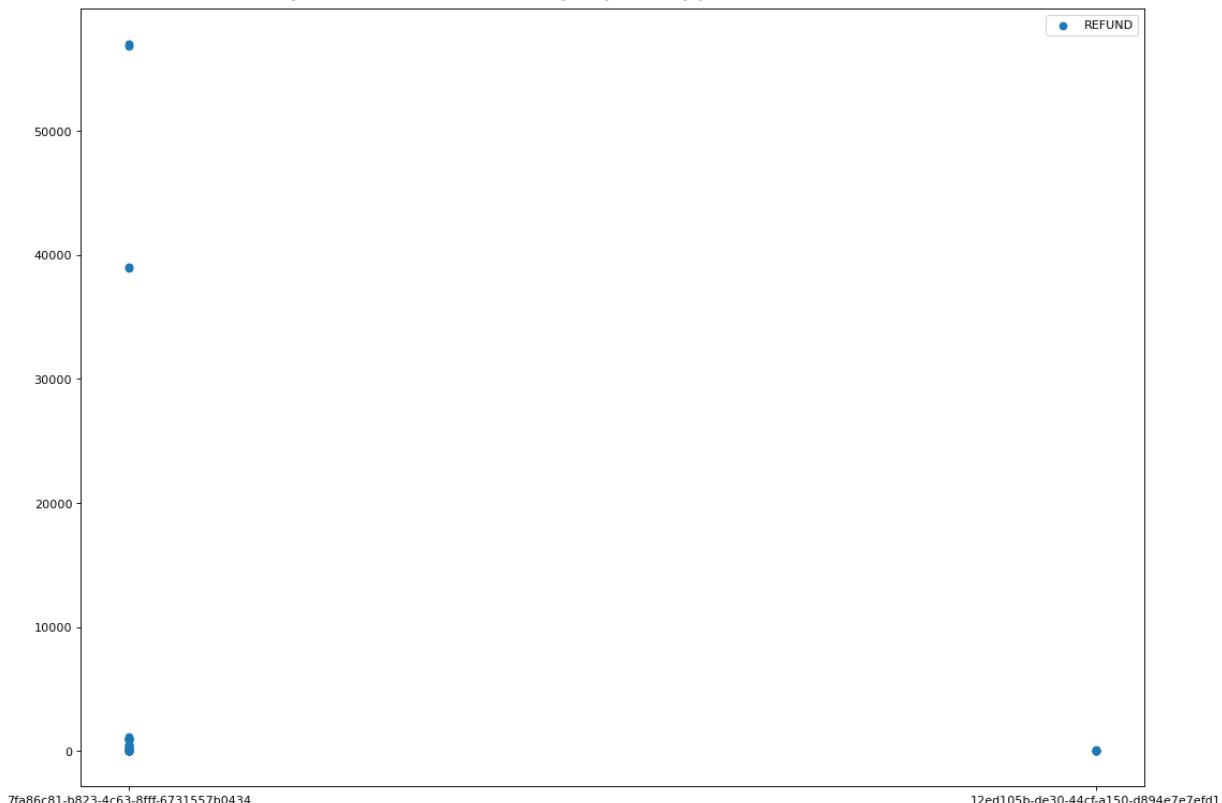
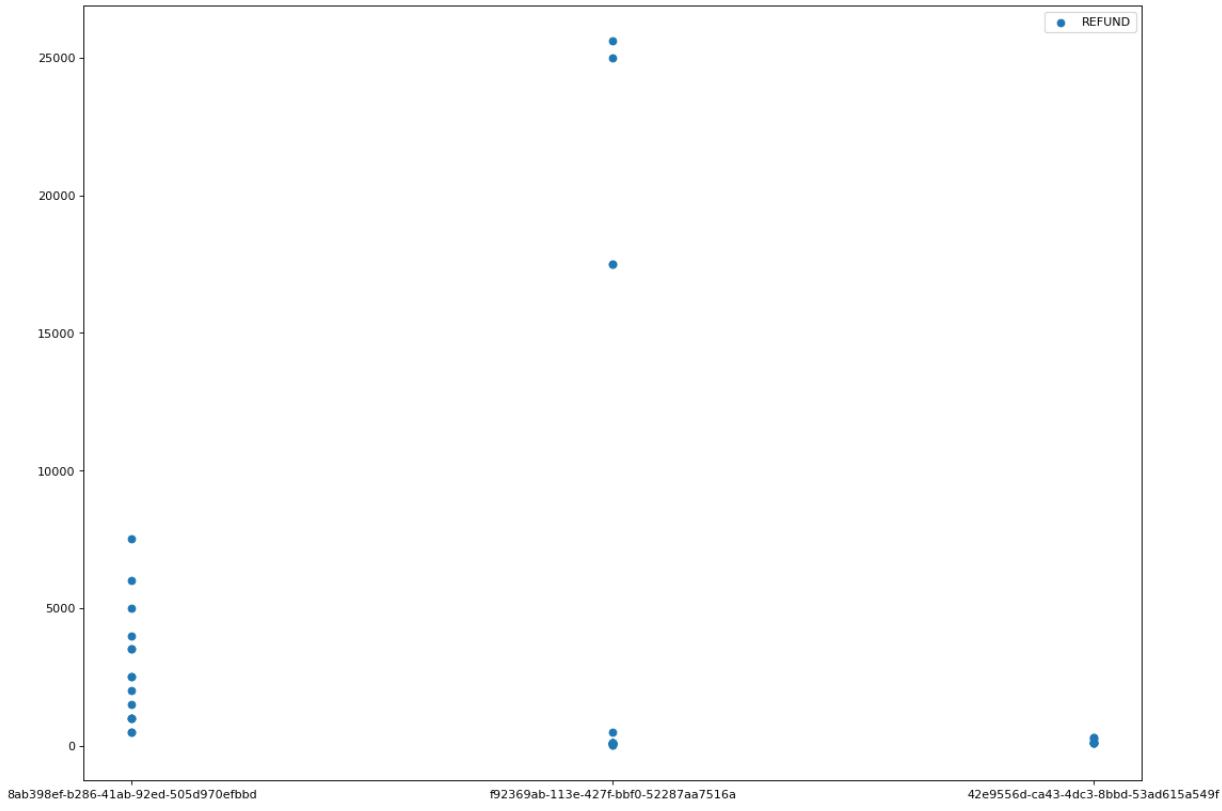
TRAVEL 2

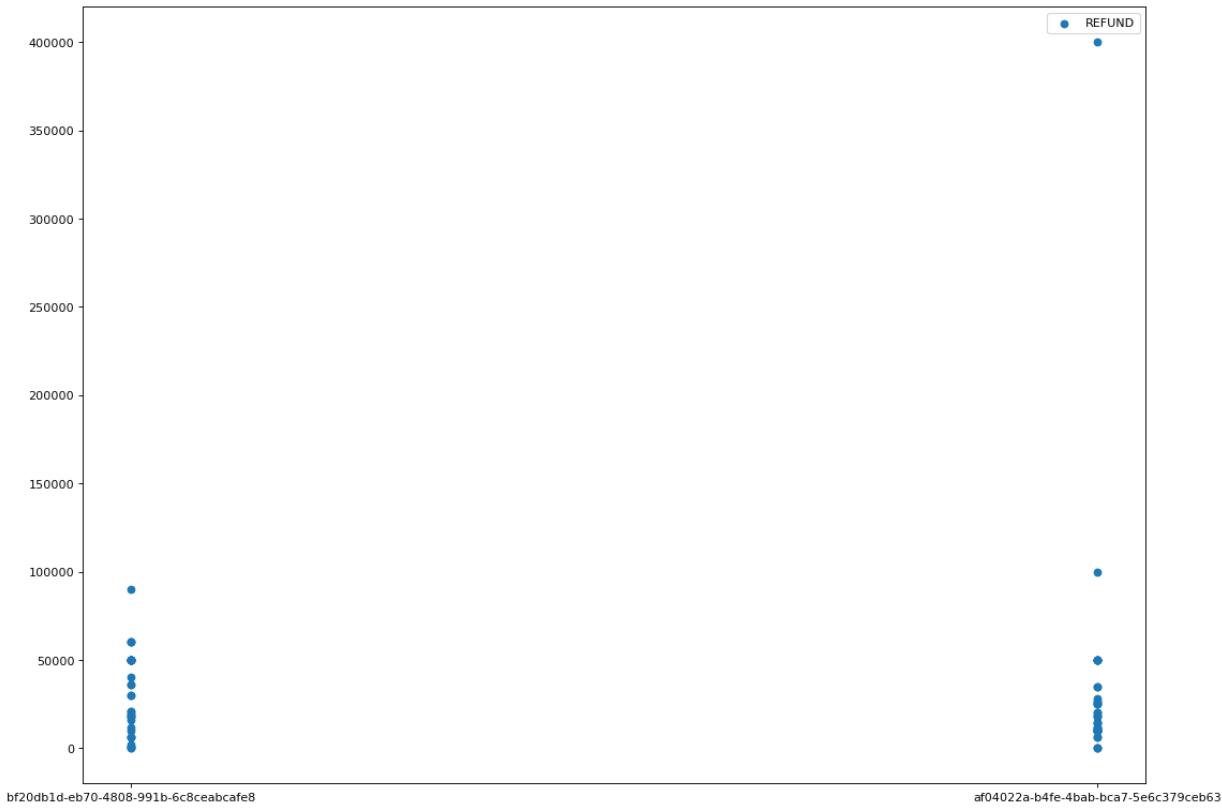
Name: externalParty.transactionCategory, dtype: int64



OTHER 57

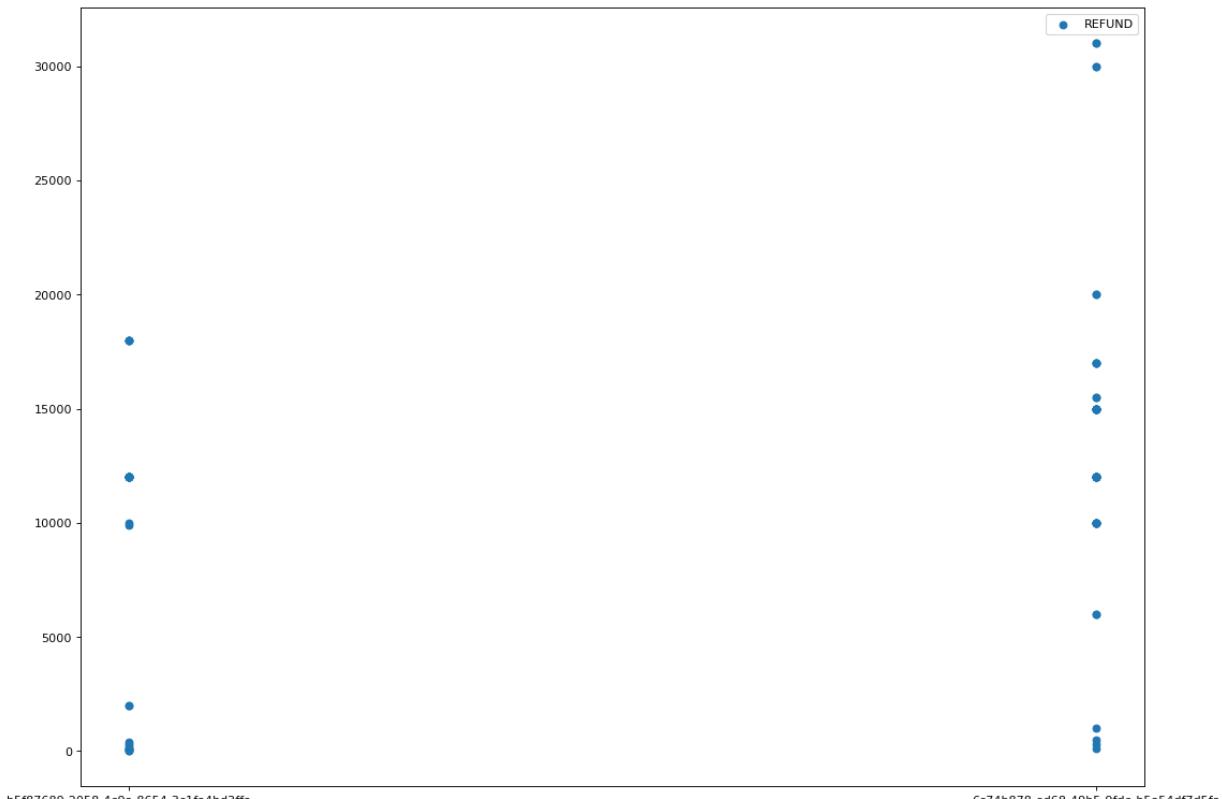
Name: externalParty.transactionCategory, dtype: int64





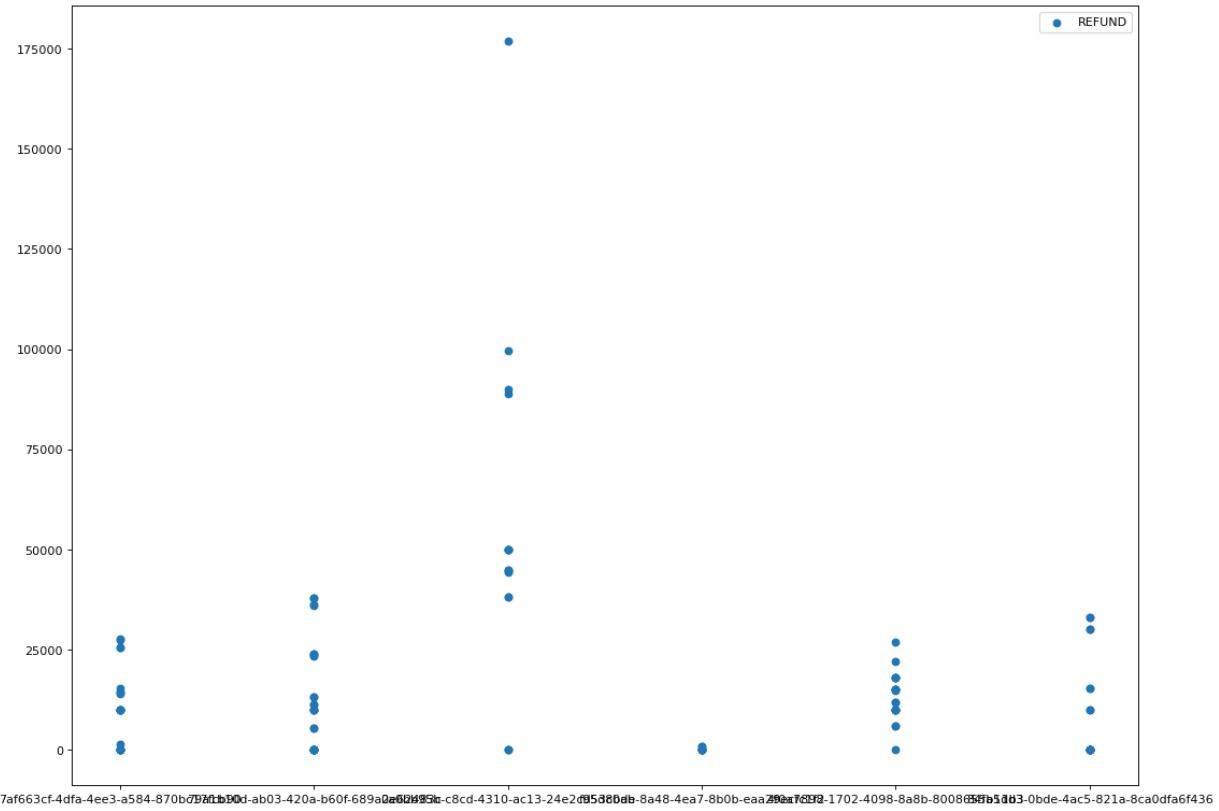
OTHER 75

Name: externalParty.transactionCategory, dtype: int64



OTHER 81

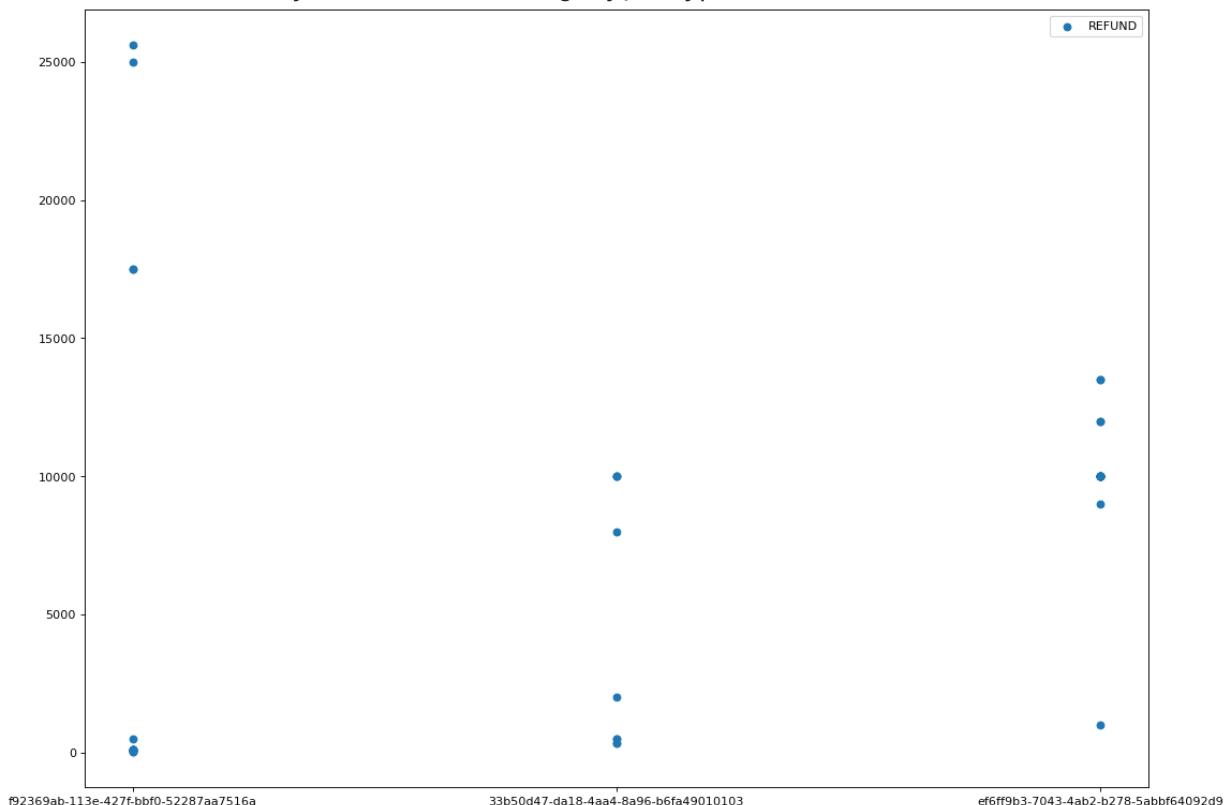
Name: externalParty.transactionCategory, dtype: int64



OTHER

117

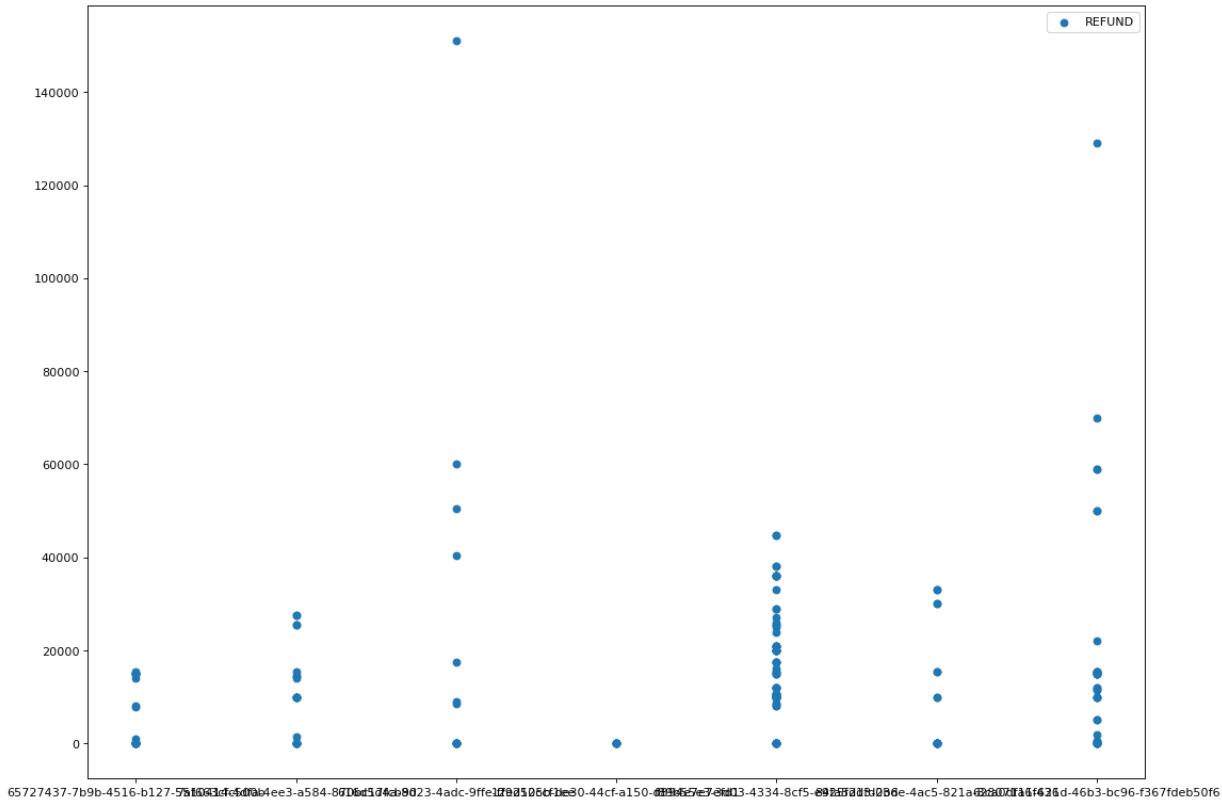
Name: externalParty.transactionCategory, dtype: int64



OTHER

42

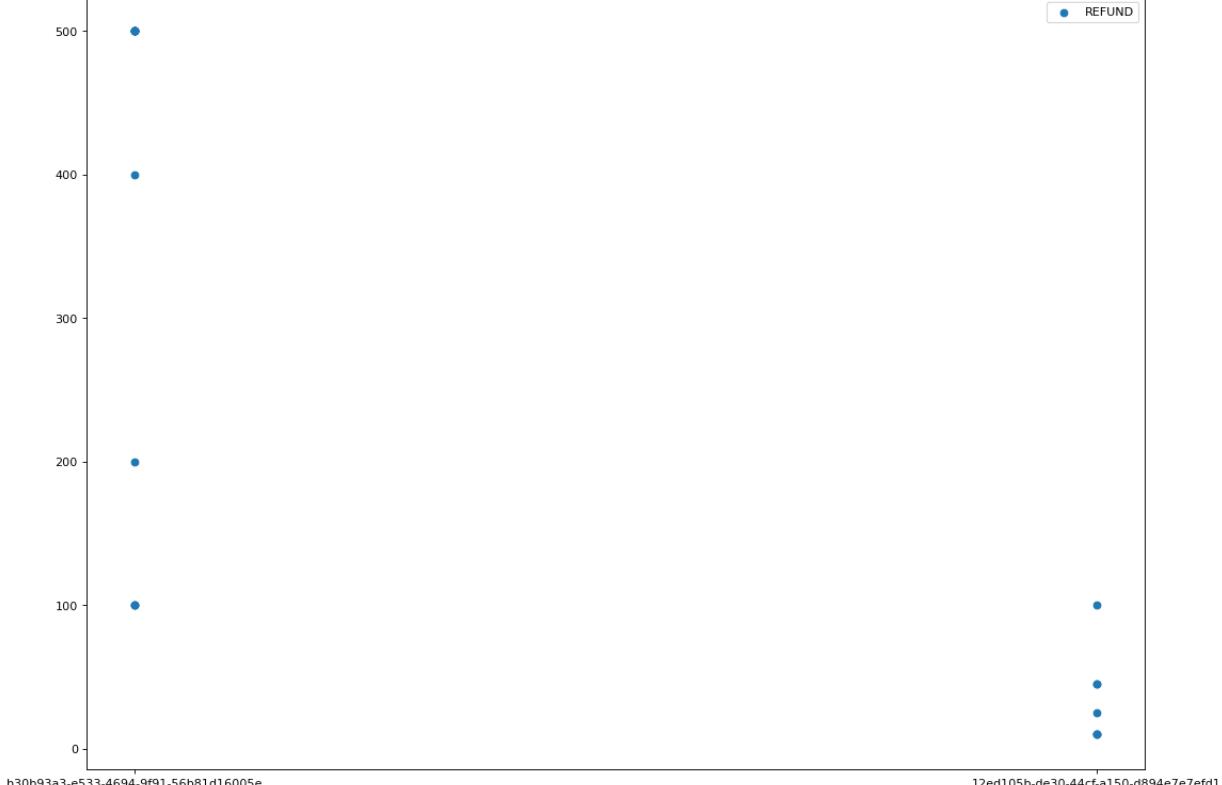
Name: externalParty.transactionCategory, dtype: int64



65727437-7b9b-4516-b127-5510d3cfefab4ee3-a584-8606d174ab9023-4adc-9ffe1f7e81056fb80-44cf-a150-48957e7a13-4334-8cf5-0929881086e-4ac5-821a6280d1a6f428d-46b3-bc96-f367fdb50f6

OTHER 211

Name: externalParty.transactionCategory, dtype: int64

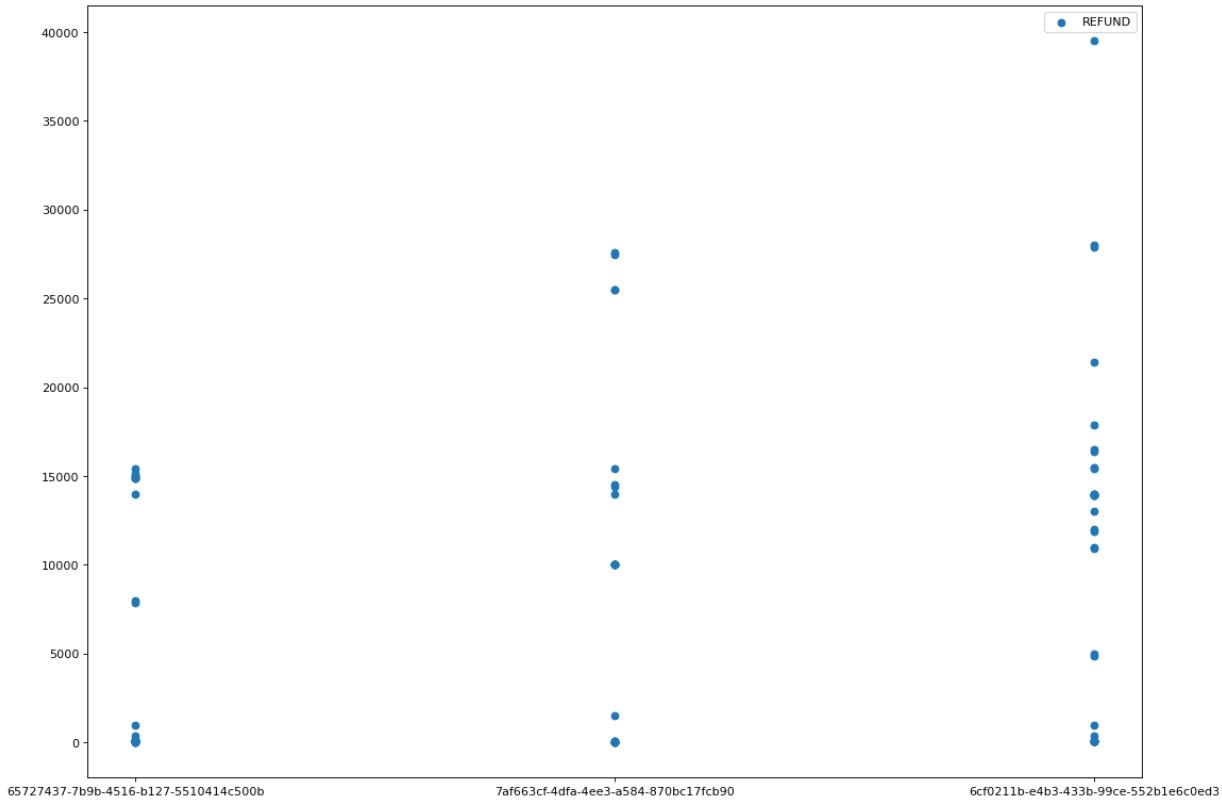


b30b93a3-e533-4694-9f91-56b81d16005e

12ed105b-de30-44cf-a150-d894e7e7efd1

OTHER 19

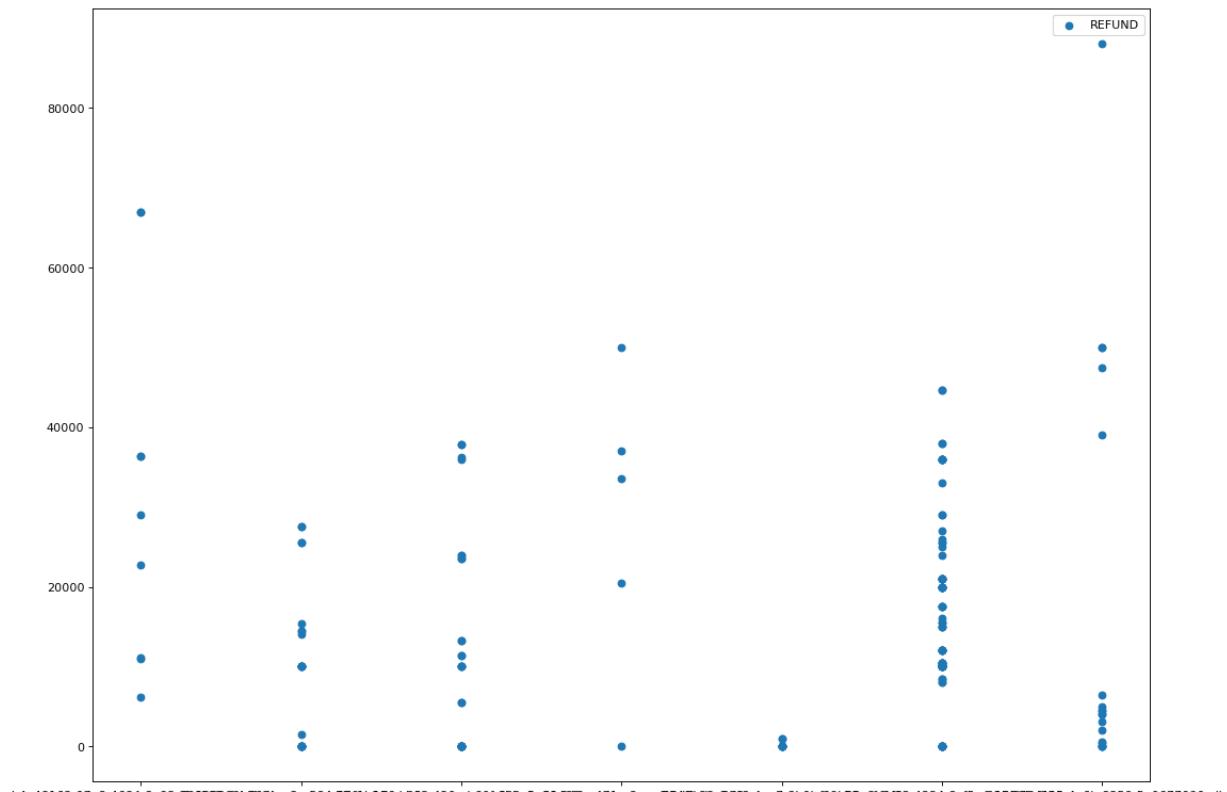
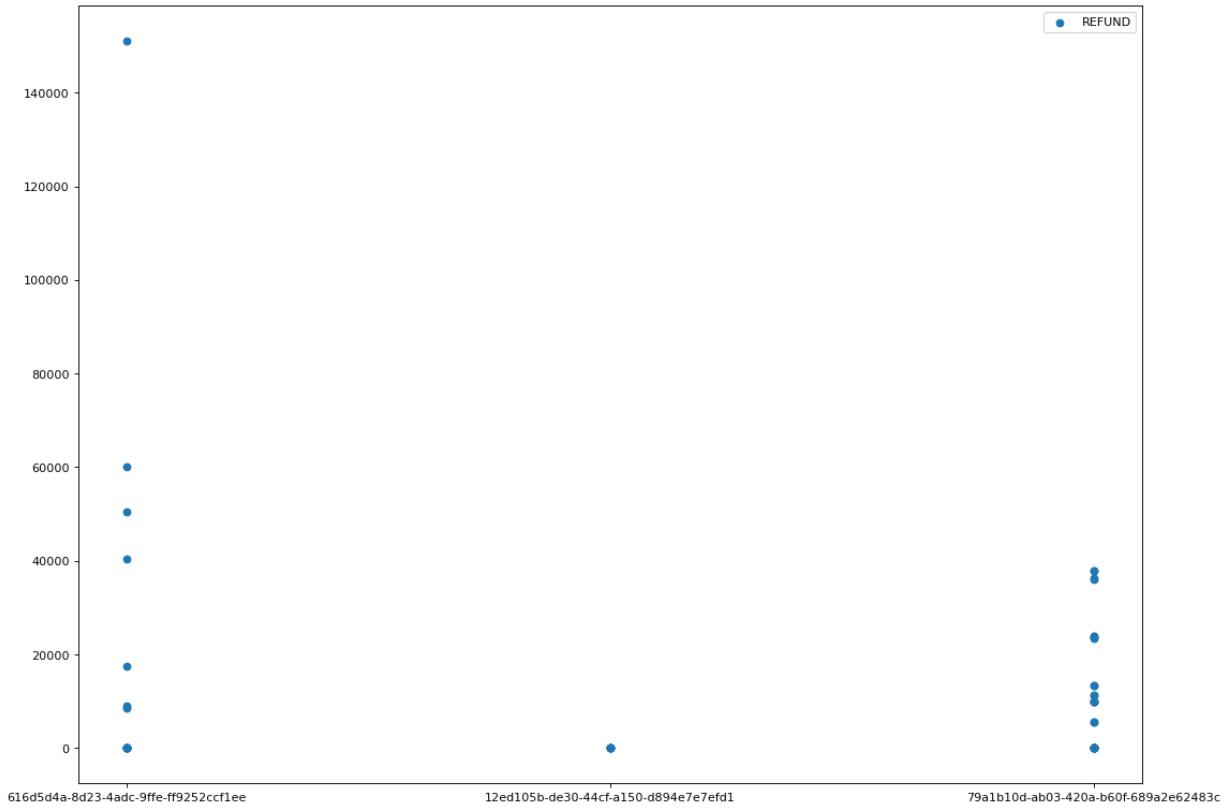
Name: externalParty.transactionCategory, dtype: int64

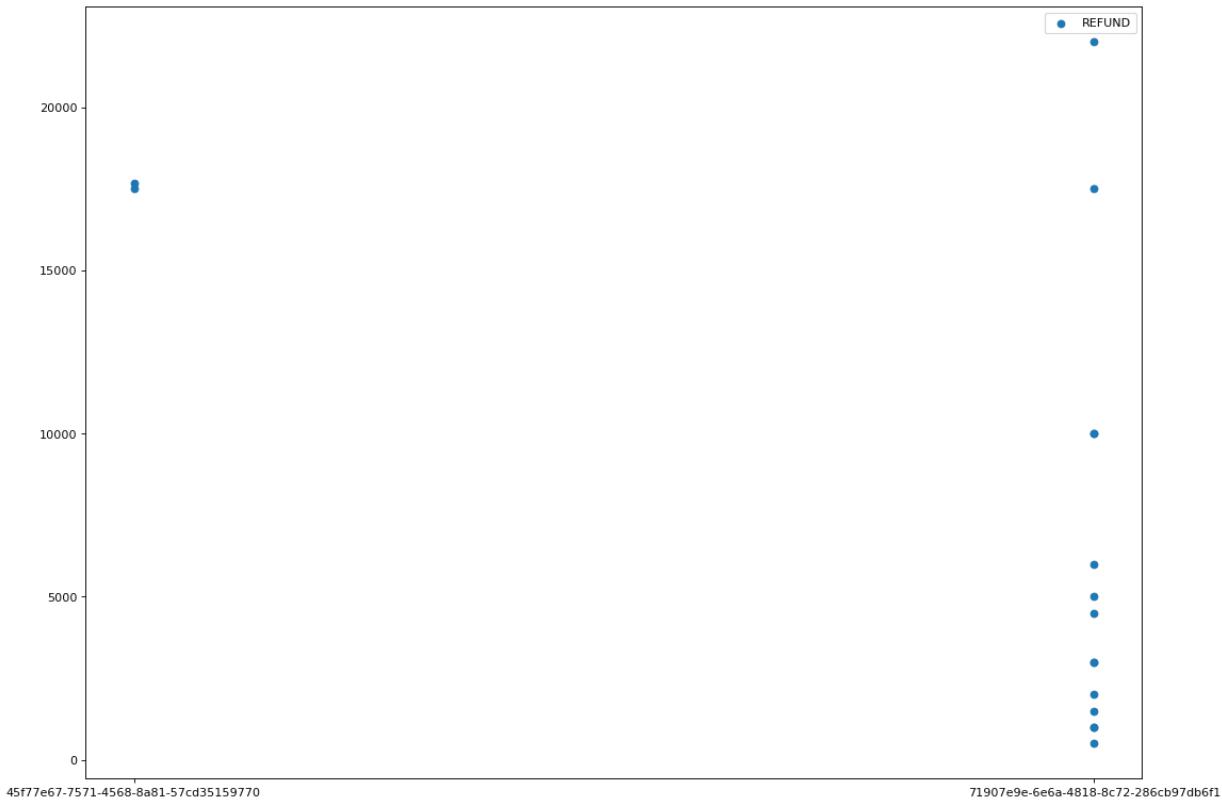


OTHER 94
Name: externalParty.transactionCategory, dtype: int64

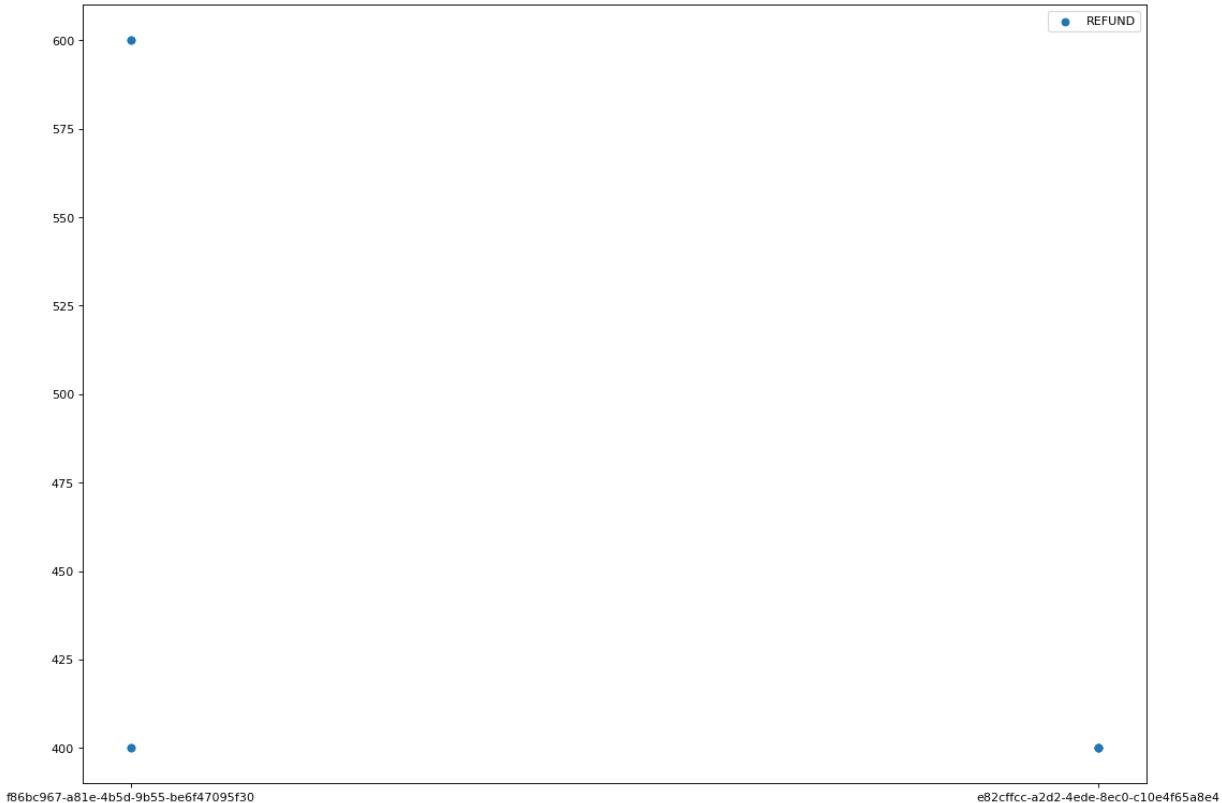


OTHER 10
Name: externalParty.transactionCategory, dtype: int64

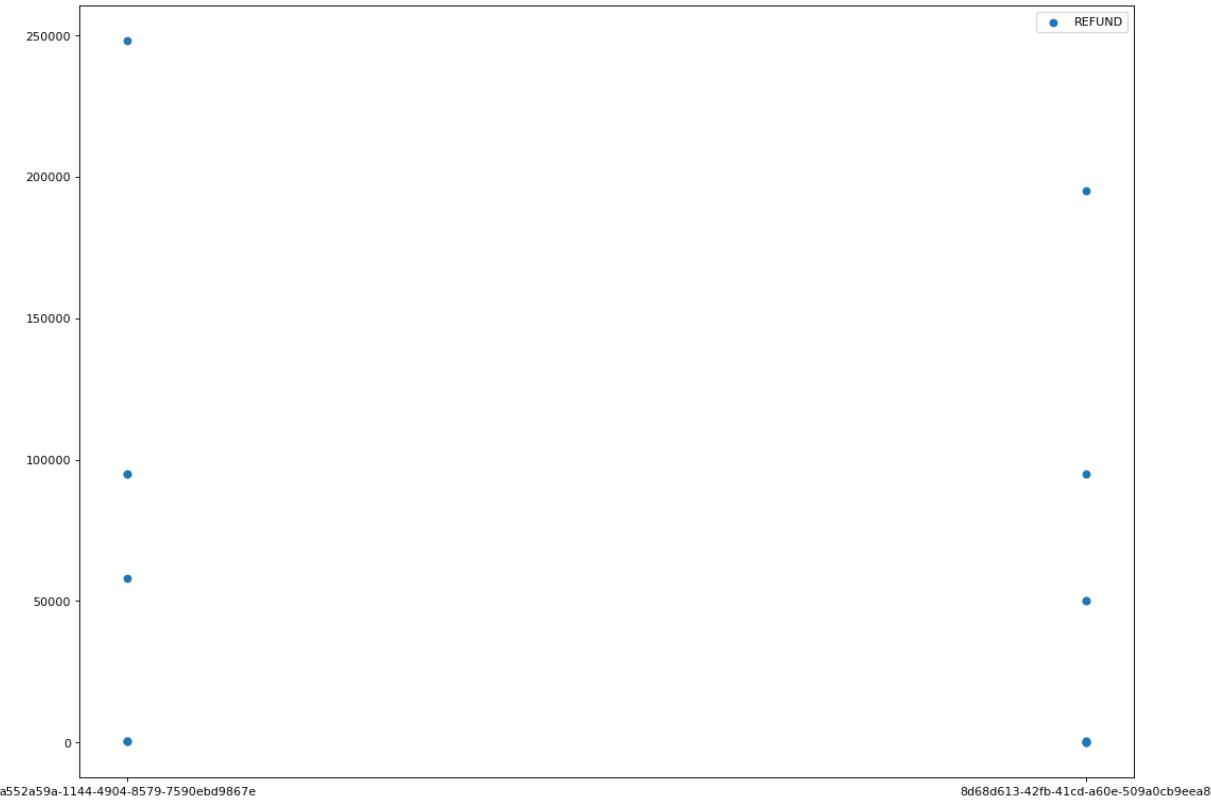




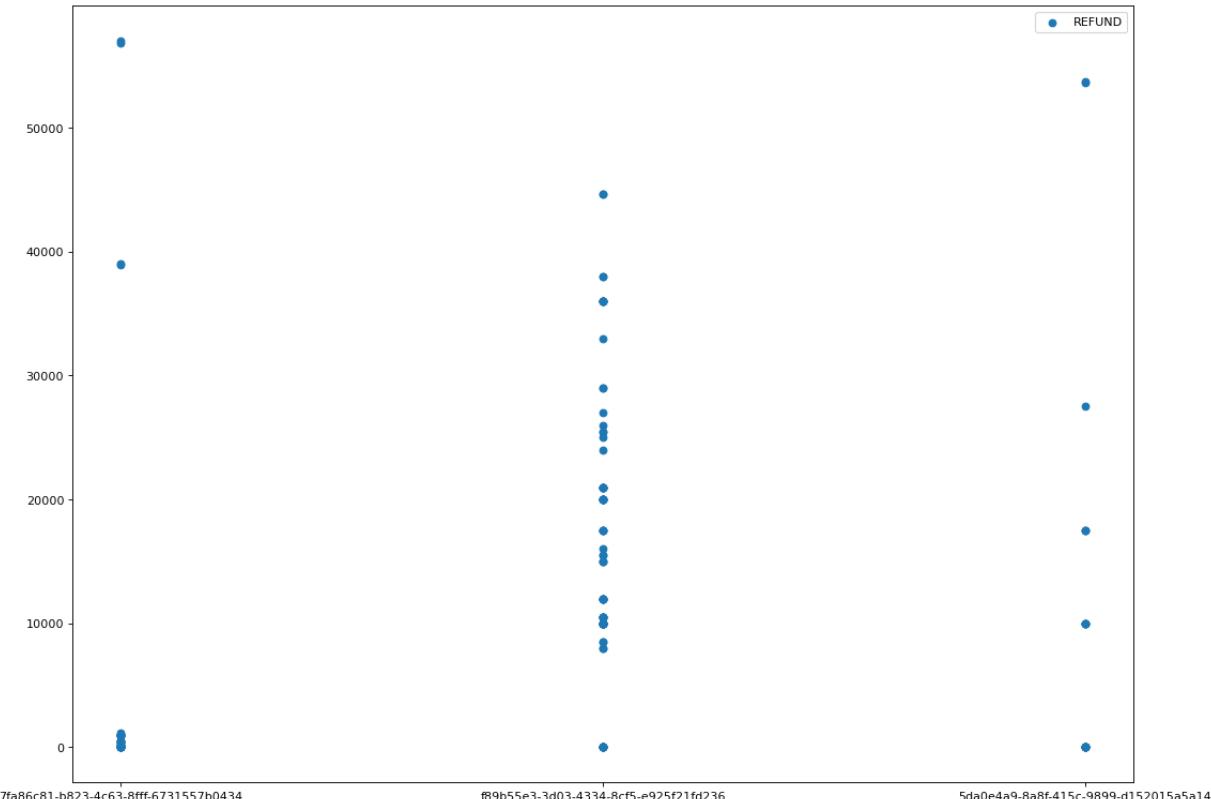
OTHER 16
Name: externalParty.transactionCategory, dtype: int64



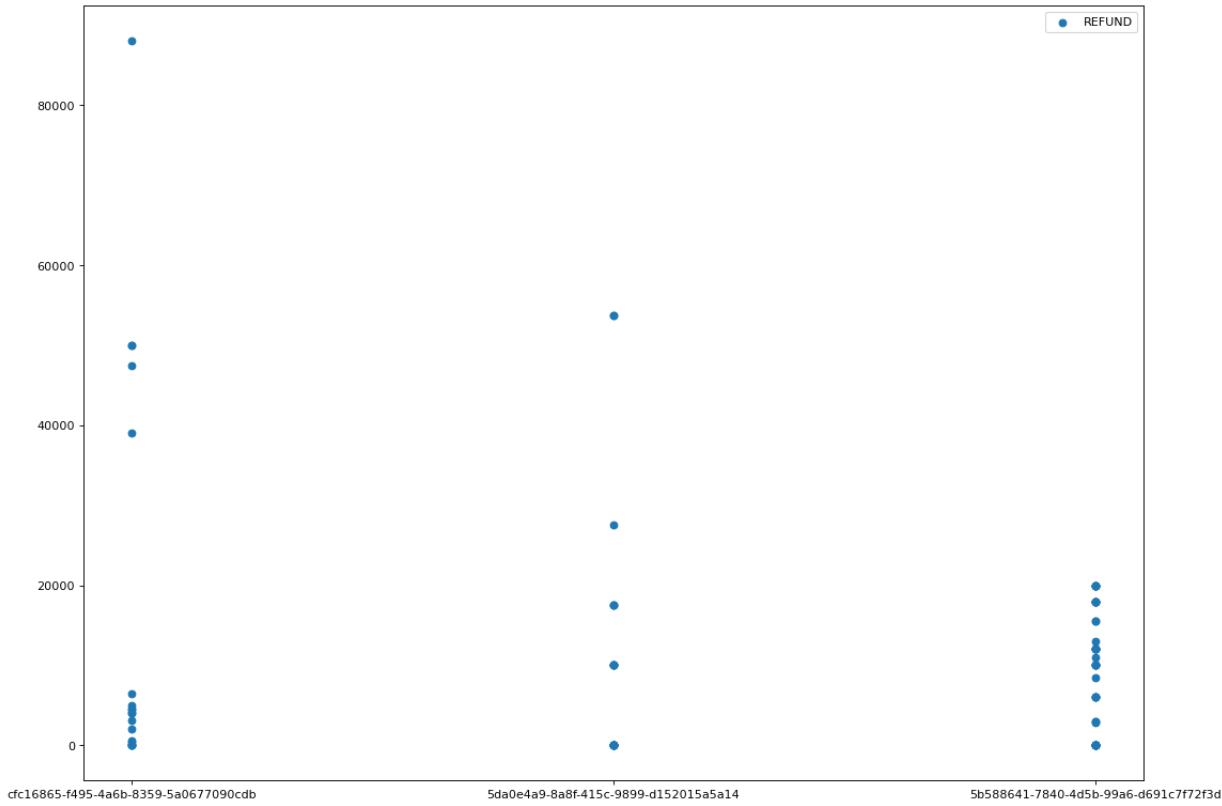
OTHER 8
Name: externalParty.transactionCategory, dtype: int64



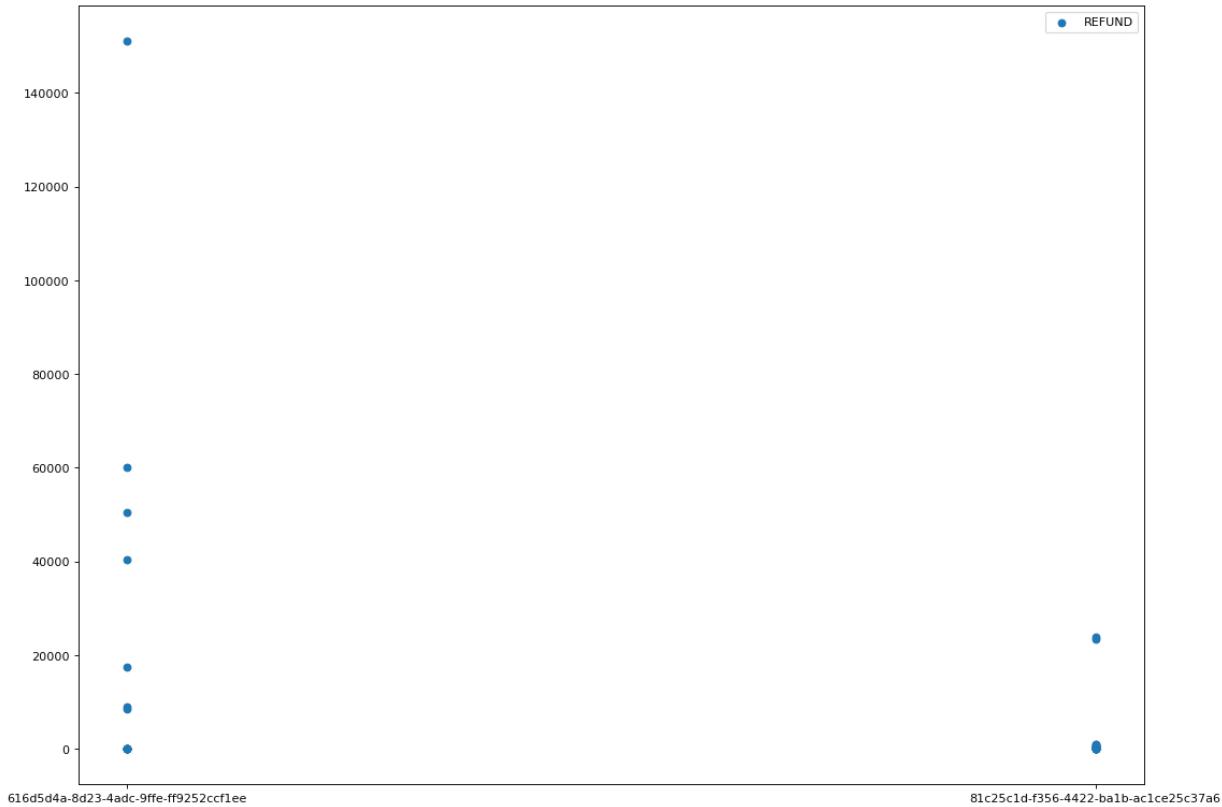
OTHER 16
Name: externalParty.transactionCategory, dtype: int64



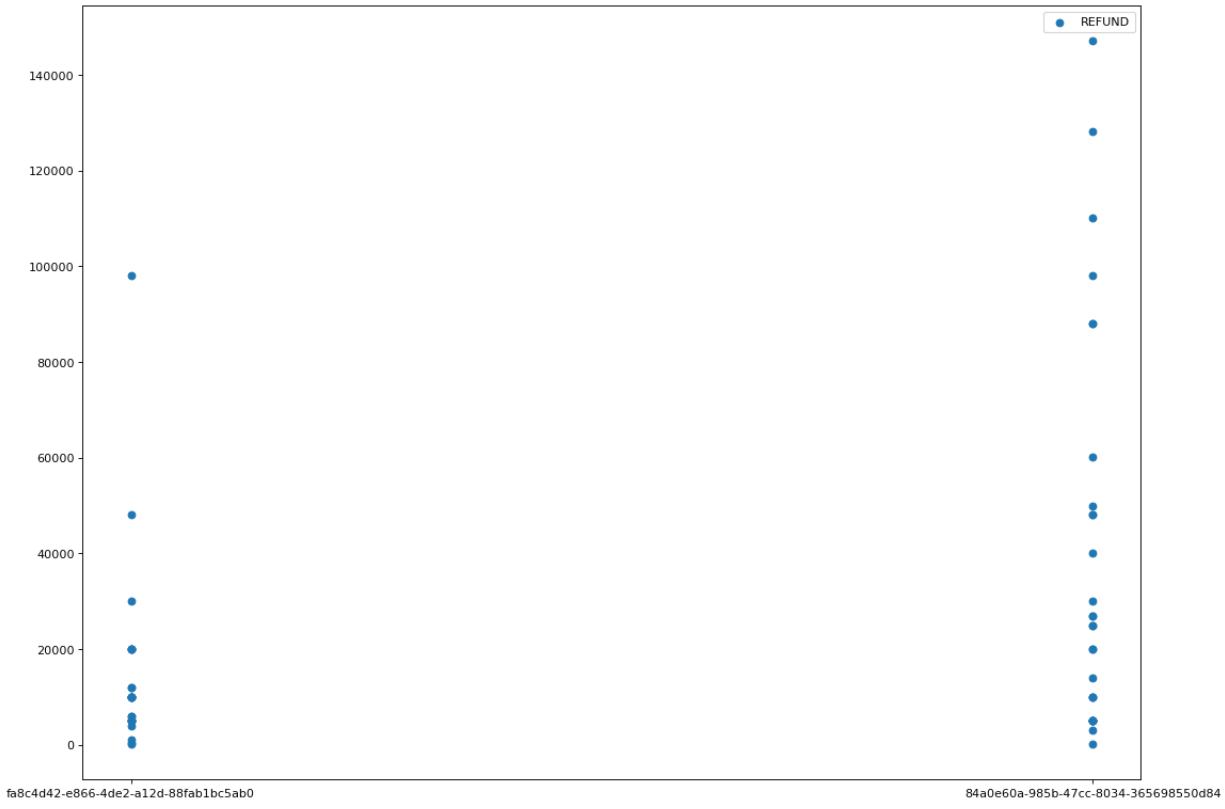
OTHER 147
SHOPPING 2
TRAVEL 2
Name: externalParty.transactionCategory, dtype: int64



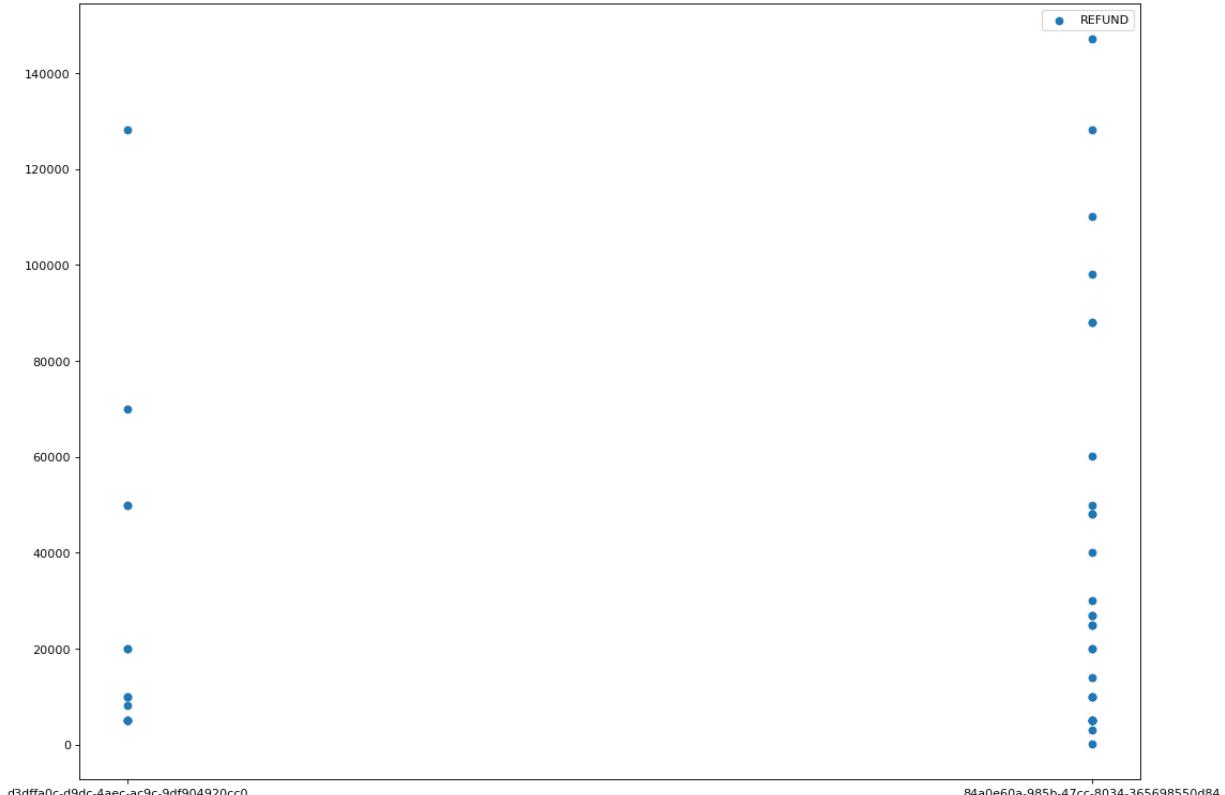
OTHER 87
Name: externalParty.transactionCategory, dtype: int64



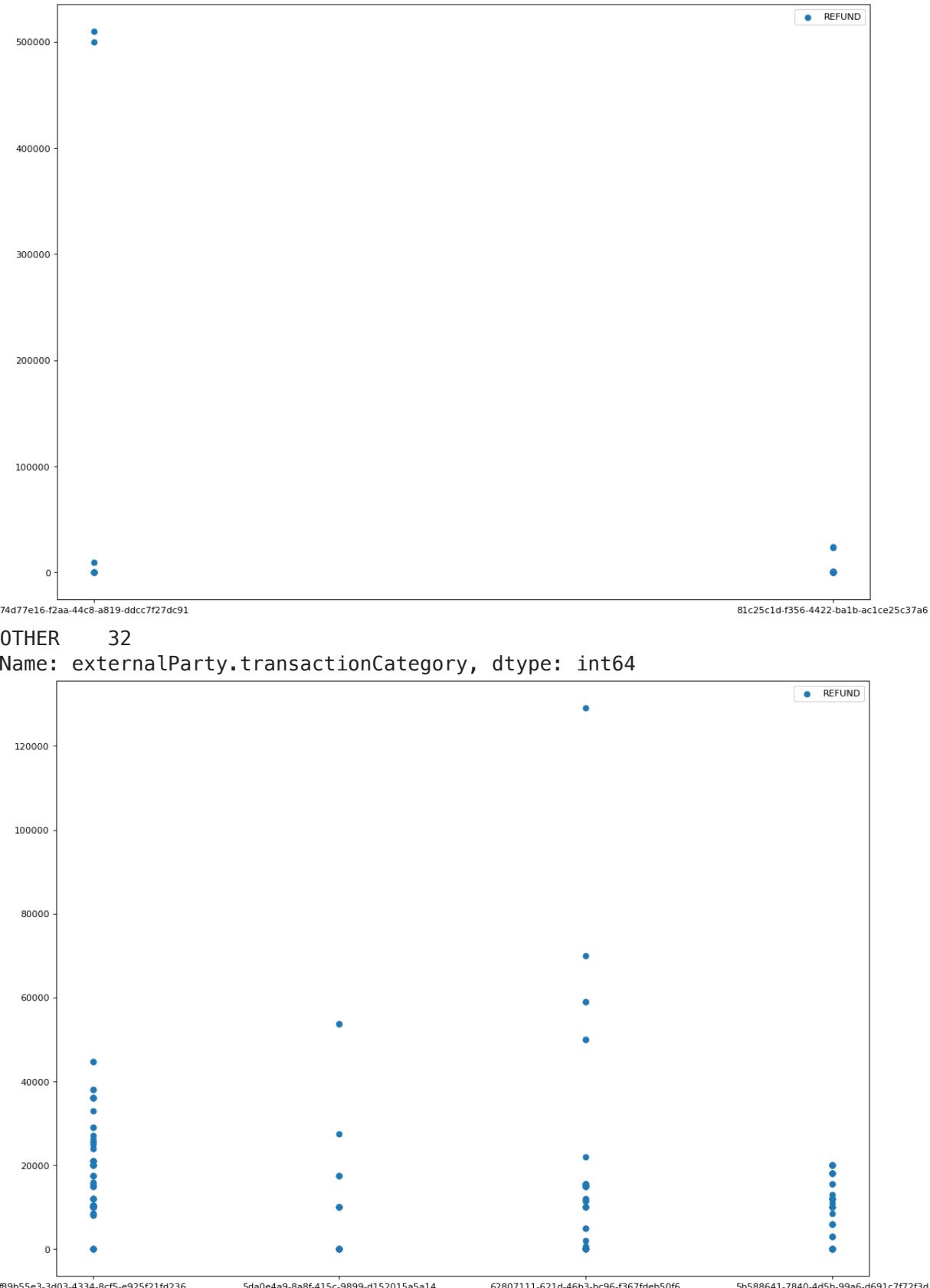
OTHER 36
Name: externalParty.transactionCategory, dtype: int64



OTHER 56
Name: externalParty.transactionCategory, dtype: int64



OTHER 43
Name: externalParty.transactionCategory, dtype: int64



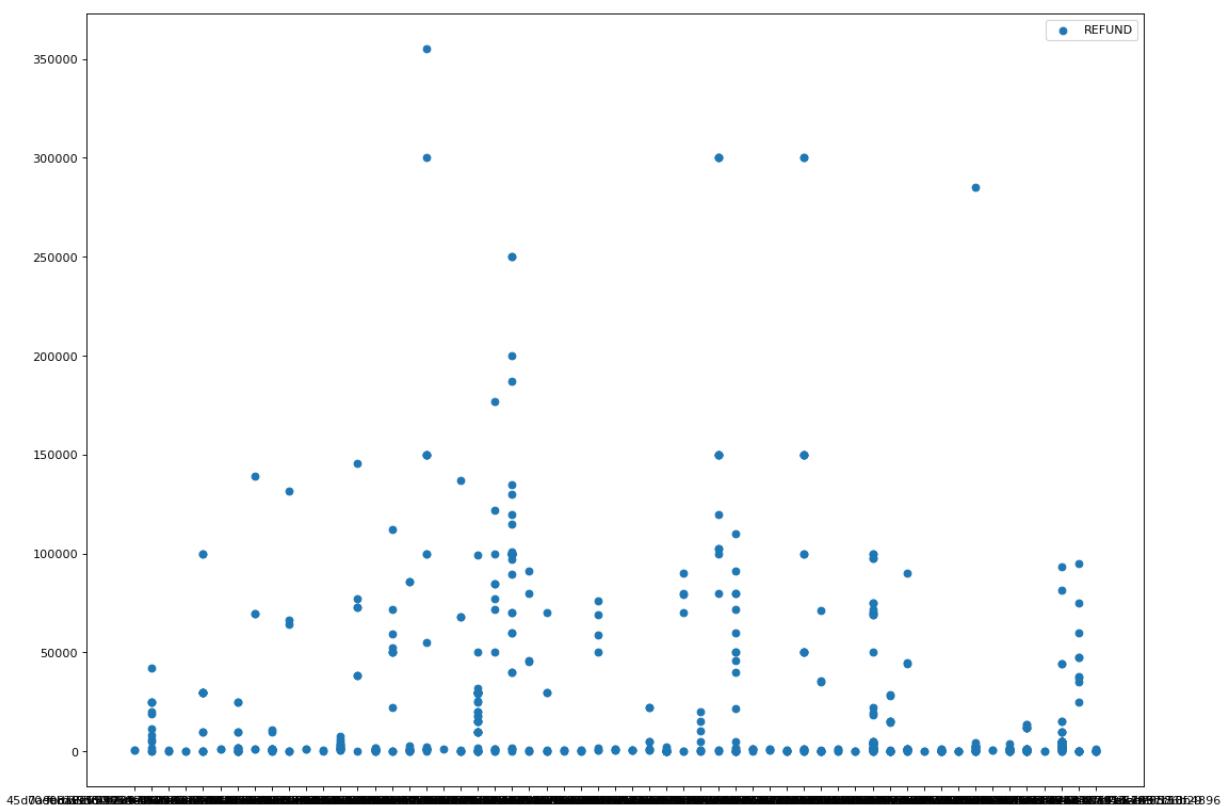
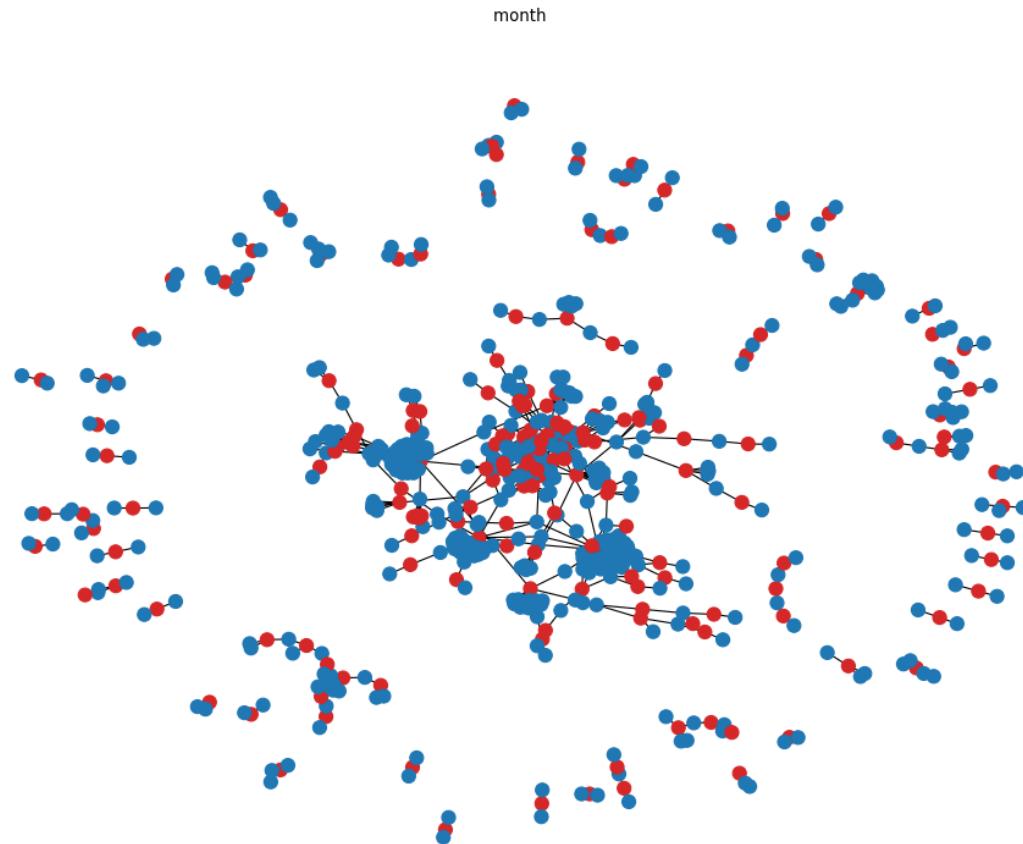
OTHER 189

Name: externalParty.transactionCategory, dtype: int64

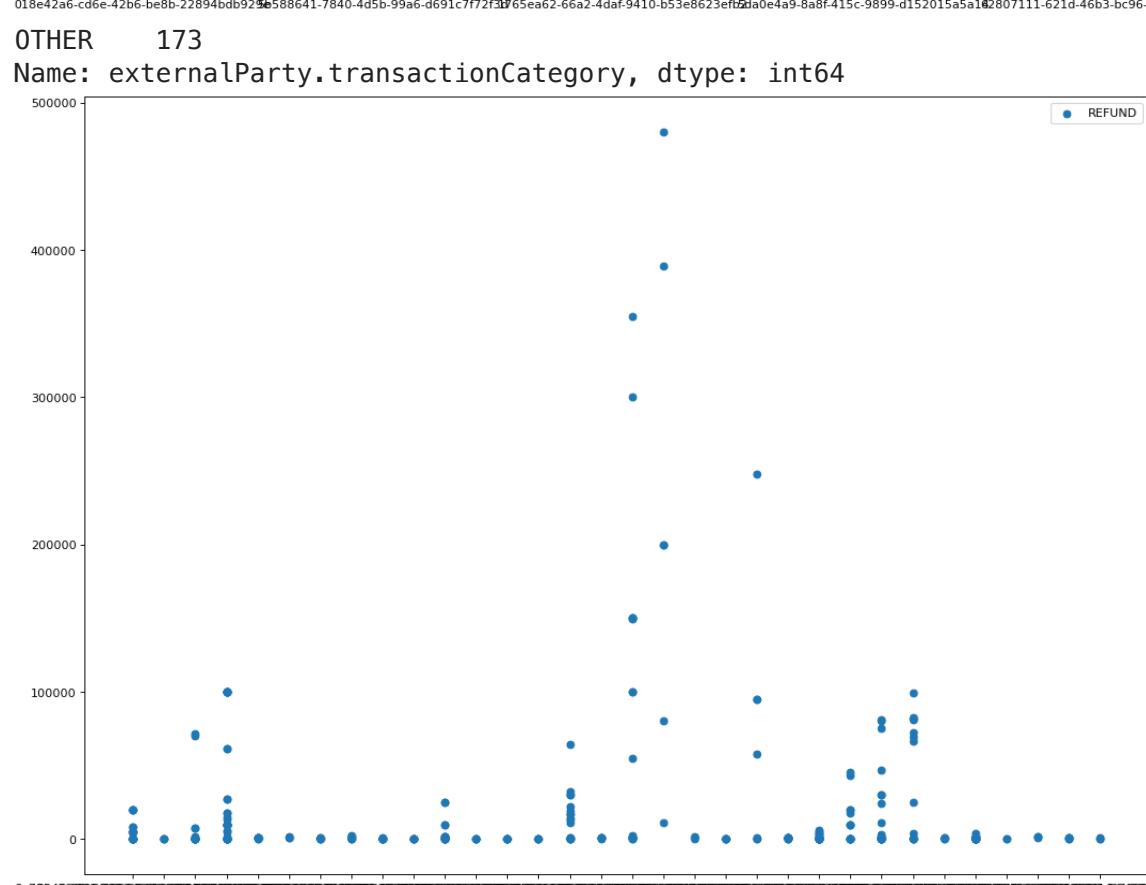
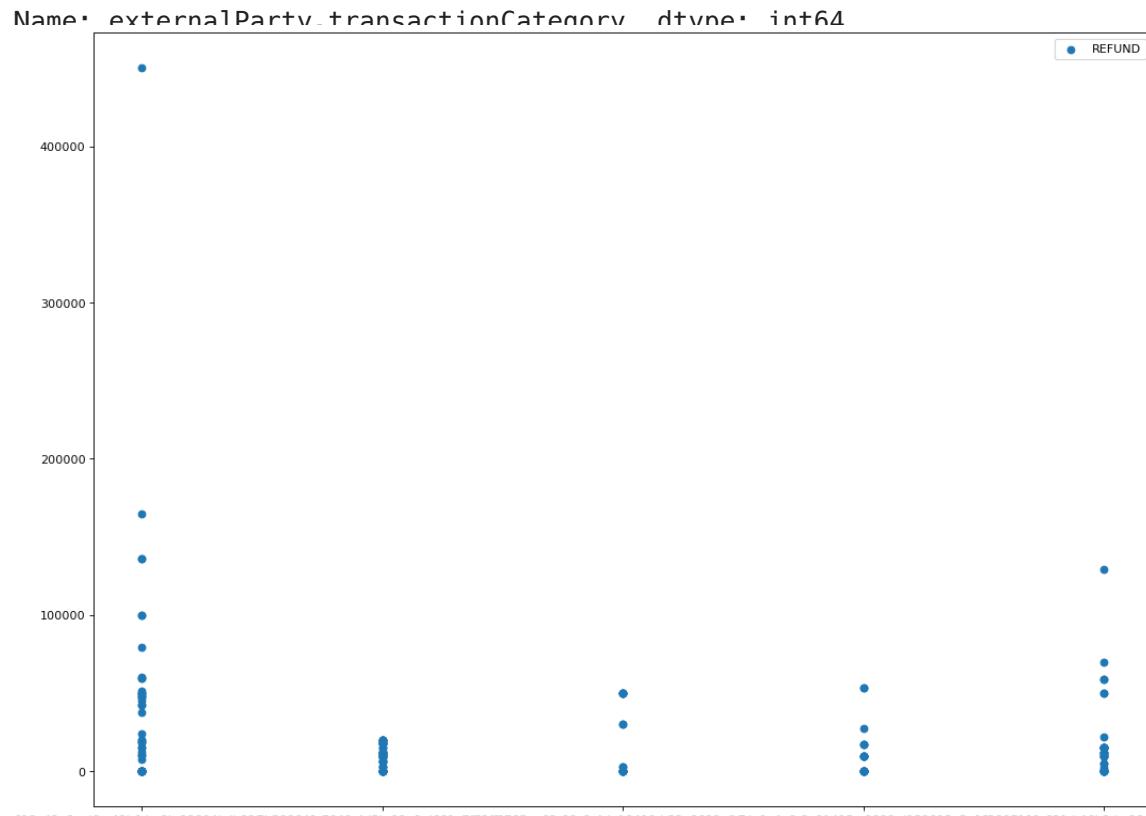
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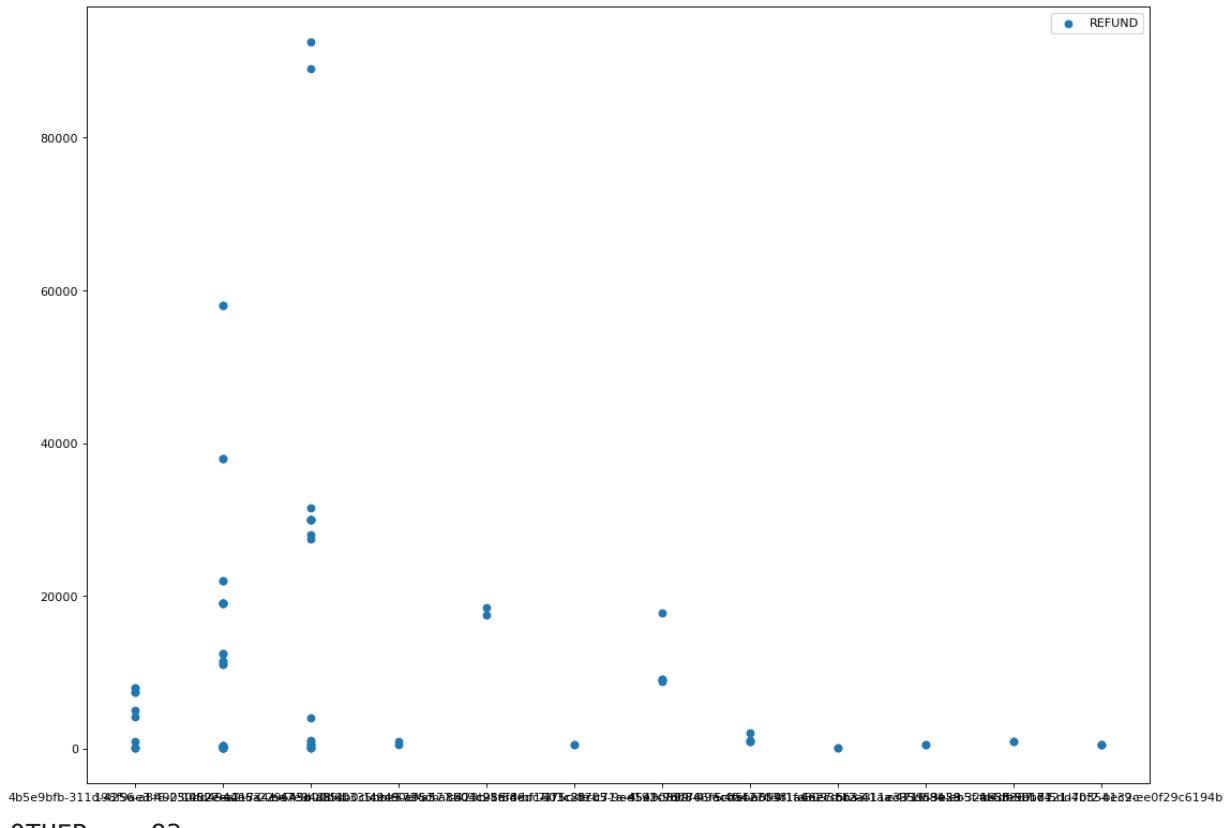


OTHER	664
GROCERIES	9
TRAVEL	8
LIFESTYLE	2
SHOPPING	1

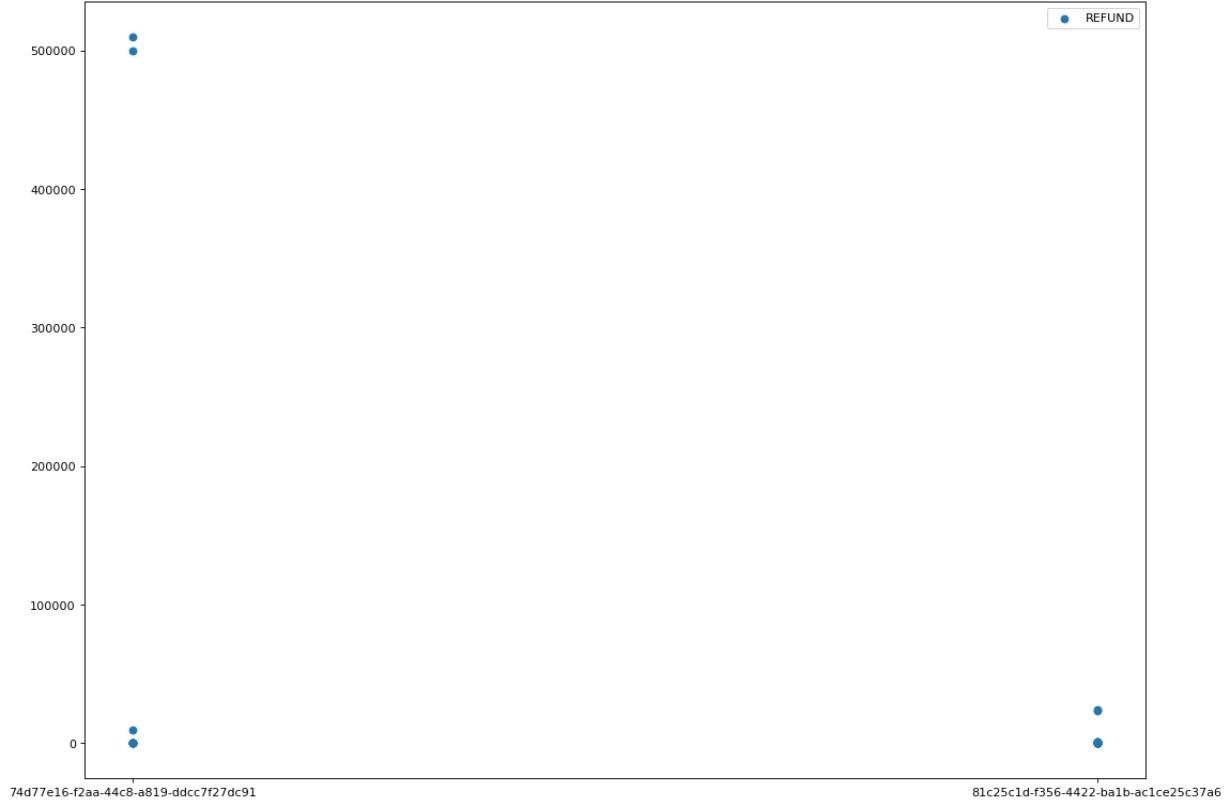


OTHER	320
GROCERIES	3
TRAVEL	2
LIFESTYLE	1

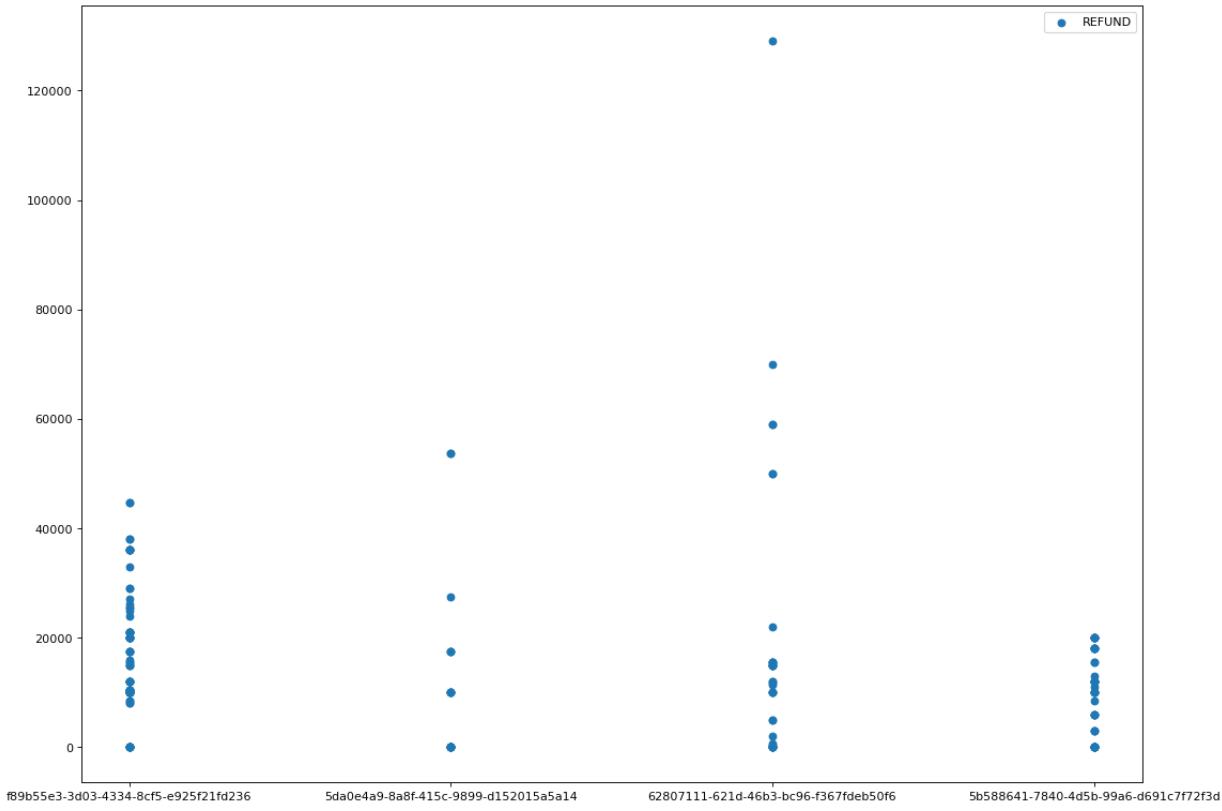
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OTHER    83  
Name: externalParty.transactionCategory, dtype: int64
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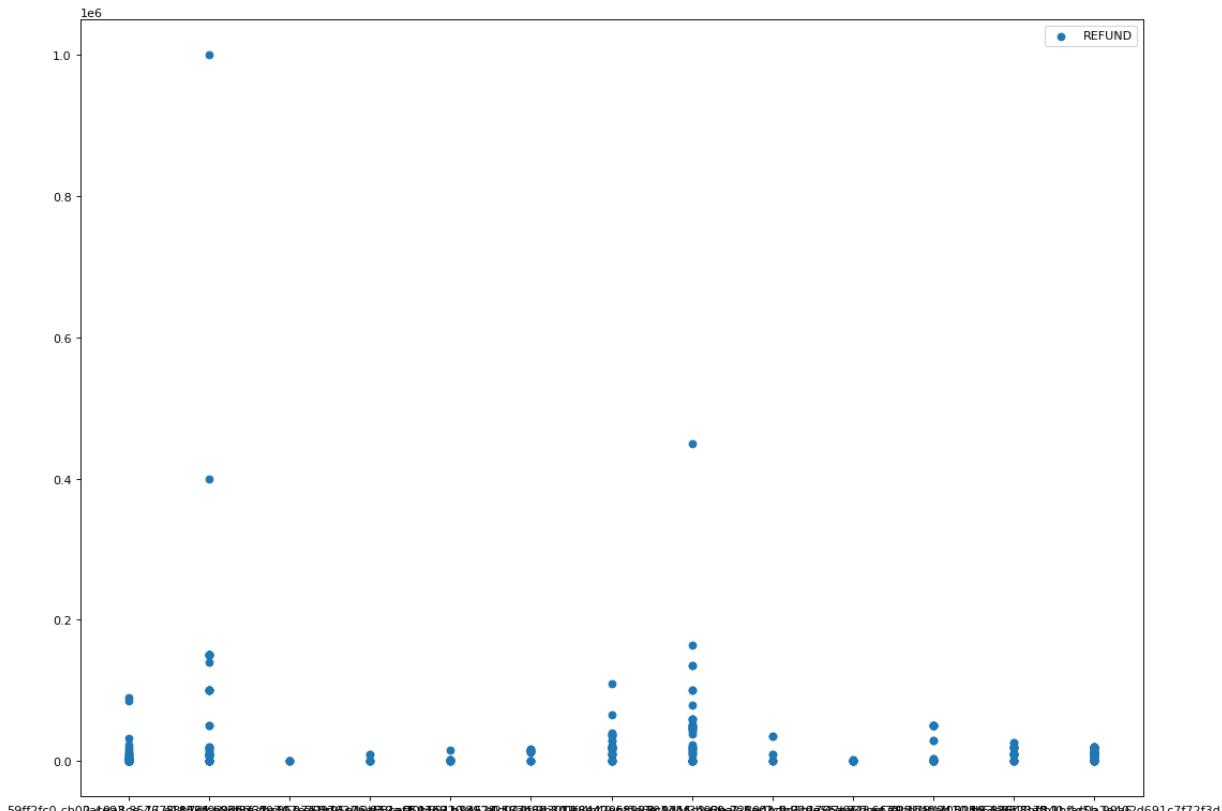


OTHER 32
Name: externalParty.transactionCategory, dtype: int64



OTHER 189

Name: externalParty.transactionCategory, dtype: int64



OTHER 312

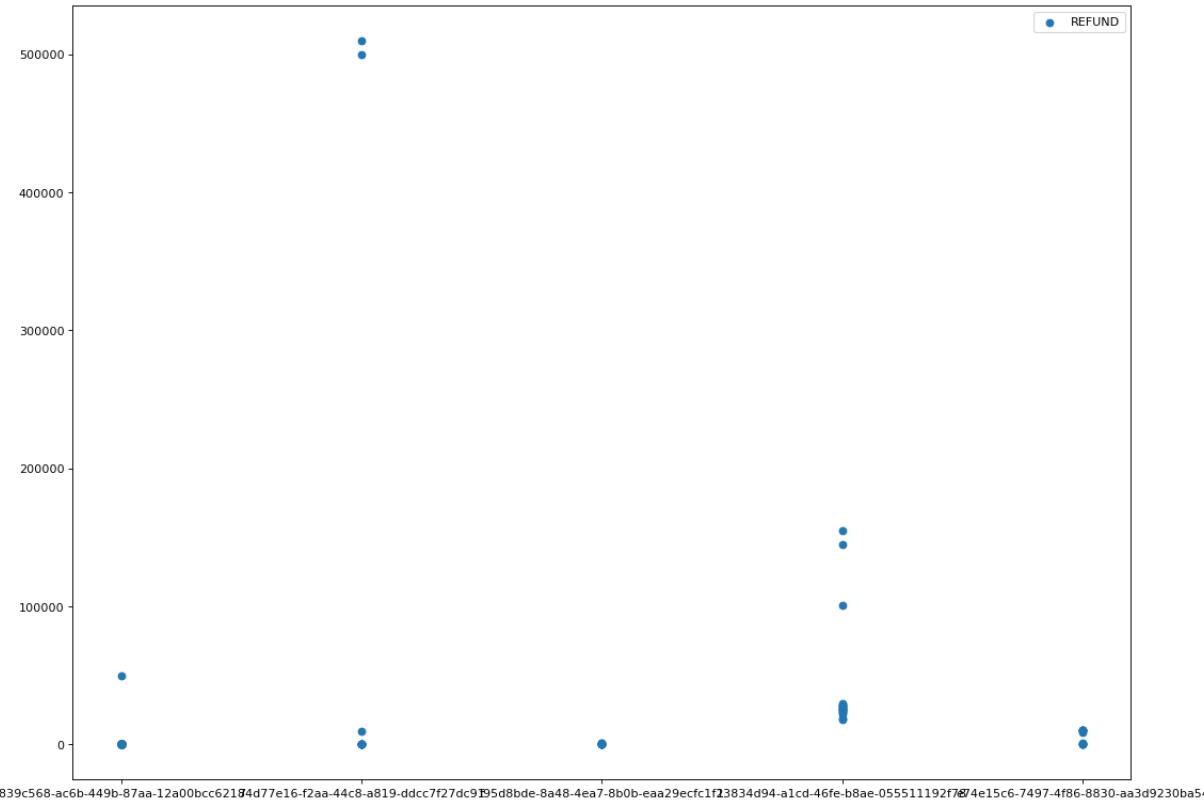
GROCERIES 25

TRAVEL 15

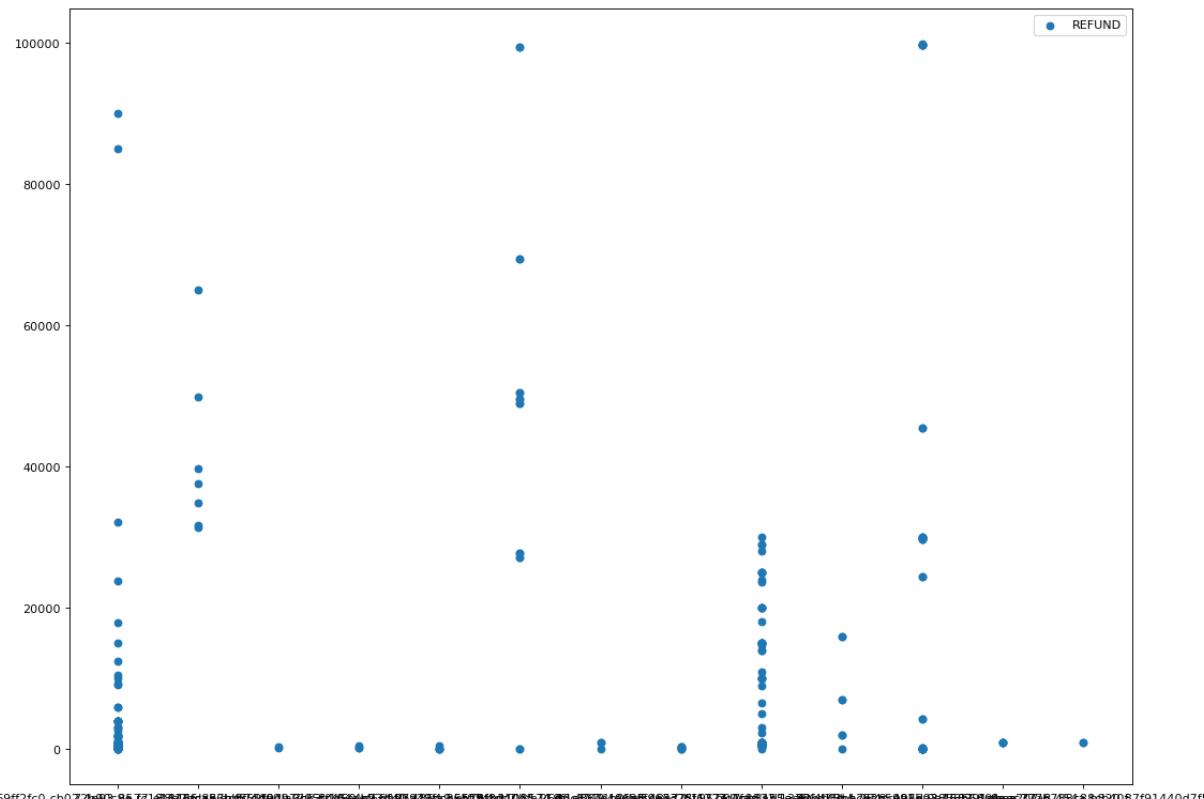
SHOPPING 8

LIFESTYLE 1

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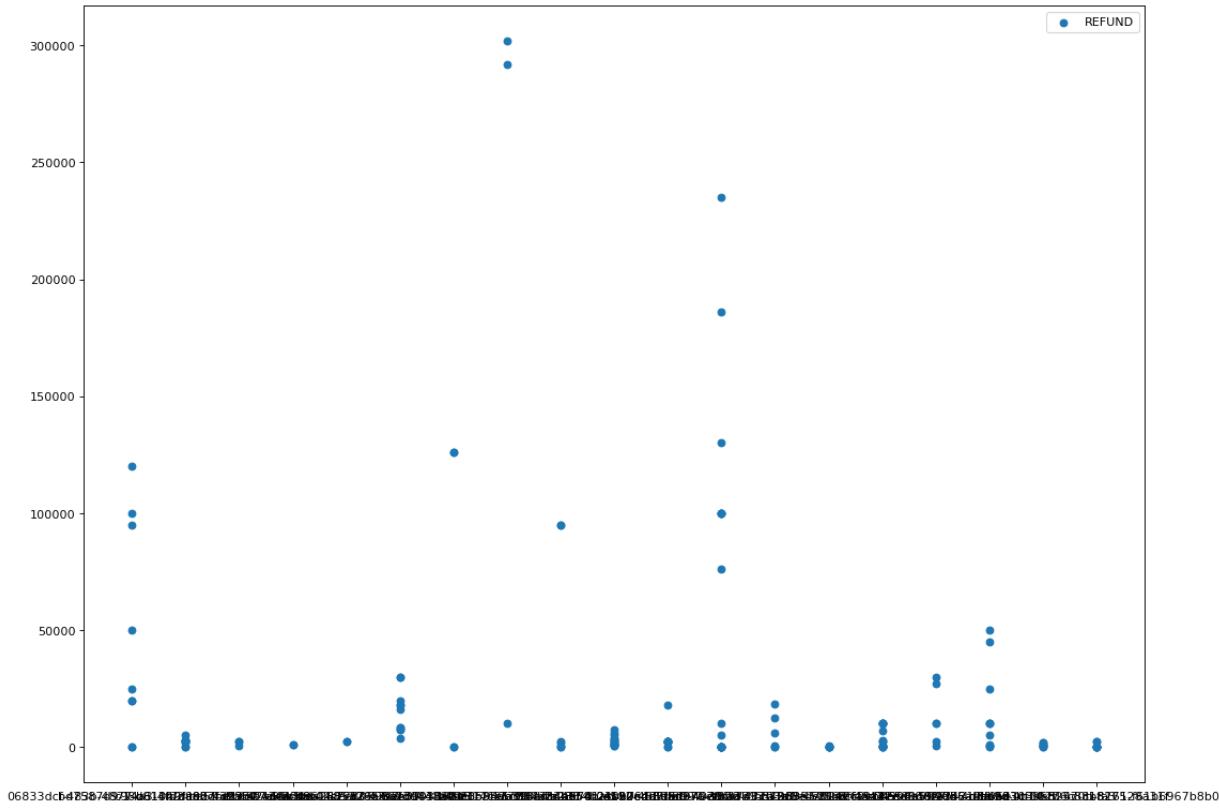


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OTHER    161  
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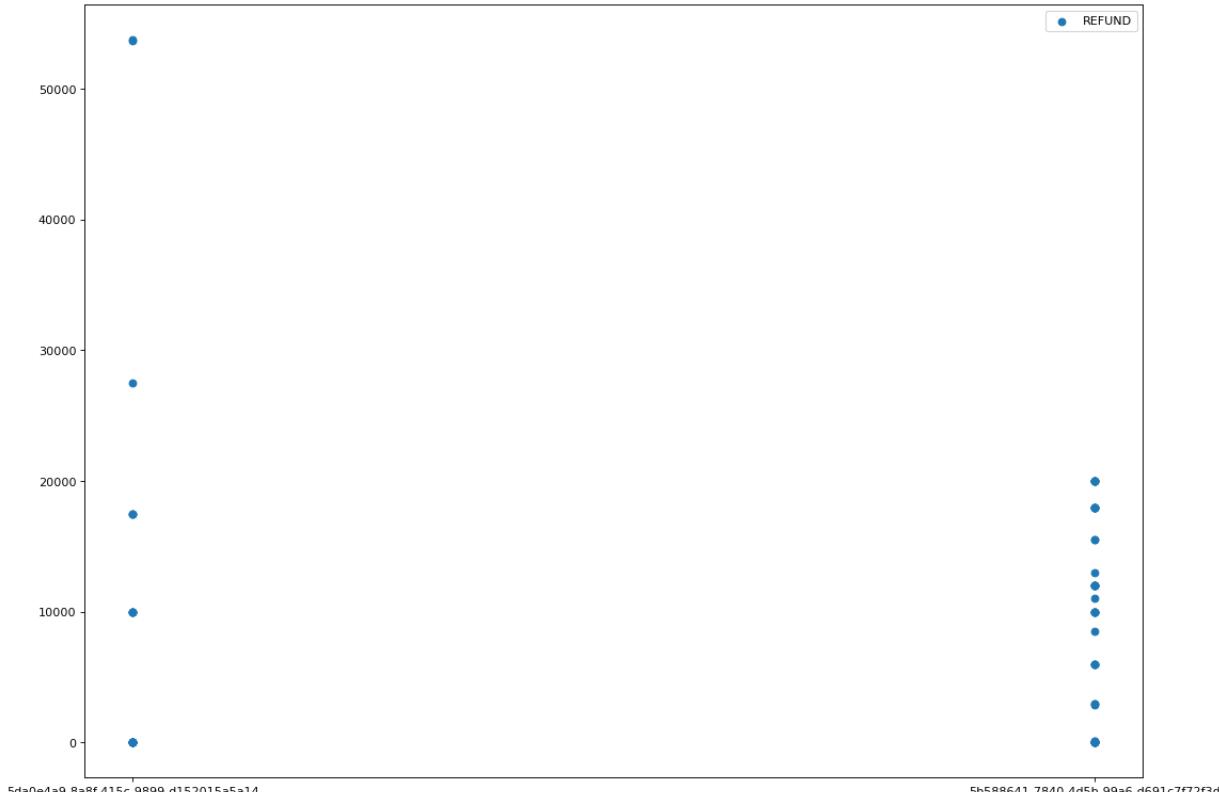


OTHER	186
GROCERIES	25
TRAVEL	13
SHOPPING	11

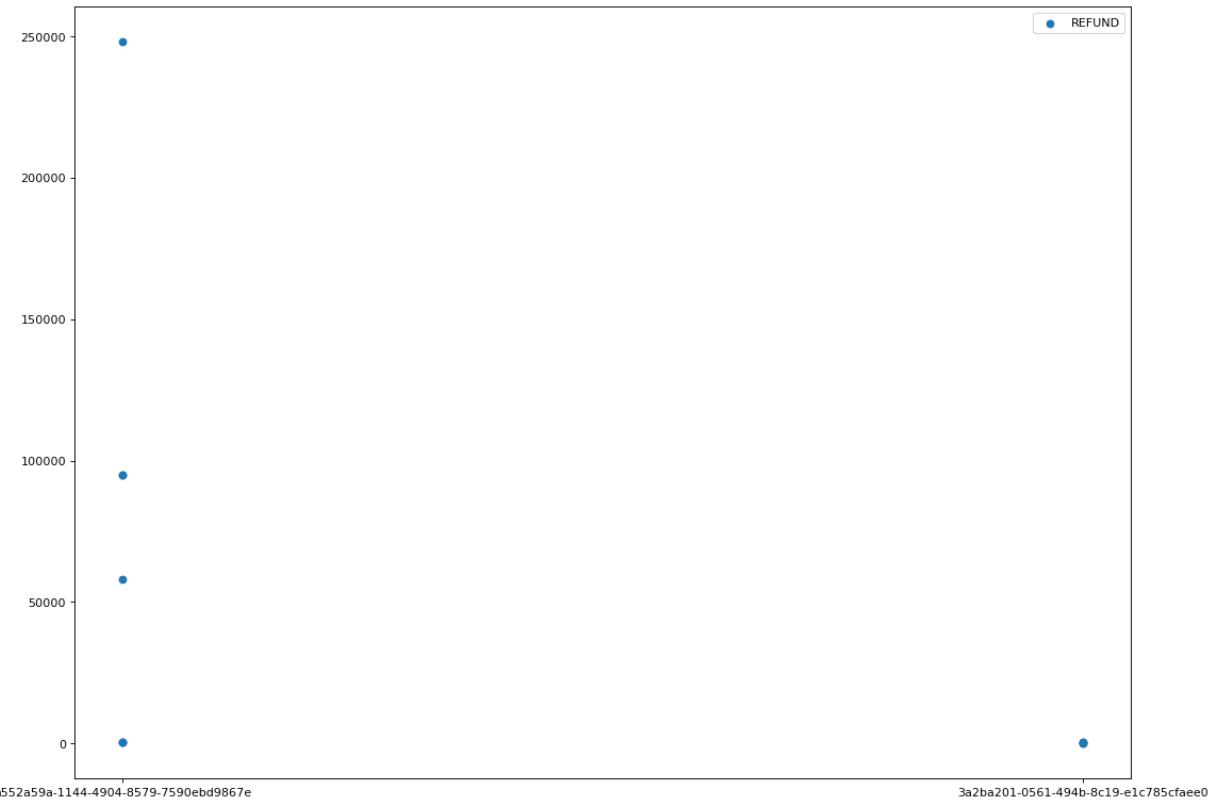
LIFESTYLE 1
Name: externalParty.transactionCategory dtype: int64



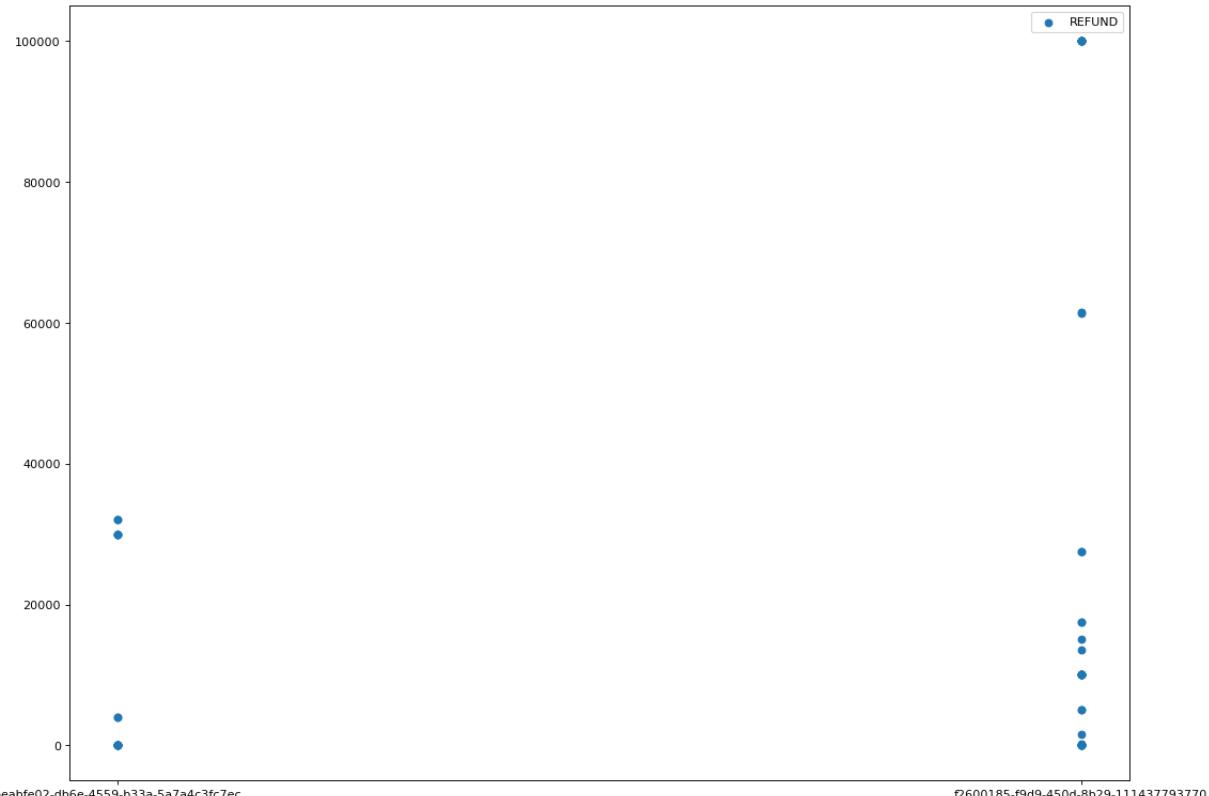
OTHER 157
Name: externalParty.transactionCategory, dtype: int64



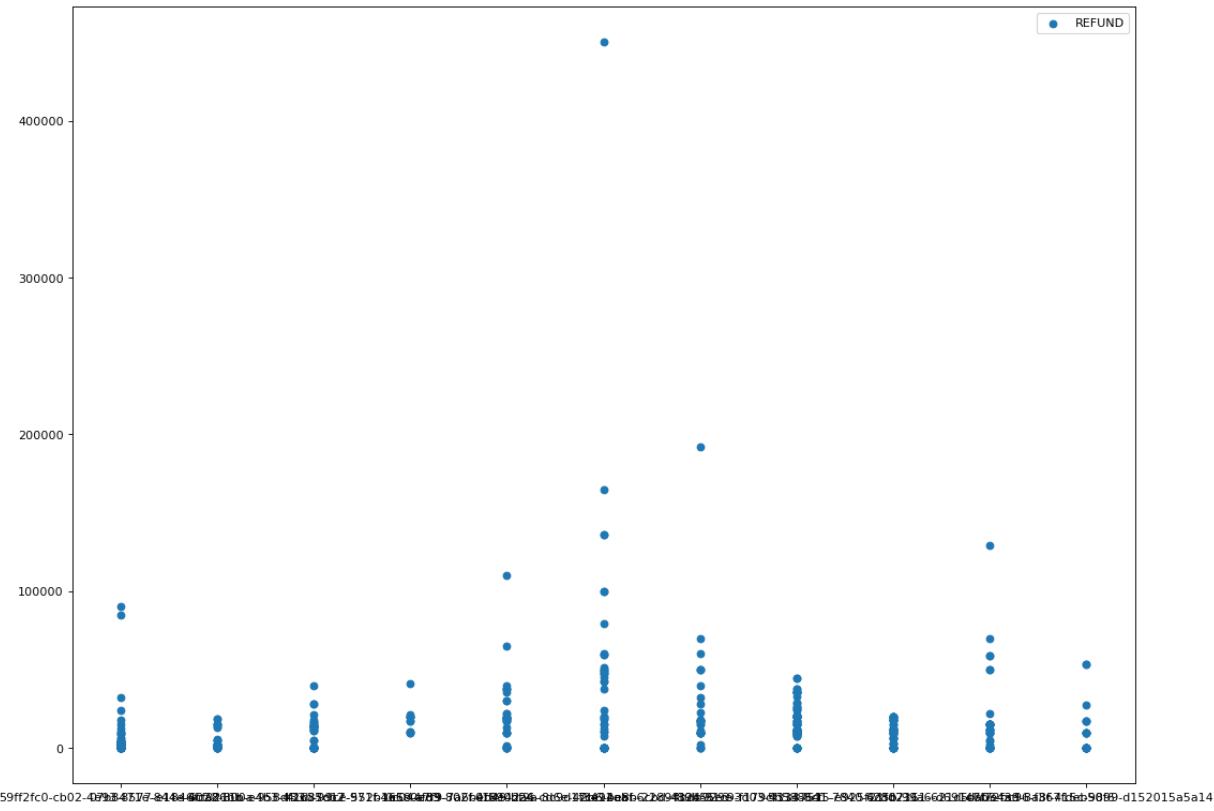
OTHER 68
Name: externalParty.transactionCategory, dtype: int64

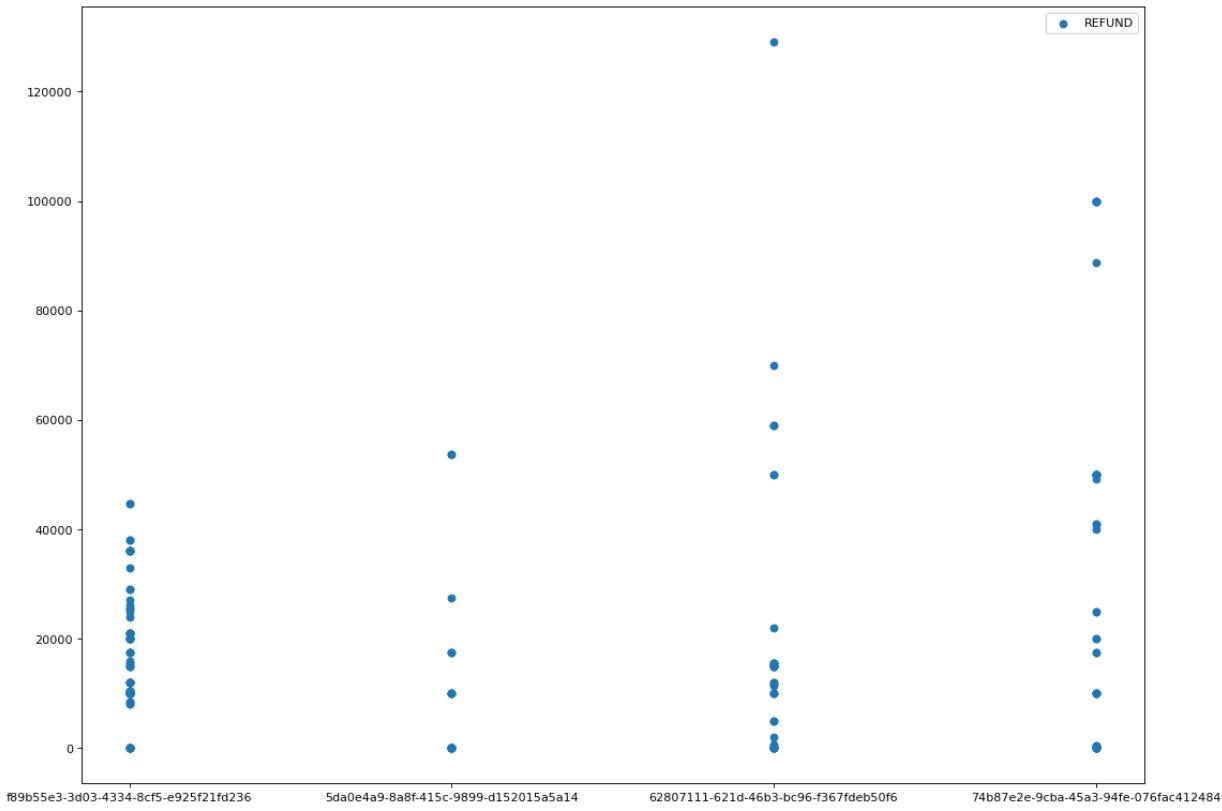


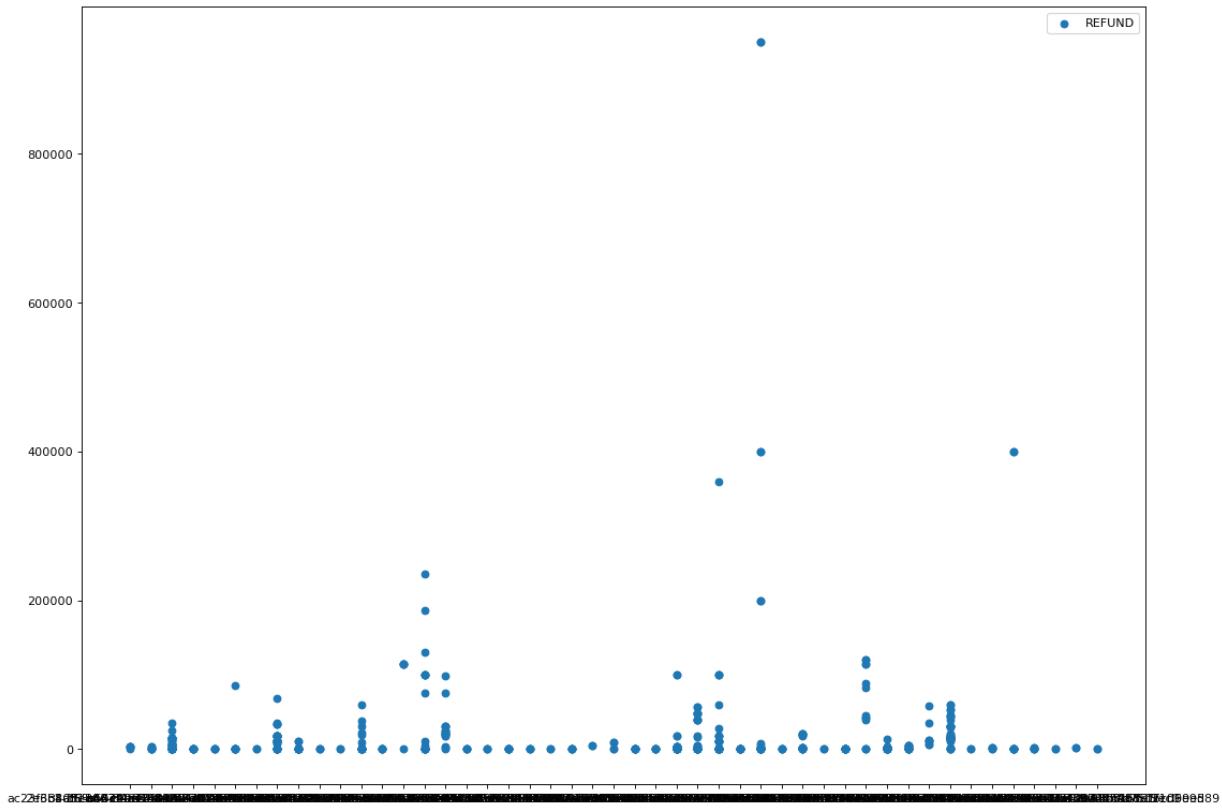
OTHER 11
Name: externalParty.transactionCategory, dtype: int64



OTHER 53
Name: externalParty.transactionCategory, dtype: int64







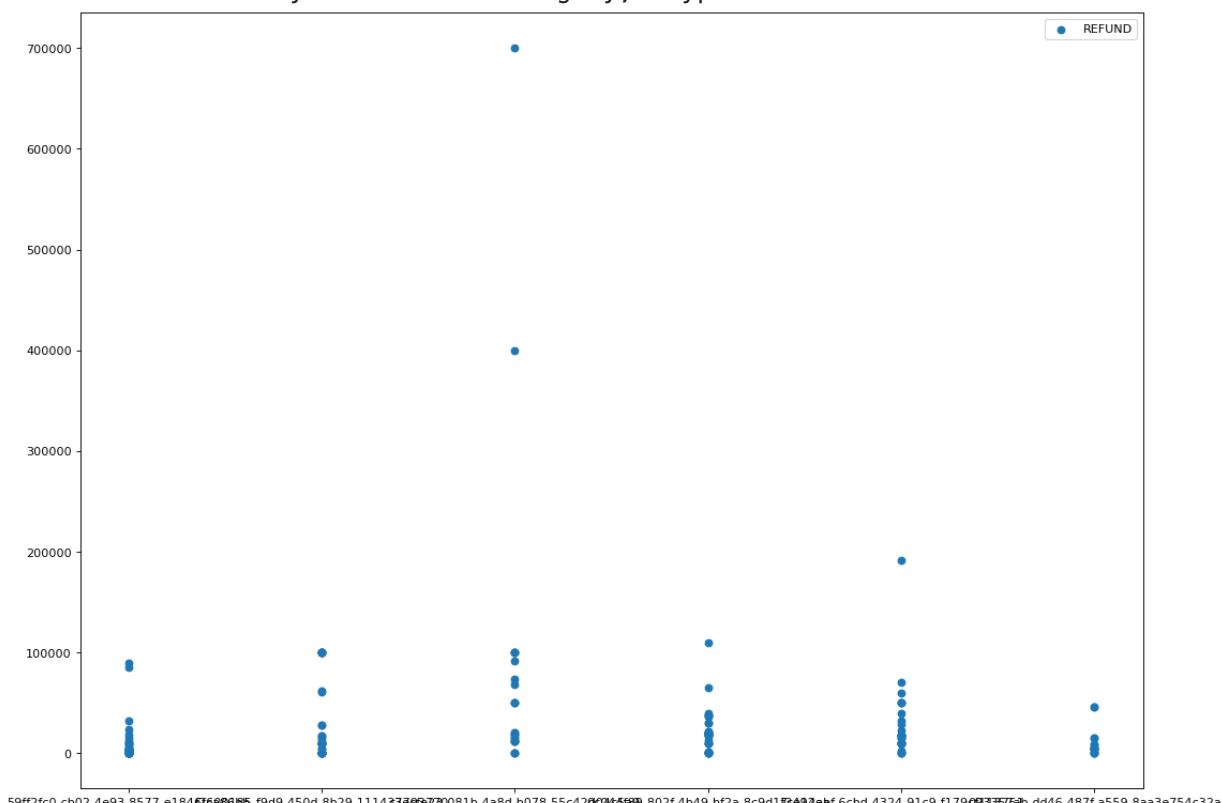
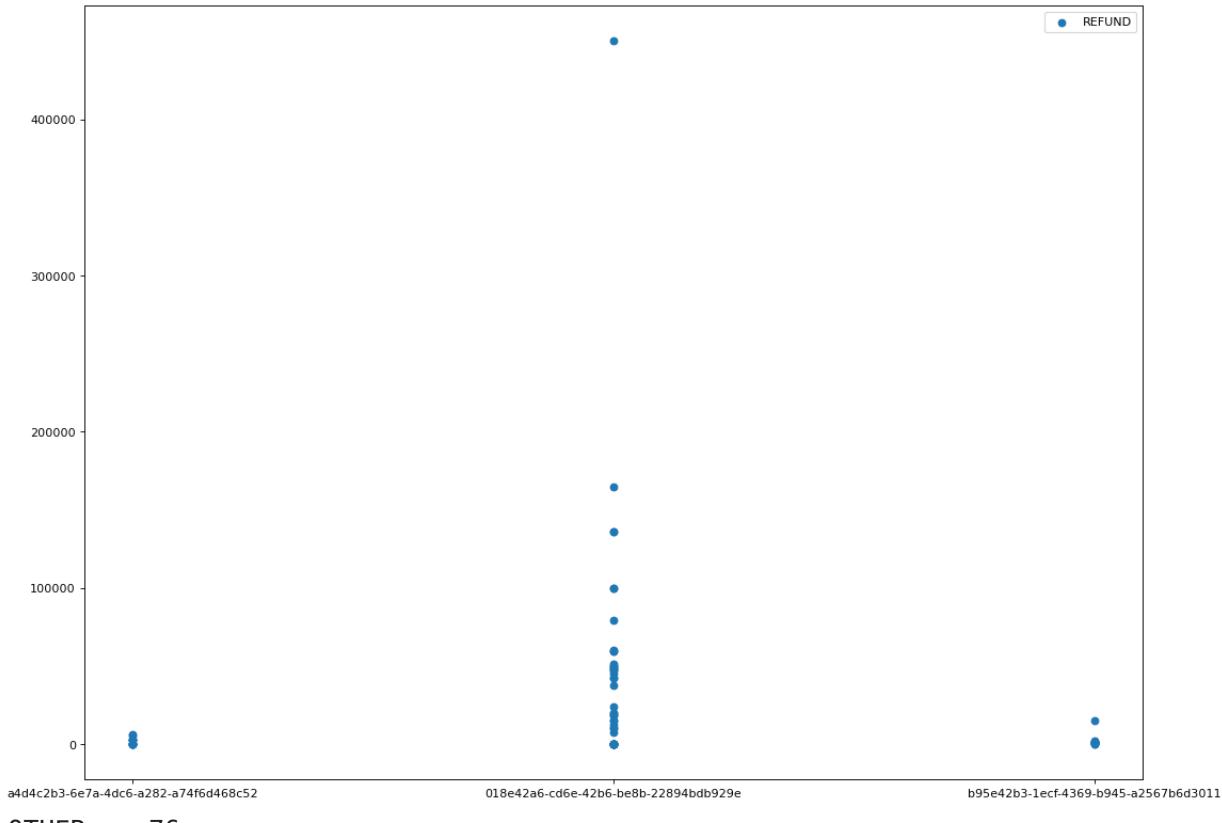
OTHER 532
LIFESTYLE 1
SHOPPING 1

Name: externalParty.transactionCategory, dtype: int64



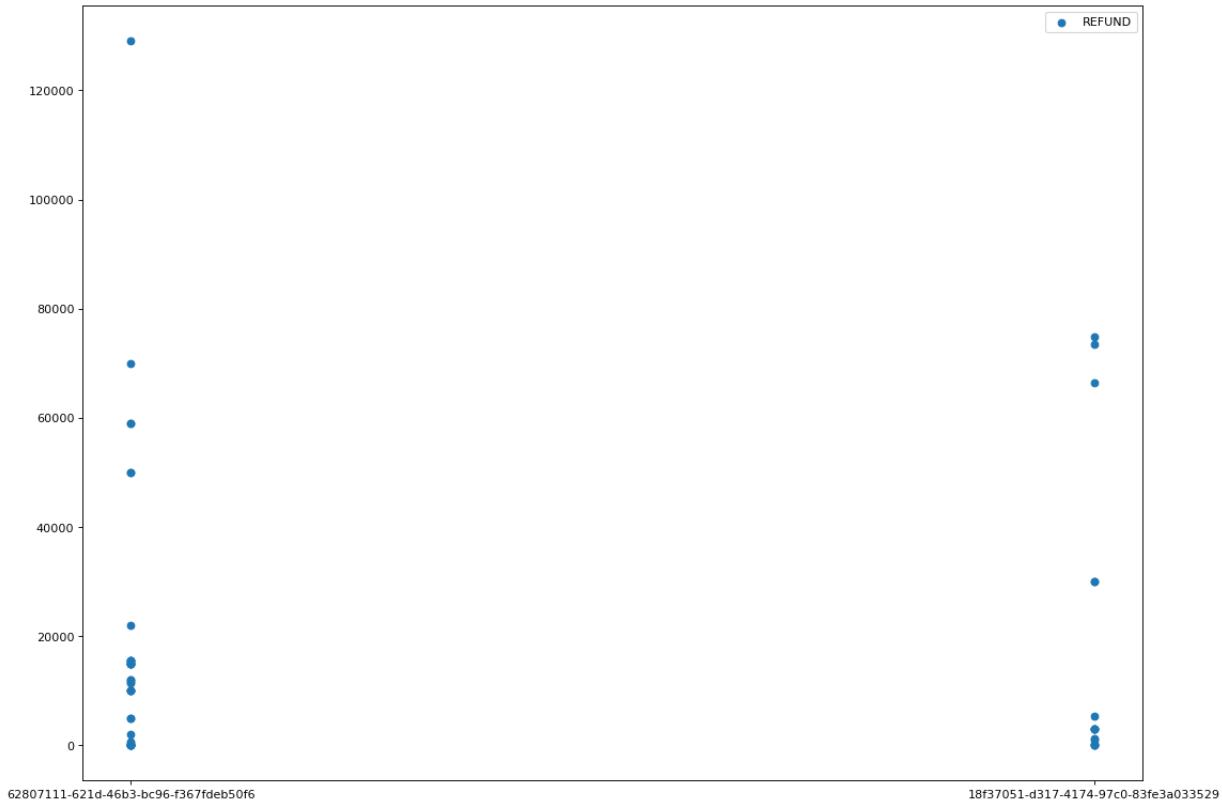
OTHER 32

Name: externalParty.transactionCategory, dtype: int64



OTHER	176
GROCERIES	25
TRAVEL	15
SHOPPING	8
LIFESTYLE	1

Name: externalParty.transactionCategory, dtype: int64



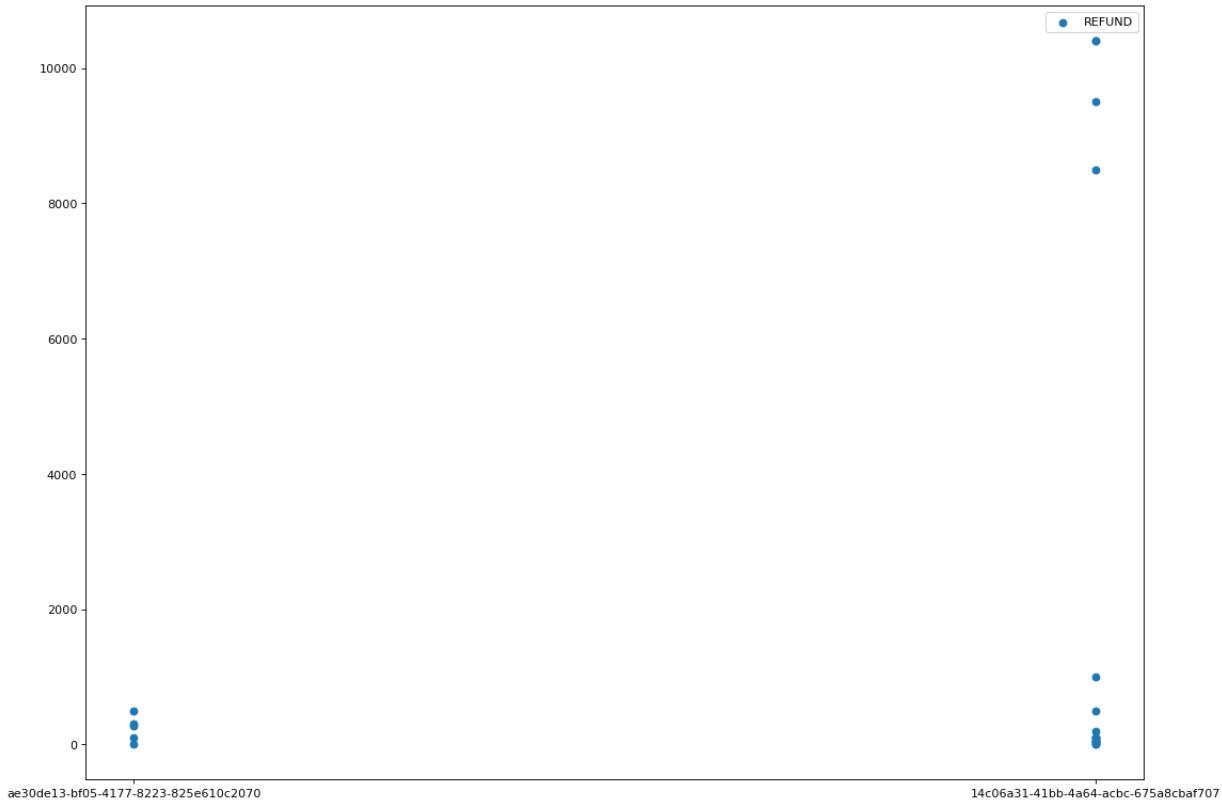
OTHER 51
SHOPPING 1

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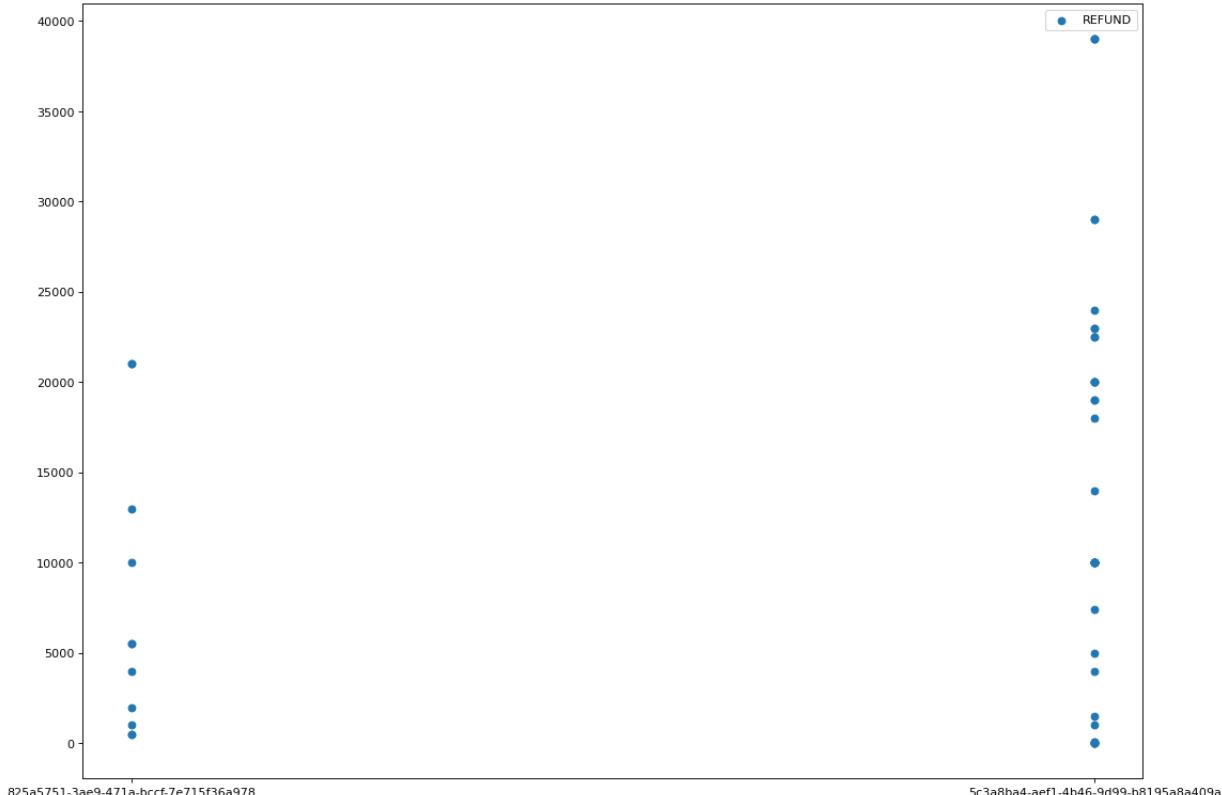


OTHER 32

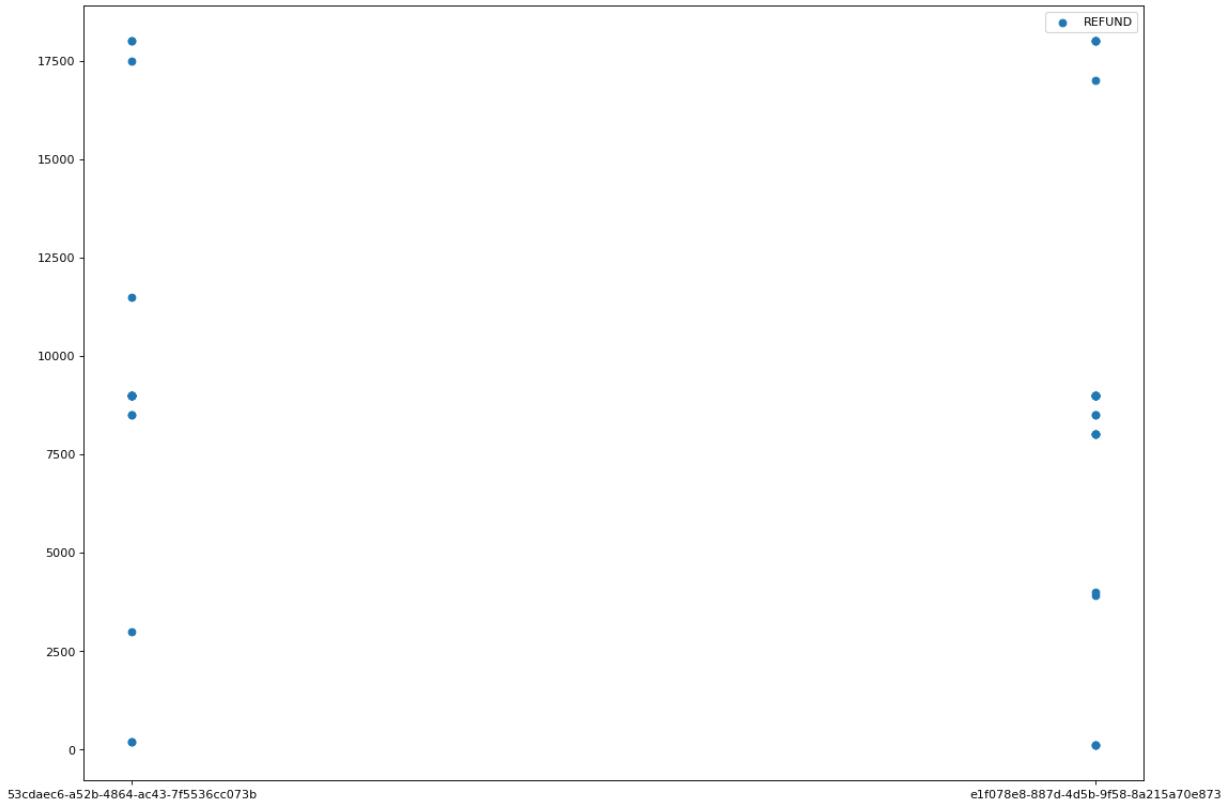
Name: externalParty.transactionCategory, dtype: int64



OTHER 23
Name: externalParty.transactionCategory, dtype: int64

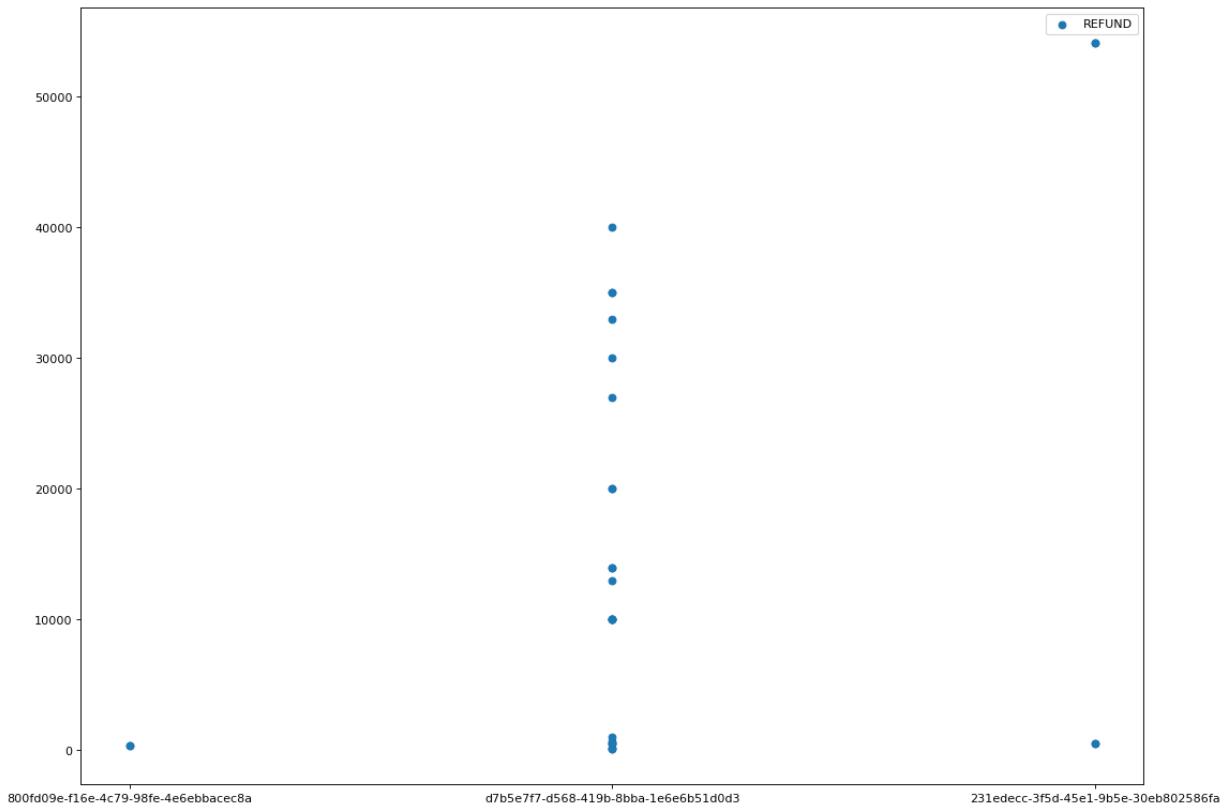


OTHER 52
Name: externalParty.transactionCategory, dtype: int64



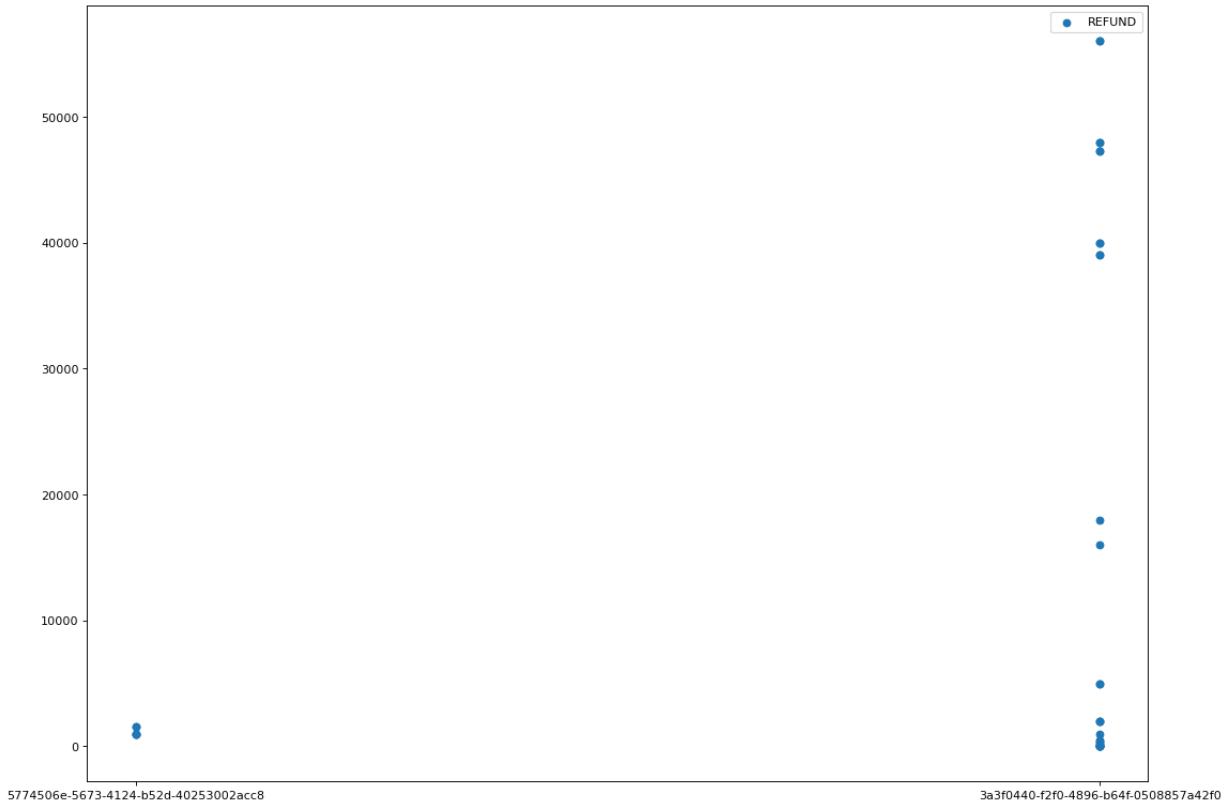
OTHER 42

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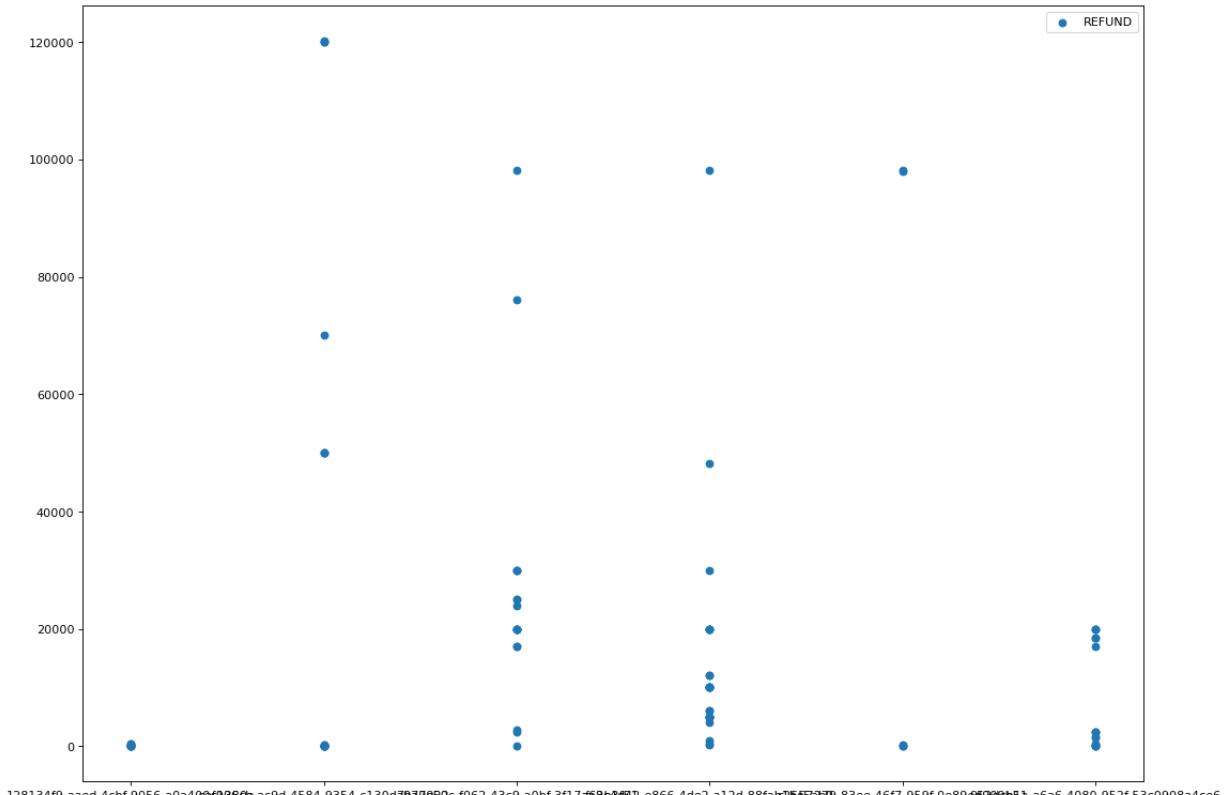
OTHER 30

Name: externalParty.transactionCategory, dtype: int64



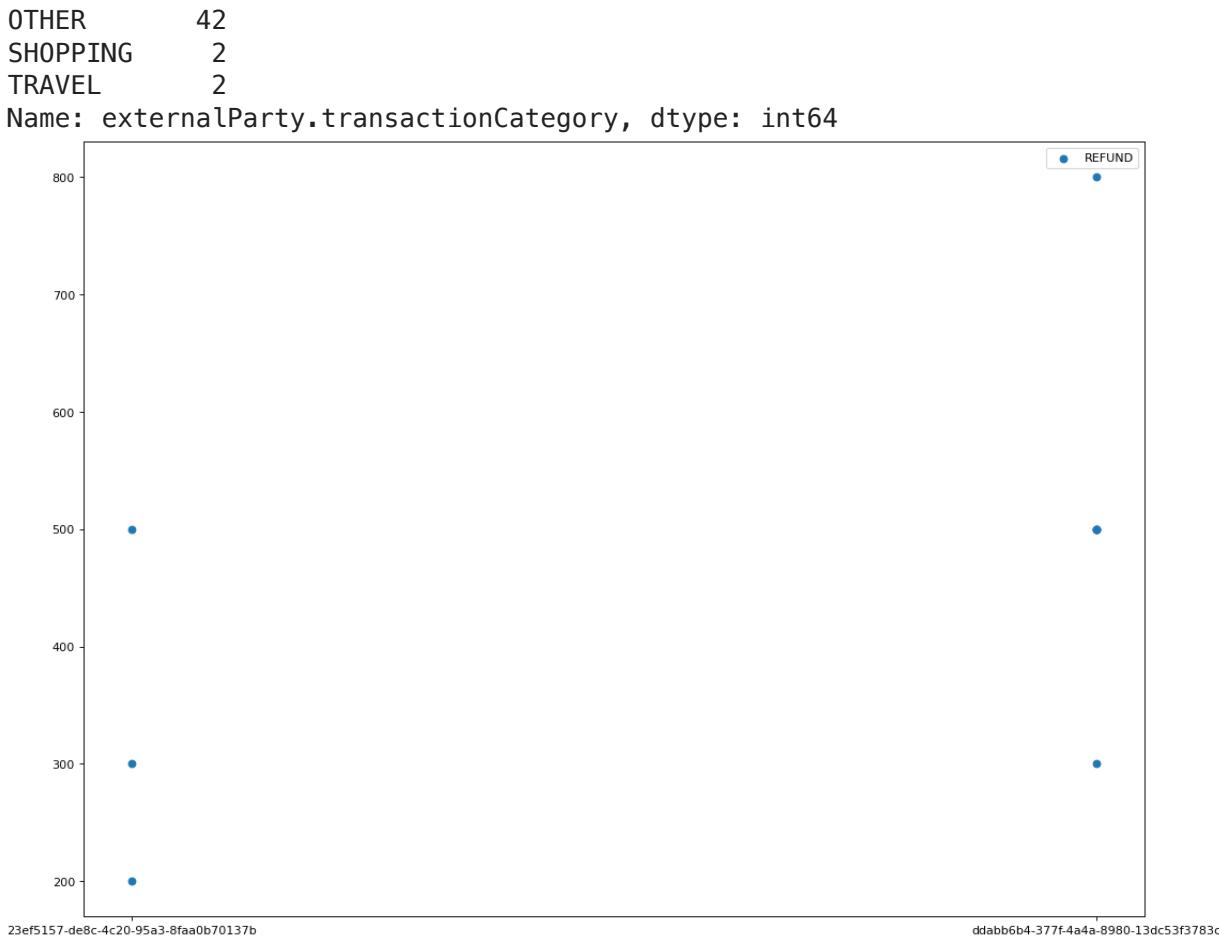
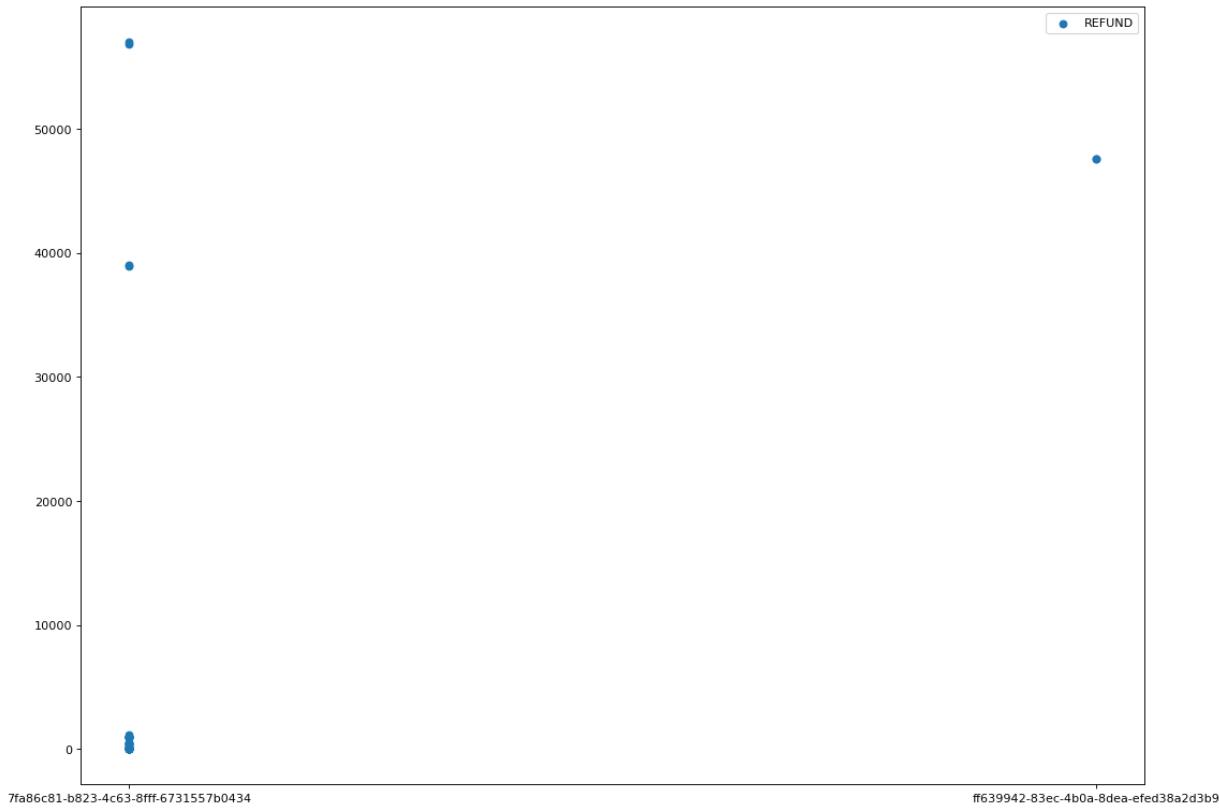
OTHER 35

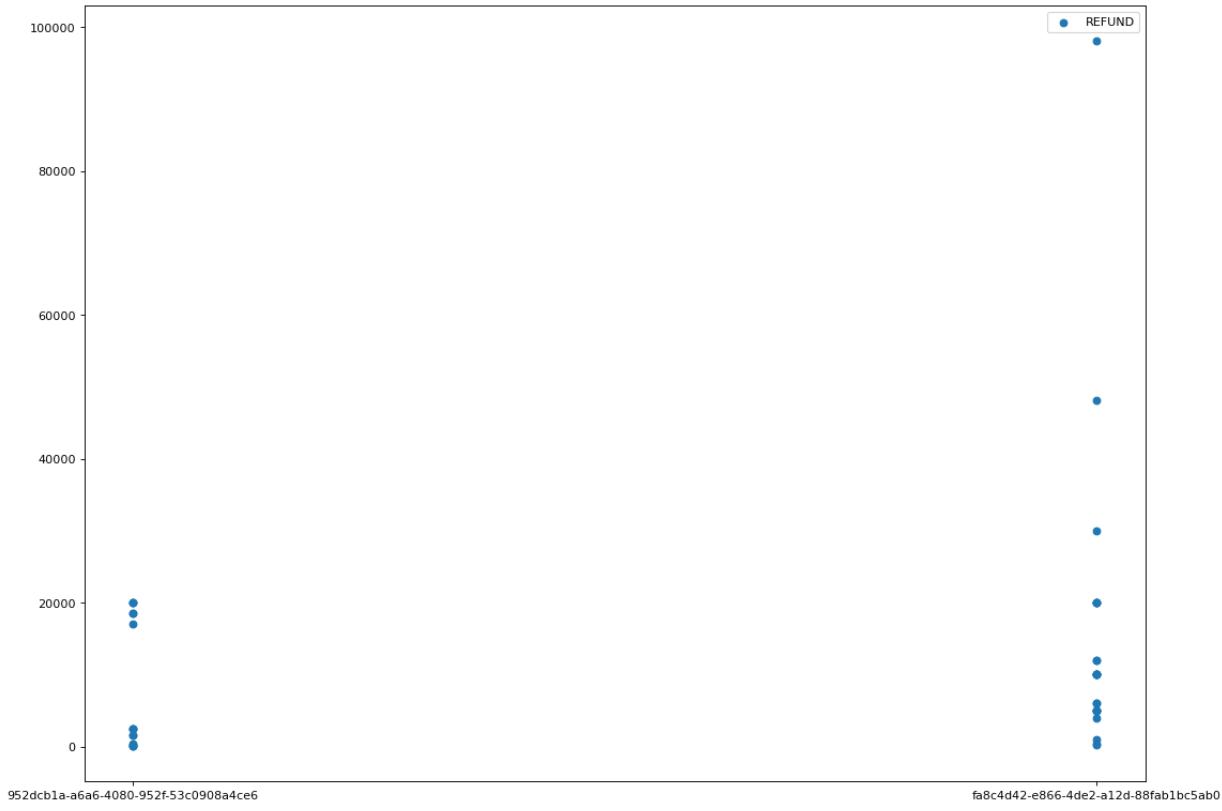
Name: externalParty.transactionCategory, dtype: int64



OTHER 90

Name: externalParty.transactionCategory, dtype: int64





OTHER 42

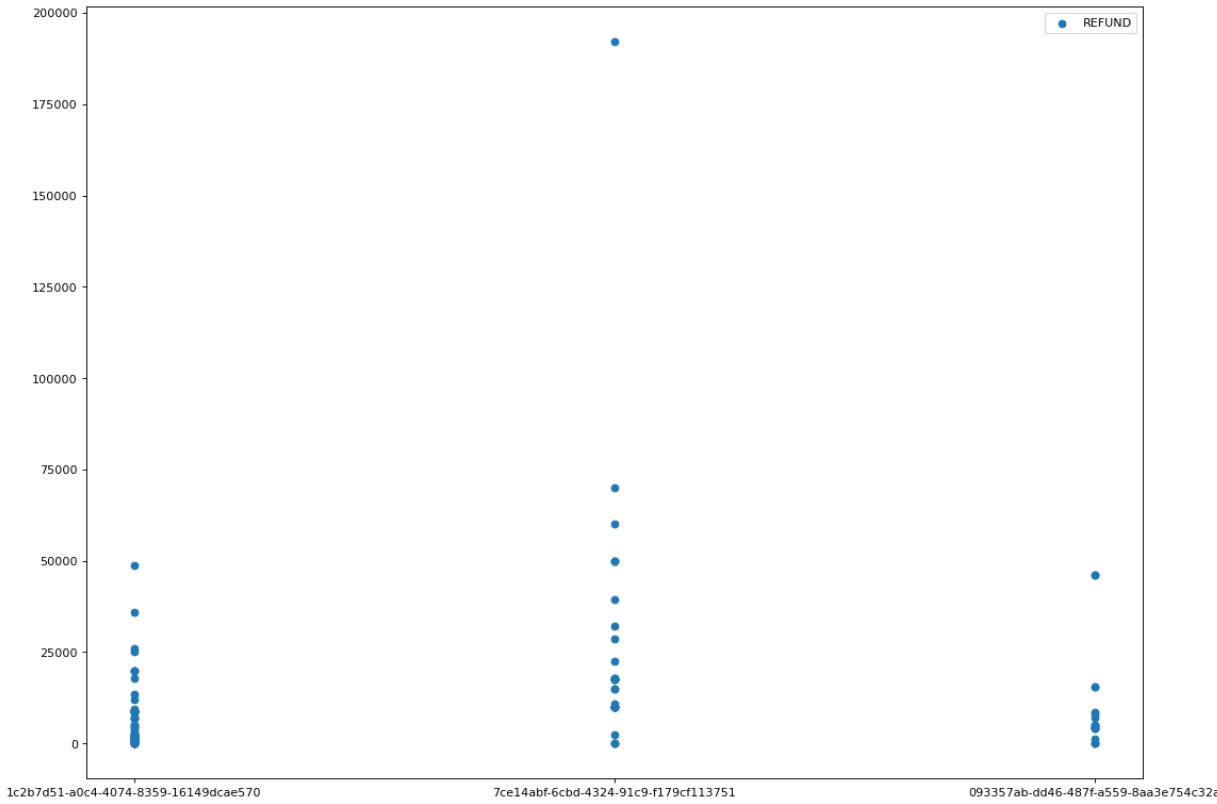
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OTHER 45

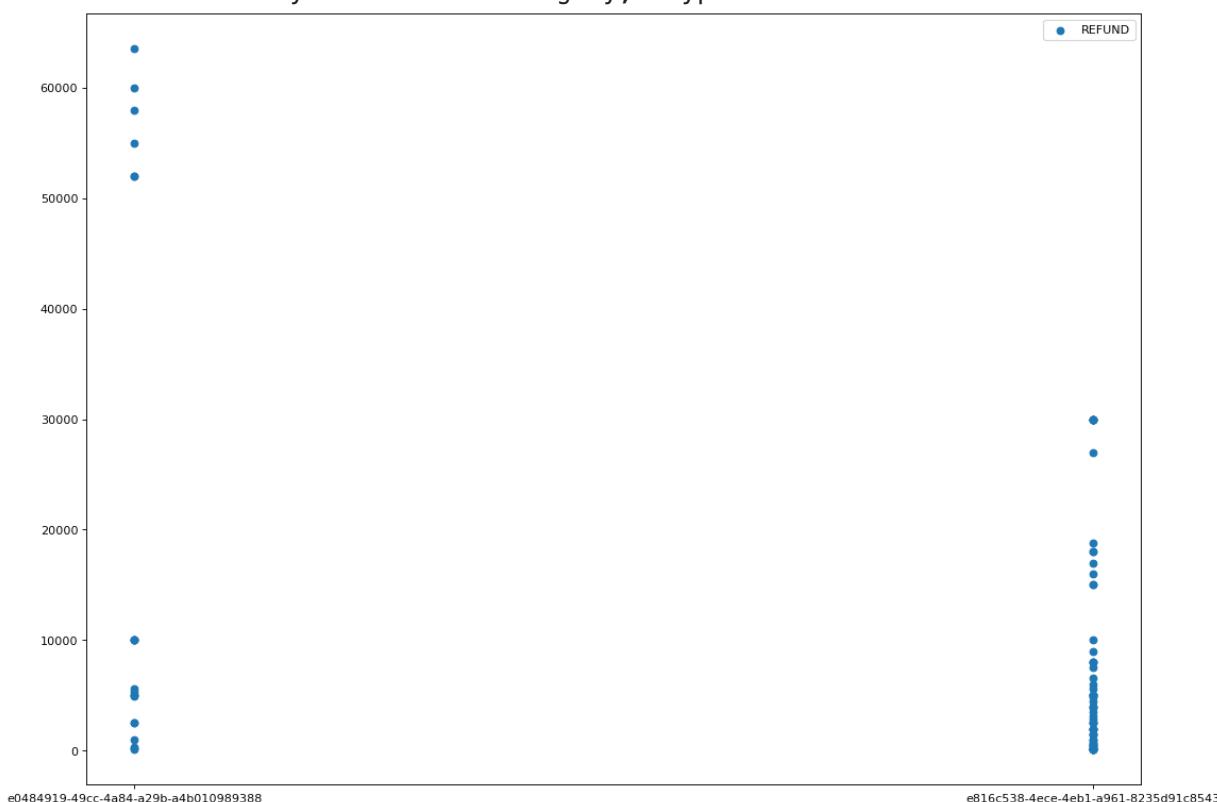
SHOPPING 1

Name: externalParty.transactionCategory, dtype: int64



Name: externalParty.transactionCategory, dtype: int64

Category	Count
OTHER	105
TRAVEL	7
LIFESTYLE	7
GROCERIES	7
SHOPPING	1

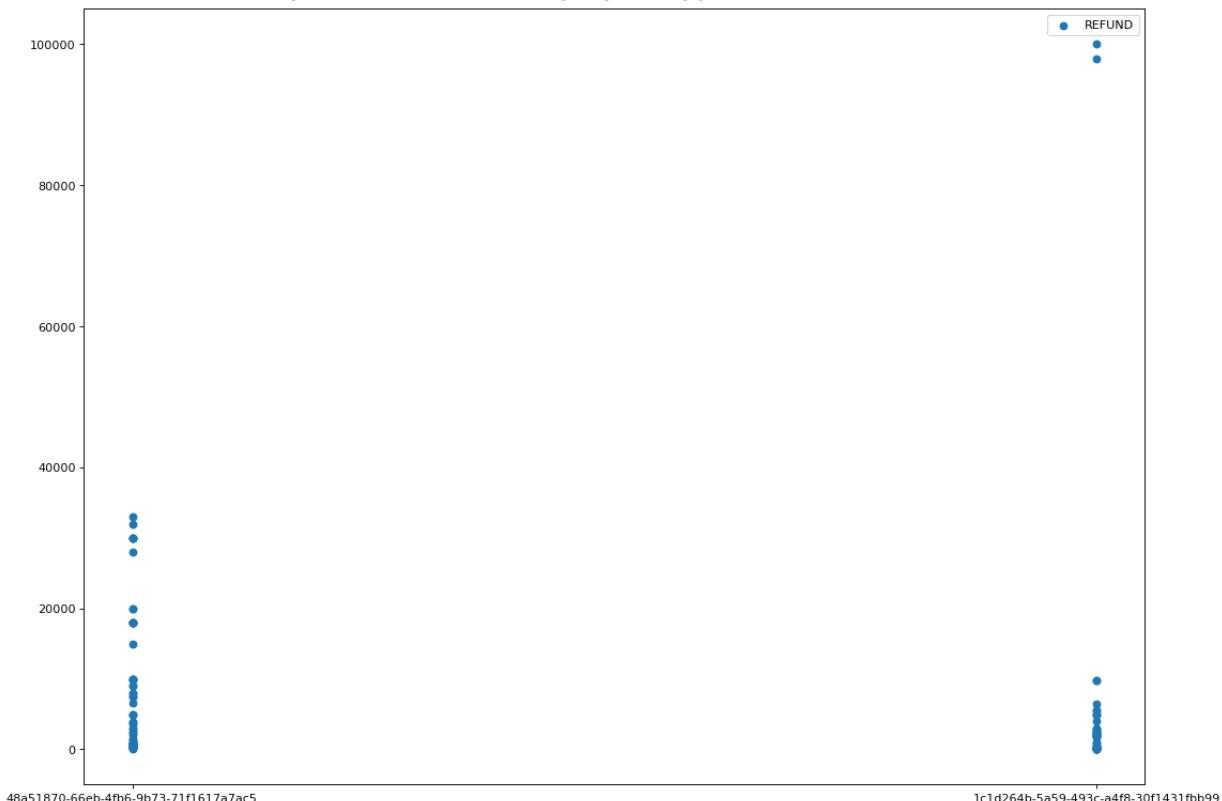


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OTHER 10

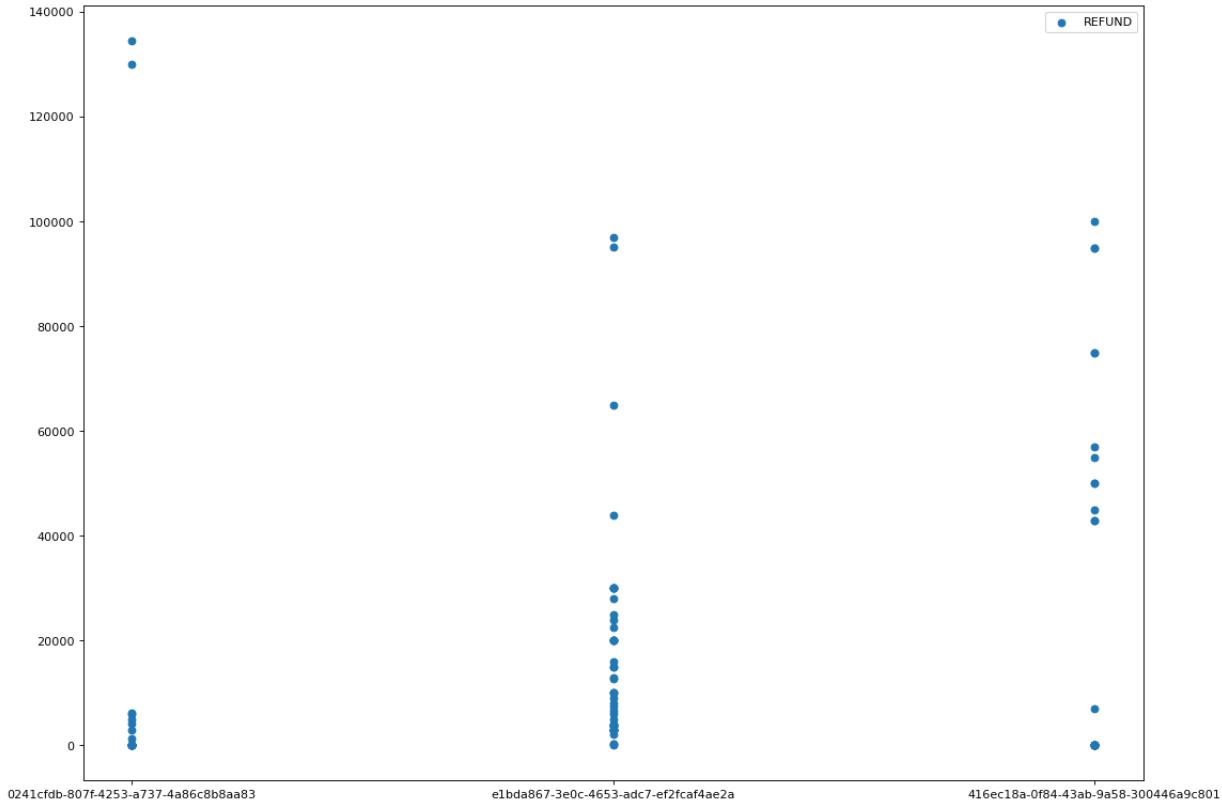
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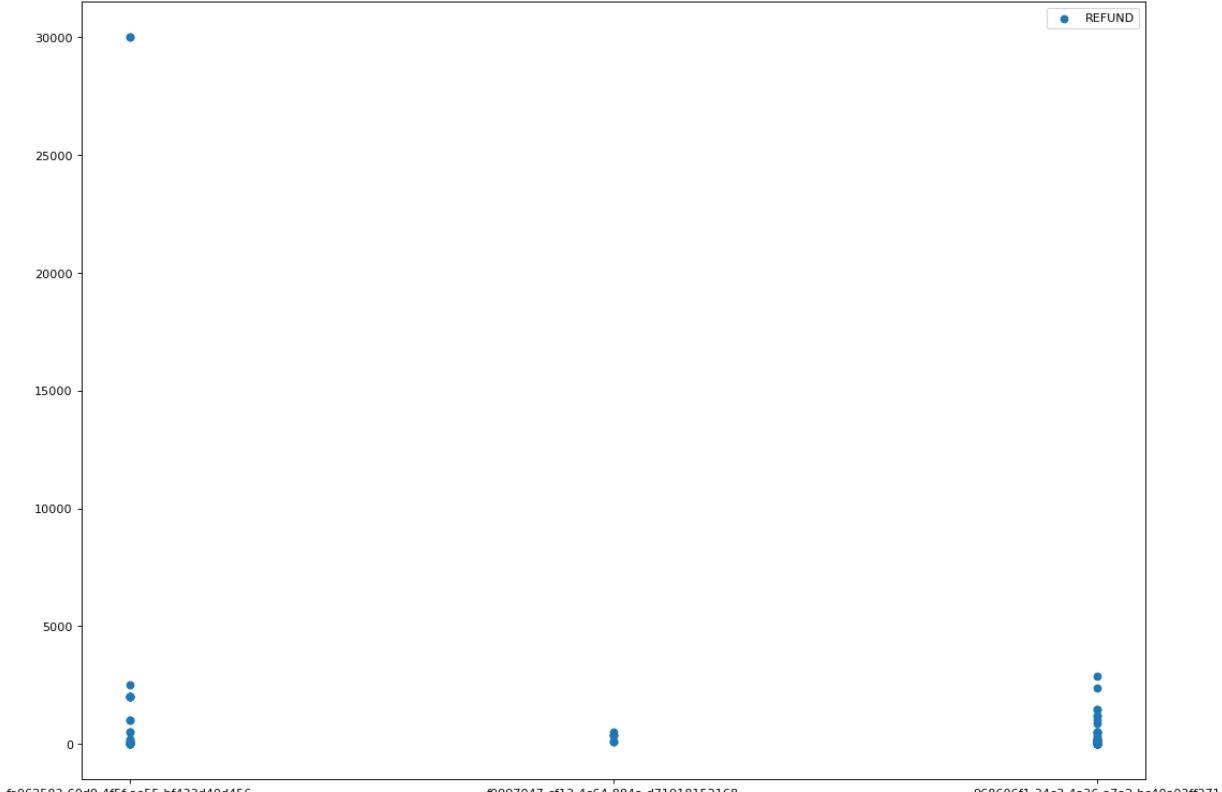
OTHER 102

LIFESTYLE 1

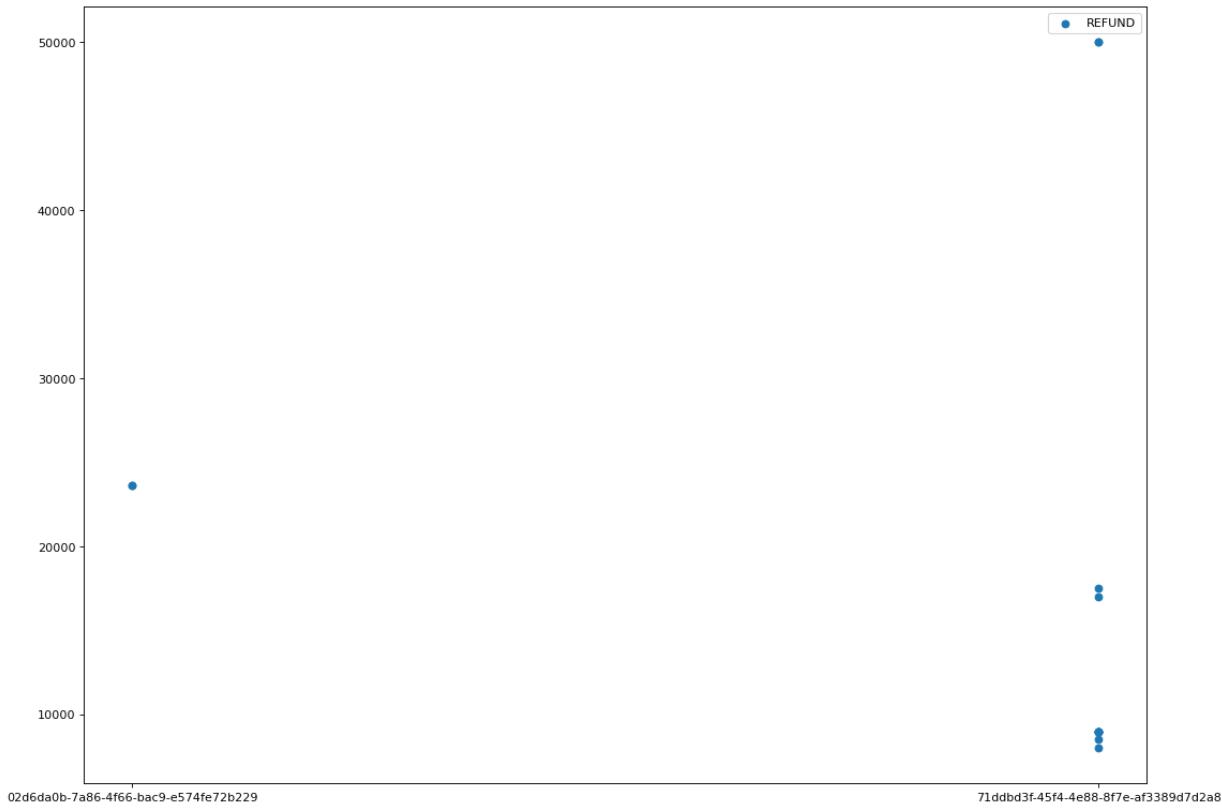
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OTHER 111
Name: externalParty.transactionCategory, dtype: int64

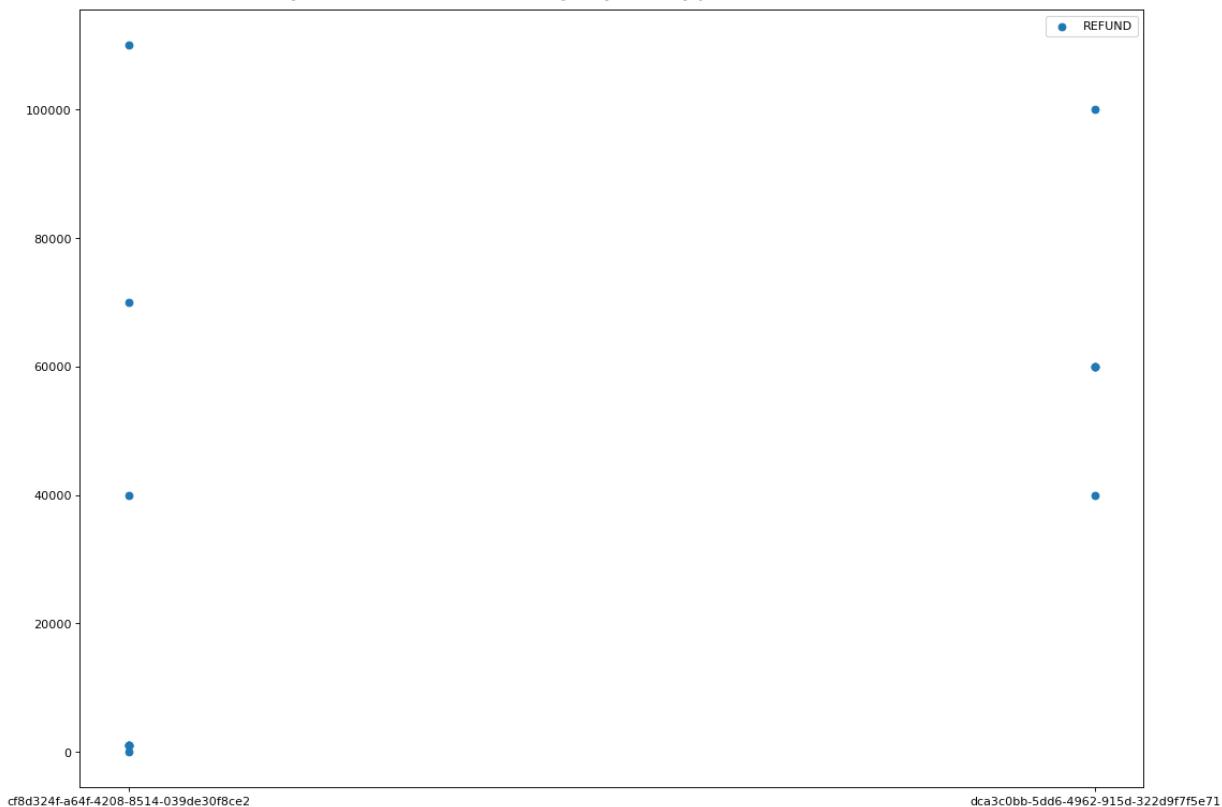


OTHER 117
Name: externalParty.transactionCategory, dtype: int64



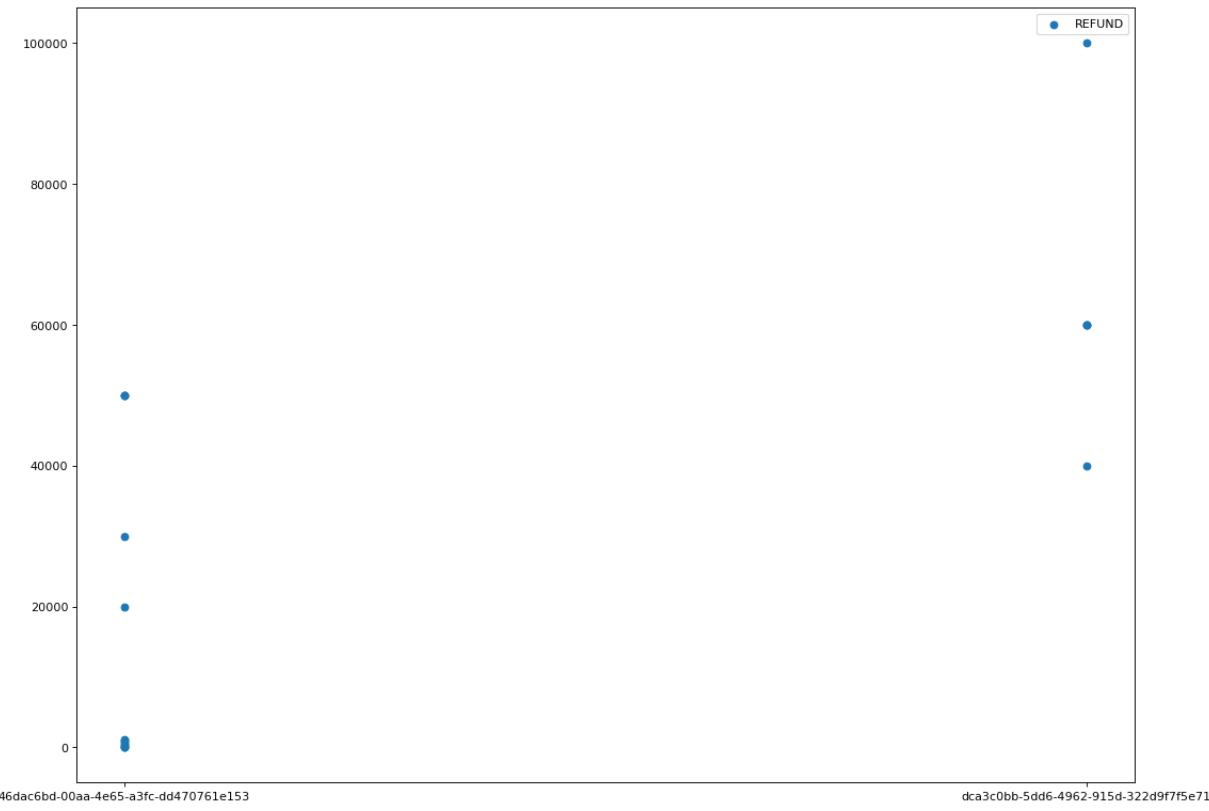
OTHER 14

Name: externalParty.transactionCategory, dtype: int64

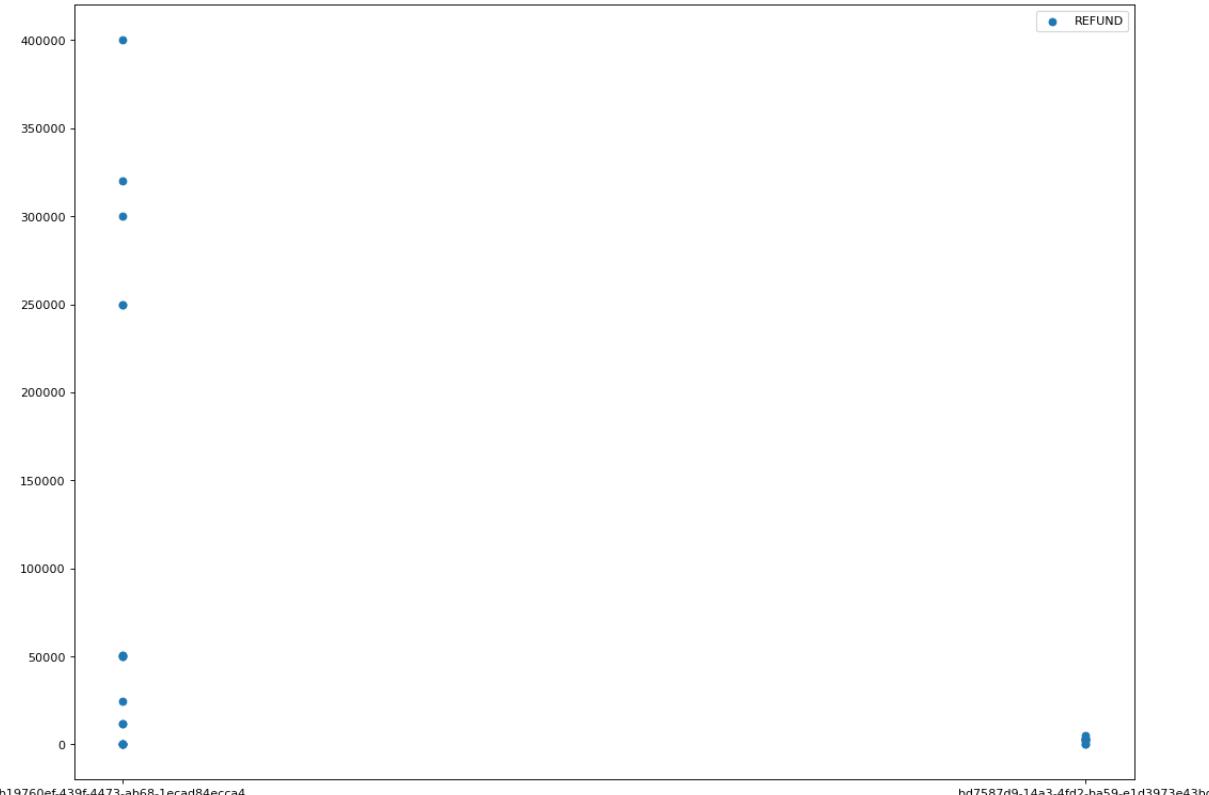


OTHER 13

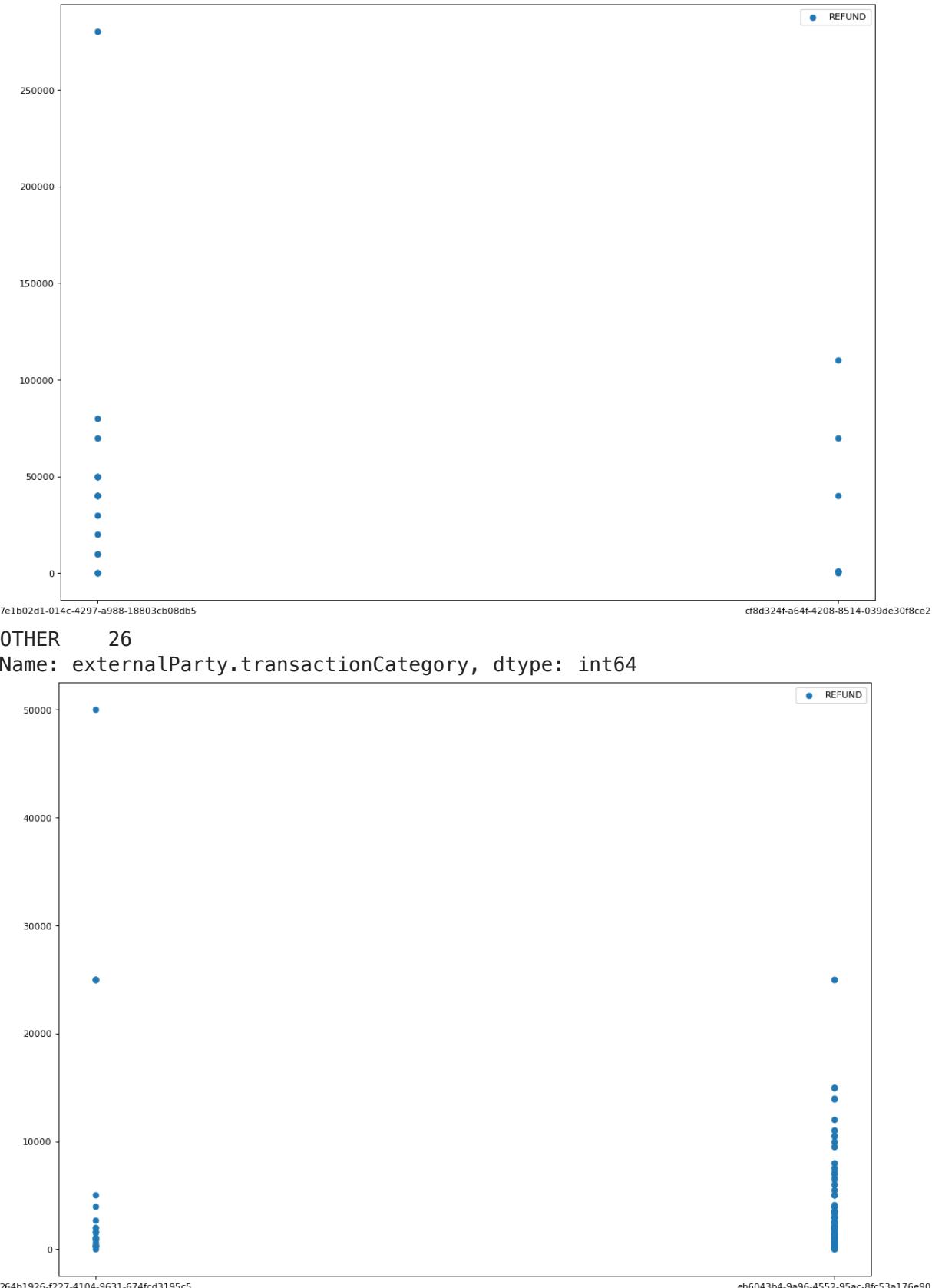
Name: externalParty.transactionCategory, dtype: int64



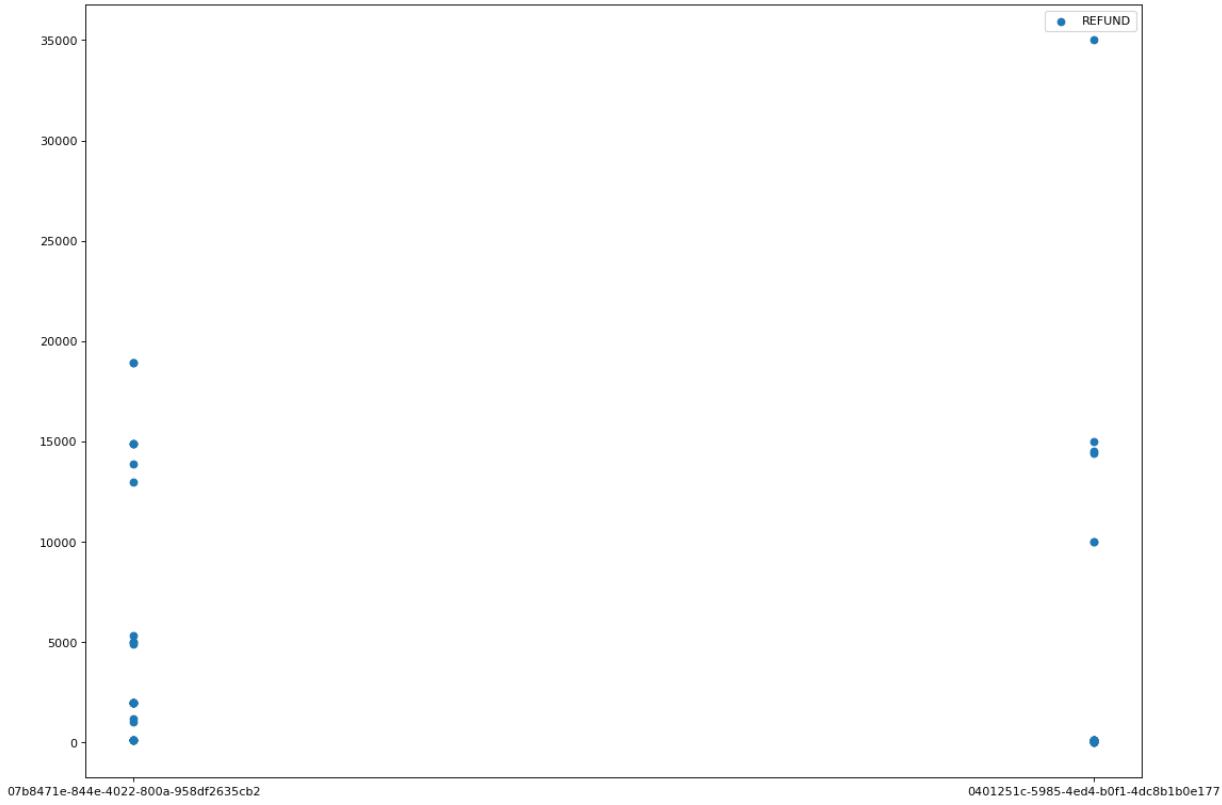
OTHER 18
Name: externalParty.transactionCategory, dtype: int64



OTHER 26
Name: externalParty.transactionCategory, dtype: int64



OTHER	201
TRAVEL	22
LIFESTYLE	19
GROCERIES	15
SHOPPING	3
SUBSCRIPTION	1



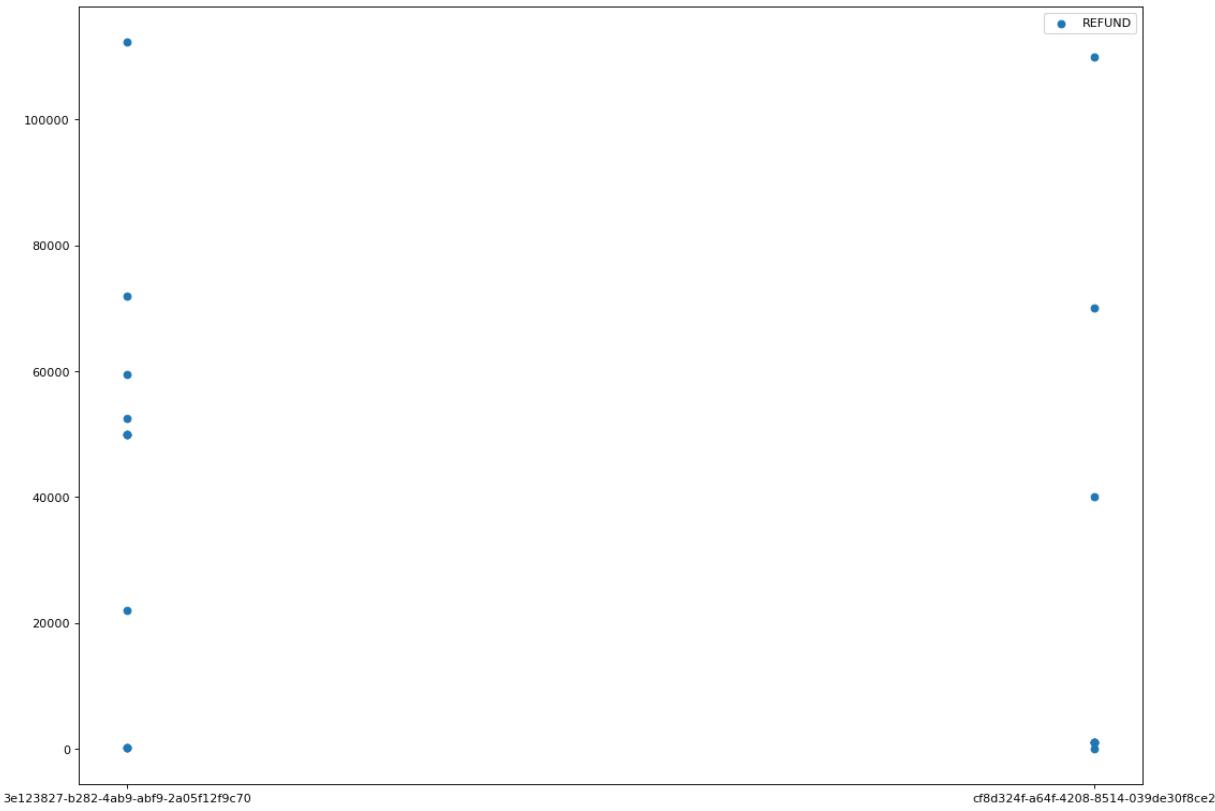
OTHER 46

Name: externalParty.transactionCategory, dtype: int64



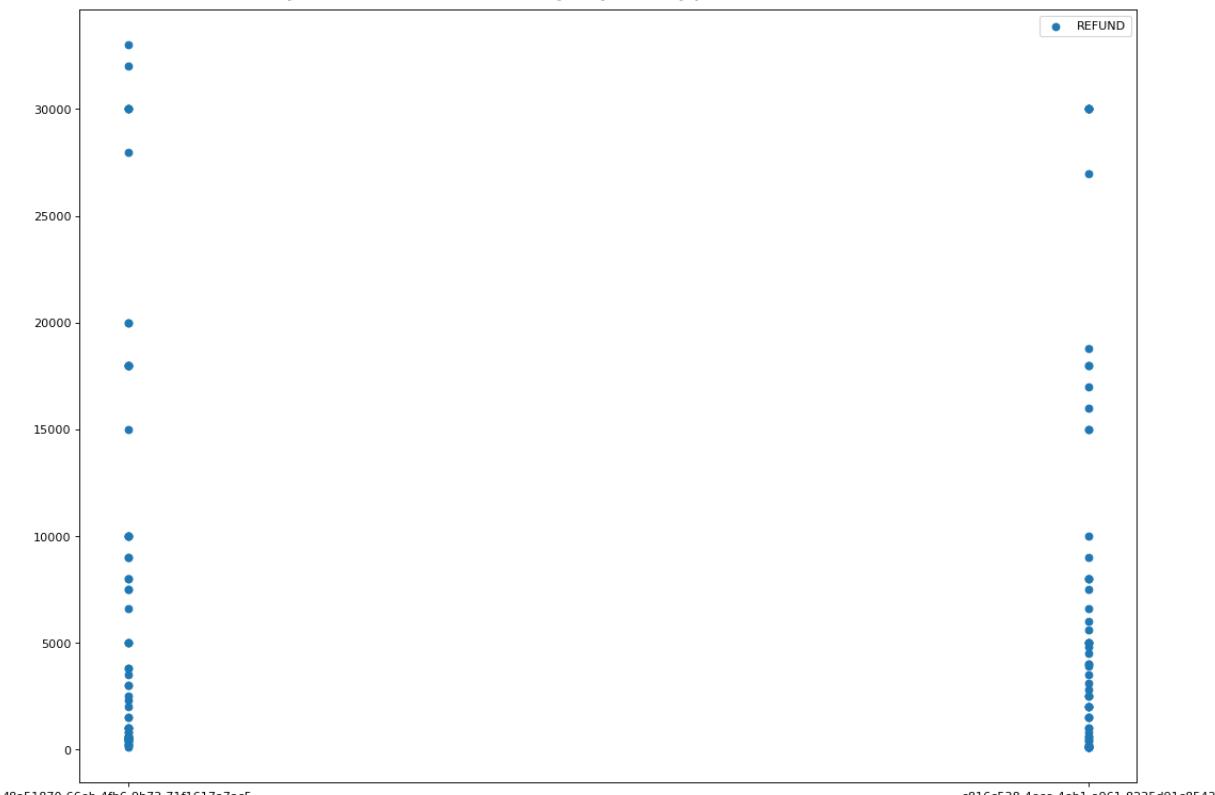
OTHER 80

Name: externalParty.transactionCategory, dtype: int64



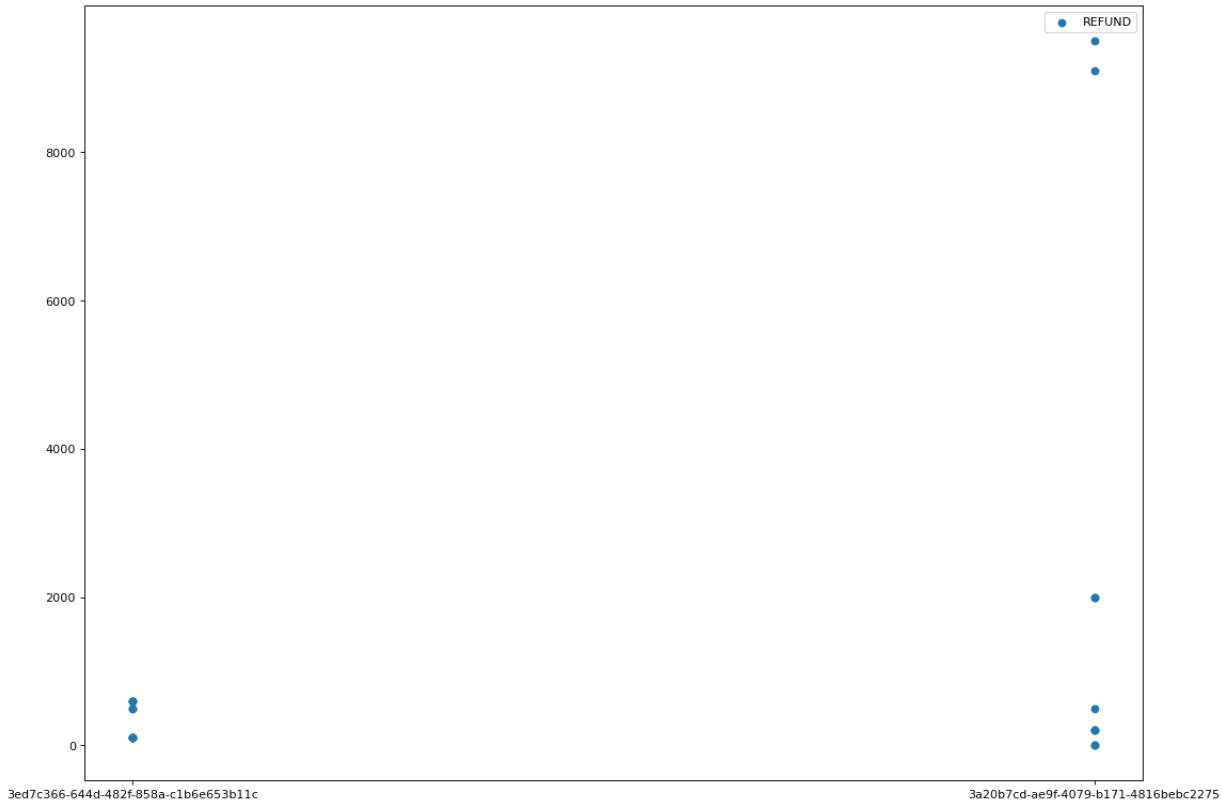
OTHER 19

Name: externalParty.transactionCategory, dtype: int64



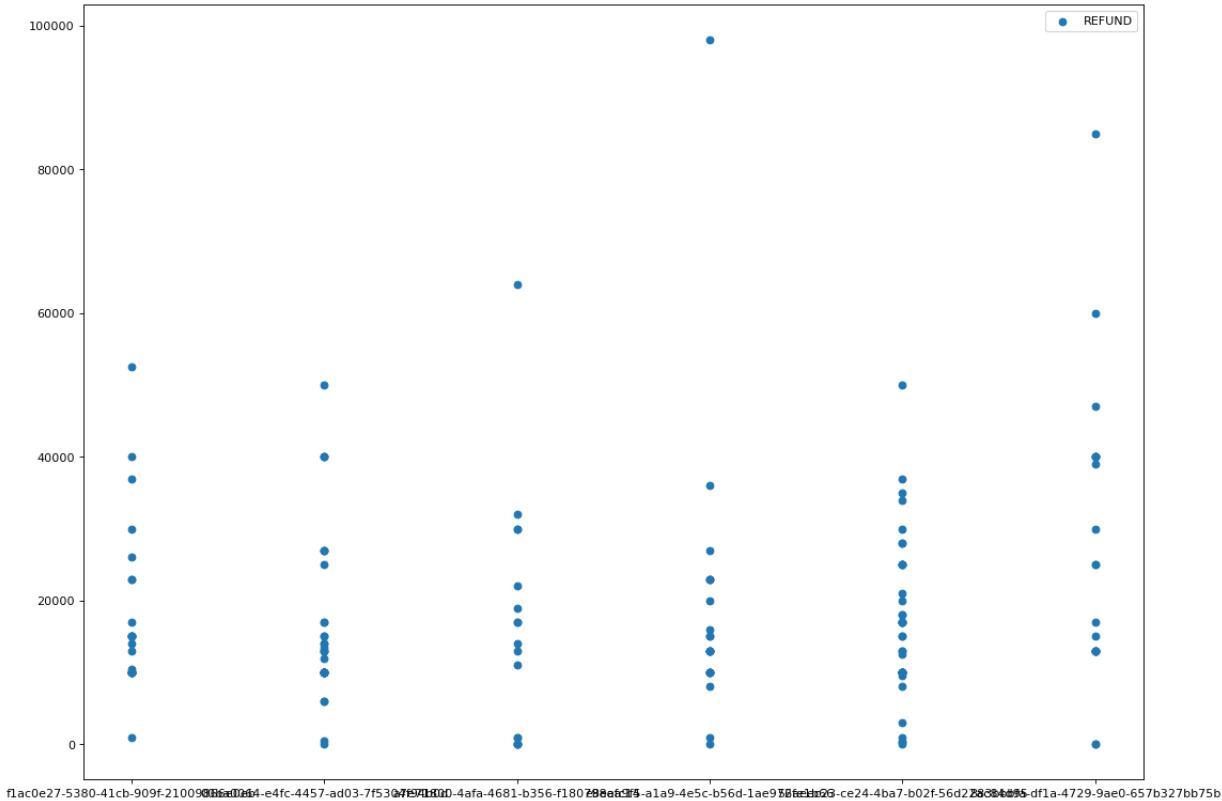
OTHER 126

Name: externalParty.transactionCategory, dtype: int64



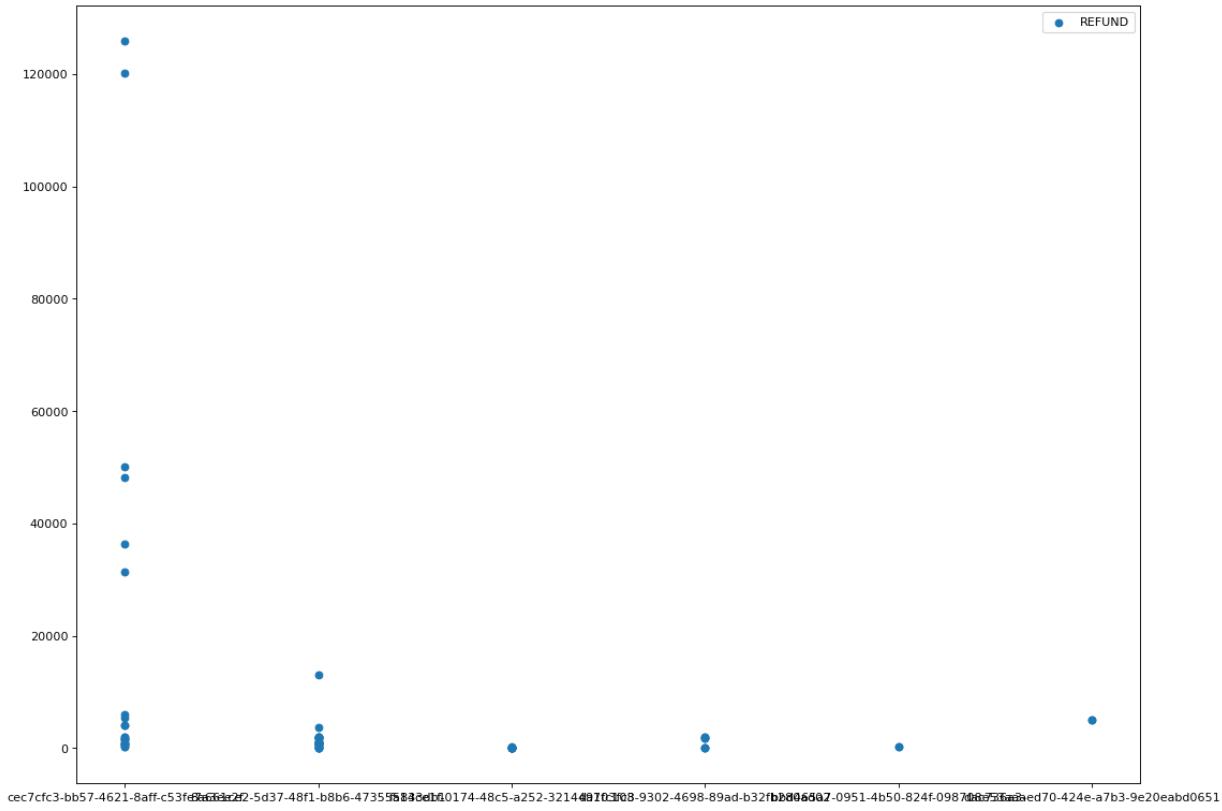
OTHER 20

Name: externalParty.transactionCategory, dtype: int64



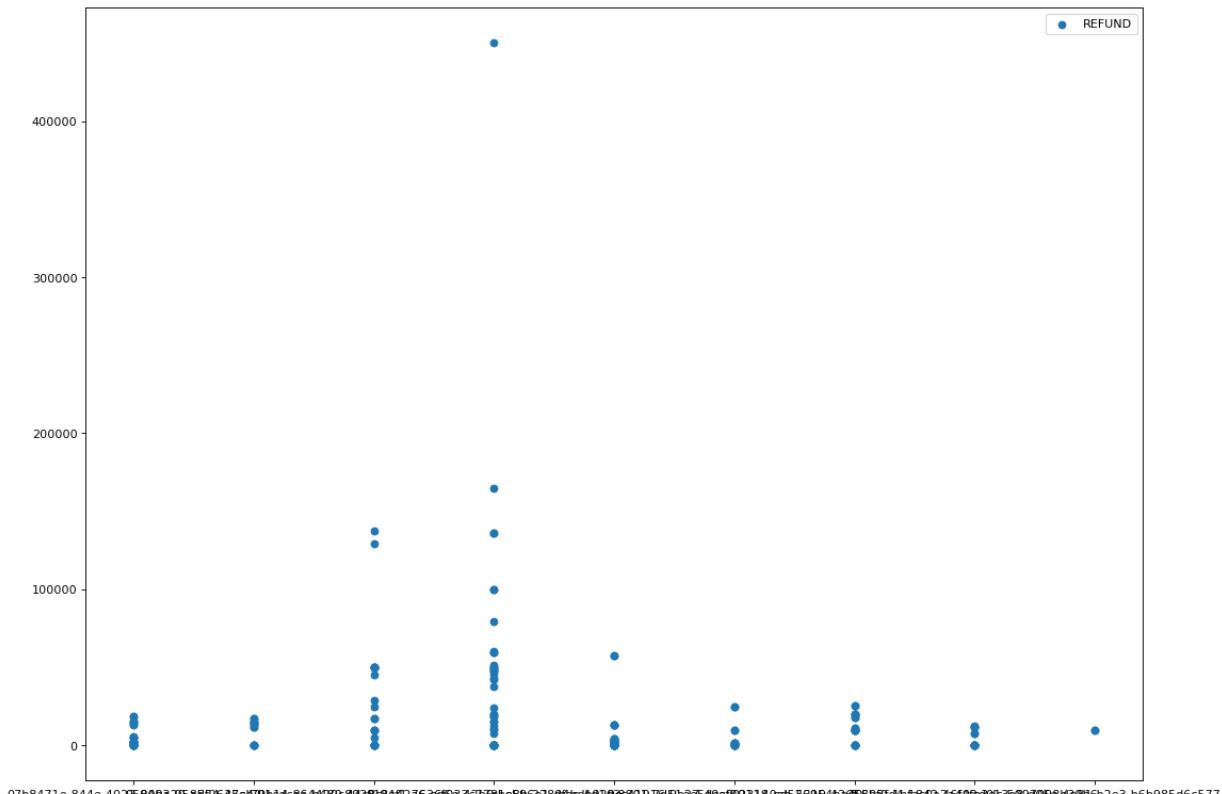
OTHER 161

Name: externalParty.transactionCategory, dtype: int64



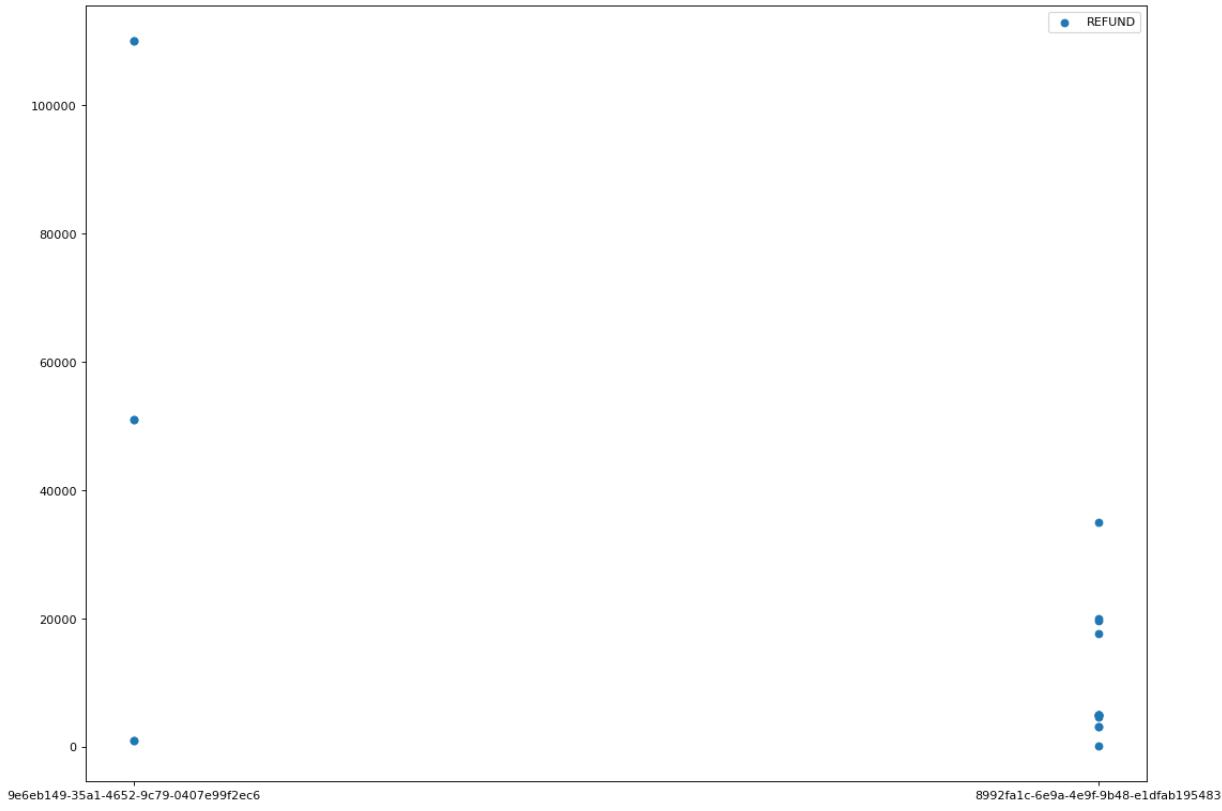
OTHER 72
LIFESTYLE 1

Name: externalParty.transactionCategory, dtype: int64



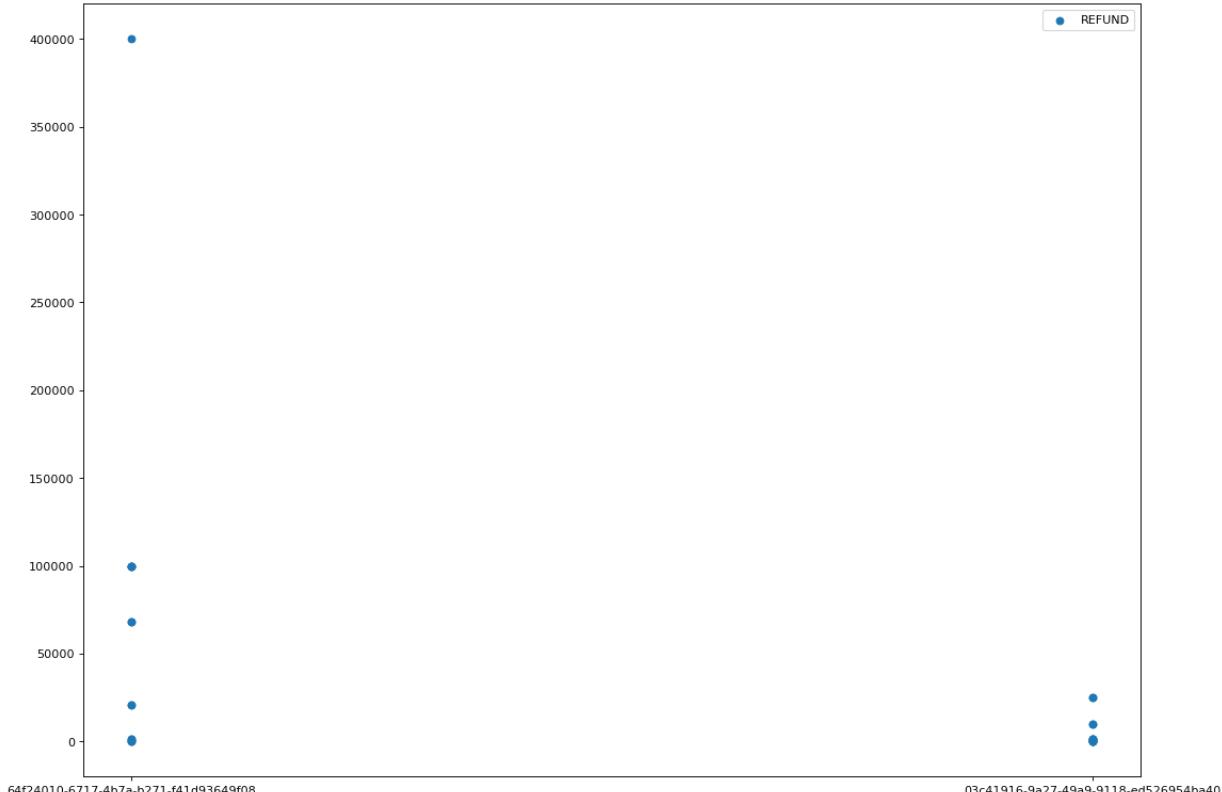
OTHER 202

Name: externalParty.transactionCategory, dtype: int64



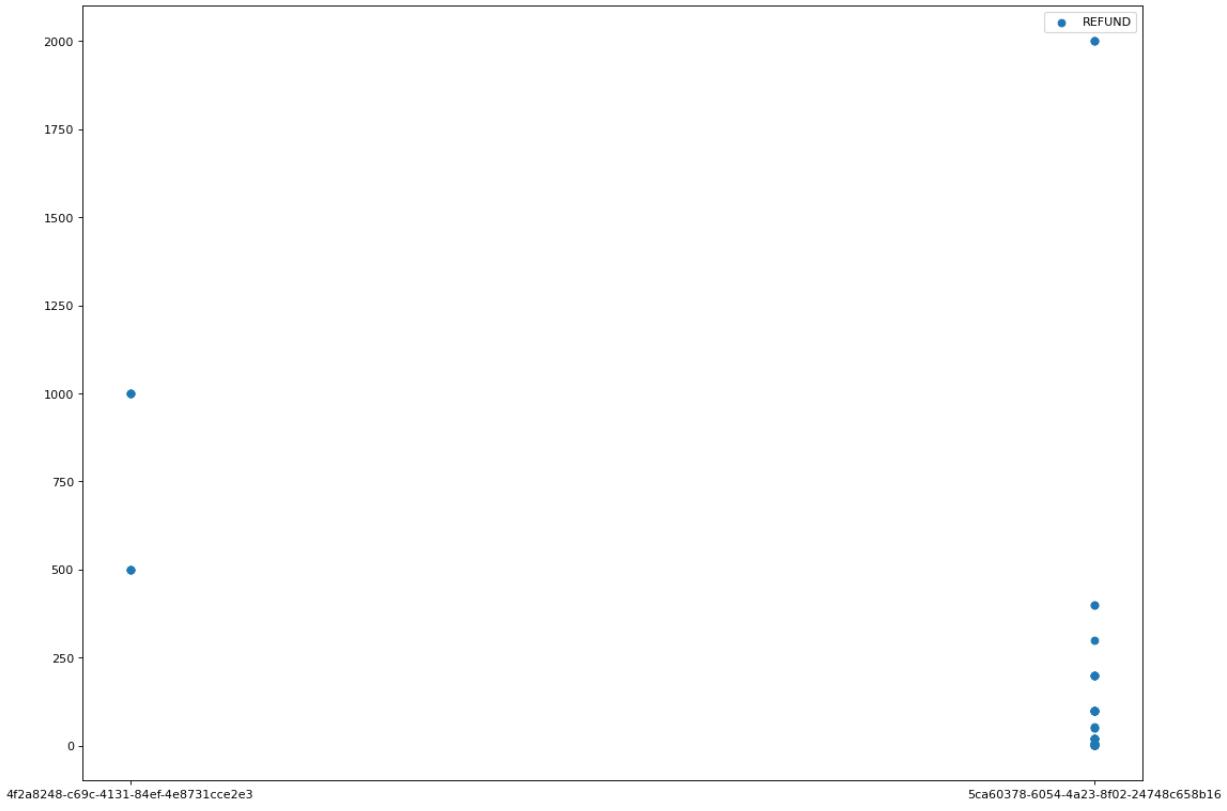
OTHER 19

Name: externalParty.transactionCategory, dtype: int64



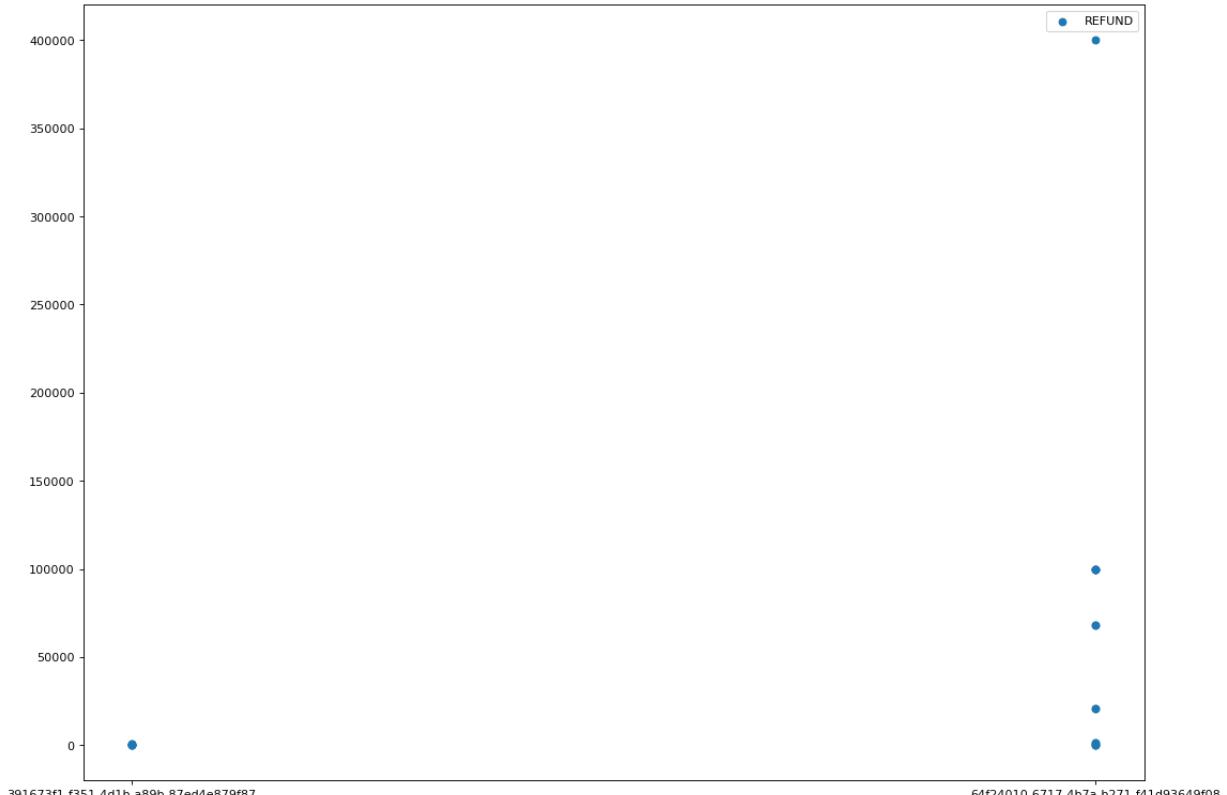
OTHER 28

Name: externalParty.transactionCategory, dtype: int64



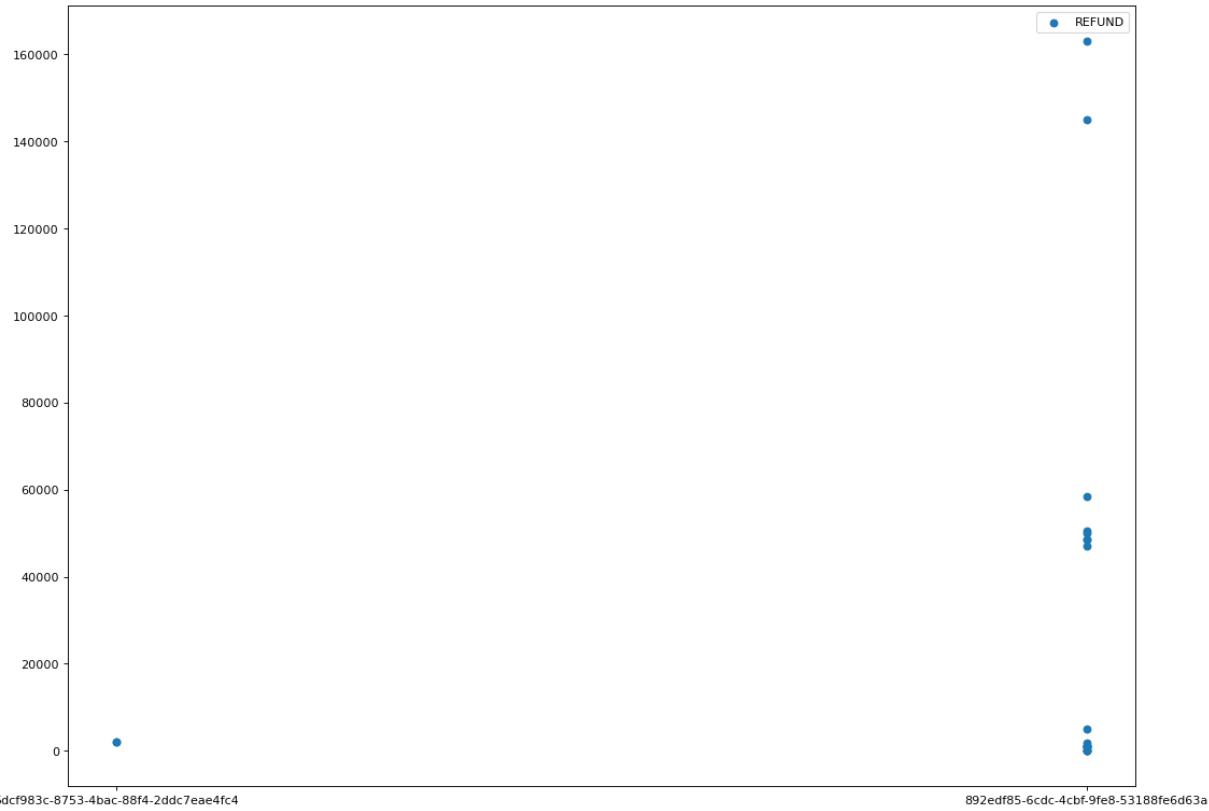
OTHER 73

Name: externalParty.transactionCategory, dtype: int64



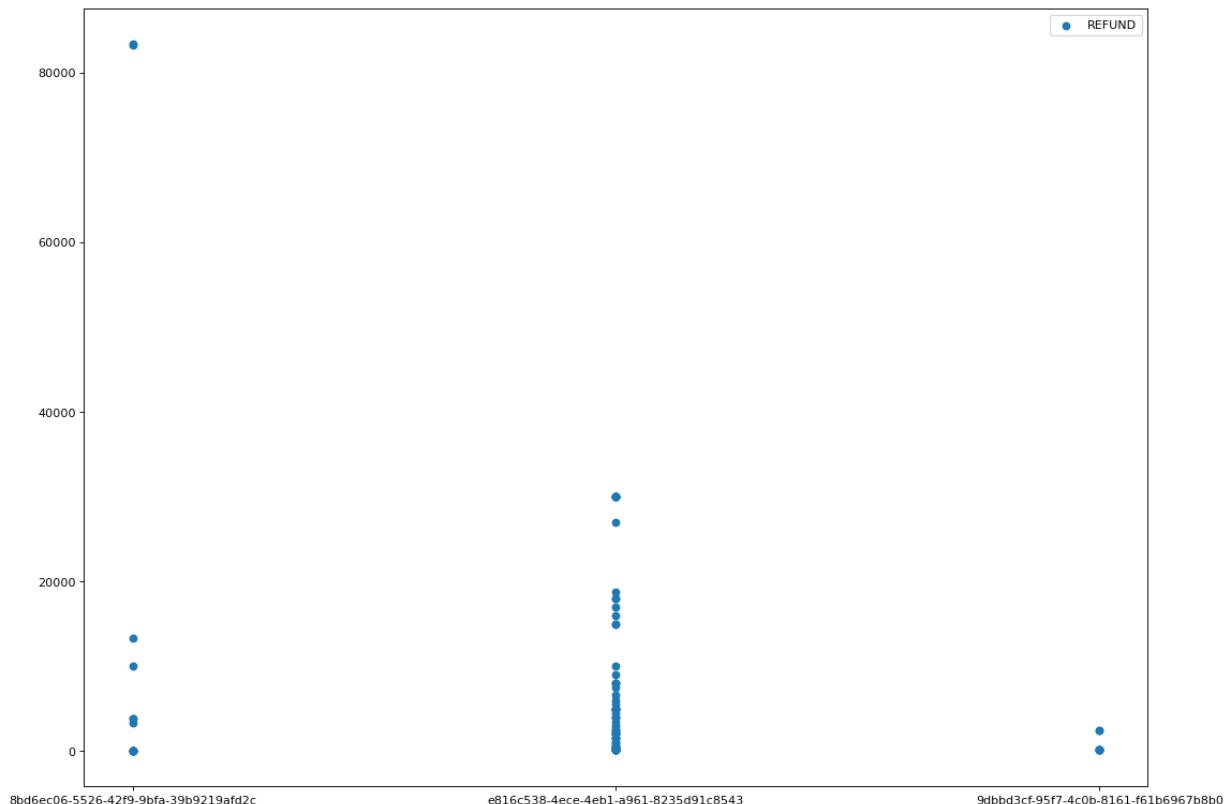
OTHER 20

Name: externalParty.transactionCategory, dtype: int64



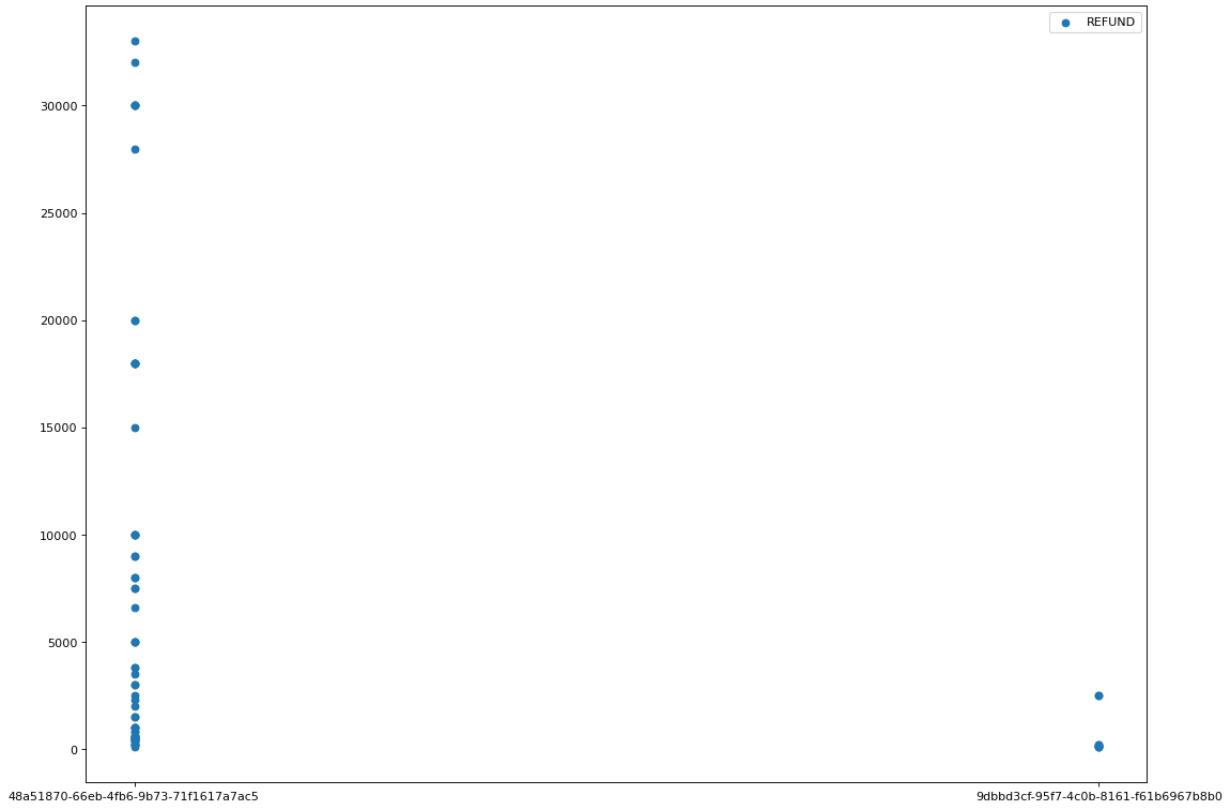
OTHER 22

Name: externalParty.transactionCategory, dtype: int64

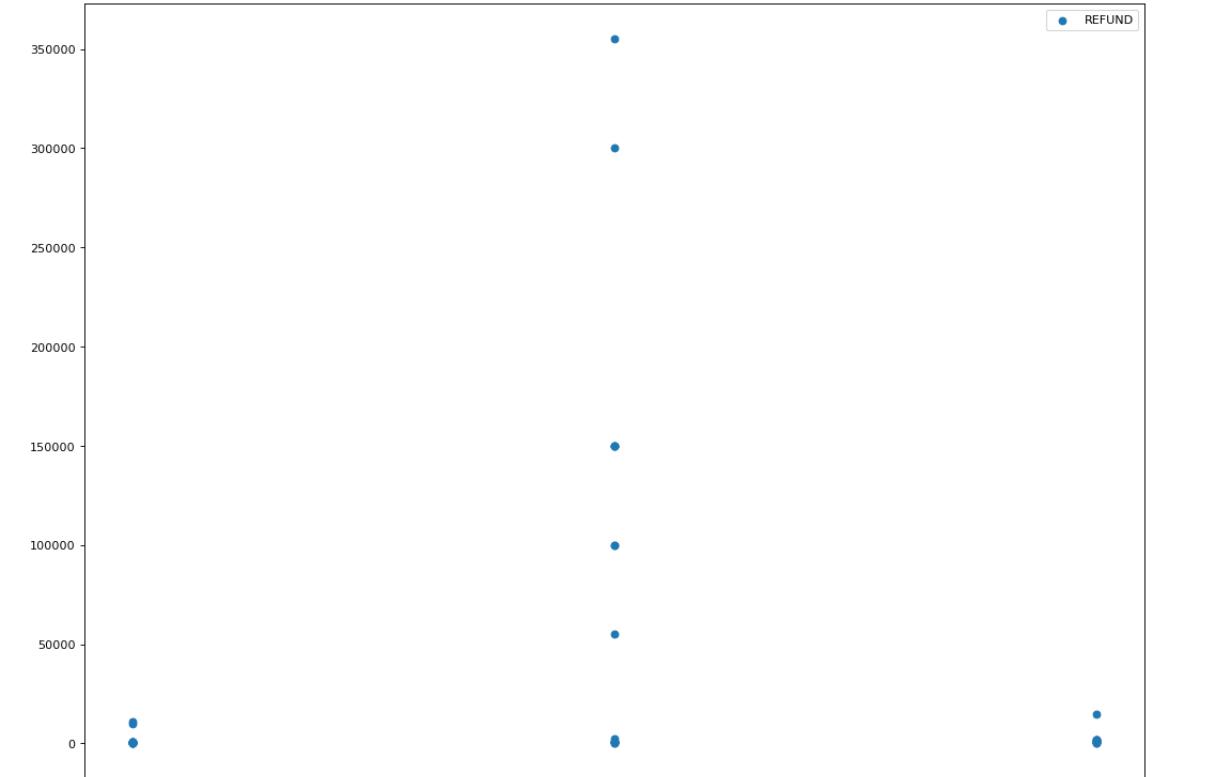


OTHER 87

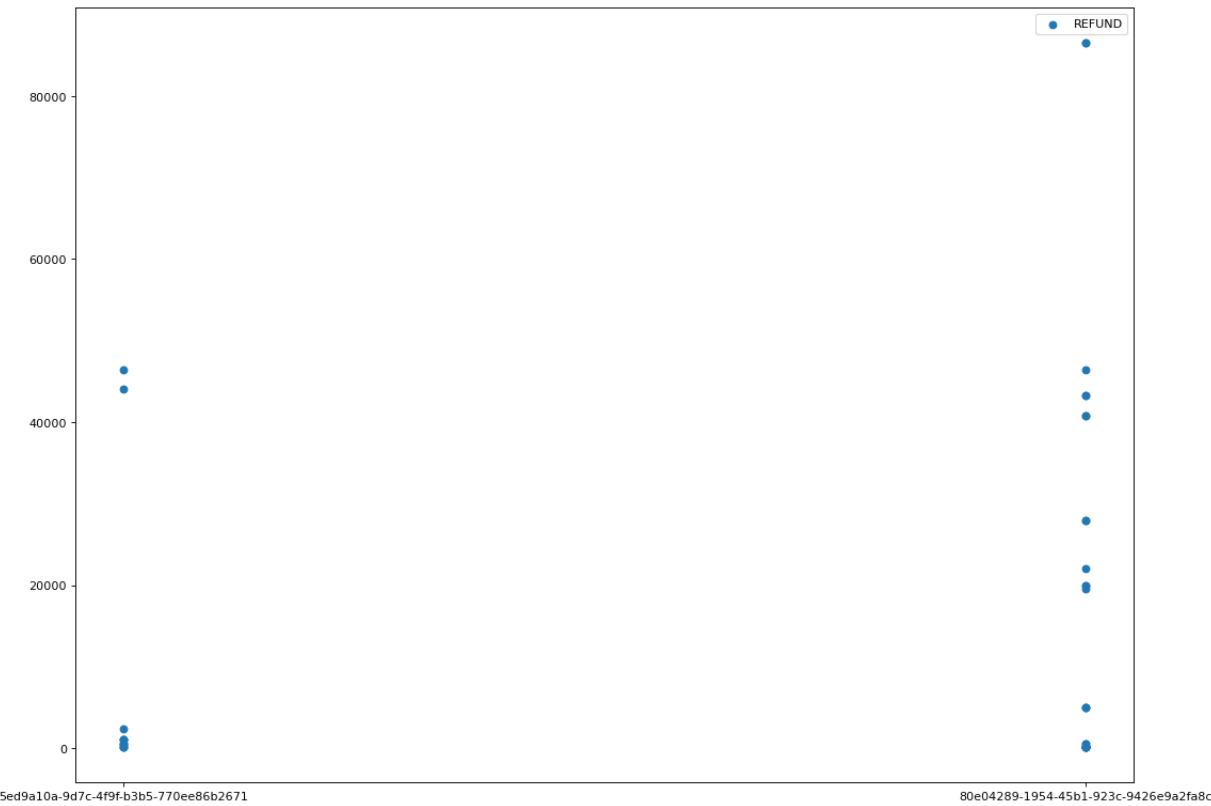
Name: externalParty.transactionCategory, dtype: int64



OTHER 72
Name: externalParty.transactionCategory, dtype: int64



OTHER 44
Name: externalParty.transactionCategory, dtype: int64



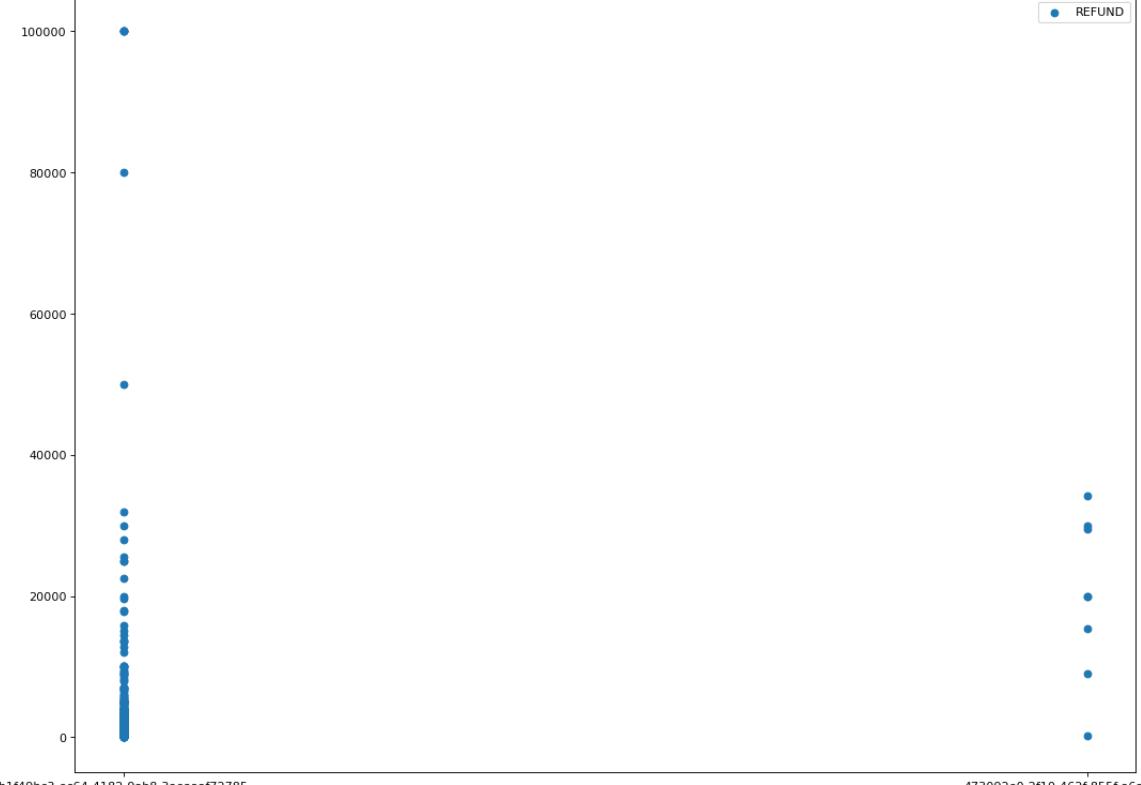
5ed9a10a-9d7c-4f9f-b3b5-770ee86b2671

80e04289-1954-45b1-923c-9426e9a2fa8c

OTHER 38

SHOPPING 1

Name: externalParty.transactionCategory, dtype: int64



b1f49bc3-ec64-4182-9ab8-3aeaaaaf72785

473092e0-2f10-462f-855f-a6a6438223c6

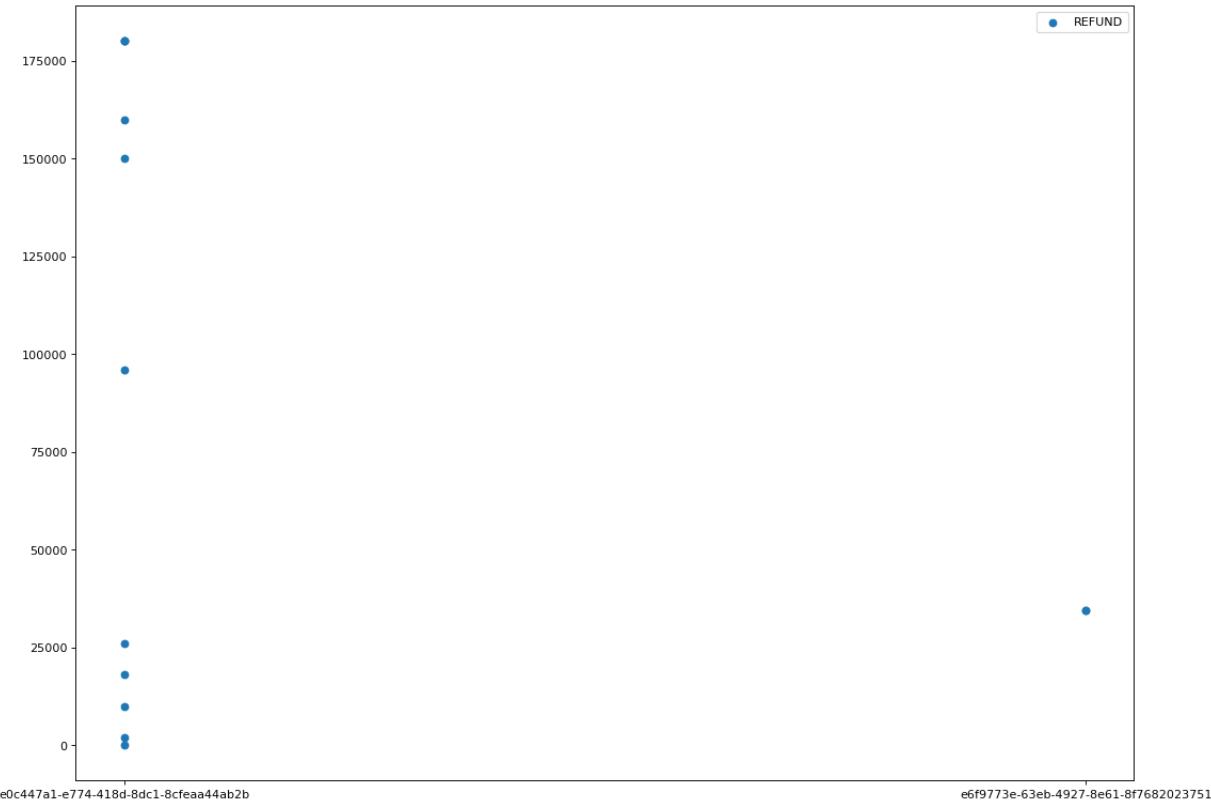
OTHER 112

TRAVEL 97

LIFESTYLE 64

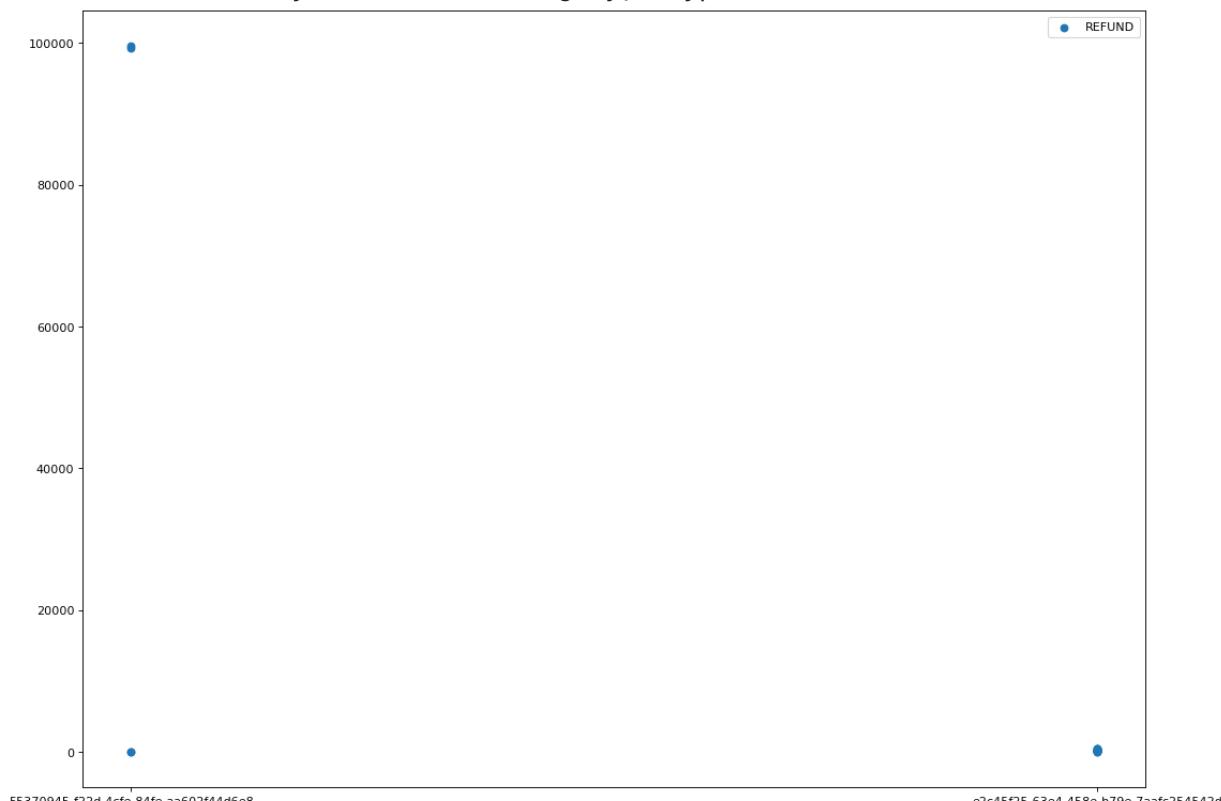
GROCERIES 27

SHOPPING 22



OTHER 13

Name: externalParty.transactionCategory, dtype: int64



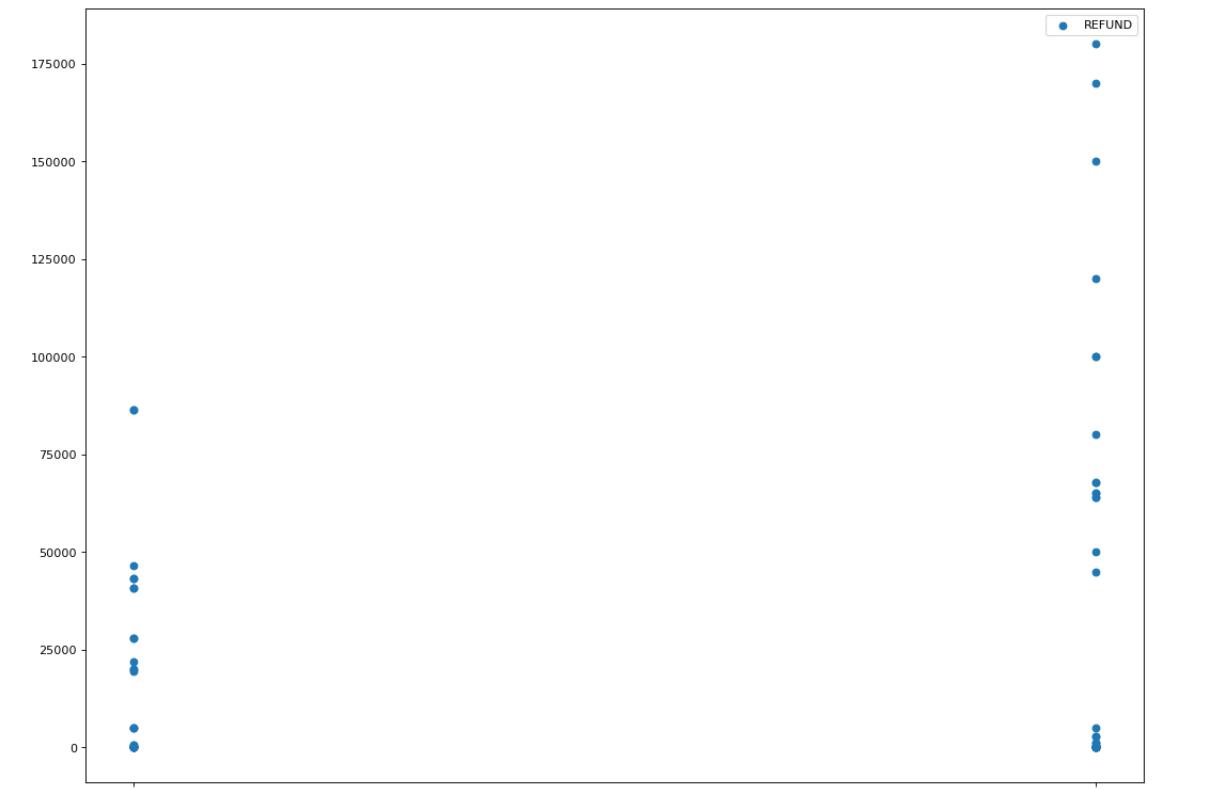
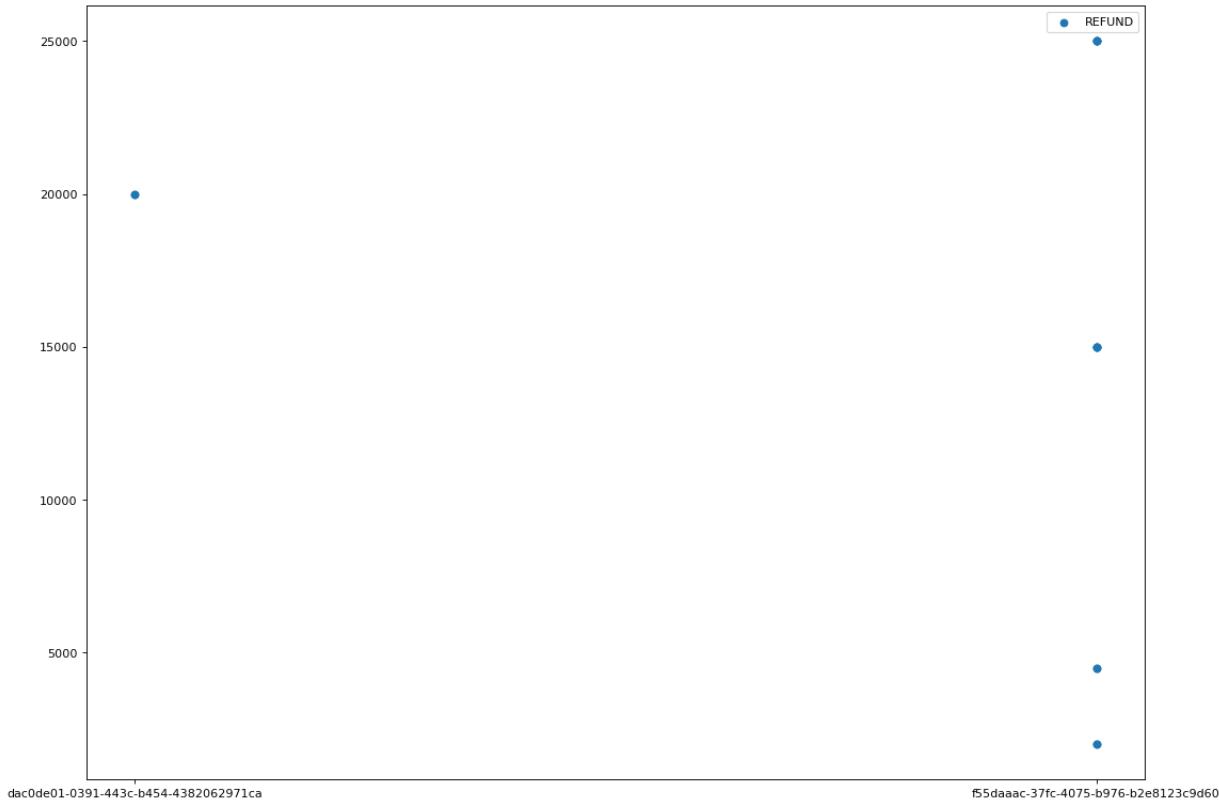
OTHER 17

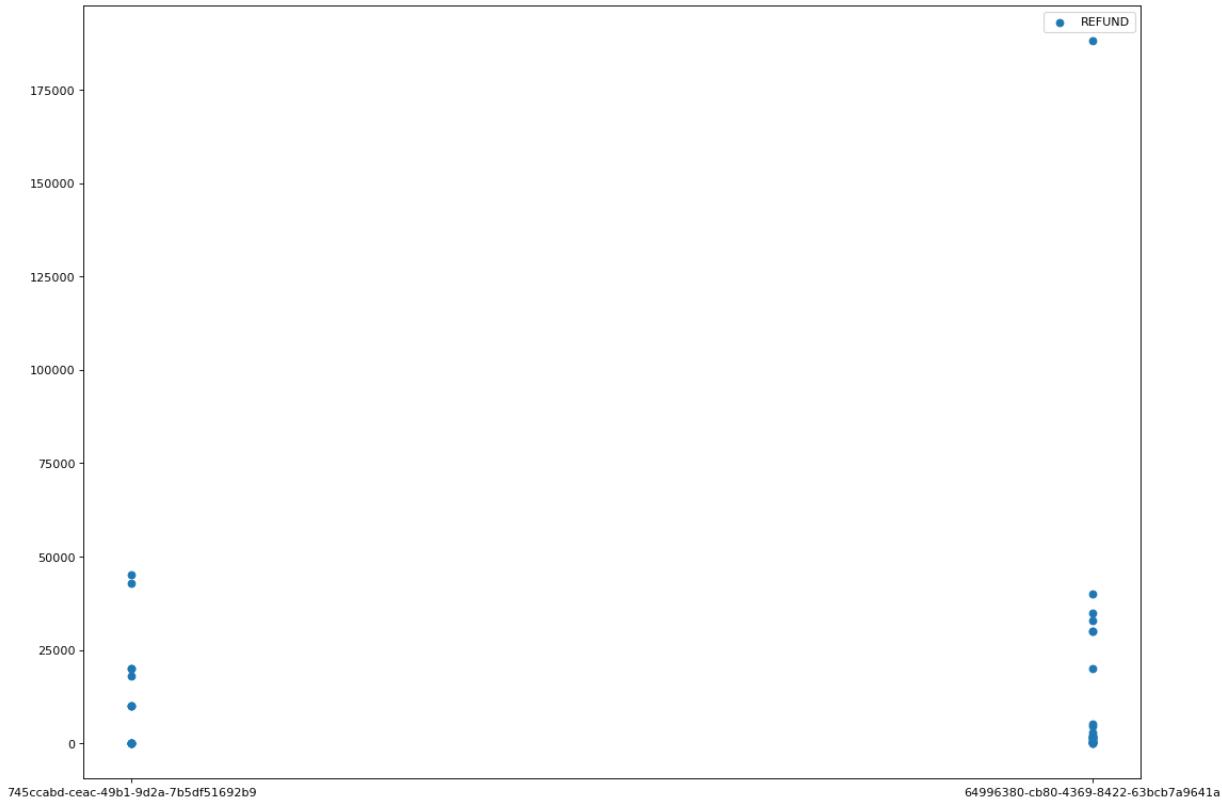
SUBSCRIPTION 2

GROCERIES 1

TRAVEL 1

Name: externalParty.transactionCategory, dtype: int64



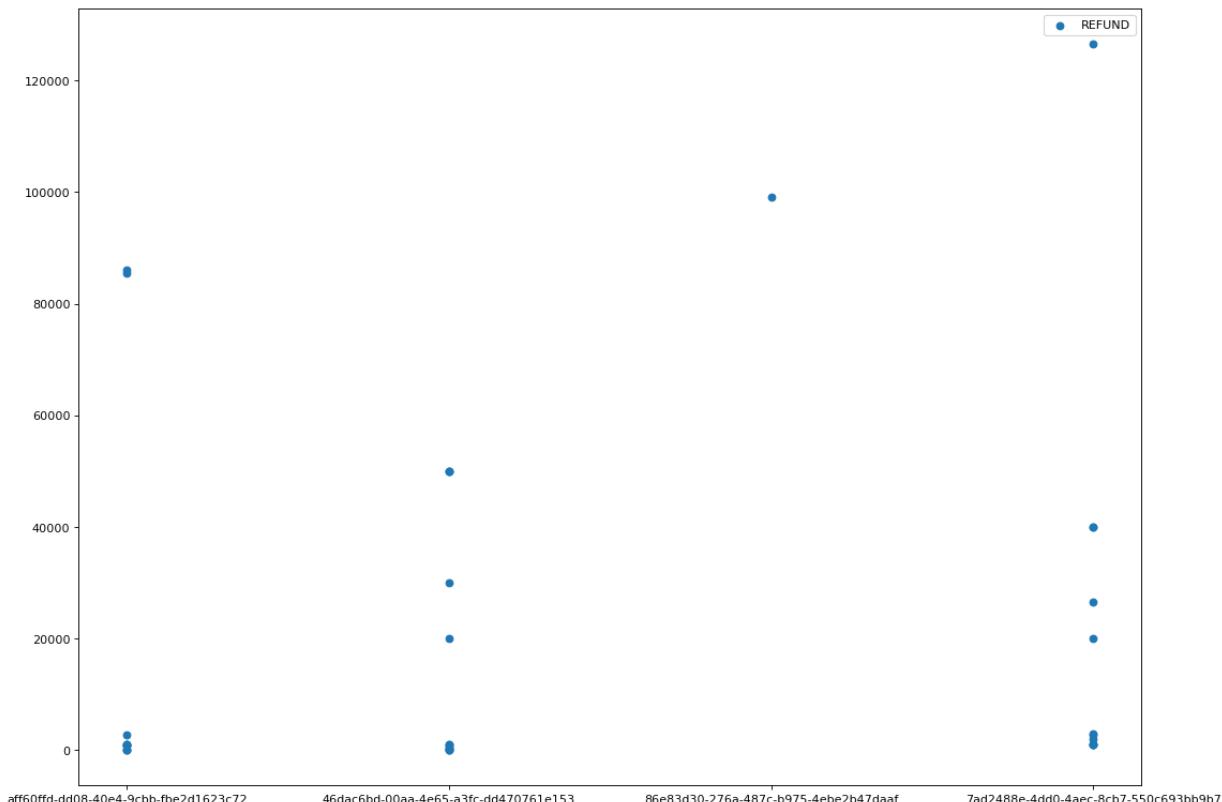


OTHER 38

LIFESTYLE 2

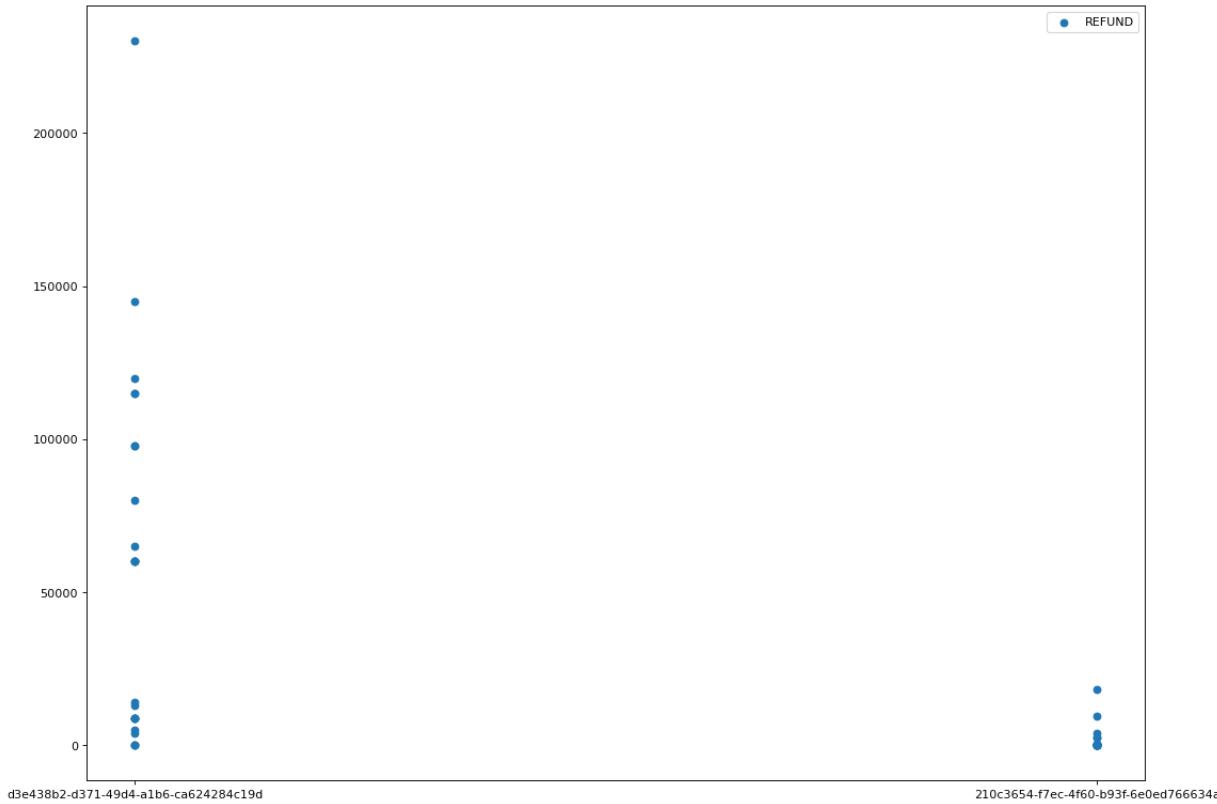
SHOPPING 1

Name: externalParty.transactionCategory, dtype: int64



OTHER 37

Name: externalParty.transactionCategory, dtype: int64

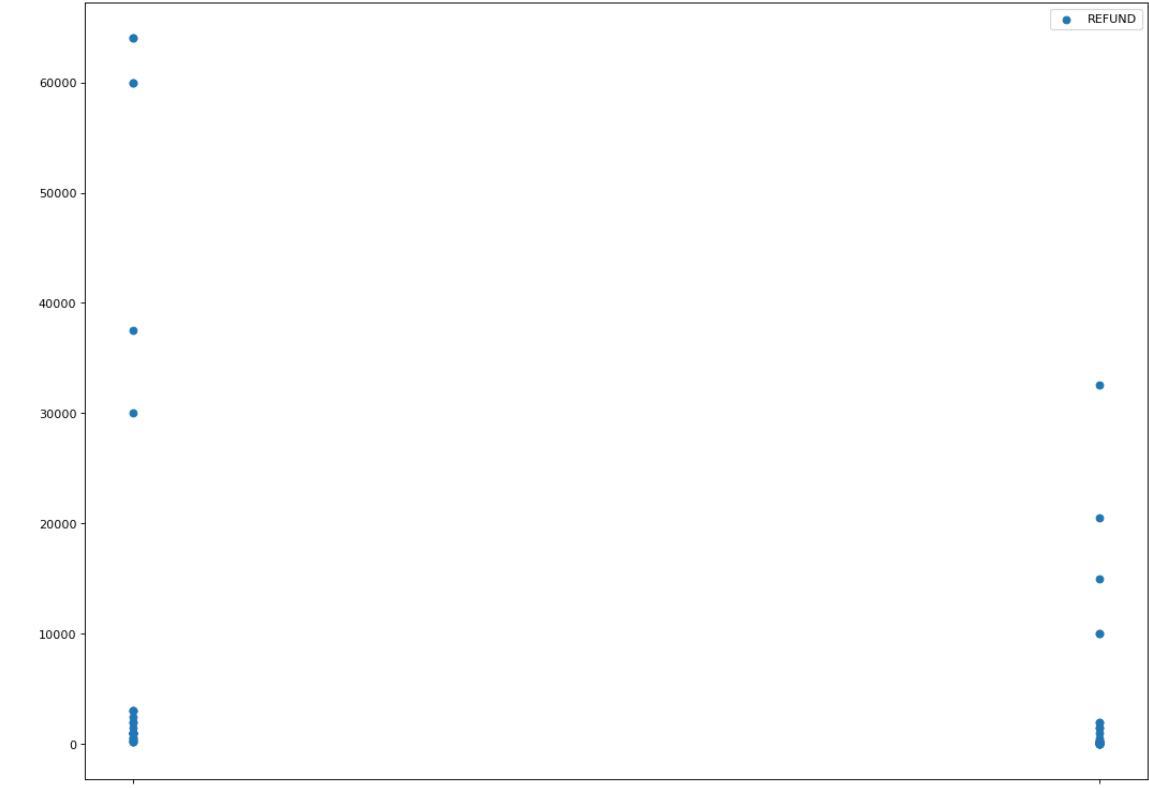


d3e438b2-d371-49d4-a1b6-ca624284c19d

210c3654-f7ec-4f60-b93f-6e0ed766634a

OTHER	61
GROCERIES	3
SHOPPING	2

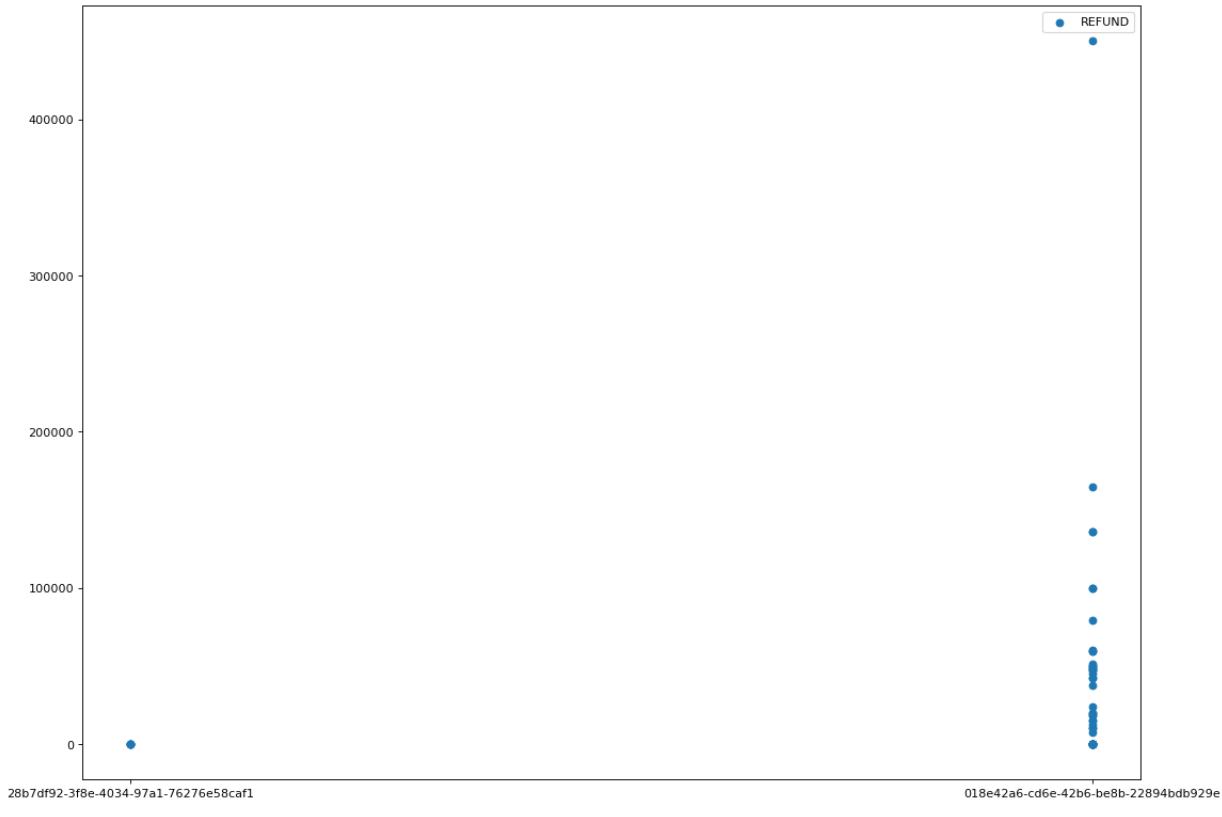
Name: externalParty.transactionCategory, dtype: int64



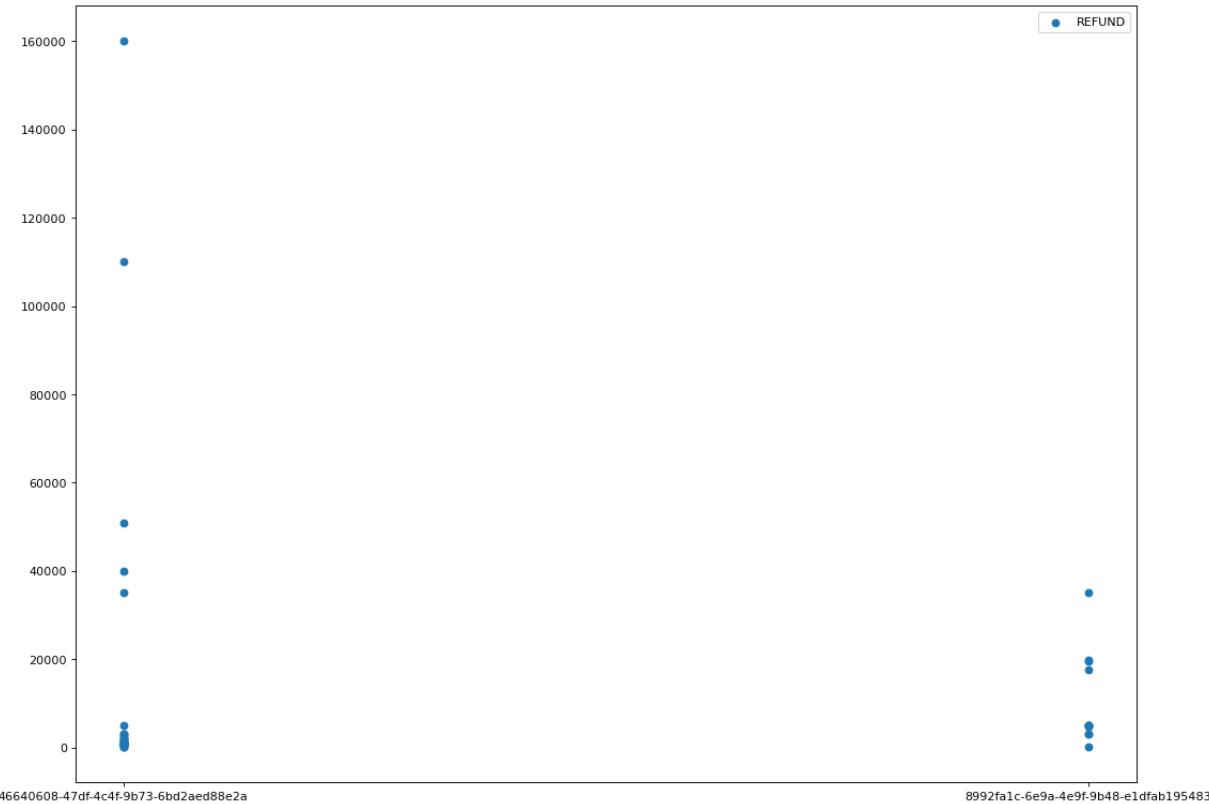
6128adbc-60c6-4cd6-80d4-d501289ef550

f5eaf026-6bac-45fe-adf1-05cda808c98e

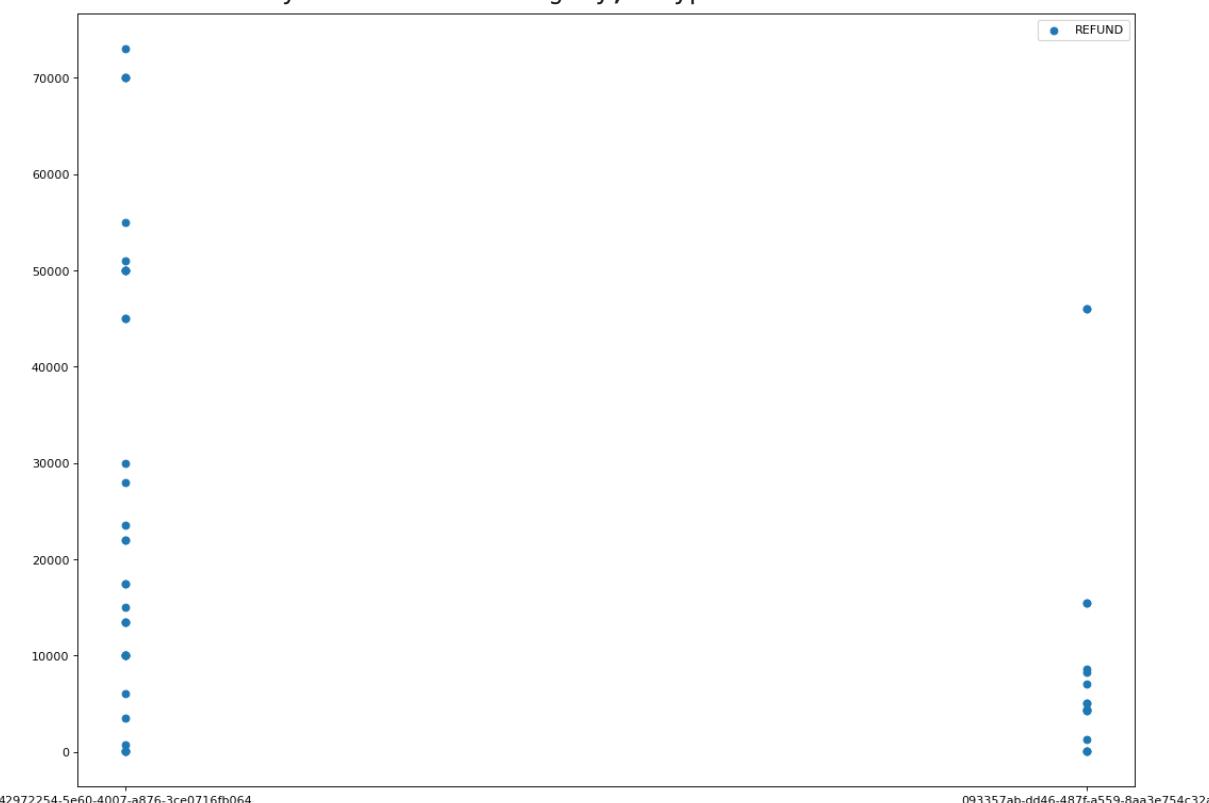
OTHER	52
LIFESTYLE	5
GROCERIES	3
SHOPPING	1



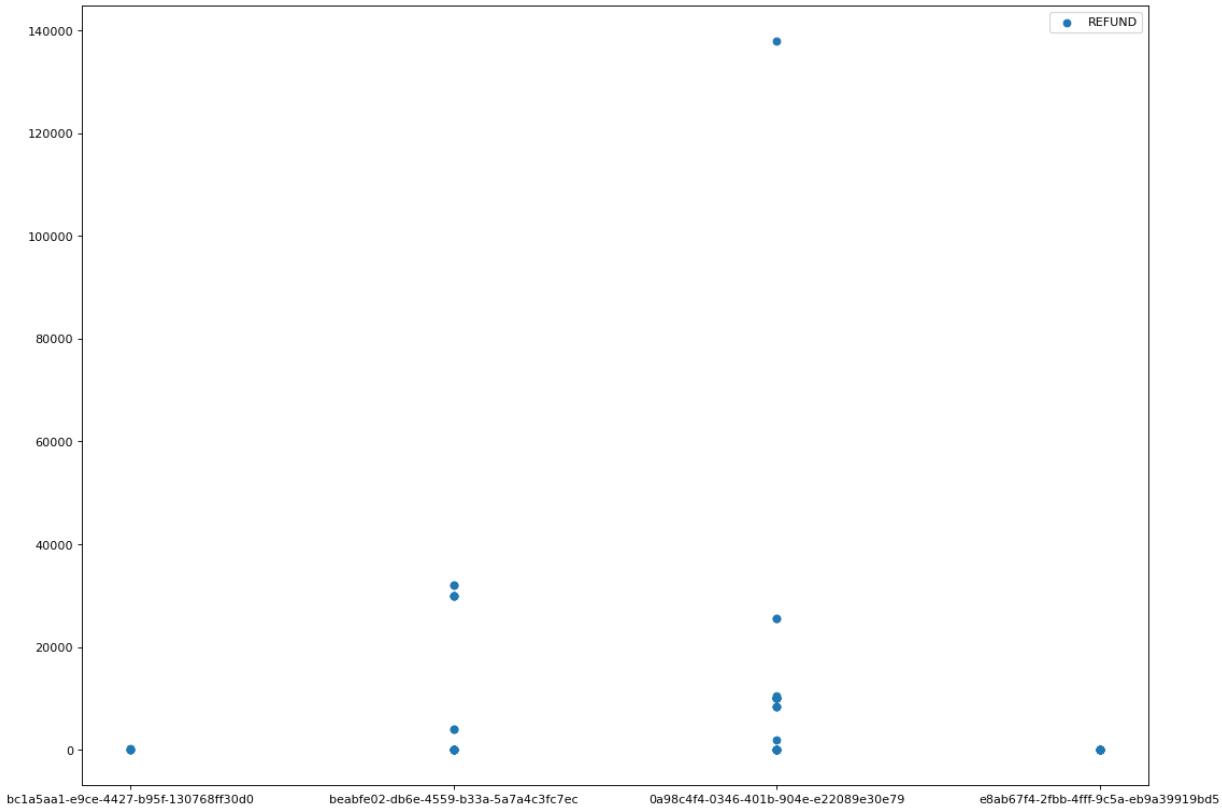
OTHER 47
GROCERIES 6
LIFESTYLE 4
Name: externalParty.transactionCategory, dtype: int64



Name: externalParty.transactionCategory, dtype: int64

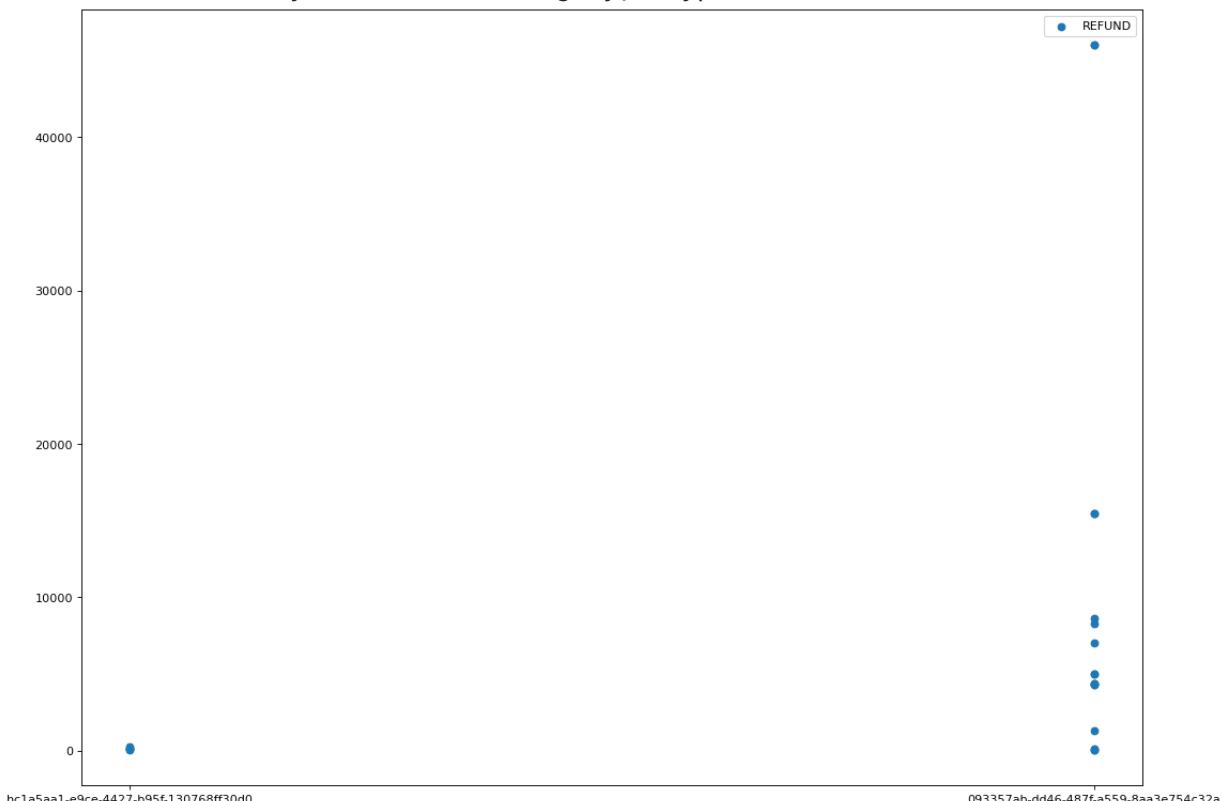


Name: externalParty.transactionCategory, dtype: int64



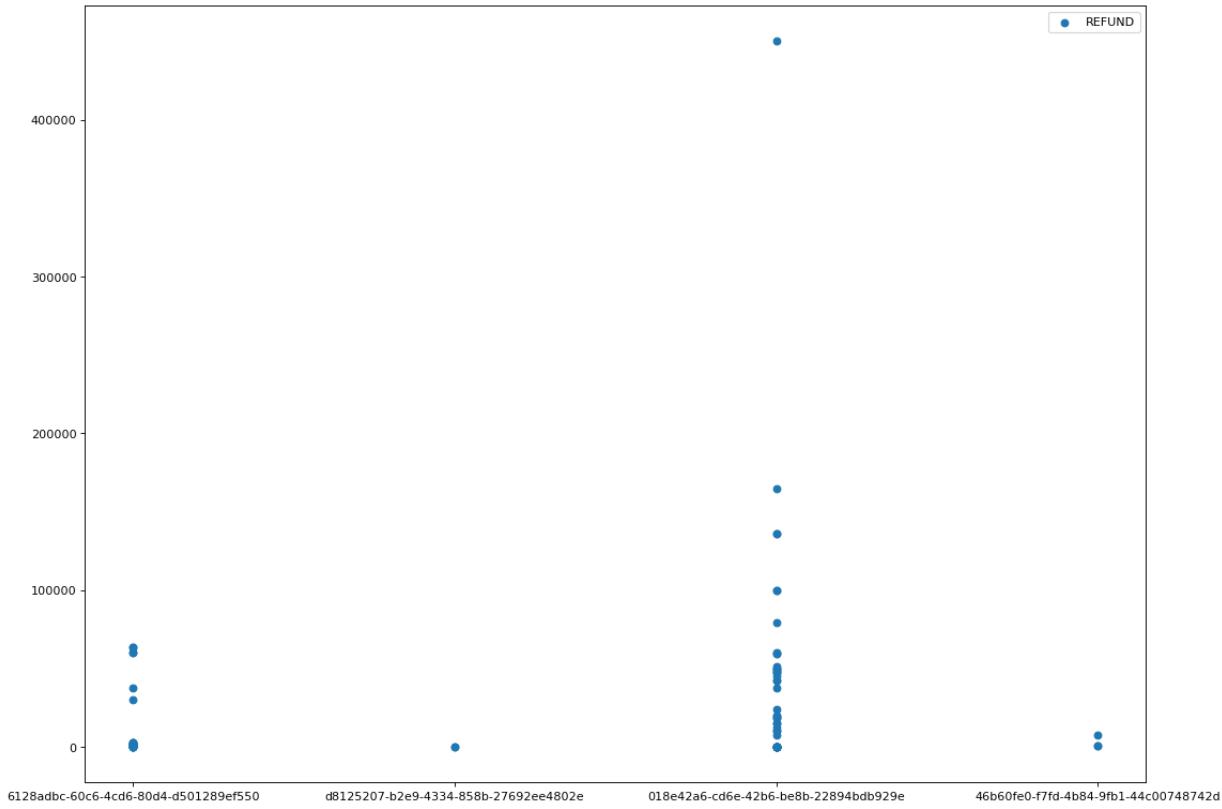
OTHER 62

Name: externalParty.transactionCategory, dtype: int64



OTHER 22

Name: externalParty.transactionCategory, dtype: int64



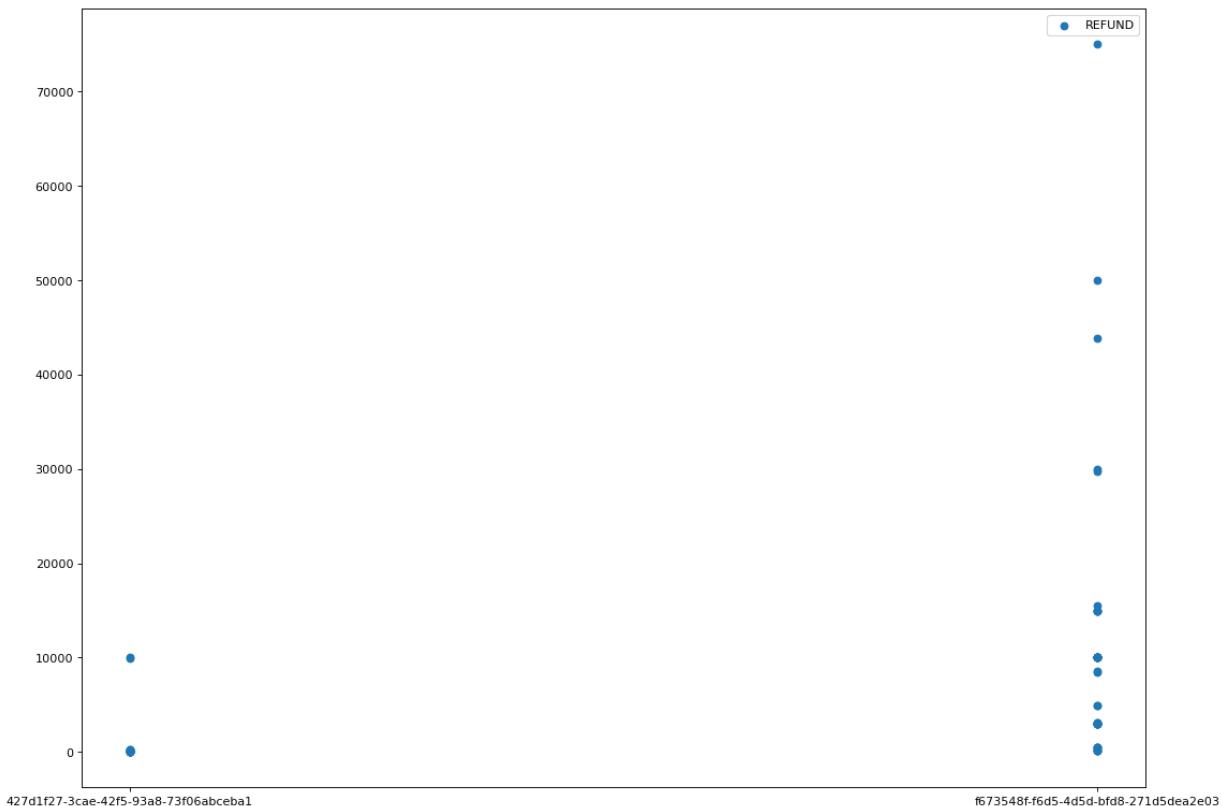
OTHER 76

LIFESTYLE 4

GROCERIES 3

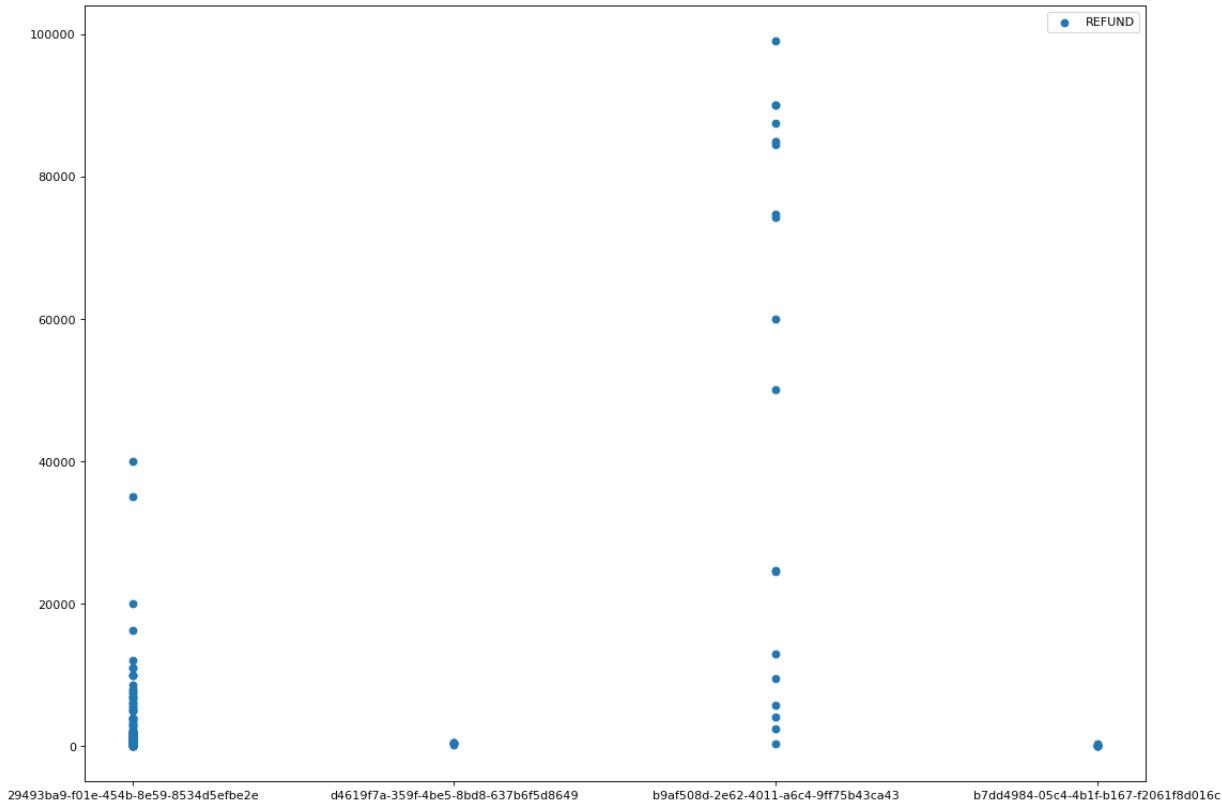
SHOPPING 1

Name: externalParty.transactionCategory, dtype: int64

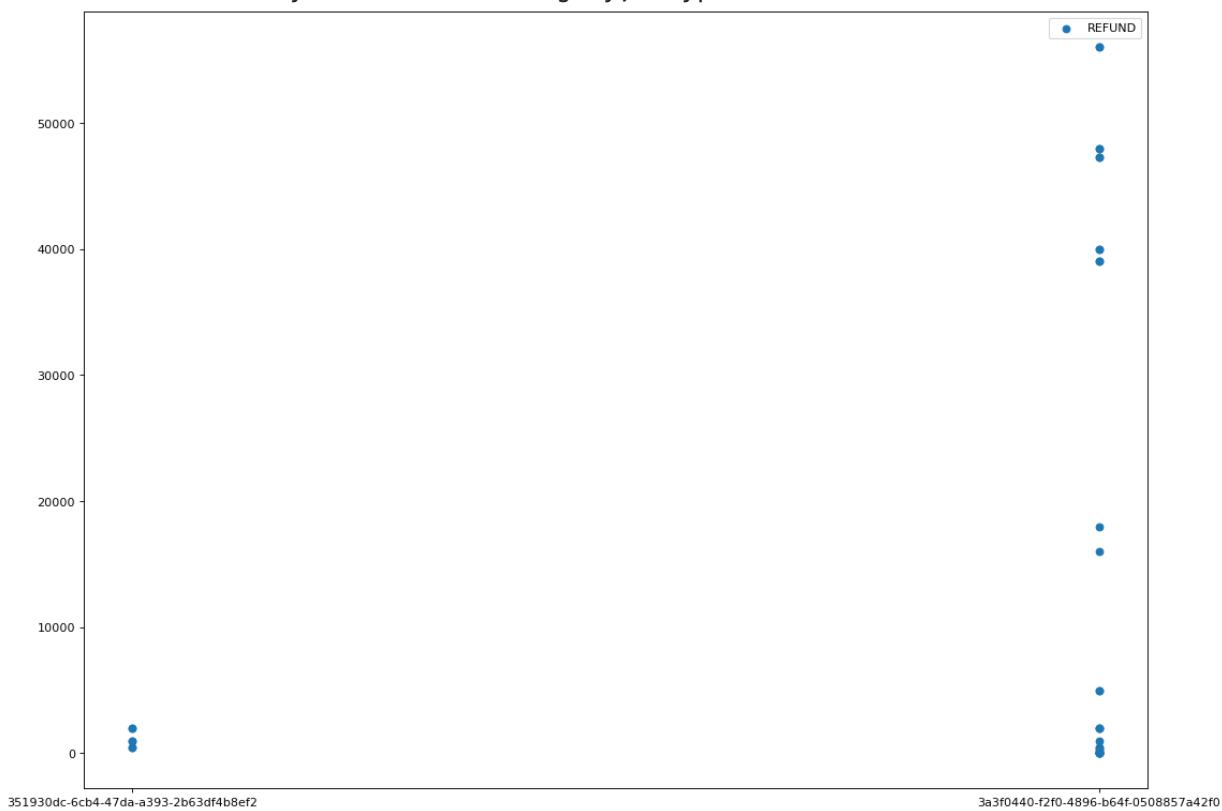


OTHER 64

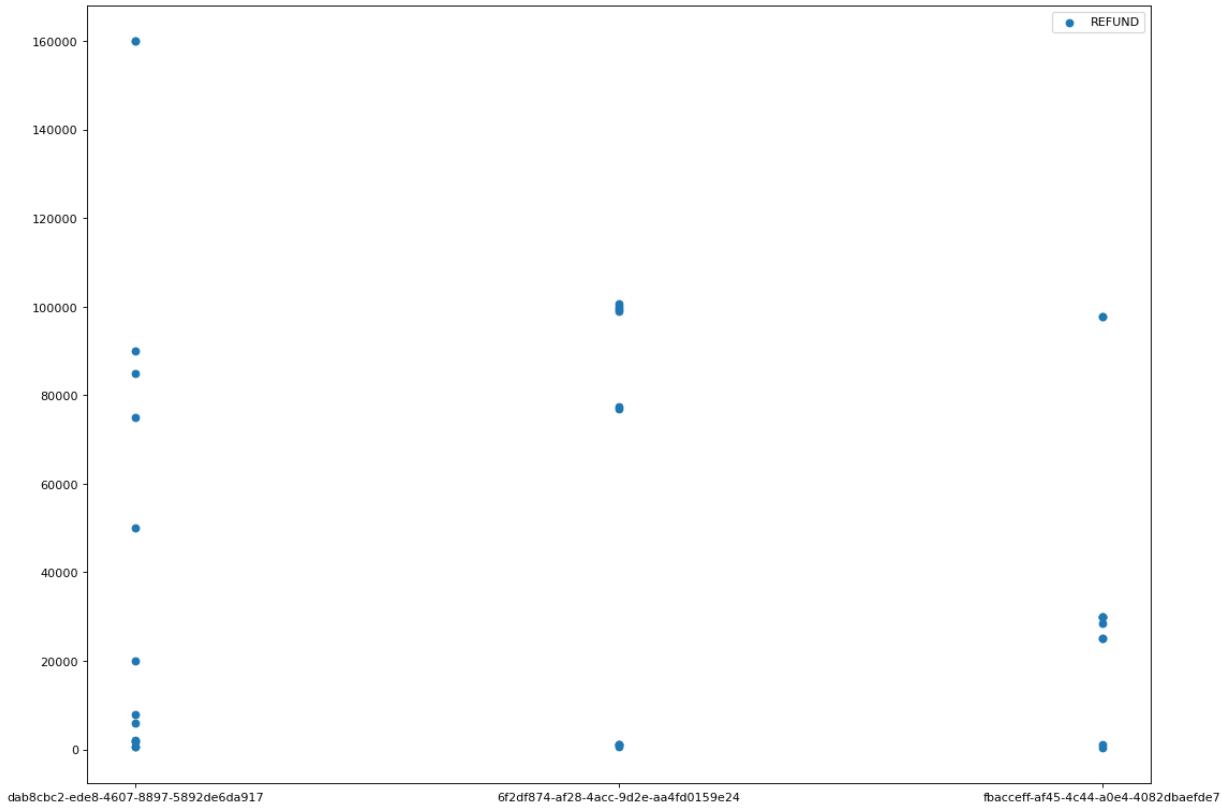
Name: externalParty.transactionCategory, dtype: int64



Name: externalParty.transactionCategory, dtype: int64



Name: externalParty.transactionCategory, dtype: int64



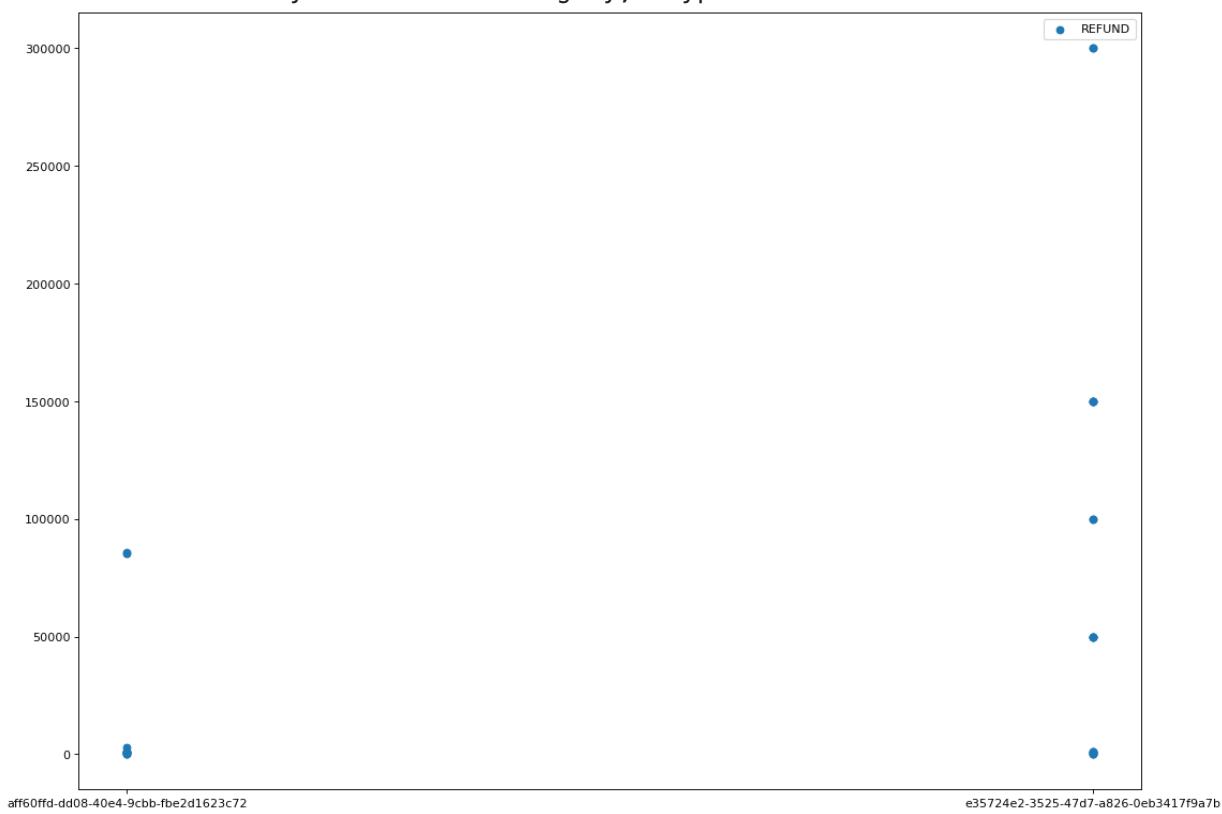
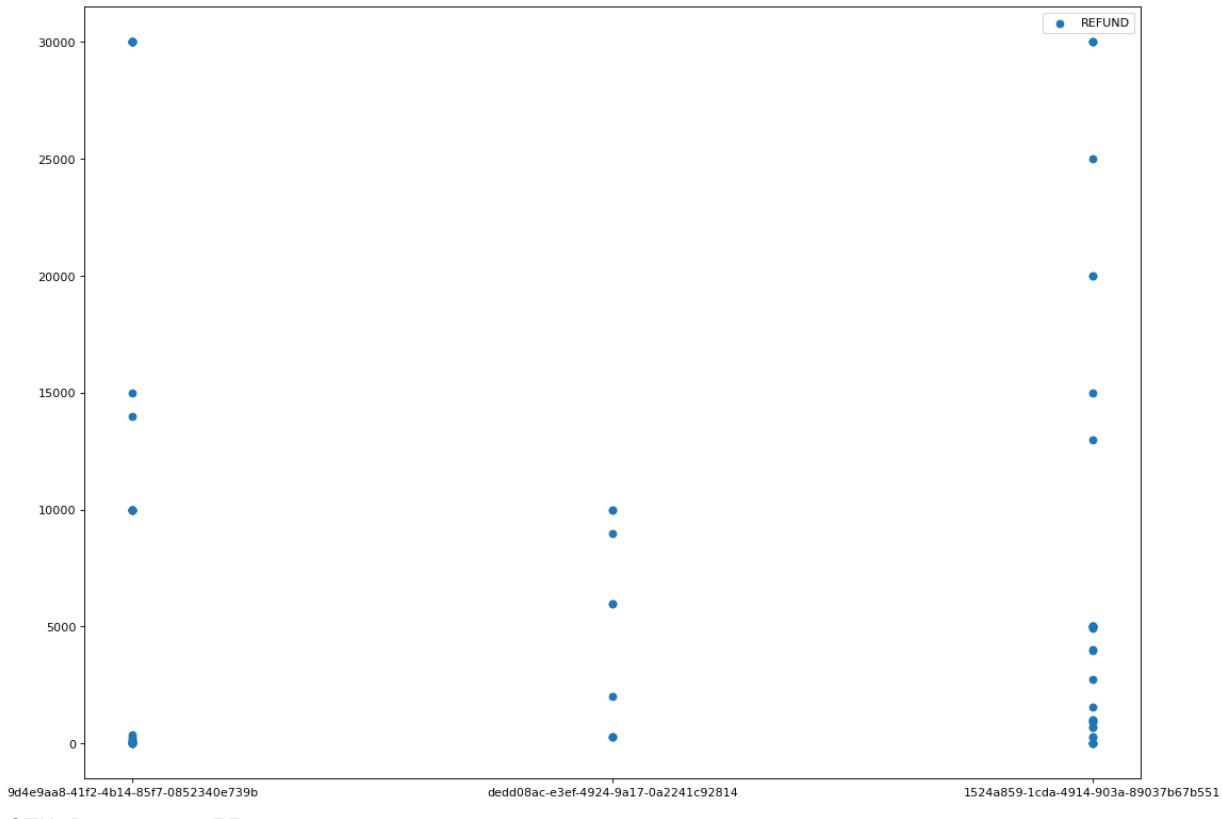
OTHER 33
SUBSCRIPTION 1

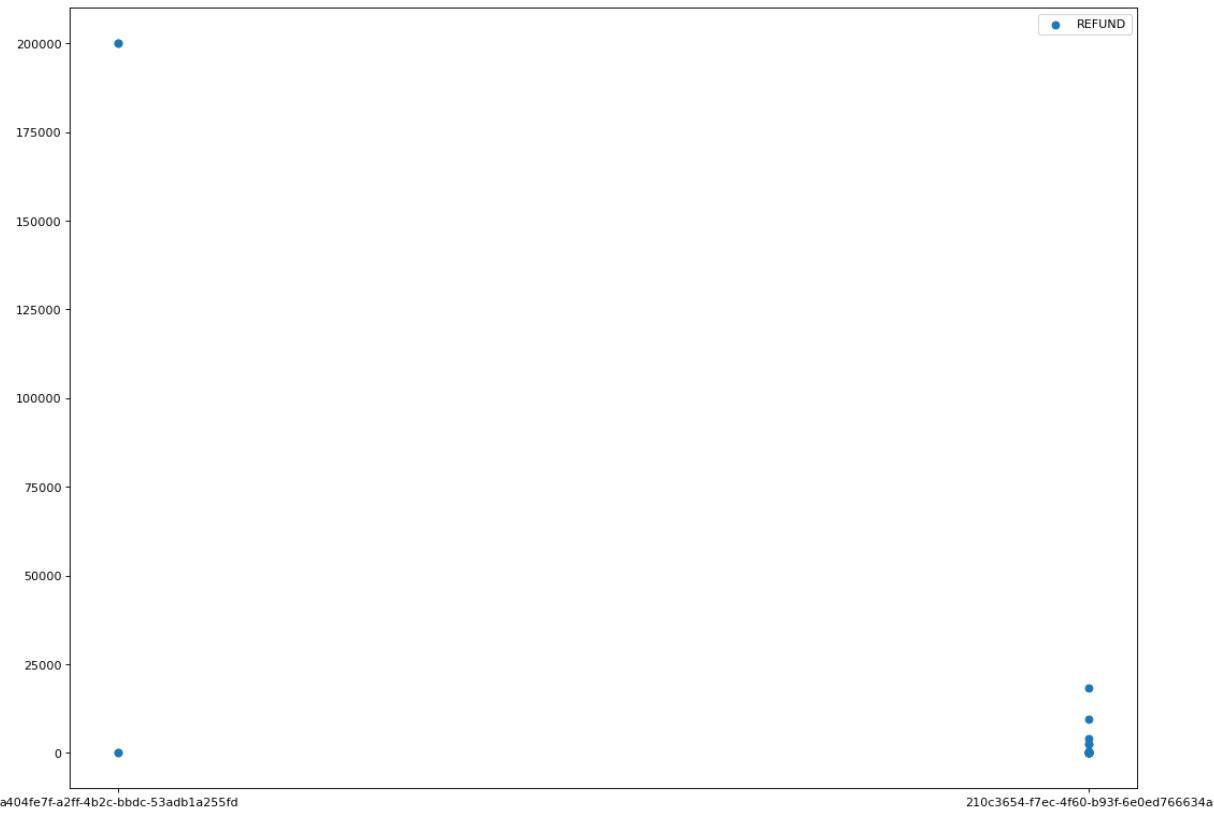
Name: externalParty.transactionCategory, dtype: int64



OTHER 17

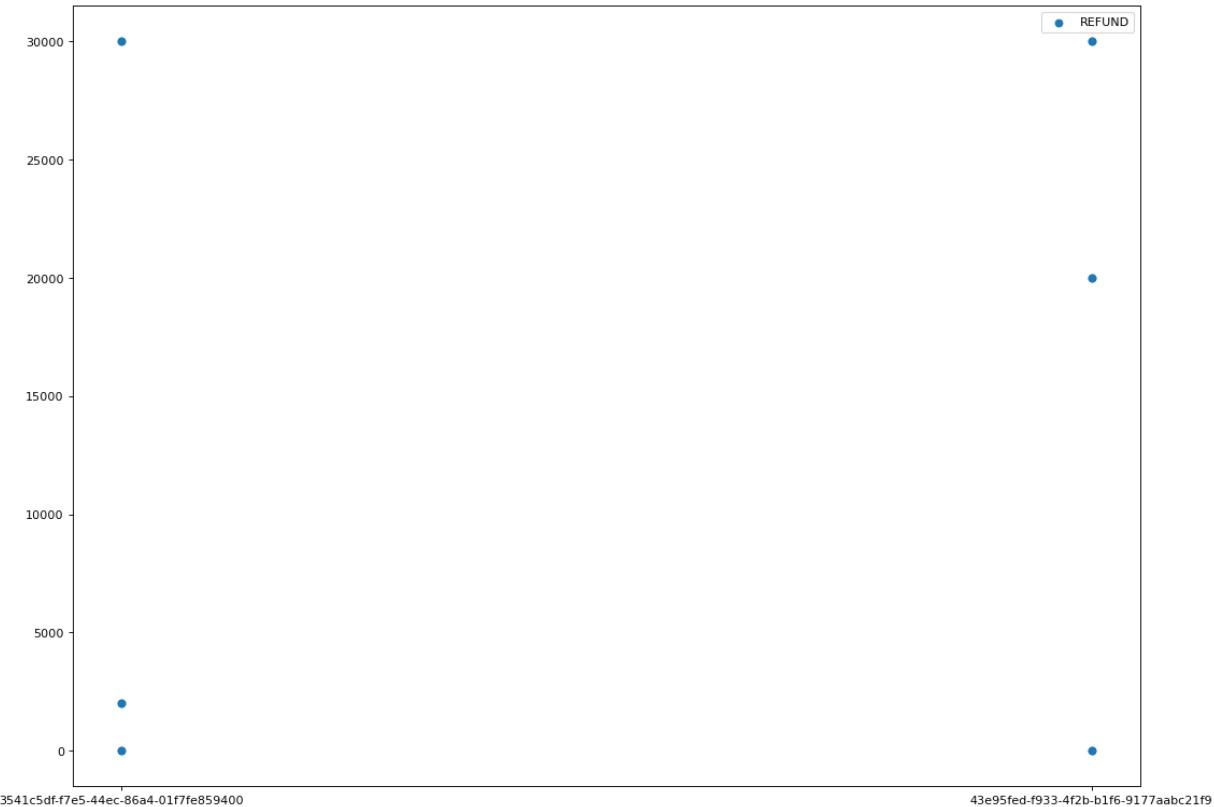
Name: externalParty.transactionCategory, dtype: int64





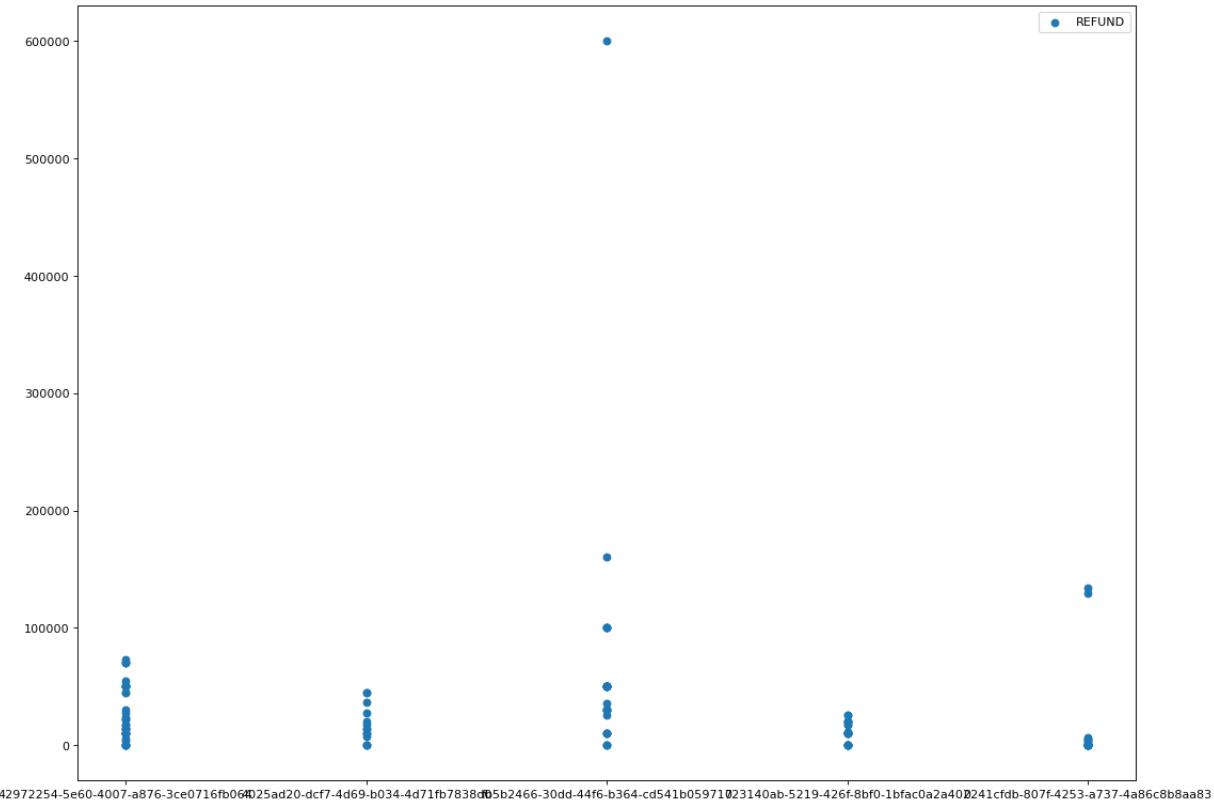
OTHER 41
GROCERIES 3
SHOPPING 2

Name: externalParty.transactionCategory, dtype: int64

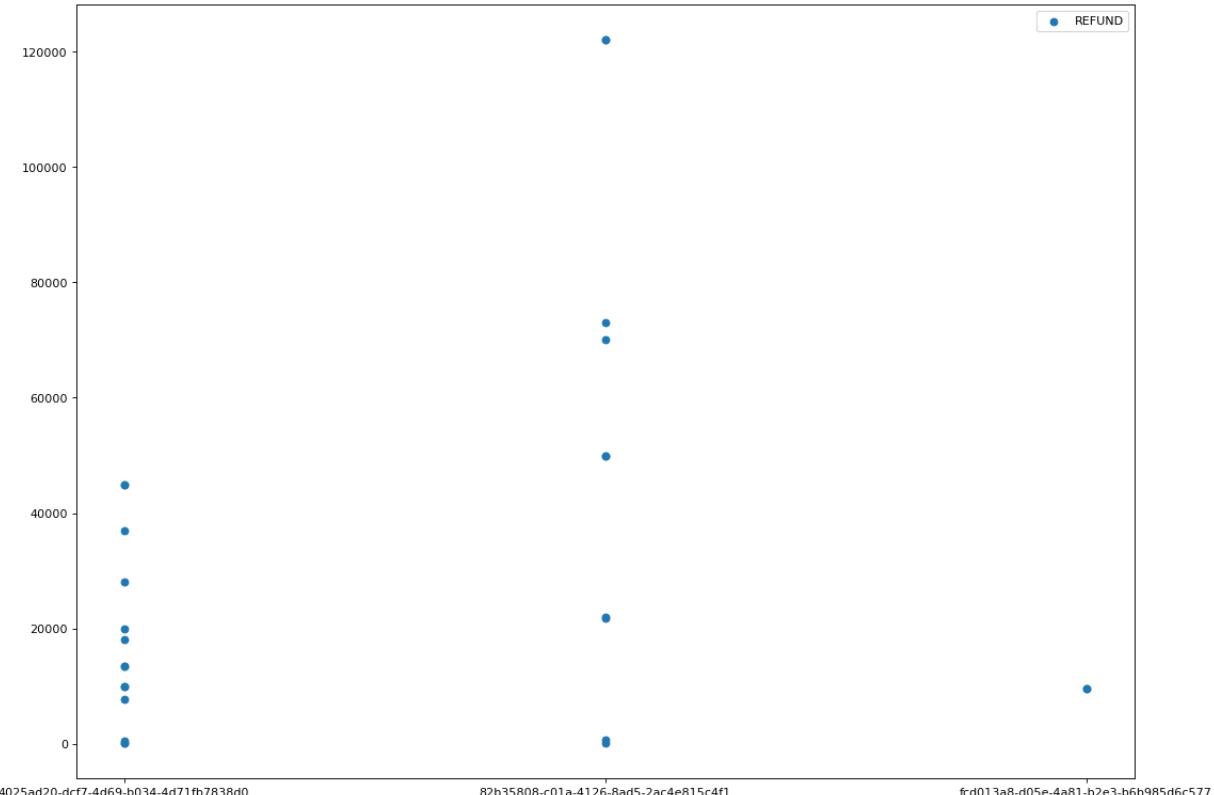


OTHER 12

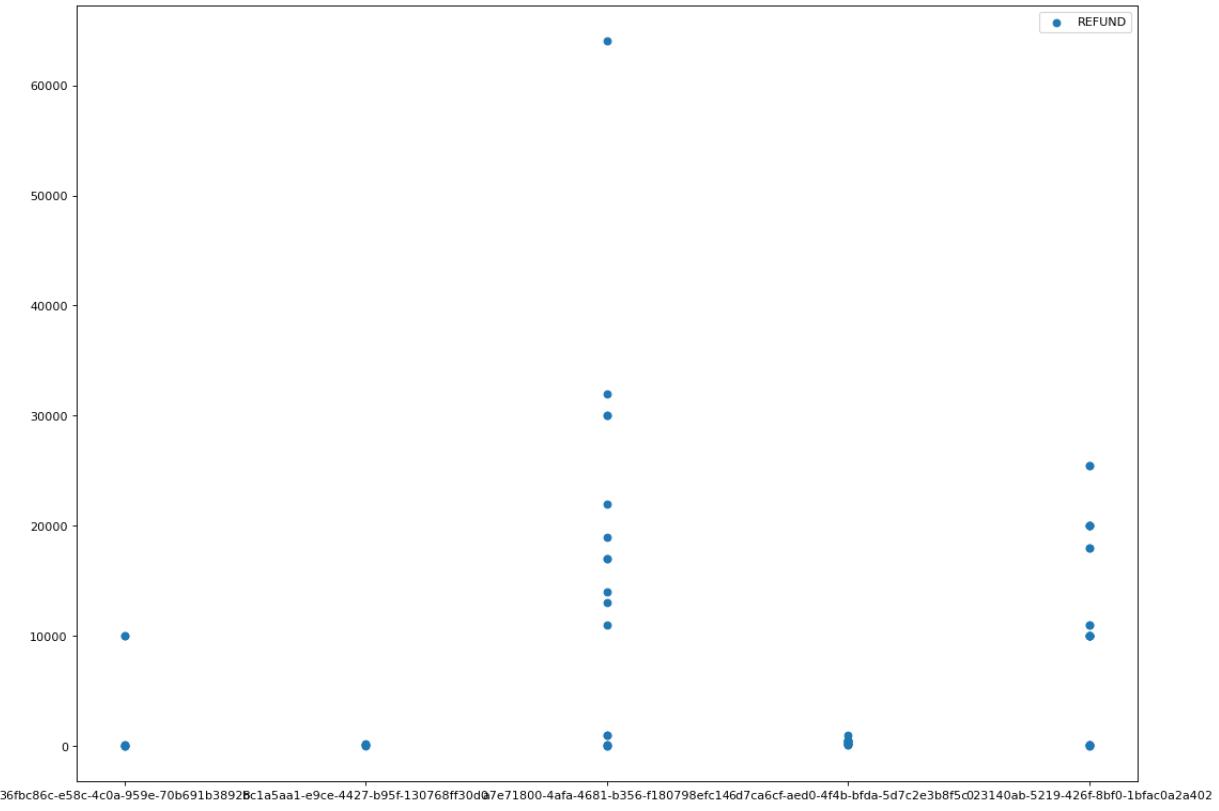
Name: externalParty.transactionCategory, dtype: int64



OTHER 123
Name: externalParty.transactionCategory, dtype: int64



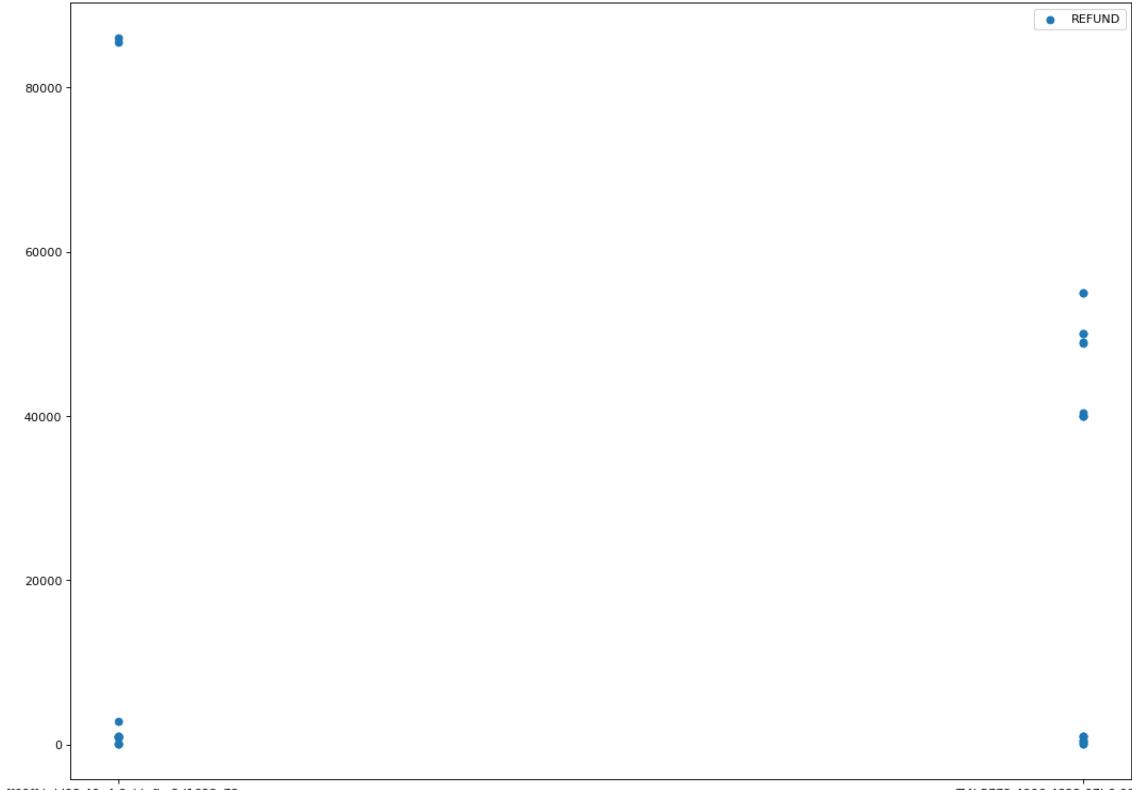
OTHER 26
Name: externalParty.transactionCategory, dtype: int64



36fbcb86c-e58c-4c0a-959e-70b691b3892Bc1a5aa1-e9ce-4427-b95f-130768ff30d@7e71800-4afa-4681-b356-f180798efc146d7ca6cf-aed0-4f4b-bfda-5d7c2e3b8f5cd023140ab-5219-426f-8bf0-1bfac0a2a402

OTHER 61
GROCERIES 1
SUBSCRIPTION 1

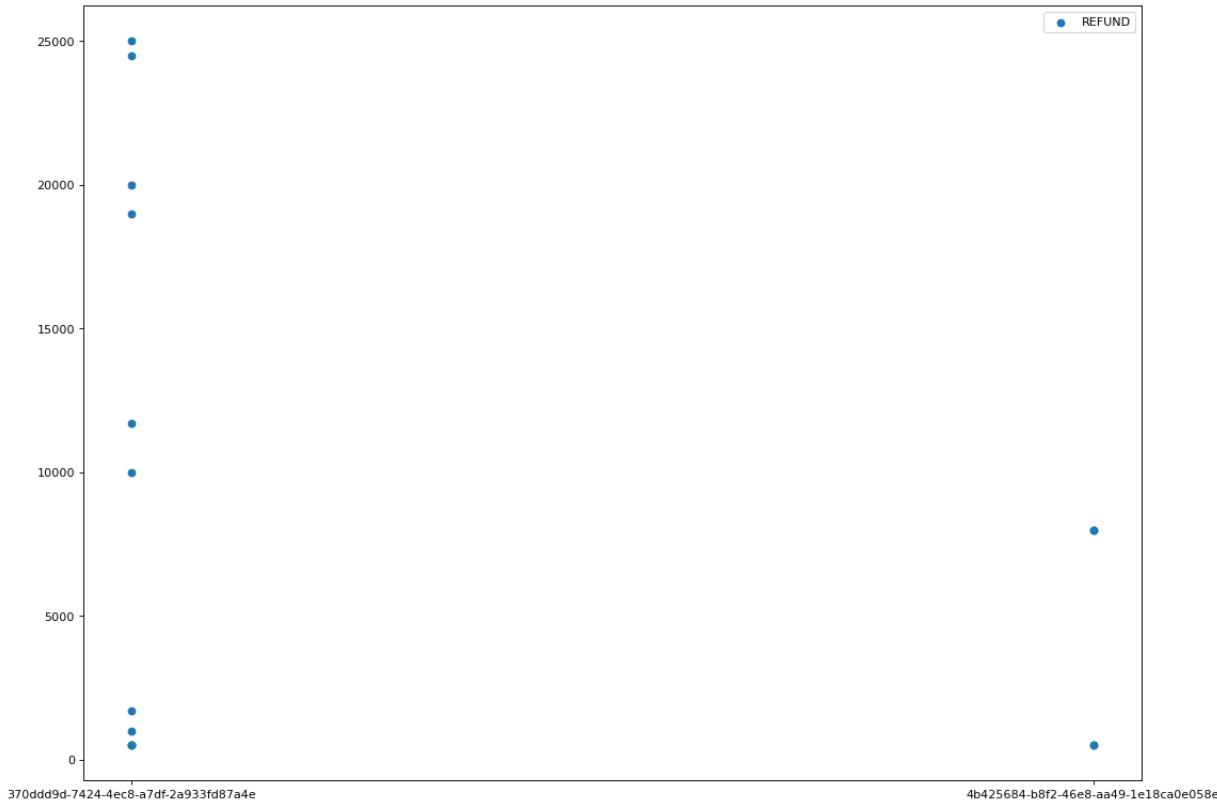
Name: externalParty.transactionCategory, dtype: int64



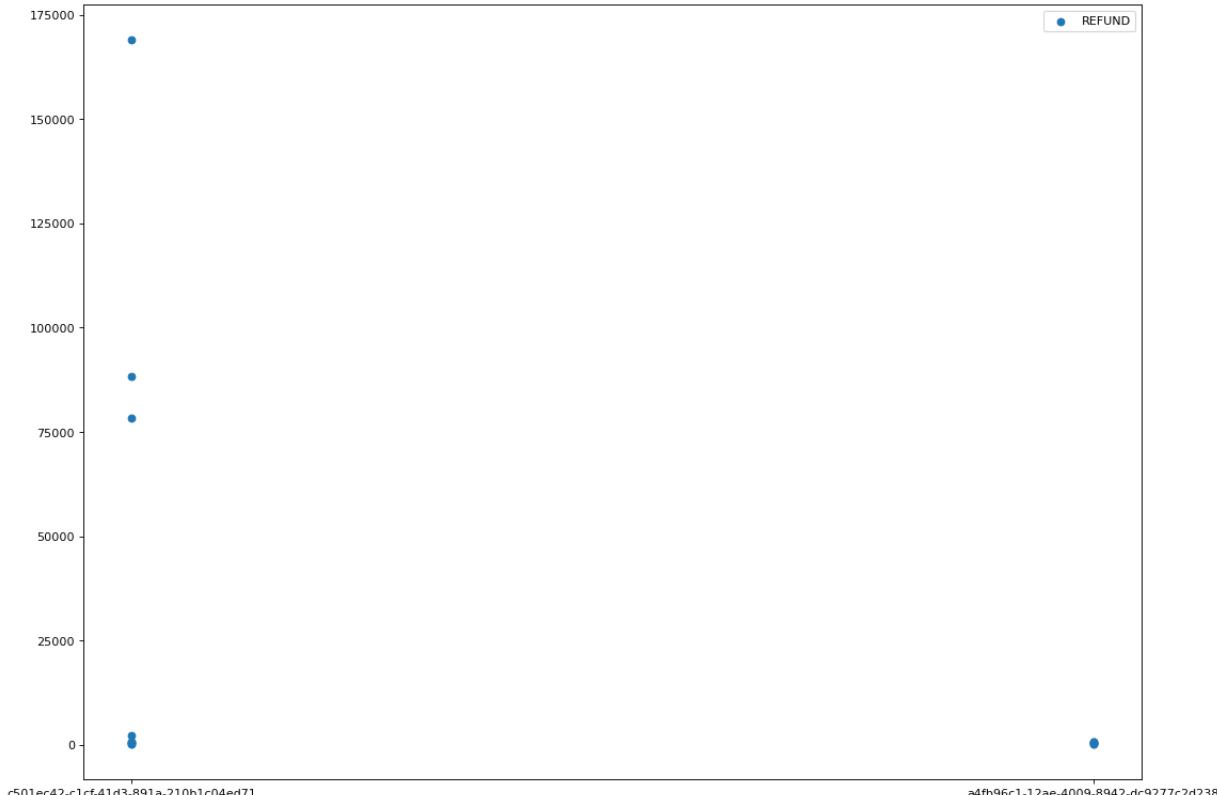
aff60ffd-dd08-40e4-9cbb-fbe2d1623c72 f74b5772-4906-4823-97b6-084606e93b30

OTHER 29

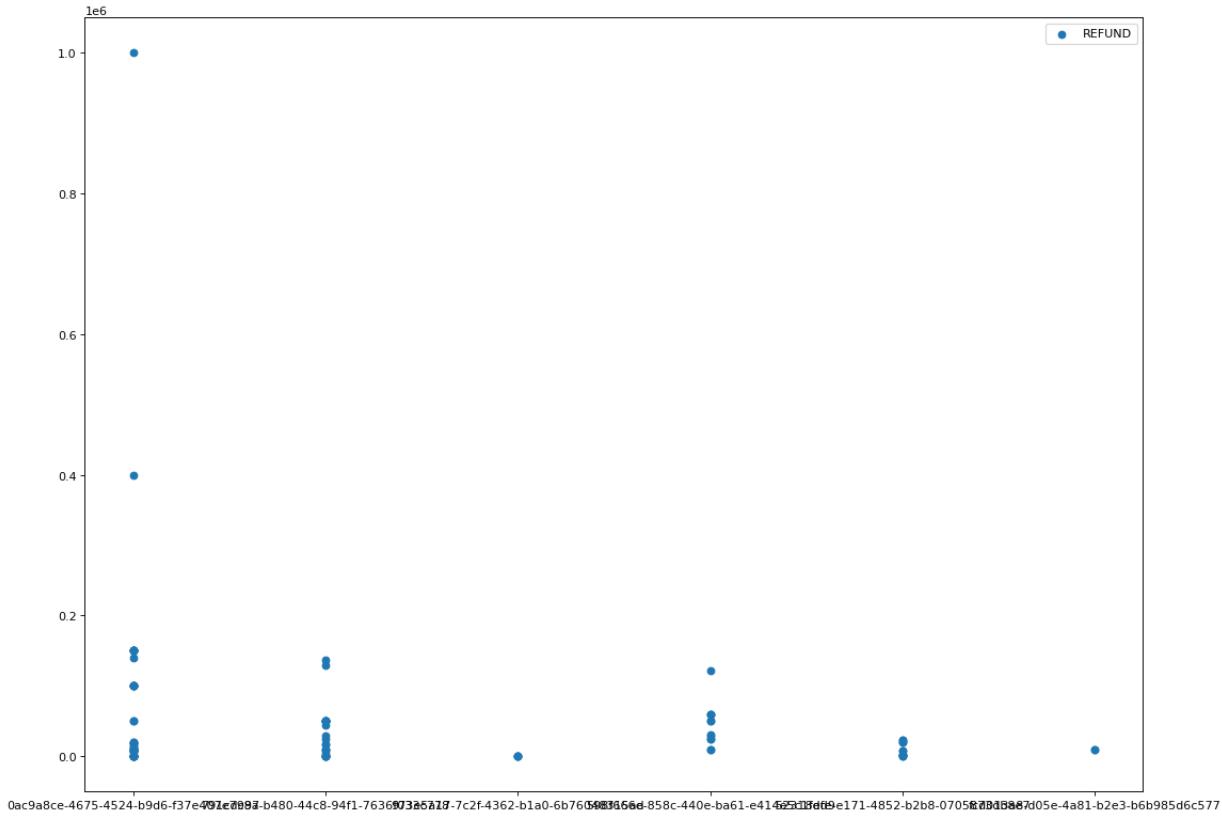
Name: externalParty.transactionCategory, dtype: int64



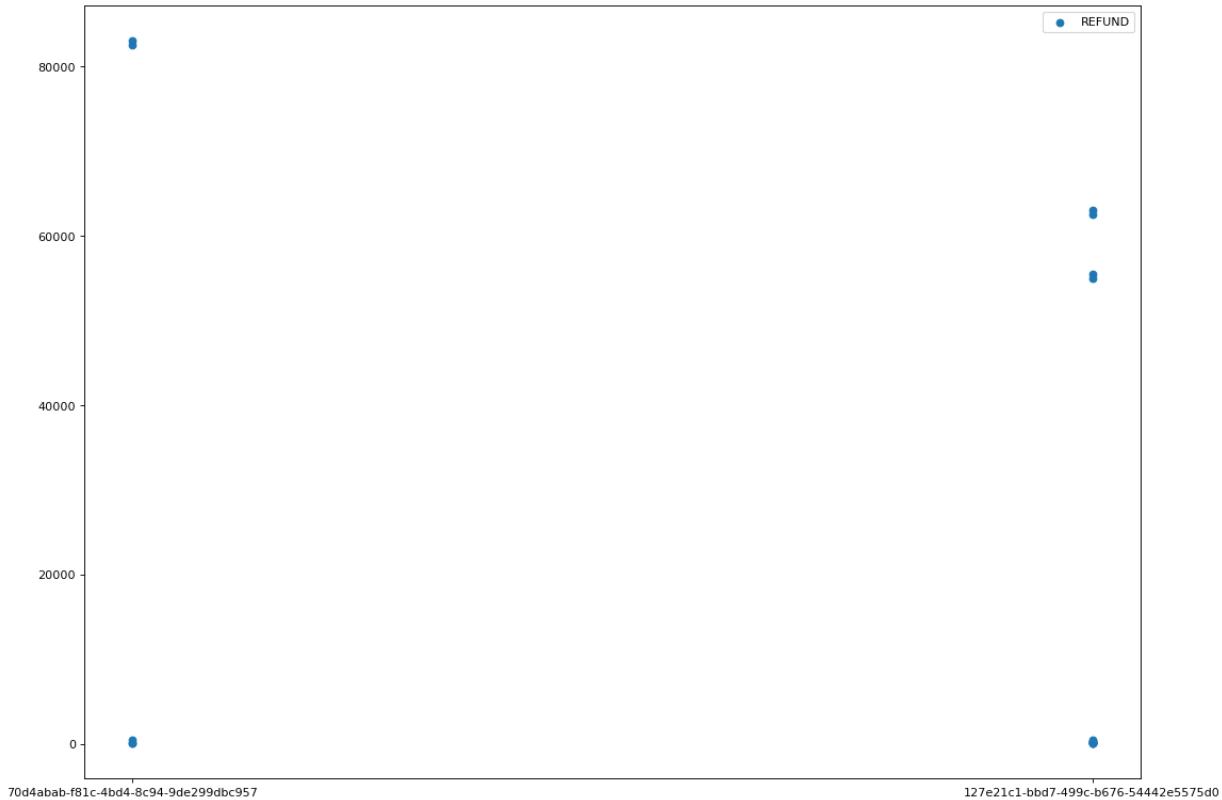
OTHER 15
Name: externalParty.transactionCategory, dtype: int64



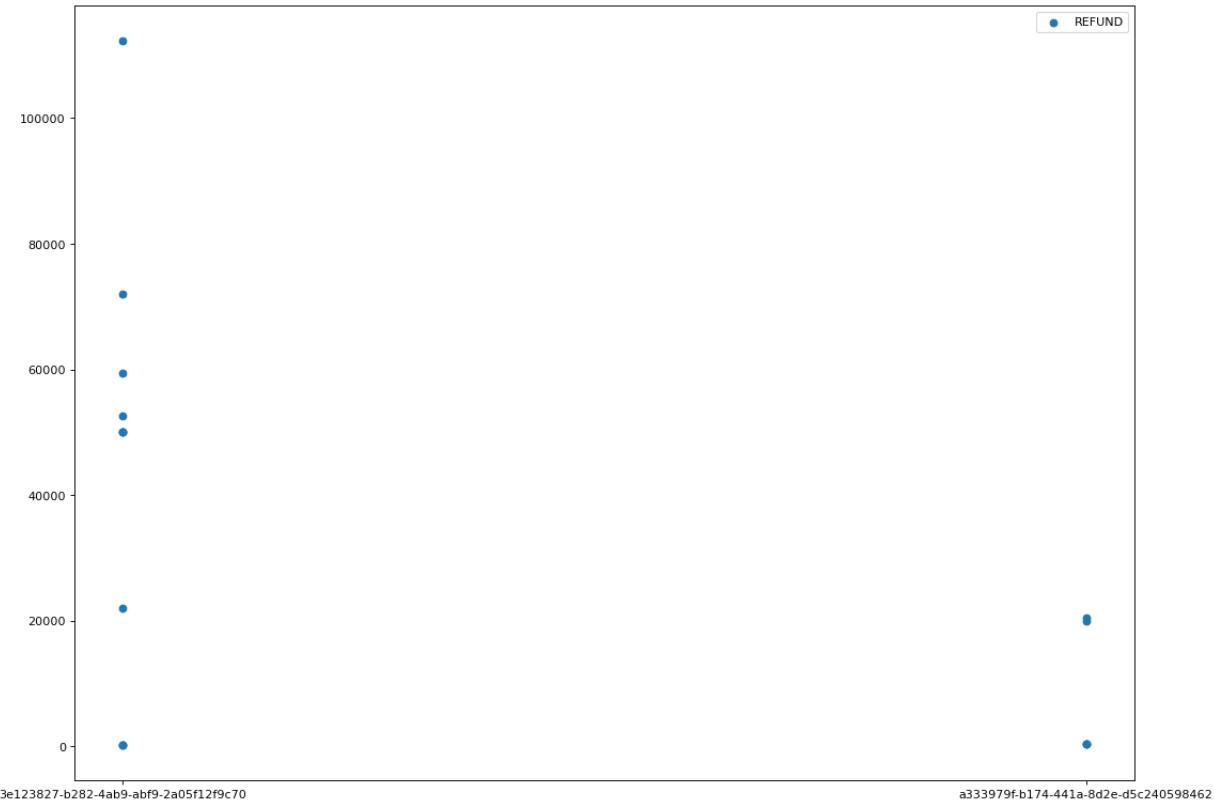
OTHER 12
SHOPPING 3
Name: externalParty.transactionCategory, dtype: int64



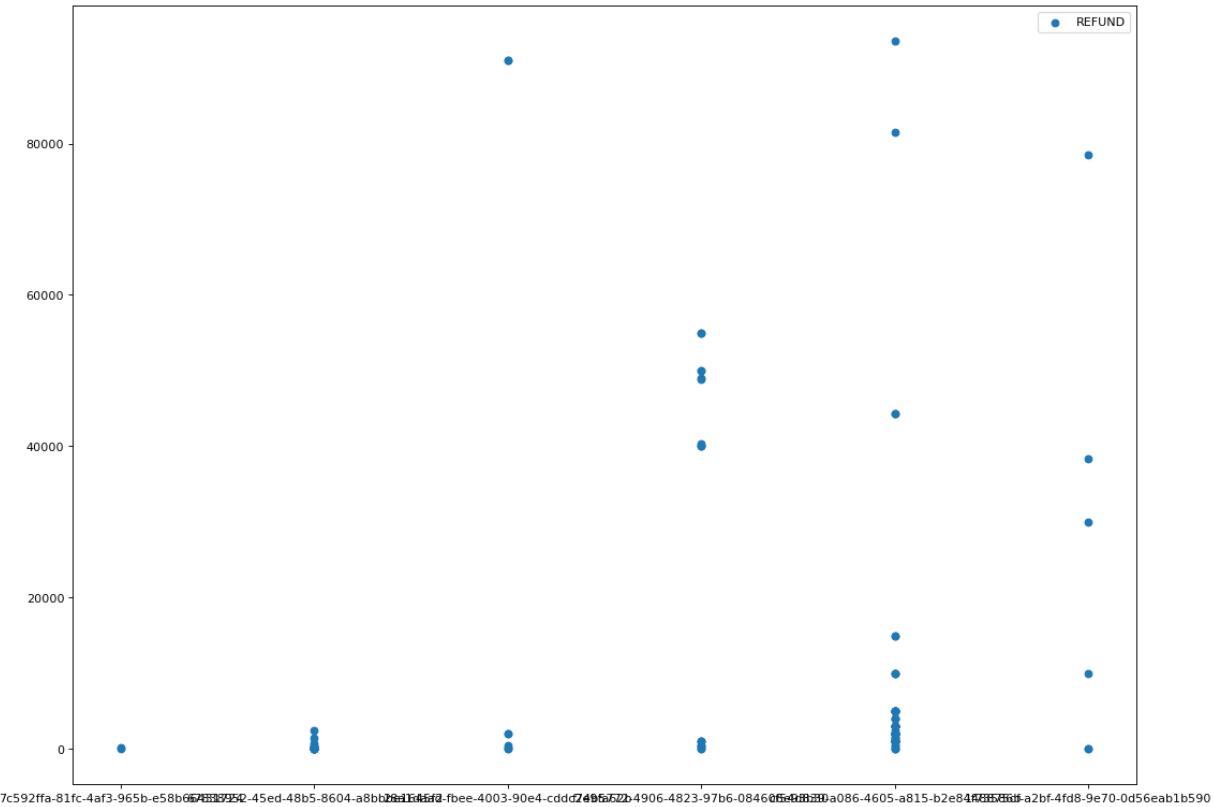
OTHER 101
Name: externalParty.transactionCategory, dtype: int64



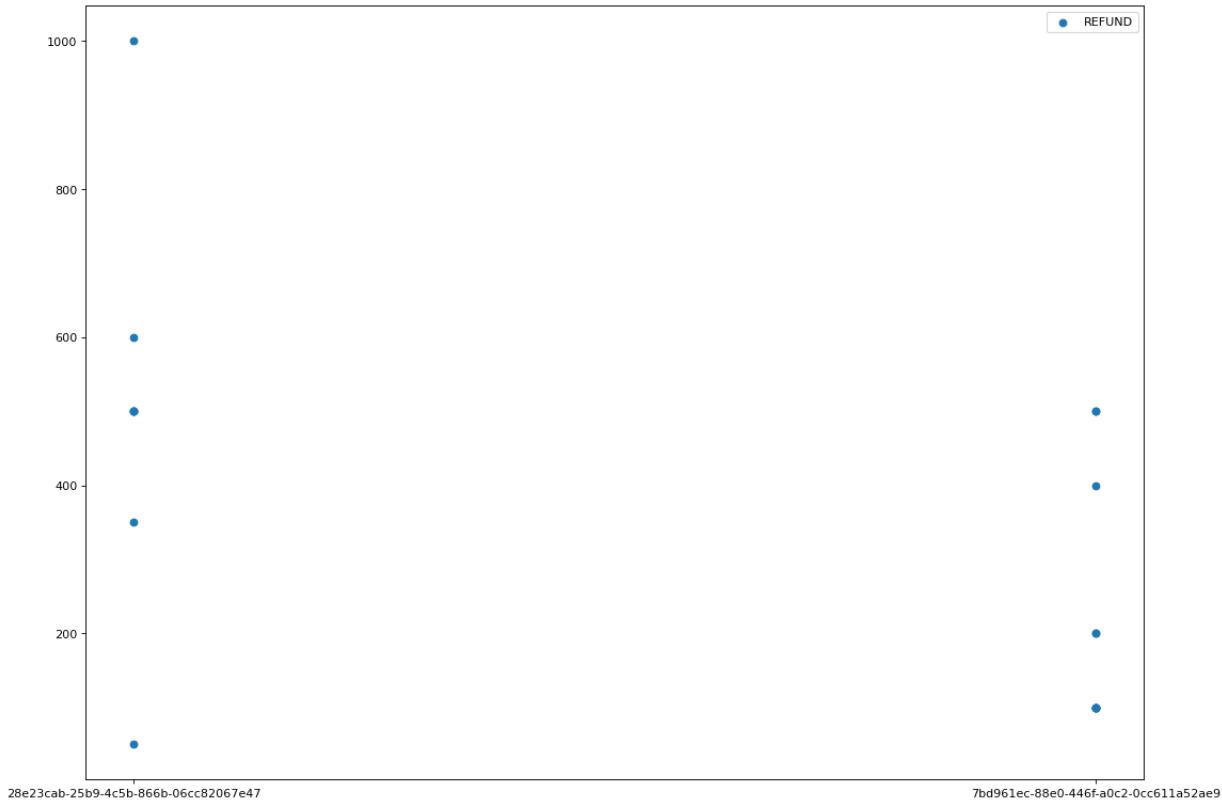
OTHER 15
SHOPPING 2
SUBSCRIPTION 1
Name: externalParty.transactionCategory, dtype: int64



OTHER 16
Name: externalParty.transactionCategory, dtype: int64

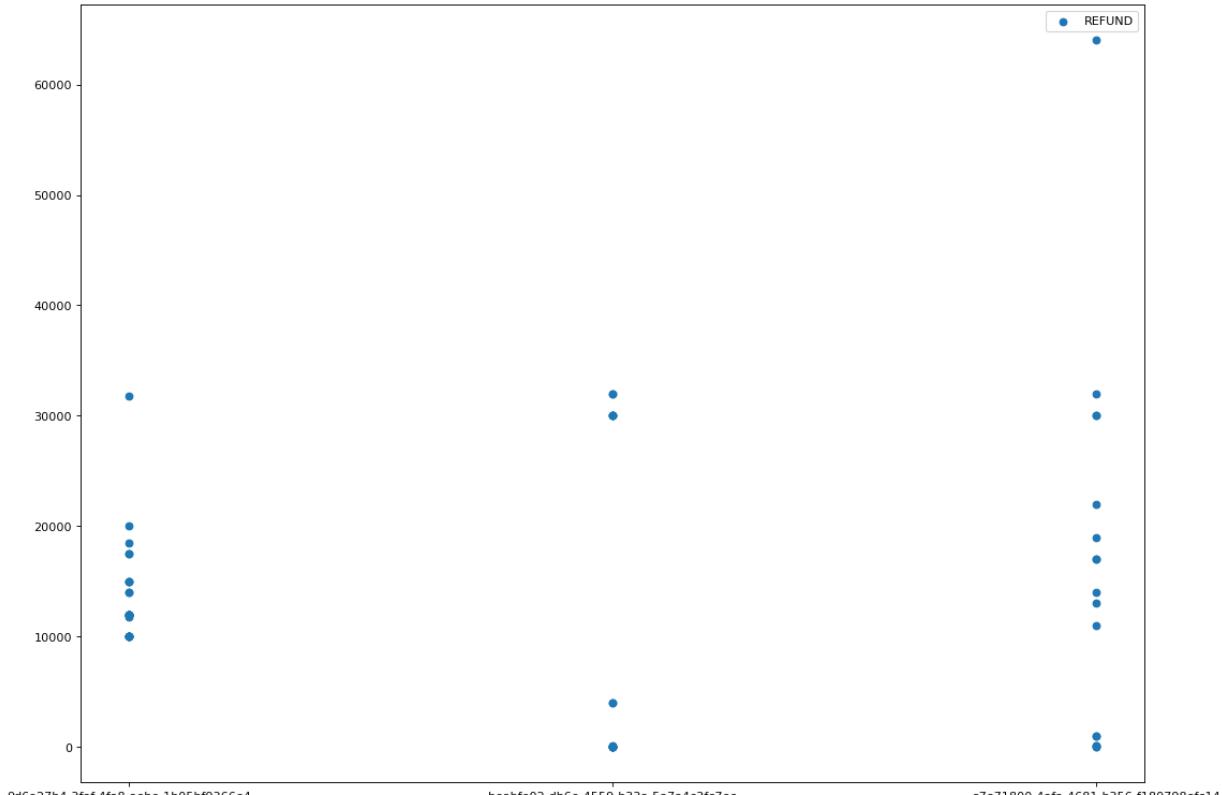


OTHER 124
TRAVEL 2
GROCERIES 1
Name: externalParty.transactionCategory, dtype: int64



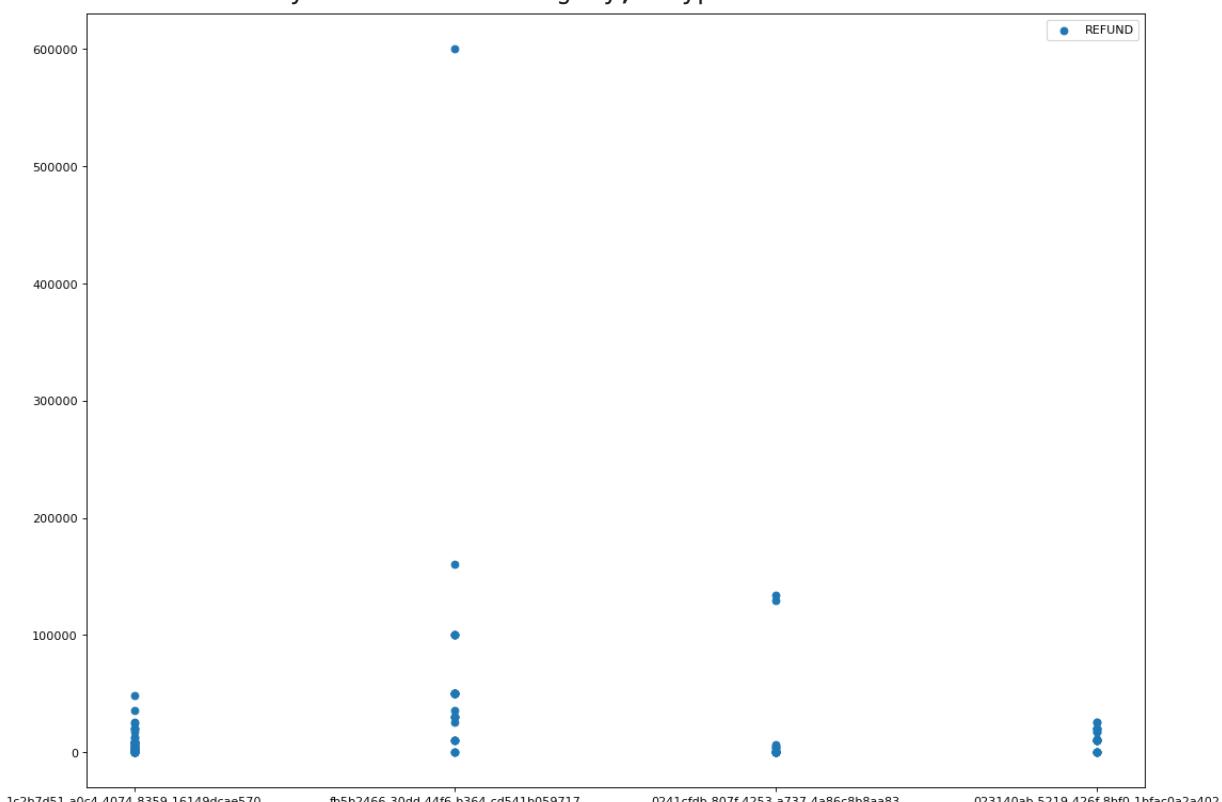
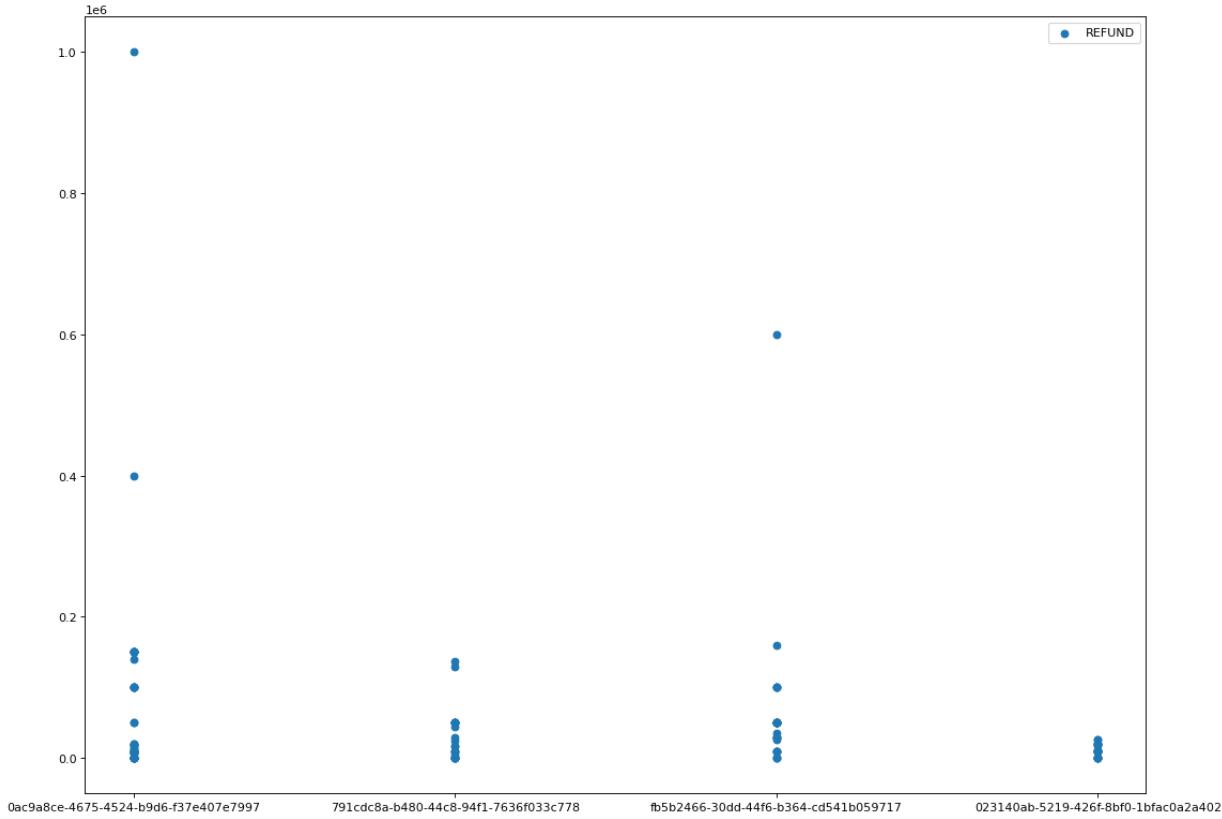
OTHER 19

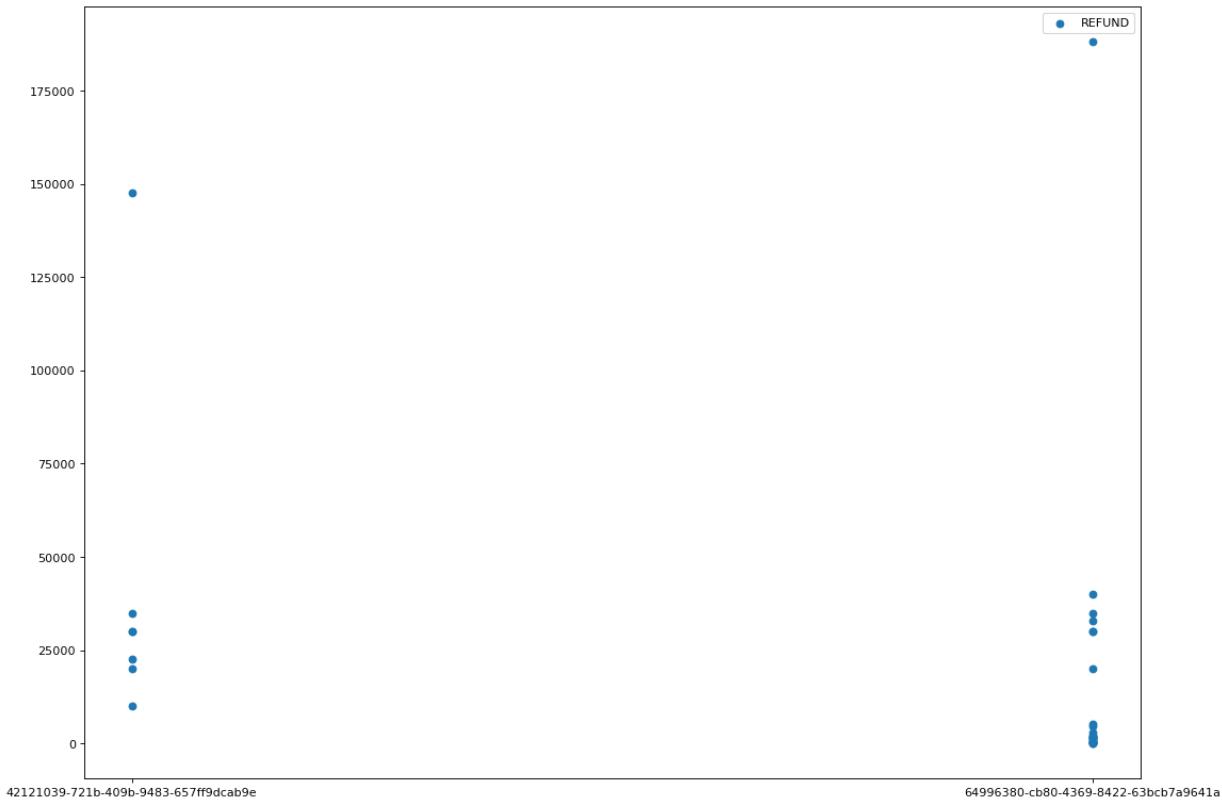
Name: externalParty.transactionCategory, dtype: int64



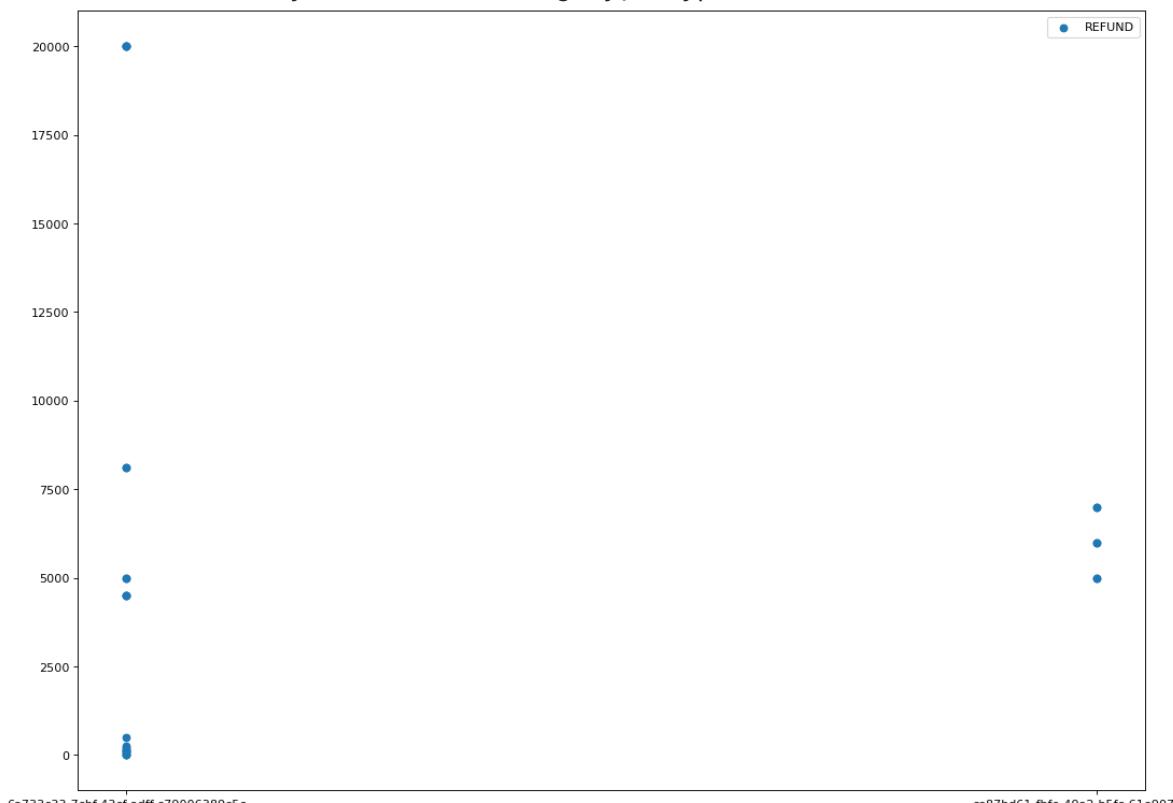
OTHER 59

Name: externalParty.transactionCategory, dtype: int64

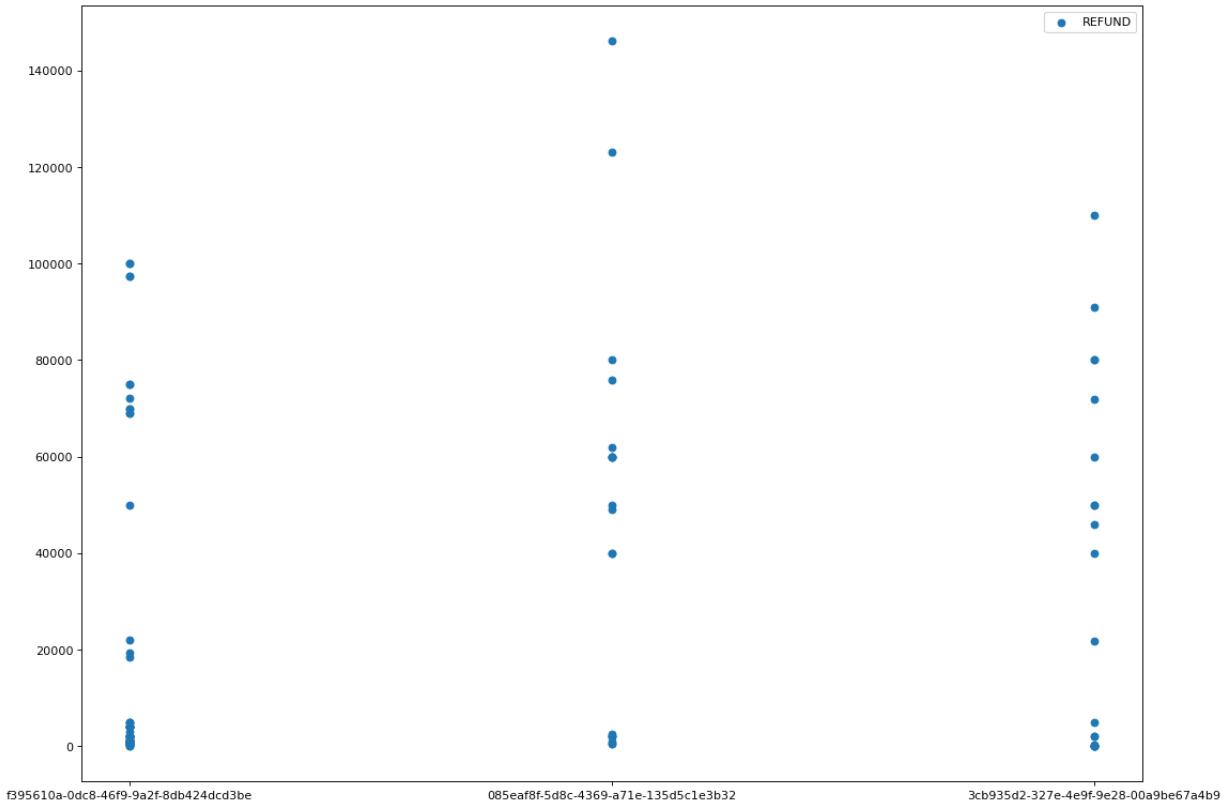




OTHER 30
LIFESTYLE 2
SHOPPING 1
Name: externalParty.transactionCategory, dtype: int64

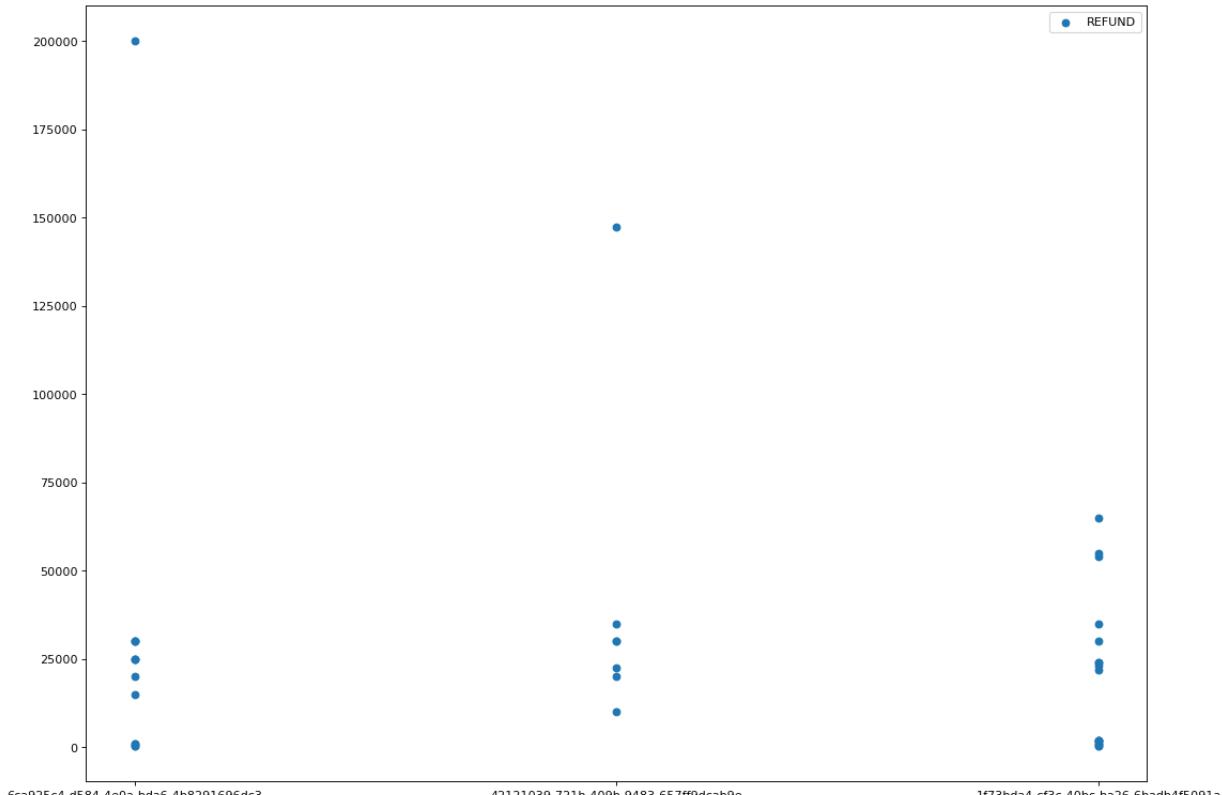


OTHER 26
LIFESTYLE 1
Name: externalParty.transactionCategory, dtype: int64



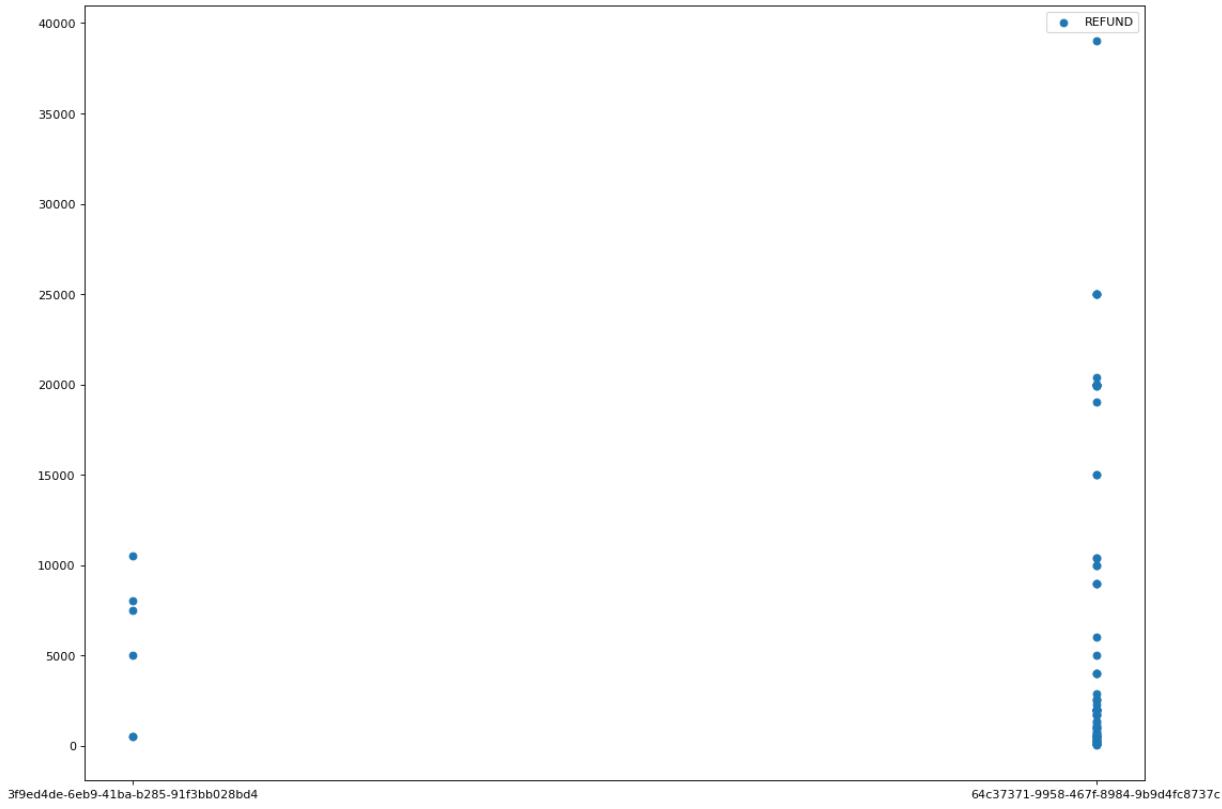
OTHER 95

Name: externalParty.transactionCategory, dtype: int64



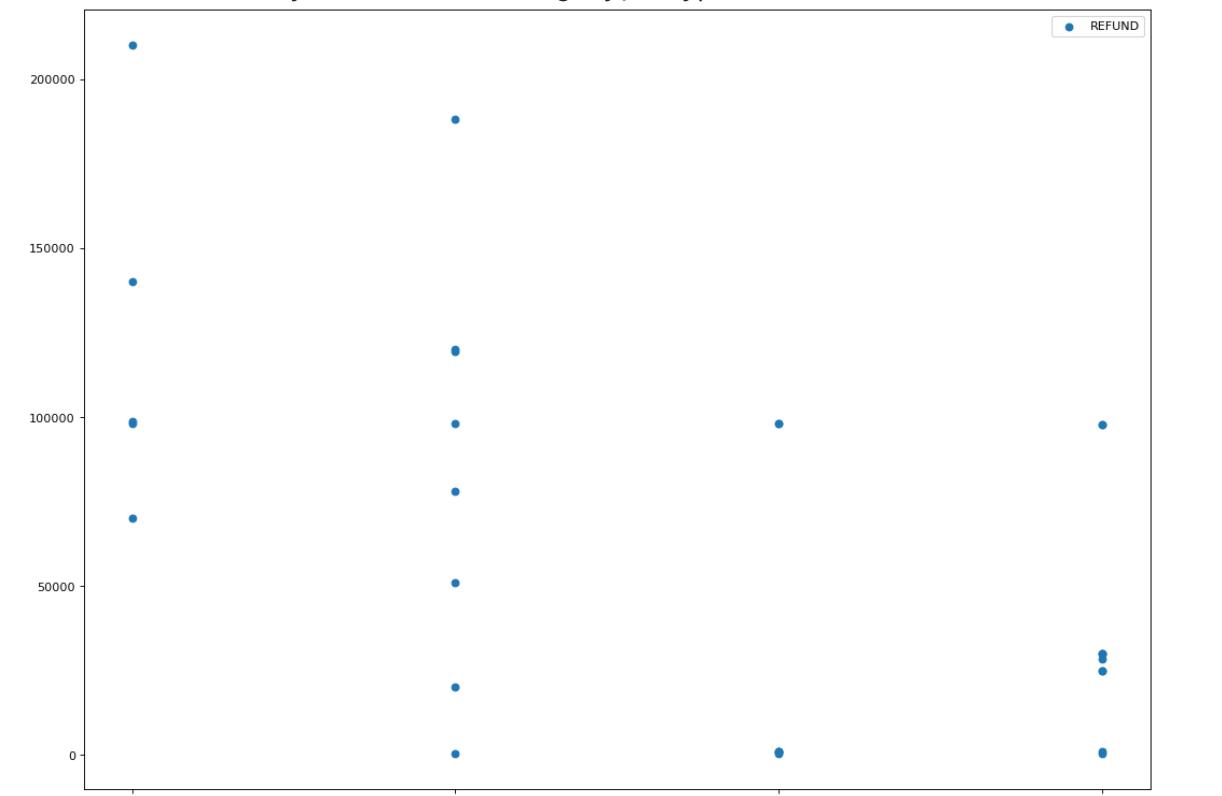
OTHER 37

Name: externalParty.transactionCategory, dtype: int64

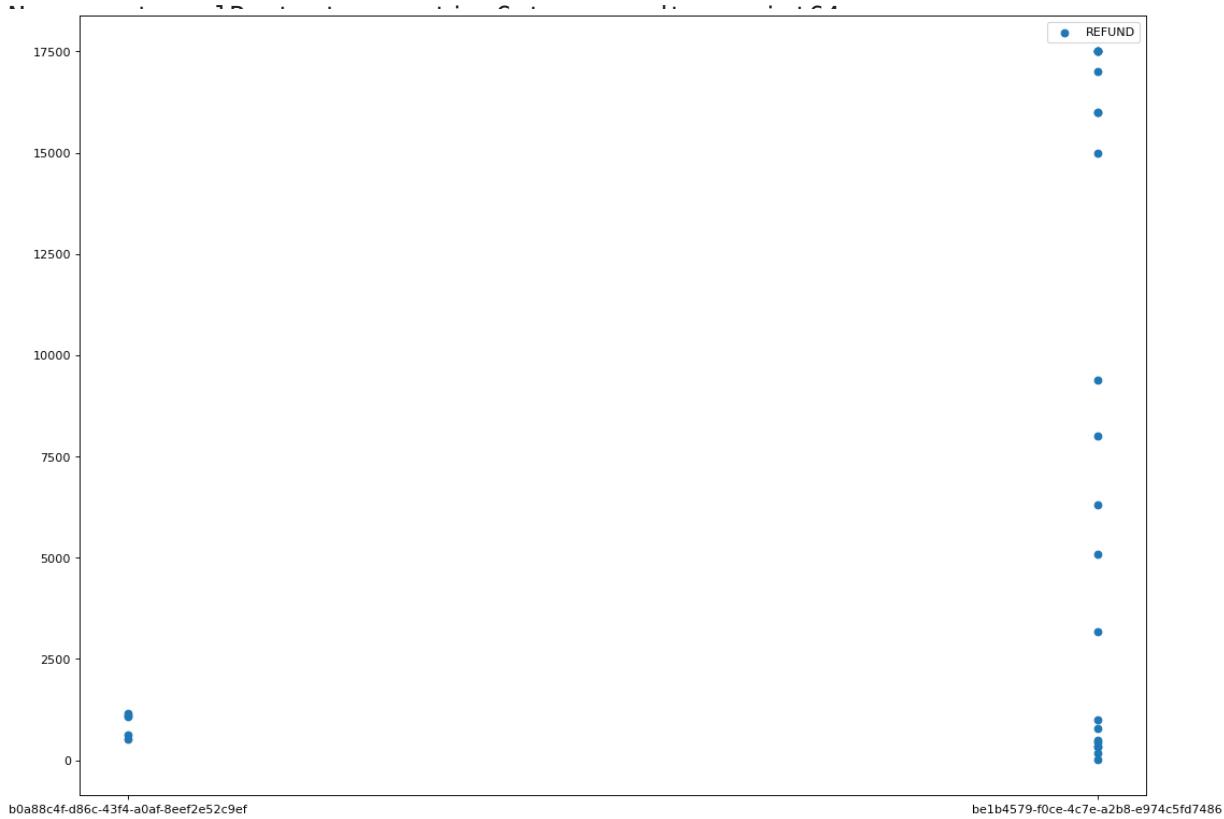


OTHER 57
GROCERIES 12
LIFESTYLE 11
SHOPPING 8
TRAVEL 6

Name: externalParty.transactionCategory, dtype: int64



OTHER 29
SUBSCRIPTION 1

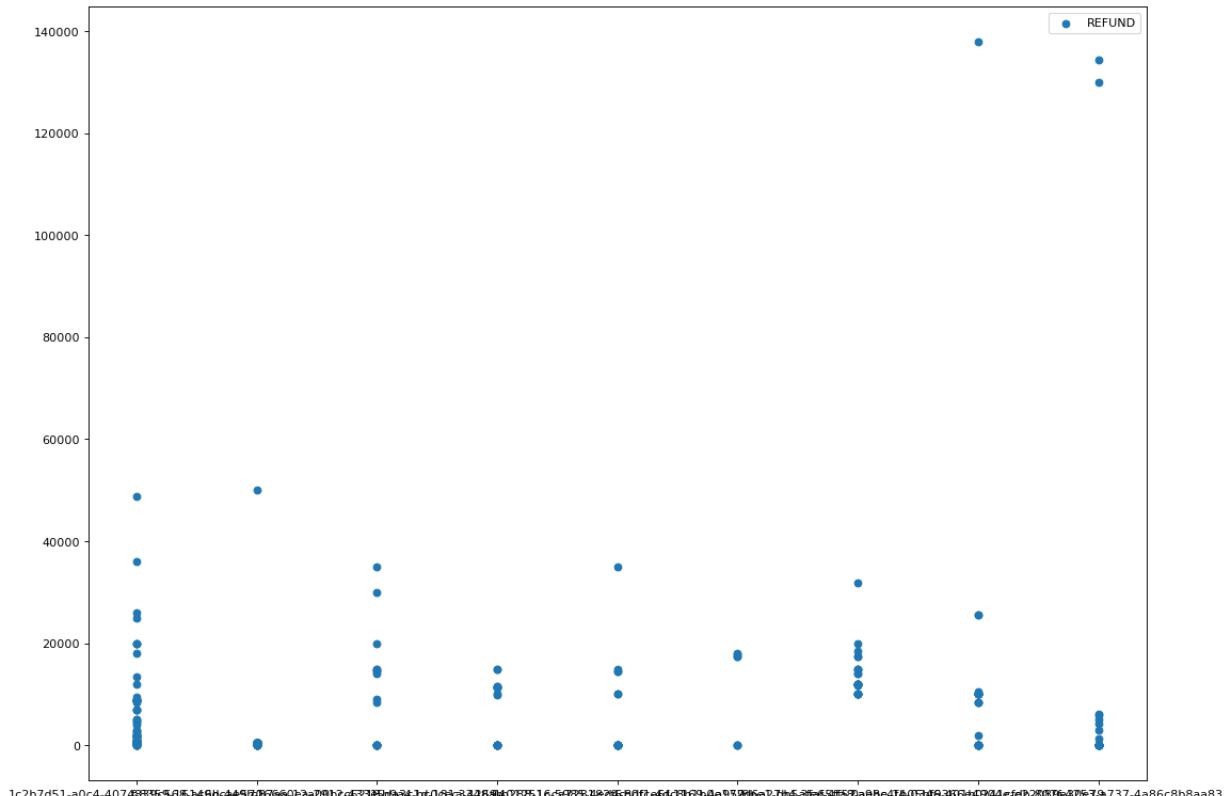


b0a88c4f-d86c-43f4-a0af-8eef2e52c9ef

b1b4579-f0ce-4c7e-a2b8-e974c5fd7486

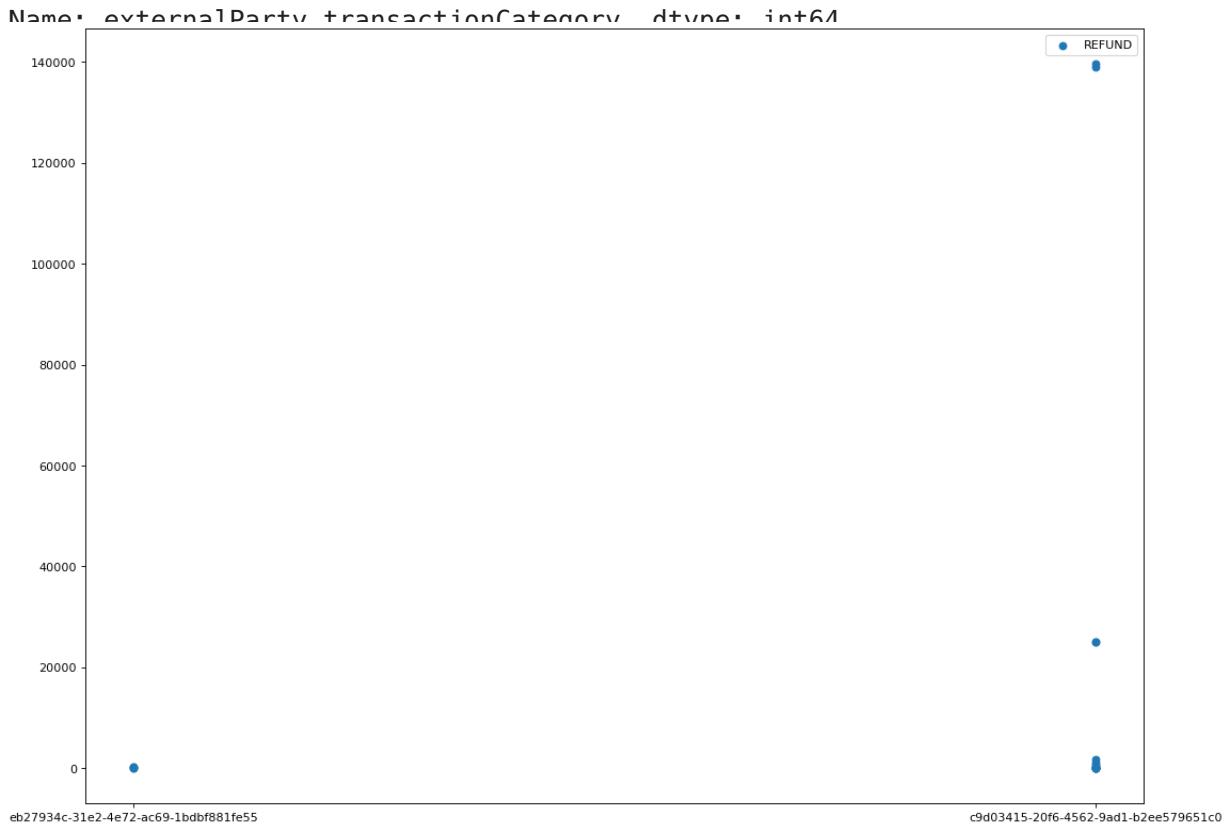
OTHER	15
SHOPPING	4
TRAVEL	3
GROCERIES	2
LIFESTYLE	2

Name: externalParty.transactionCategory, dtype: int64



OTHER	305
TRAVEL	7

LIFESTYLE 7
GROCERIES 7
SHOPPING 1

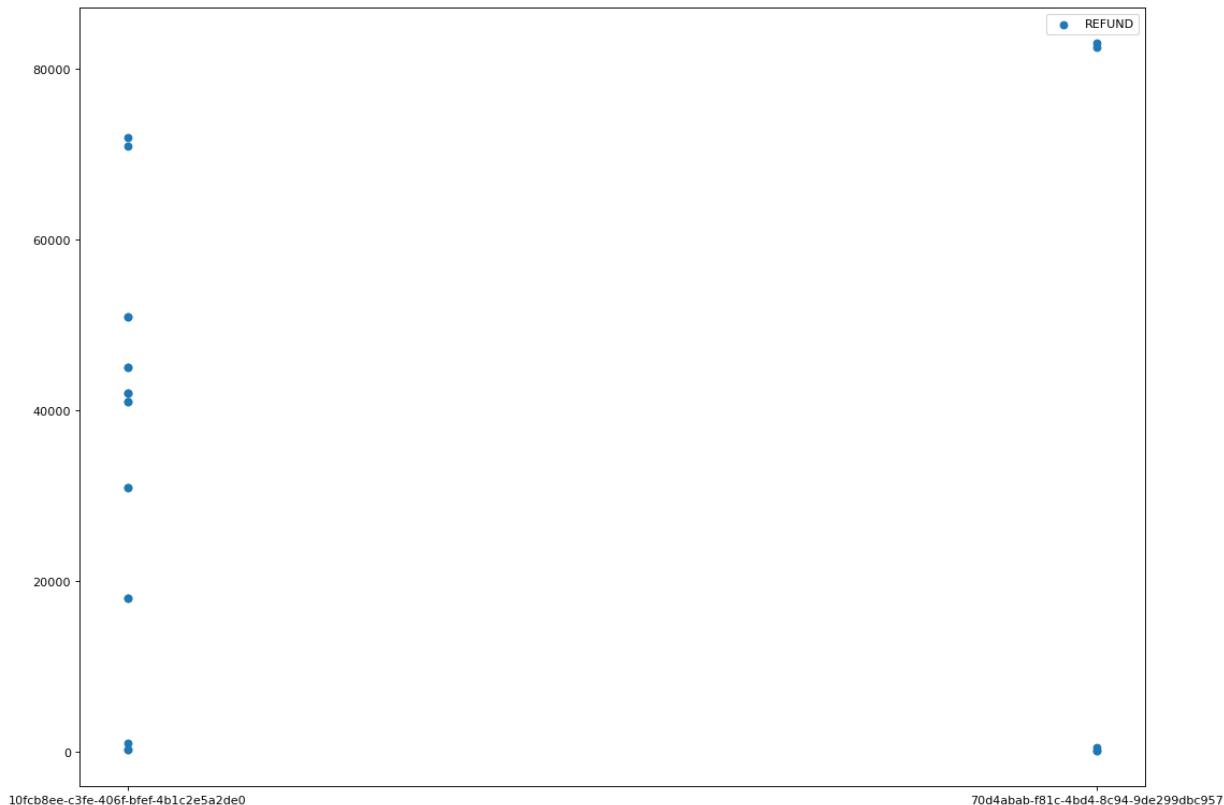


eb27934c-31e2-4e72-ac69-1bdbf881fe55

c9d03415-20f6-4562-9ad1-b2ee579651c0

OTHER 17
GROCERIES 2

Name: externalParty.transactionCategory, dtype: int64

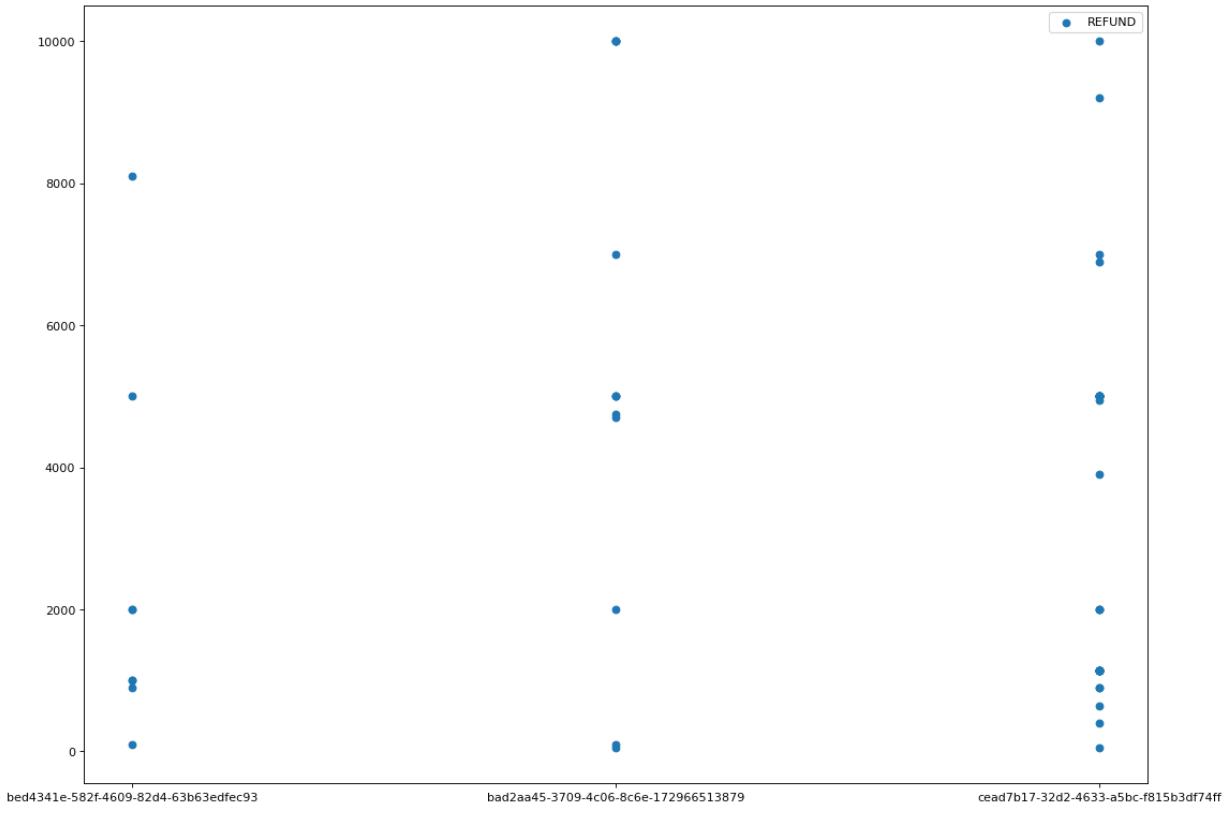


10fc8bee-c3fe-406f-bfef-4b1c2e5a2de0

70d4abab-f81c-4bd4-8c94-9de299dbc957

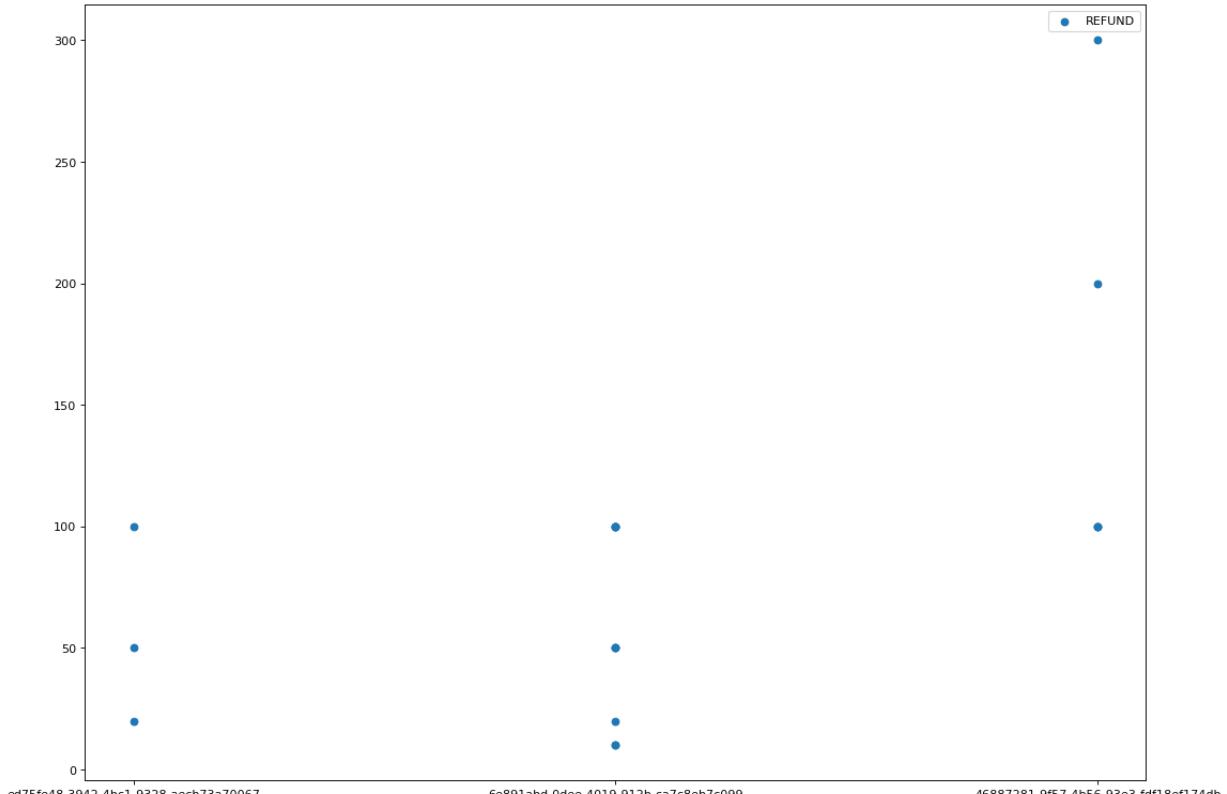
OTHER 22

Name: externalParty.transactionCategory, dtype: int64



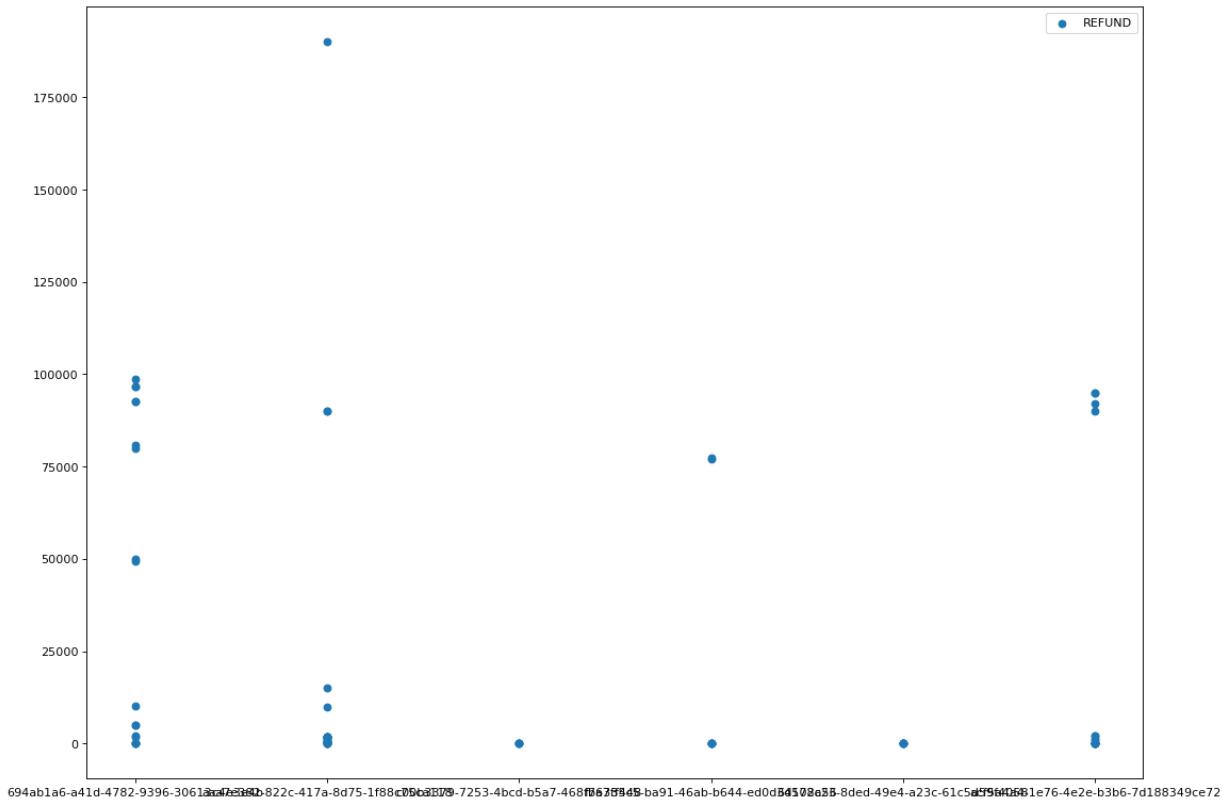
OTHER 60

Name: externalParty.transactionCategory, dtype: int64

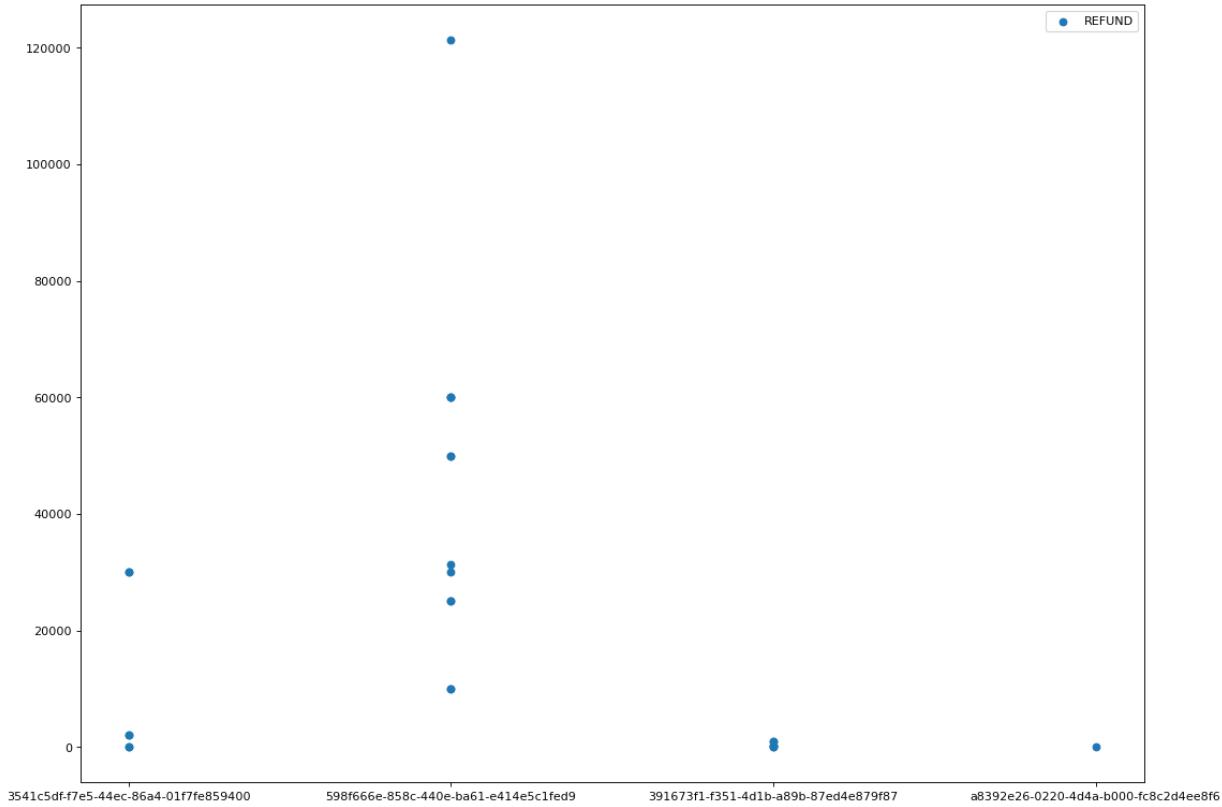


OTHER 18

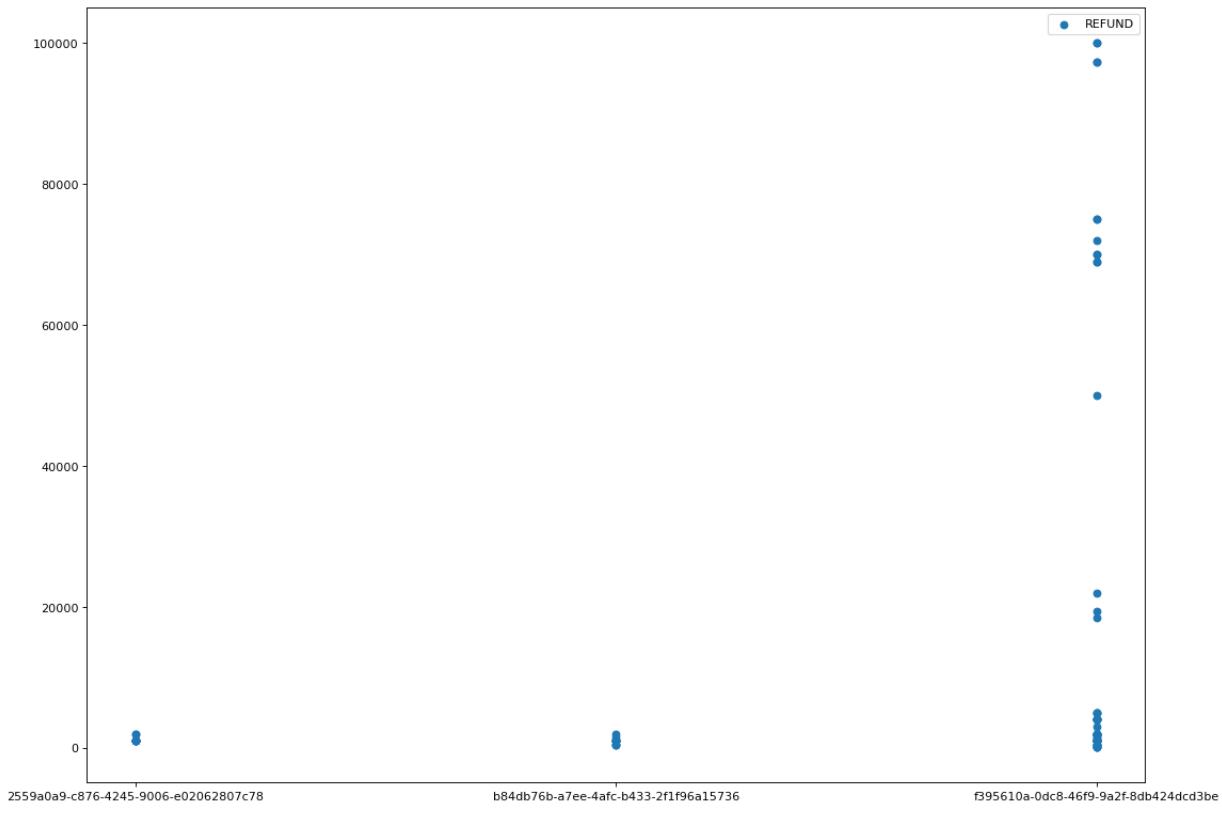
Name: externalParty.transactionCategory, dtype: int64



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OTHER    74  
Name: externalParty.transactionCategory, dtype: int64
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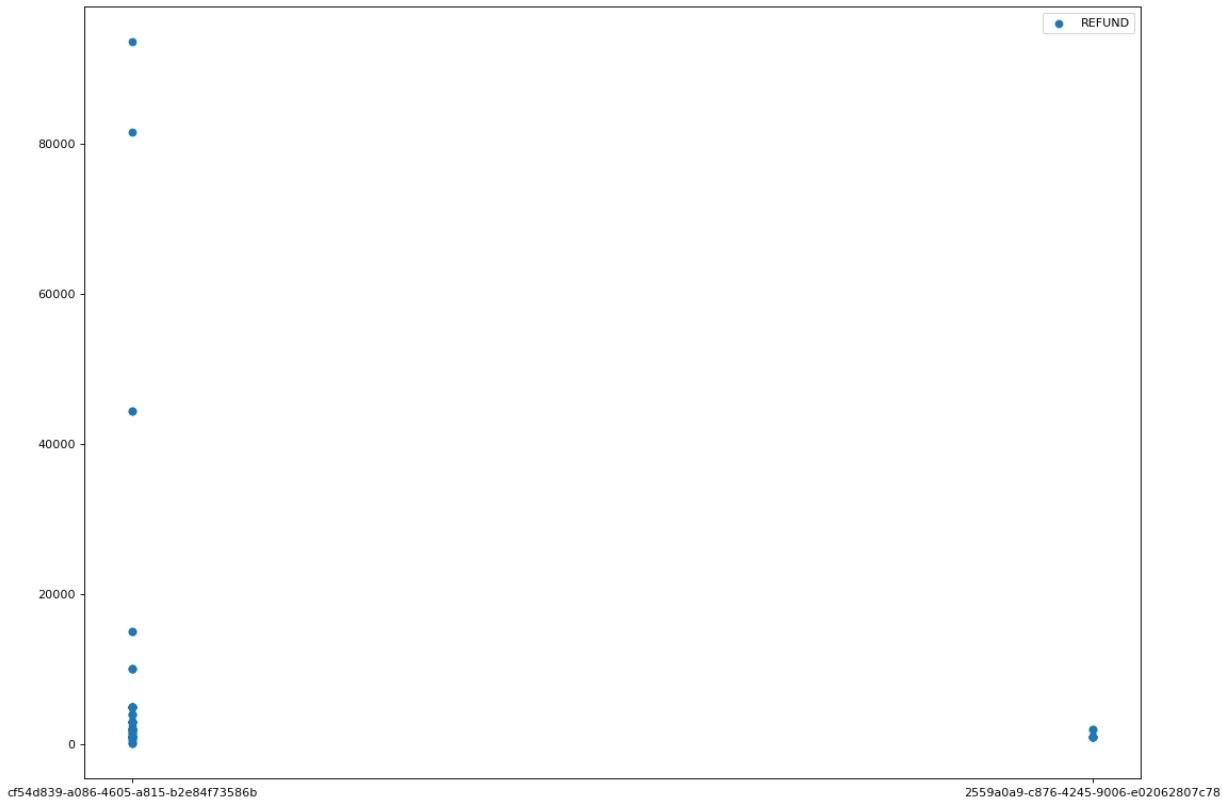
OTHER 25
Name: externalParty.transactionCategory, dtype: int64



OTHER 75
Name: externalParty.transactionCategory, dtype: int64

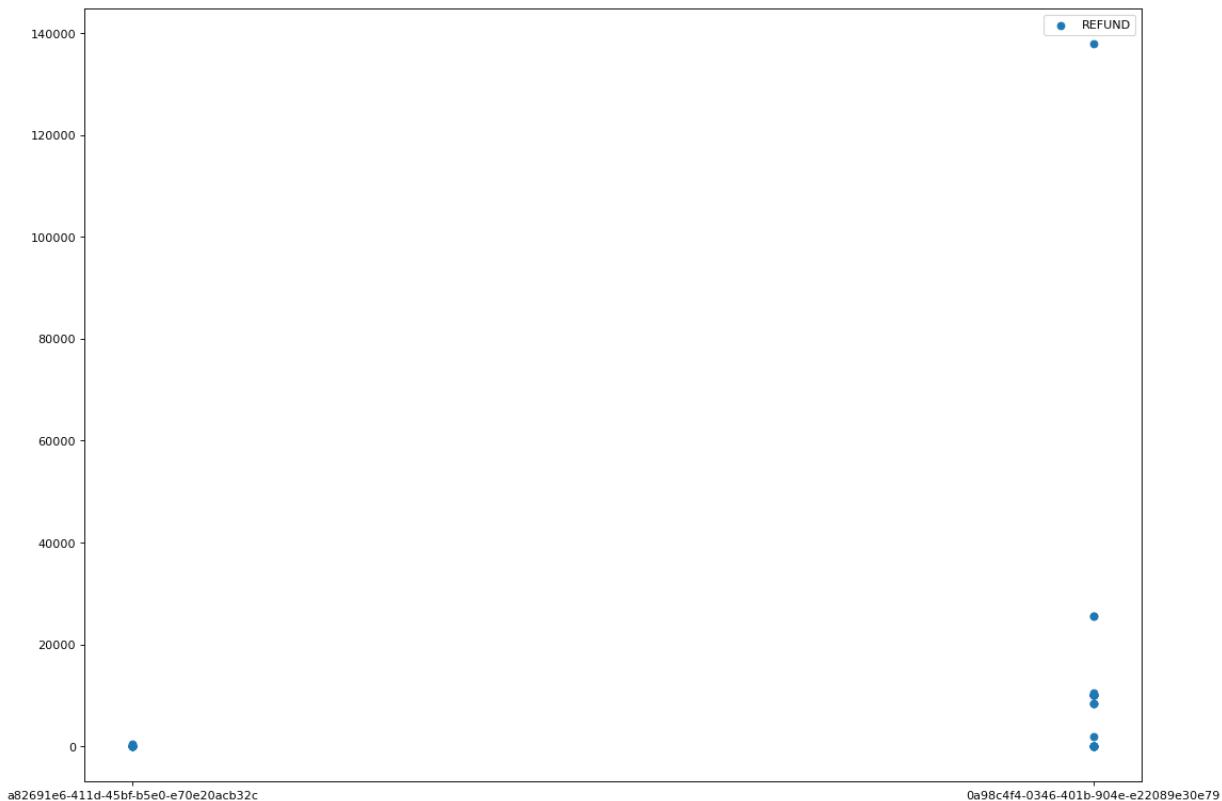


OTHER 129
Name: externalParty.transactionCategory, dtype: int64



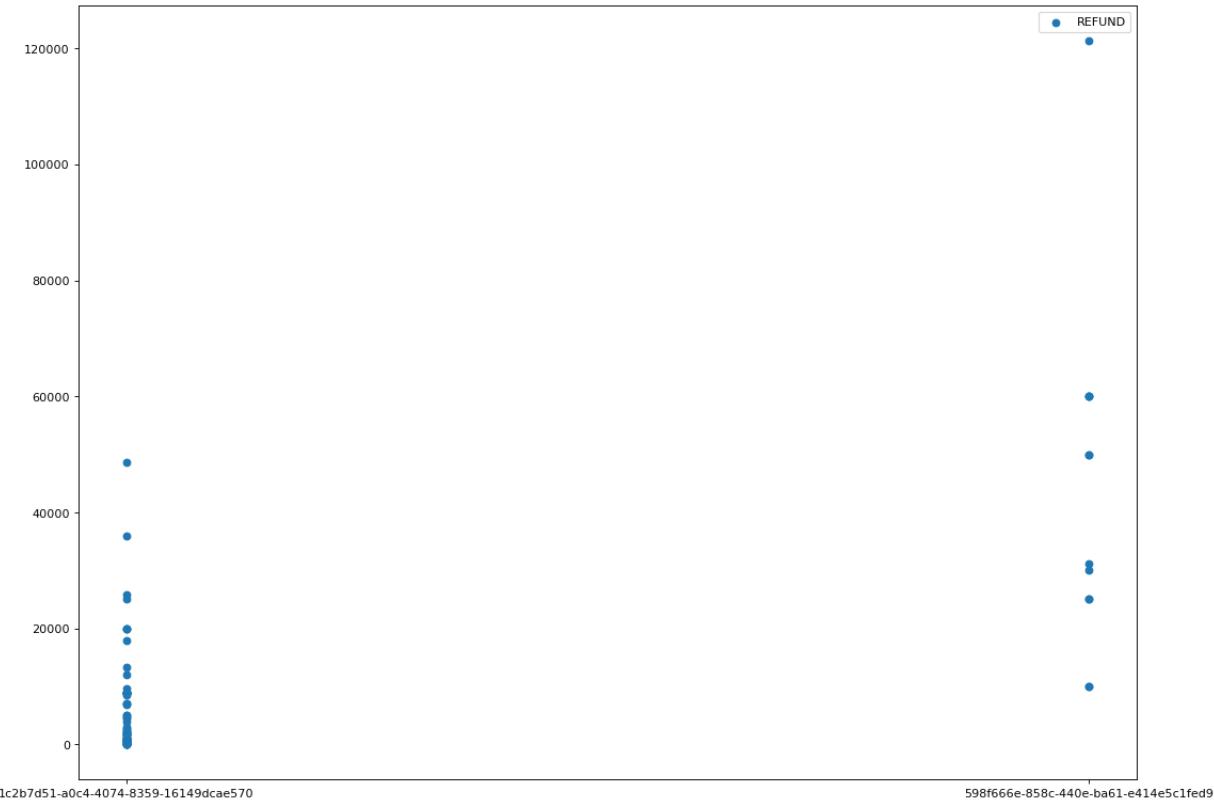
OTHER 84

Name: externalParty.transactionCategory, dtype: int64



OTHER 37

Name: externalParty.transactionCategory, dtype: int64



1c2b7d51-a0c4-4074-8359-16149dcae570

598f666e-858c-440e-ba61-e414e5c1fed9

OTHER	71
TRAVEL	7
LIFESTYLE	7
GROCERIES	7
SHOPPING	1

Name: externalParty.transactionCategory, dtype: int64

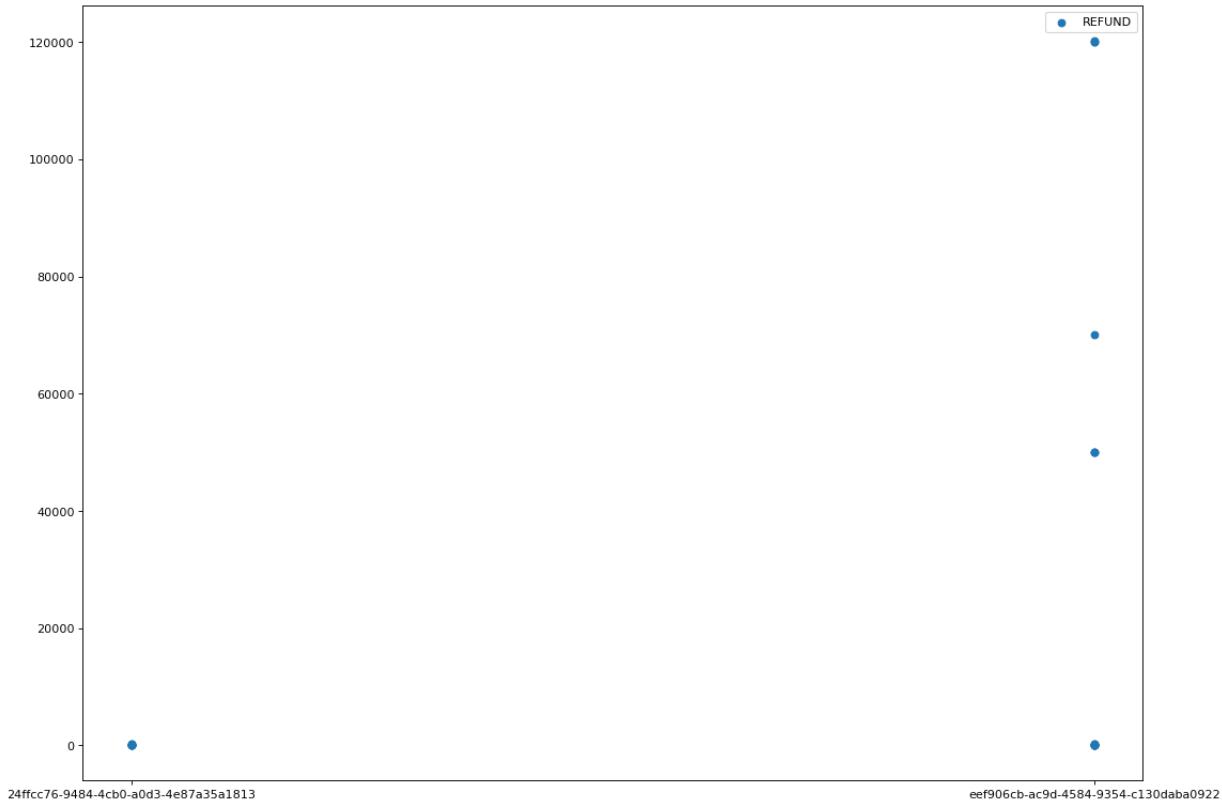


73bdce46-e1e2-4463-acc0-987d63569679

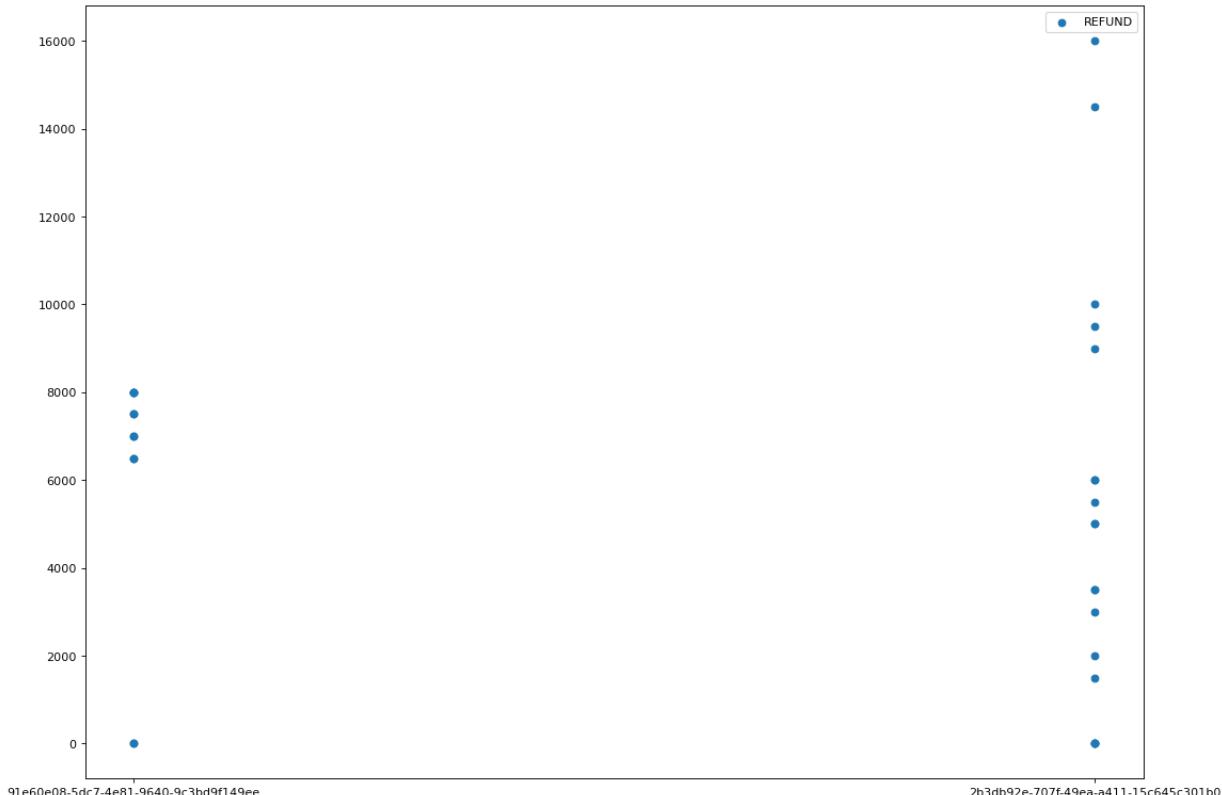
28e472f7-8964-45df-8a48-cad24189978d

OTHER 31

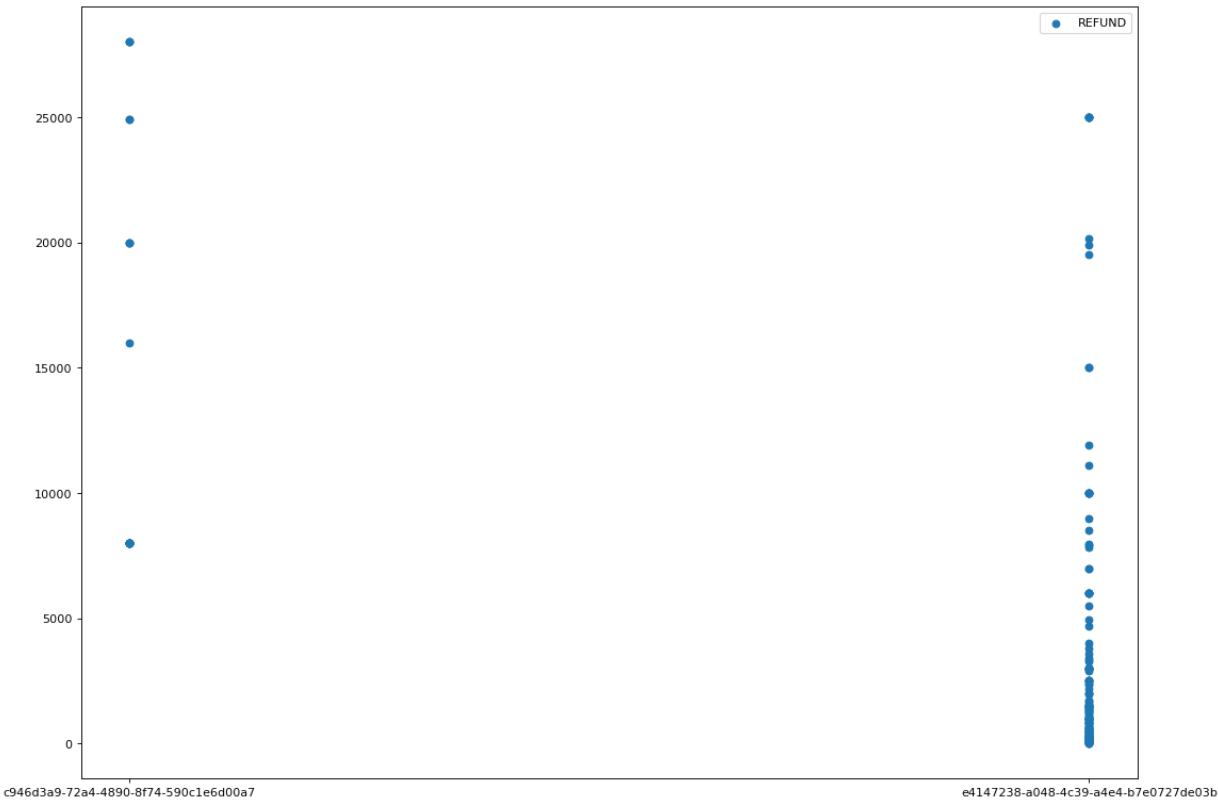
Name: externalParty.transactionCategory, dtype: int64



OTHER 24
Name: externalParty.transactionCategory, dtype: int64

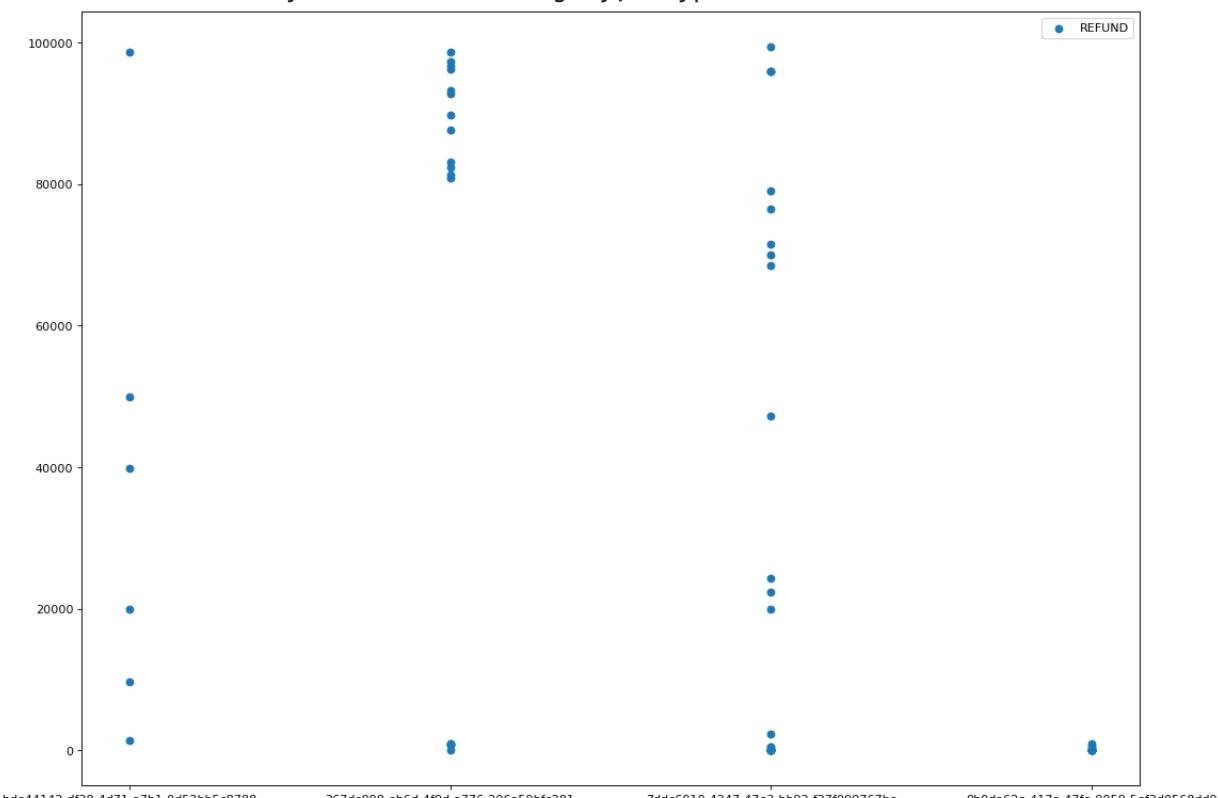


OTHER 31
Name: externalParty.transactionCategory, dtype: int64



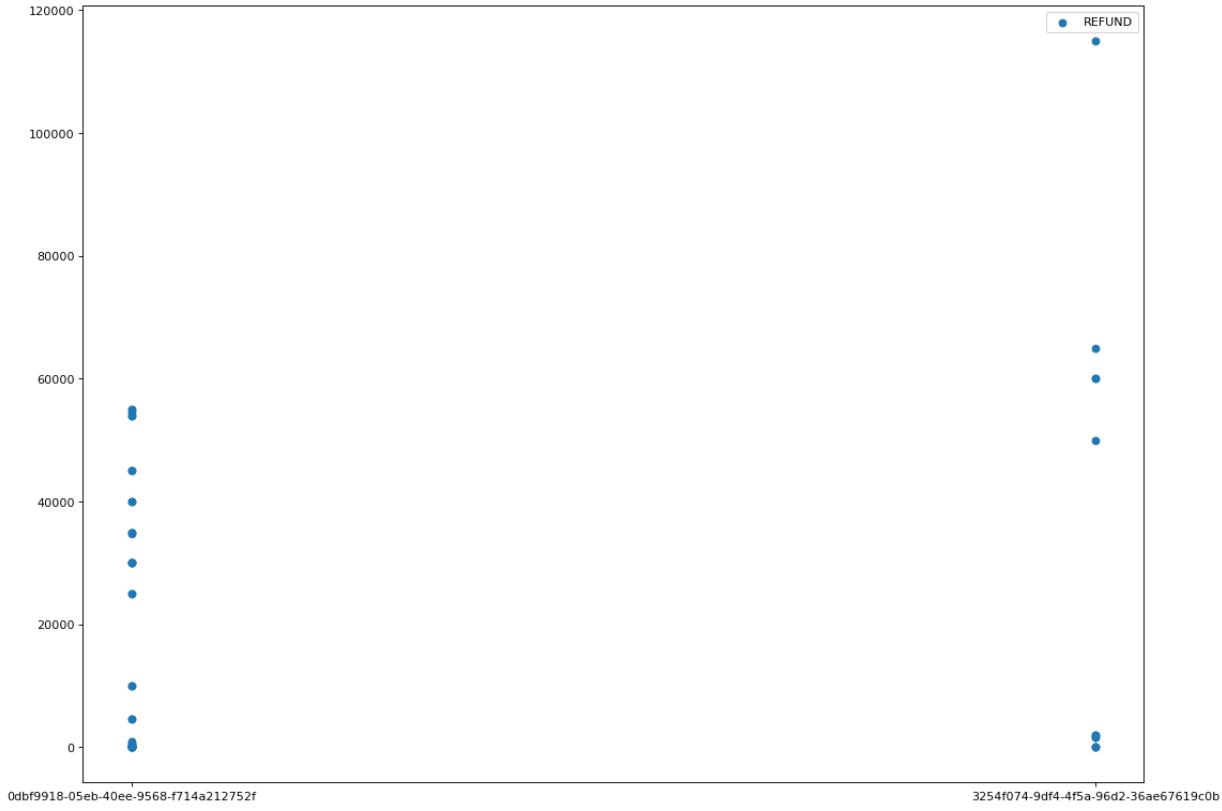
OTHER	103
GROCERIES	28
TRAVEL	13
LIFESTYLE	9
SHOPPING	4

Name: externalParty.transactionCategory, dtype: int64



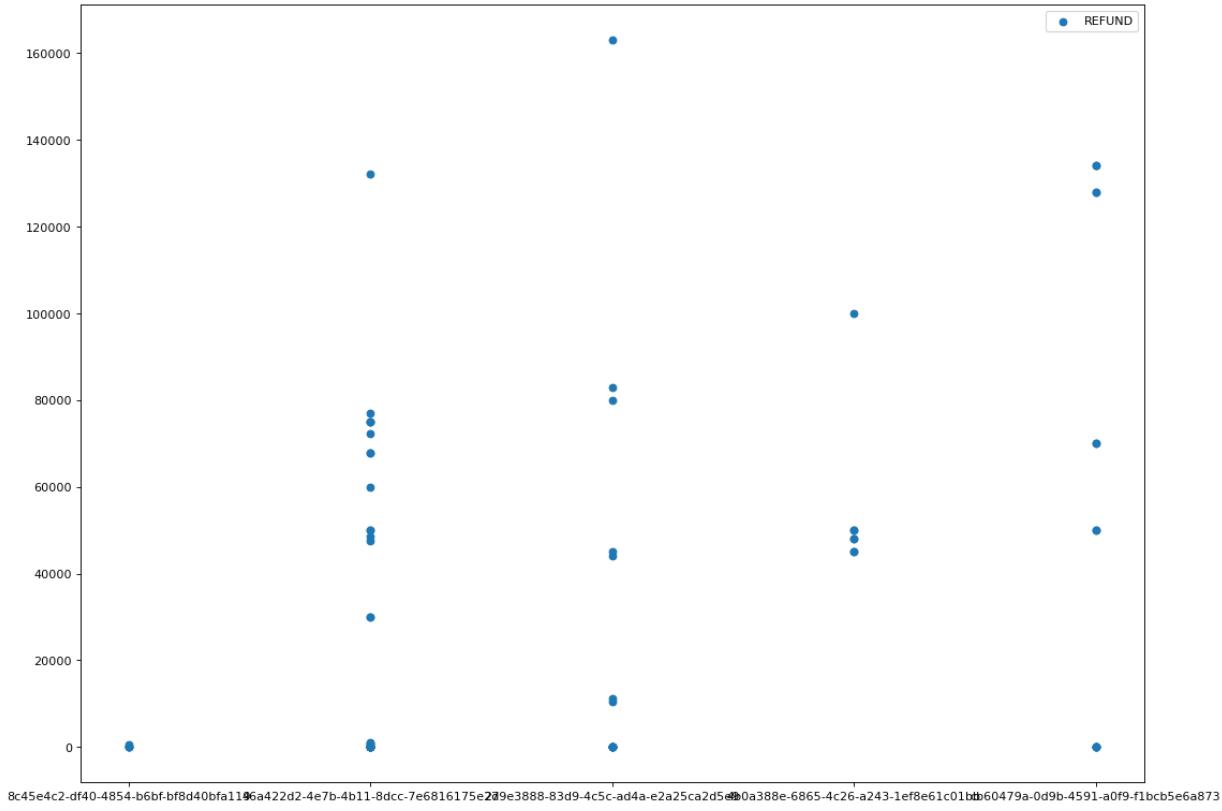
OTHER	68
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Name: externalParty.transactionCategory, dtype: int64



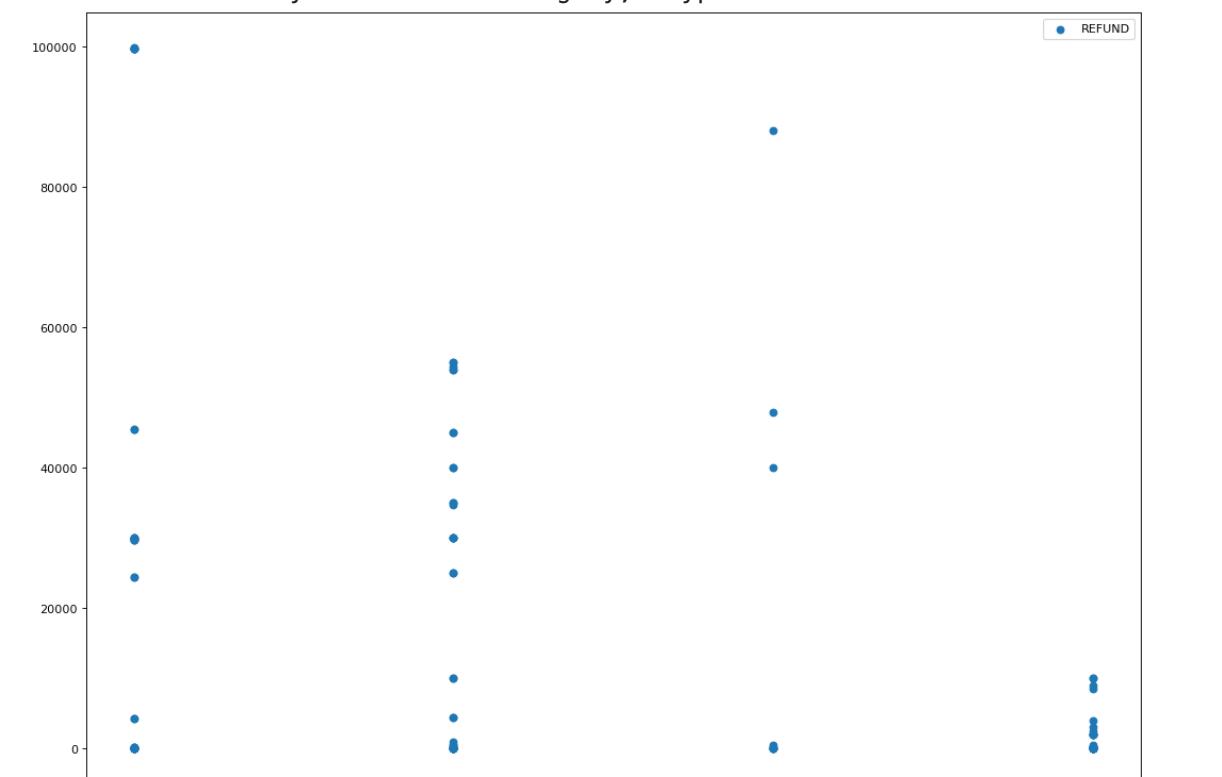
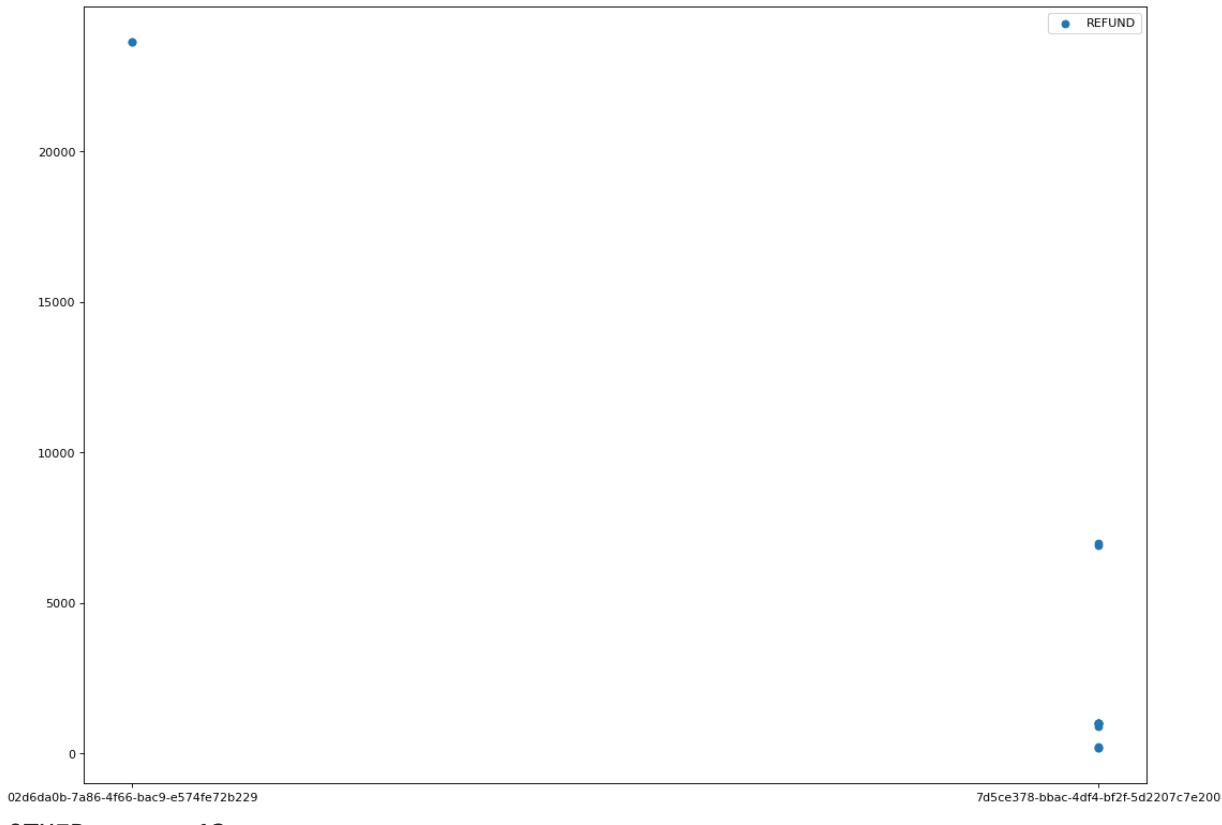
OTHER 49

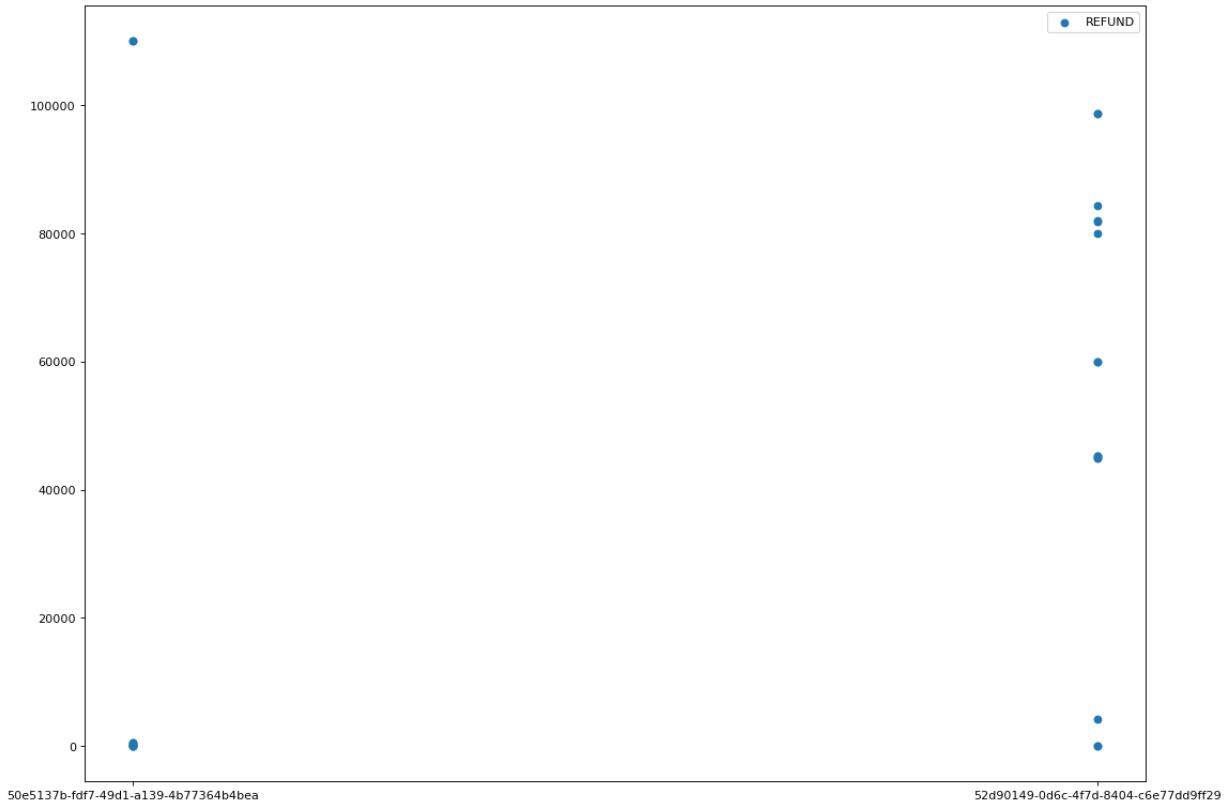
Name: externalParty.transactionCategory, dtype: int64



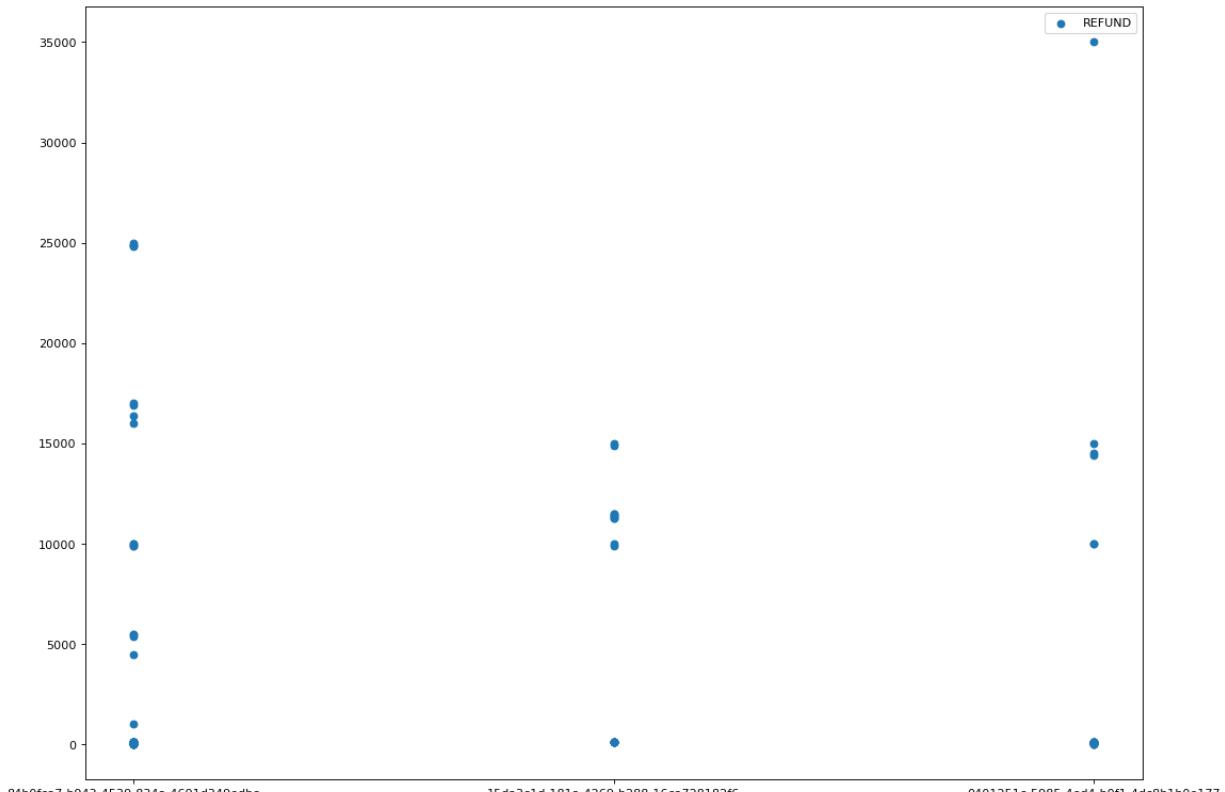
OTHER 76

Name: externalParty.transactionCategory, dtype: int64

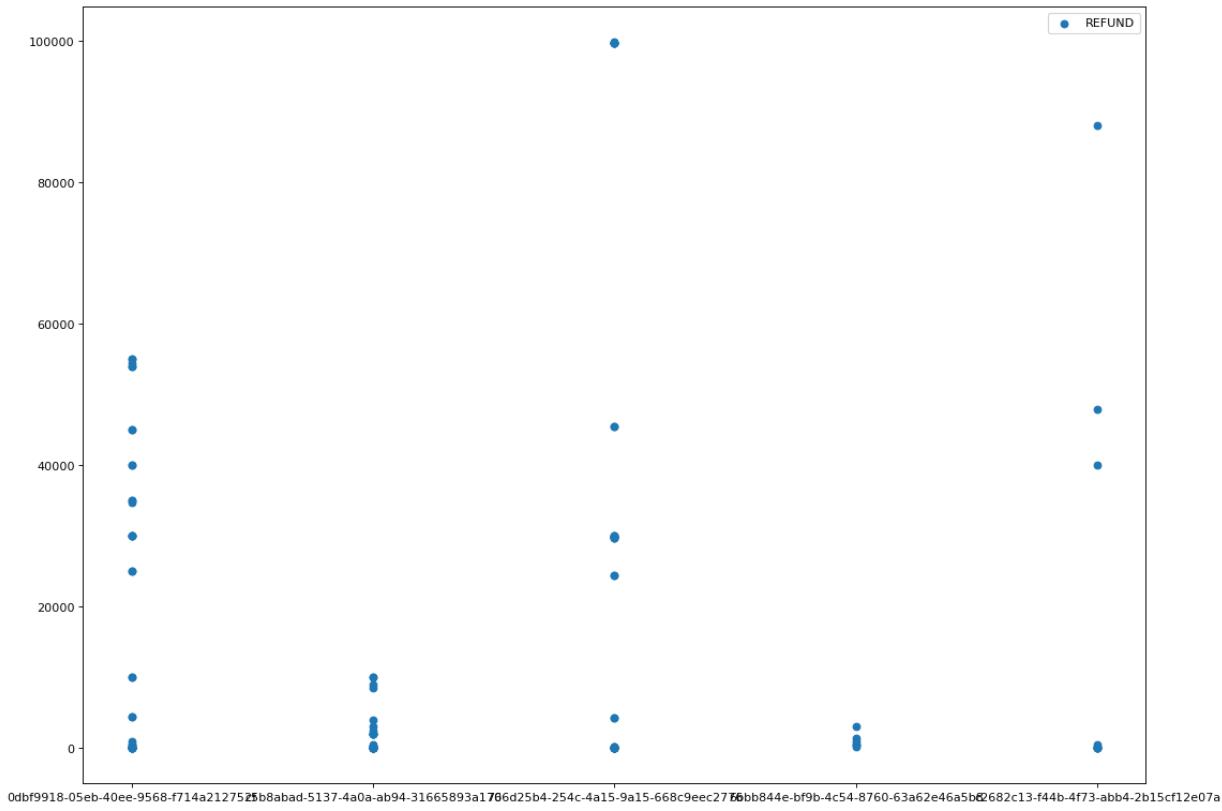




OTHER 25
Name: externalParty.transactionCategory, dtype: int64



OTHER 84
Name: externalParty.transactionCategory, dtype: int64



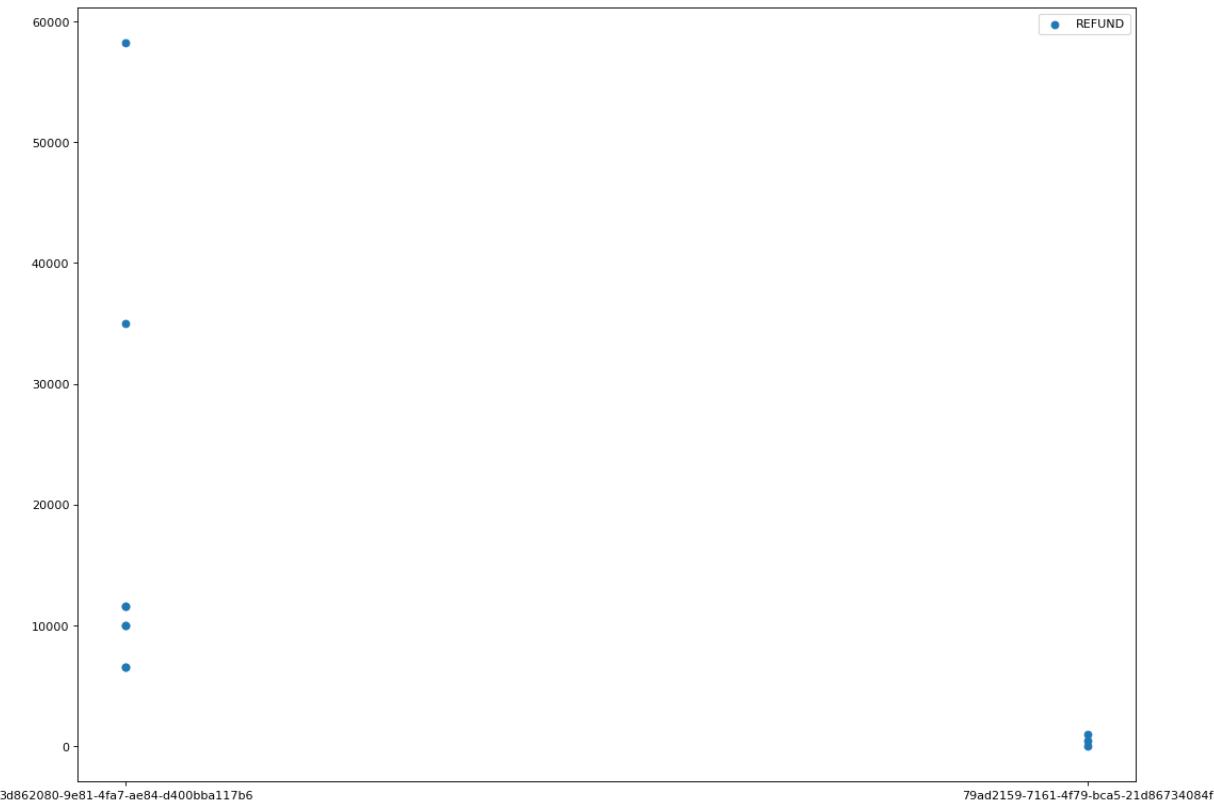
OTHER 130
LIFESTYLE 2

Name: externalParty.transactionCategory, dtype: int64

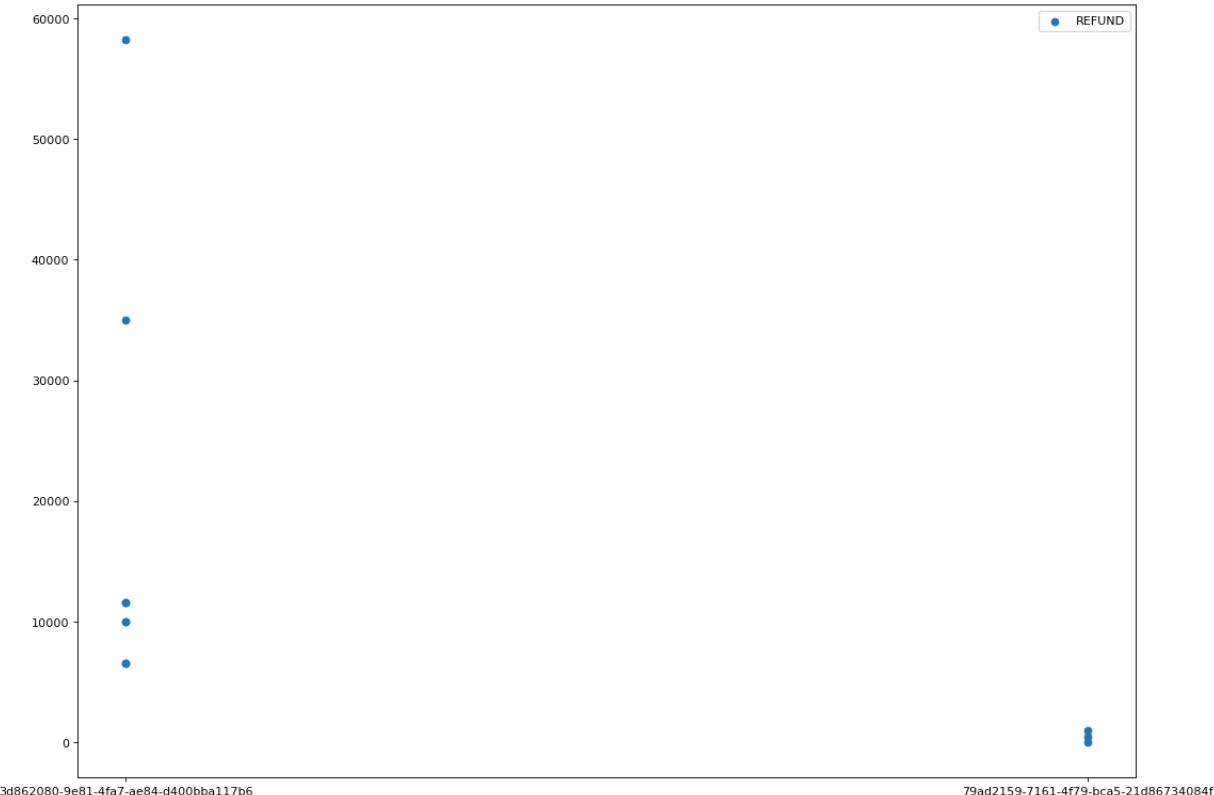


OTHER 11

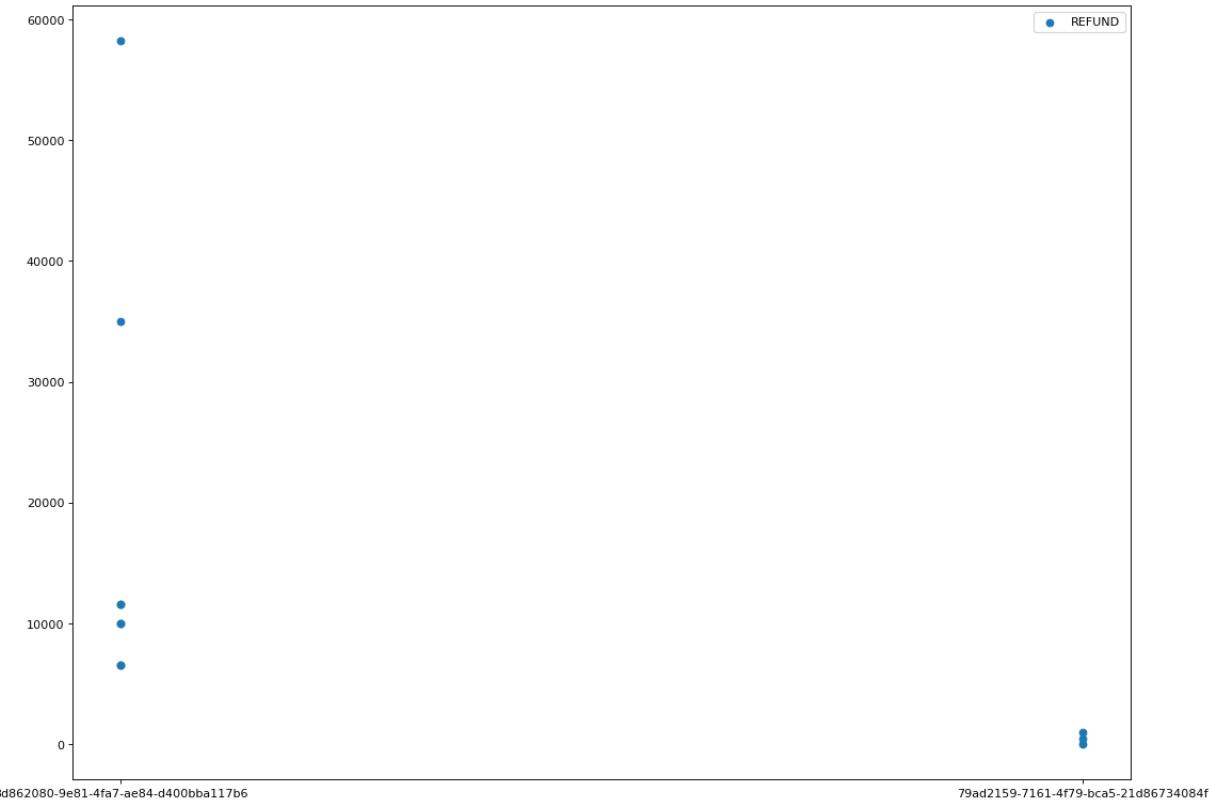
Name: externalParty.transactionCategory, dtype: int64



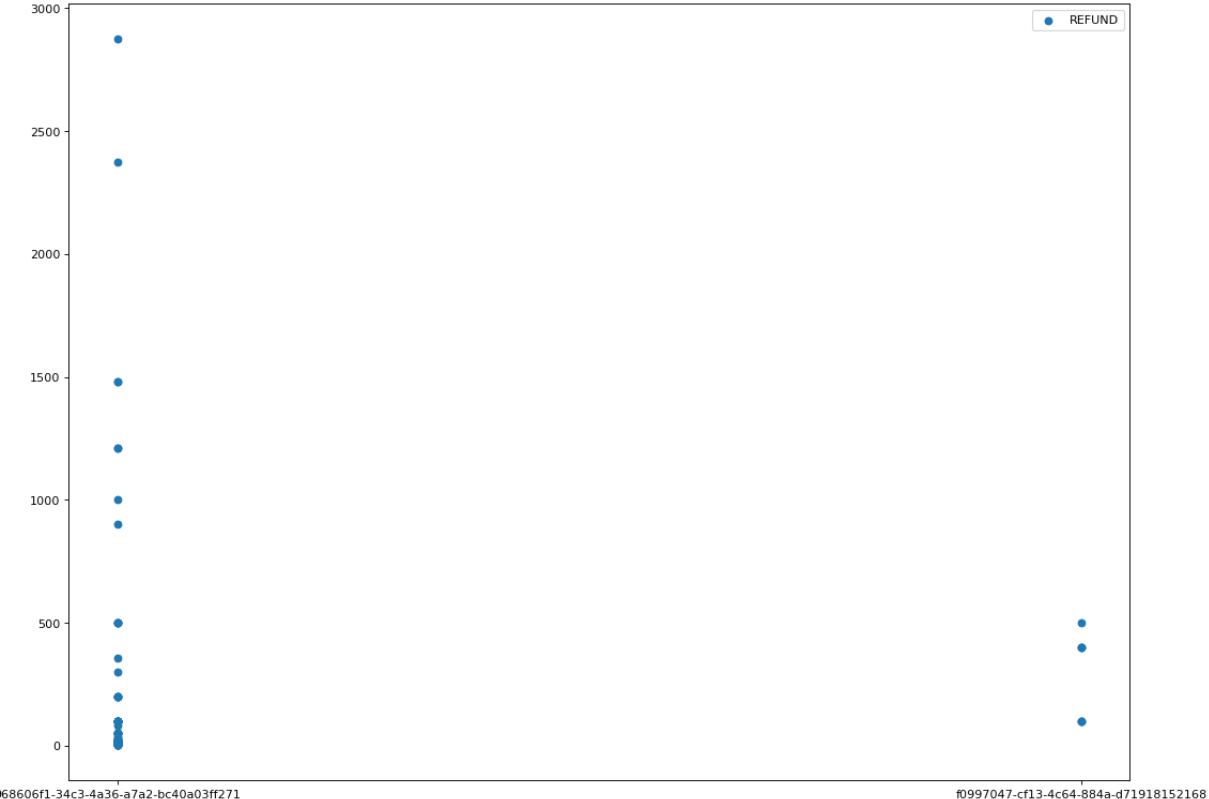
OTHER 11
Name: externalParty.transactionCategory, dtype: int64



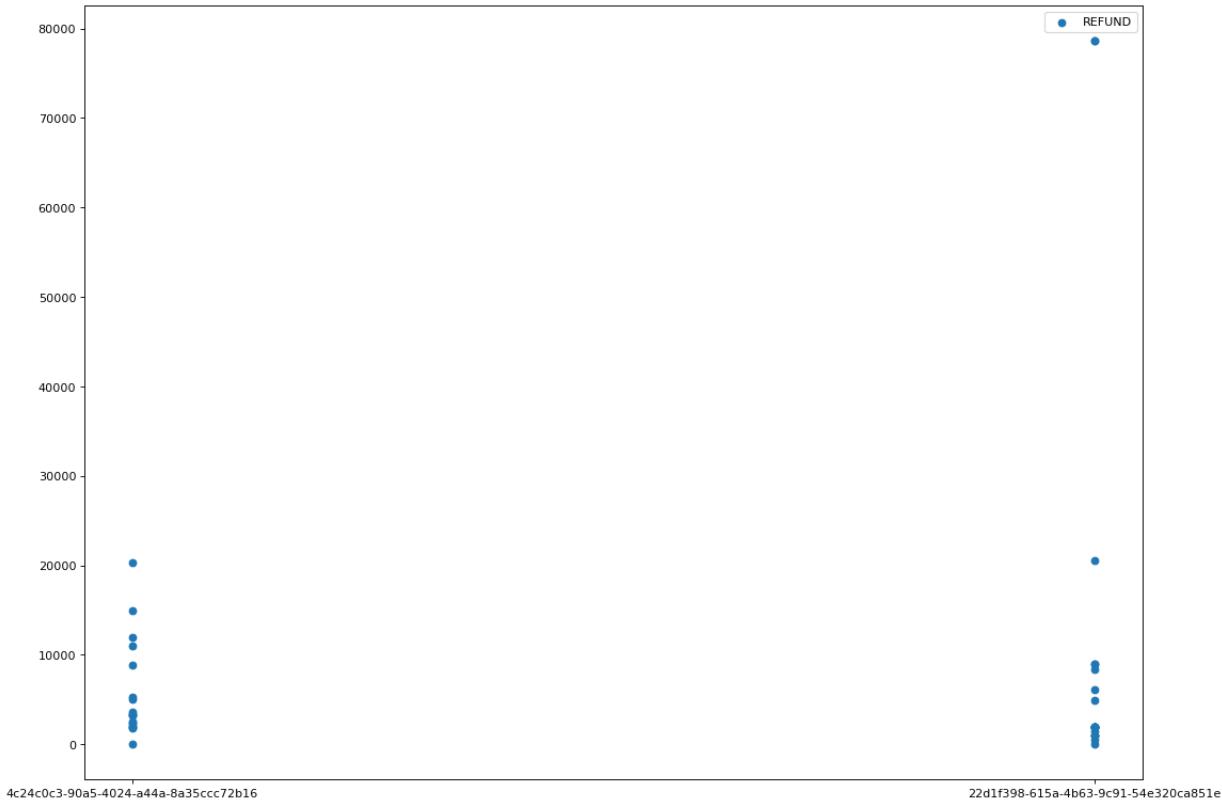
OTHER 11
Name: externalParty.transactionCategory, dtype: int64



OTHER 11
Name: externalParty.transactionCategory, dtype: int64

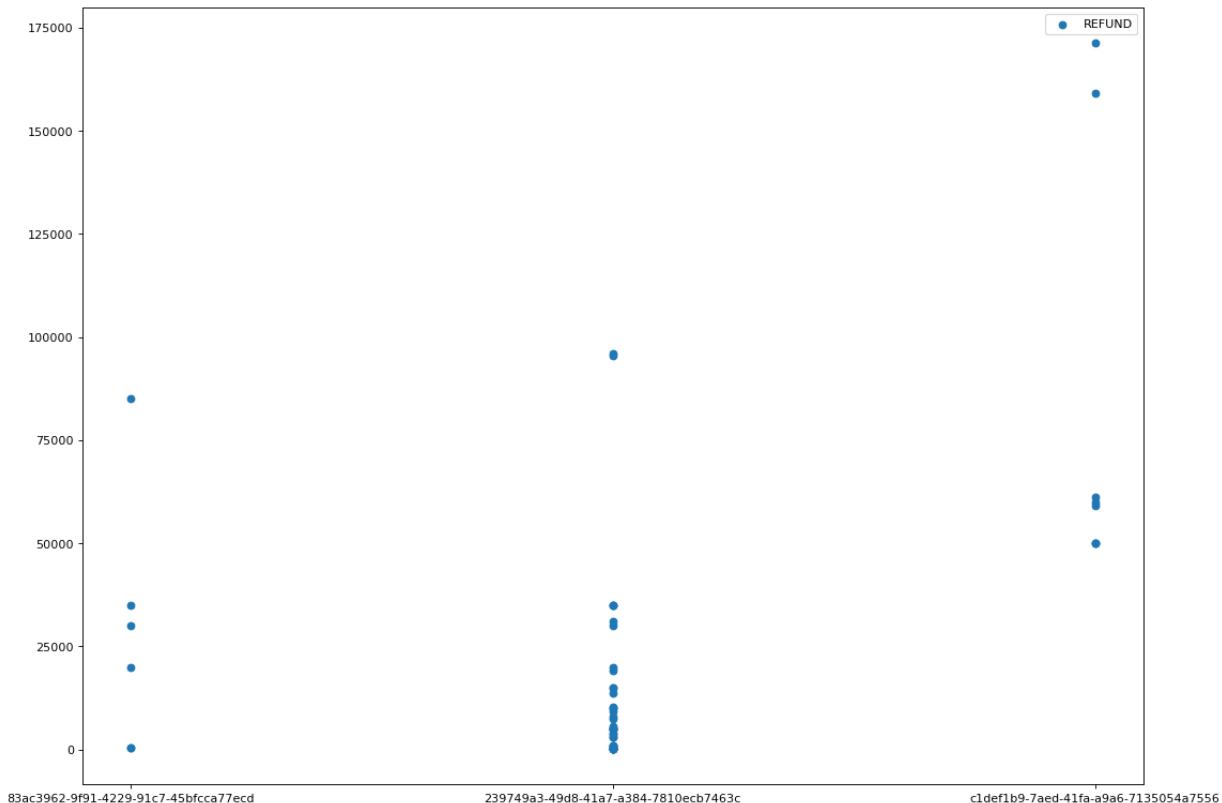


OTHER 90
Name: externalParty.transactionCategory, dtype: int64



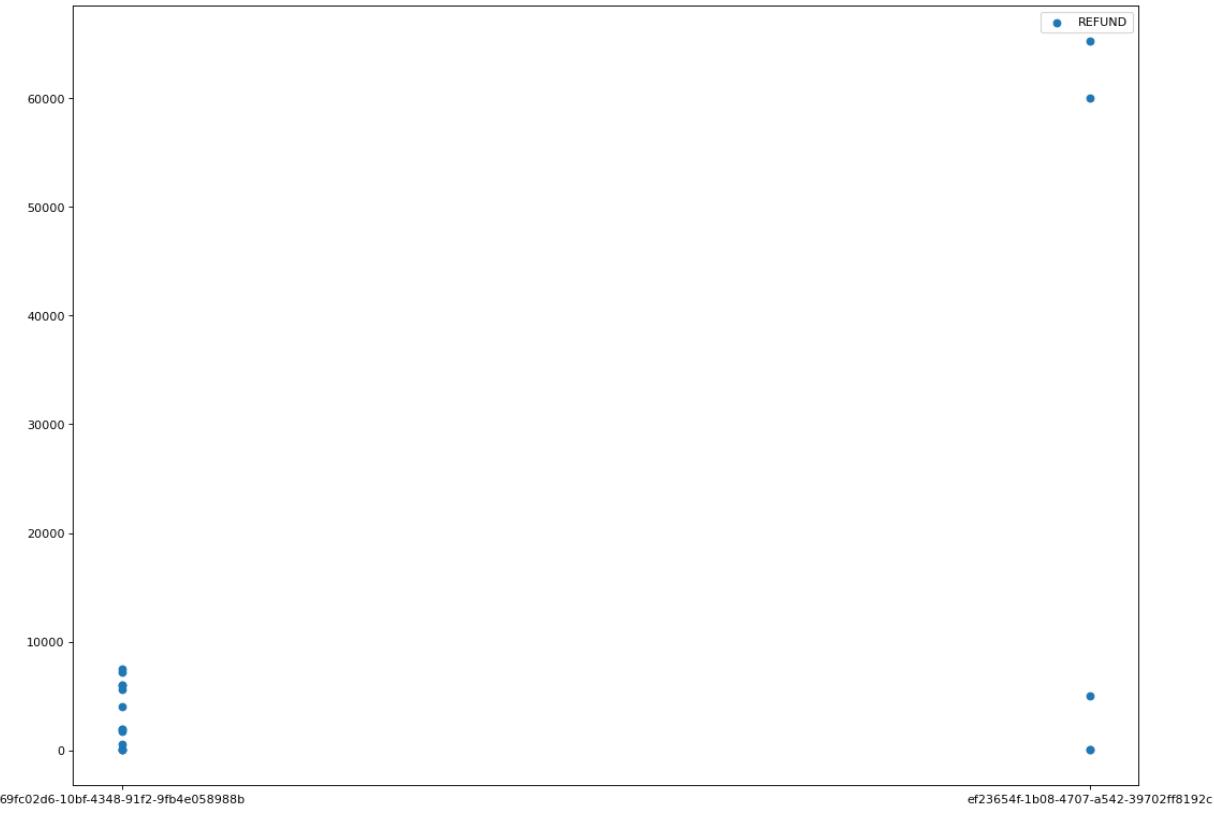
OTHER 39

Name: externalParty.transactionCategory, dtype: int64



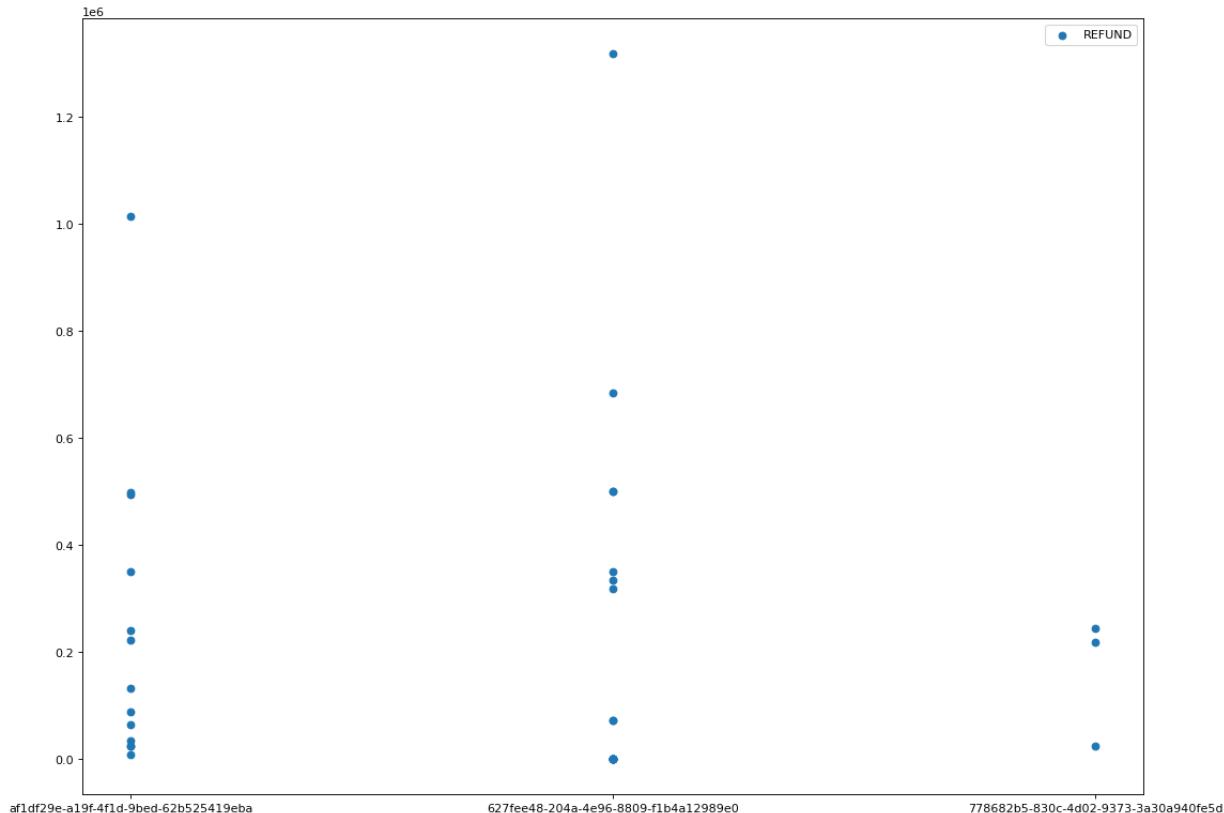
OTHER 55

Name: externalParty.transactionCategory, dtype: int64



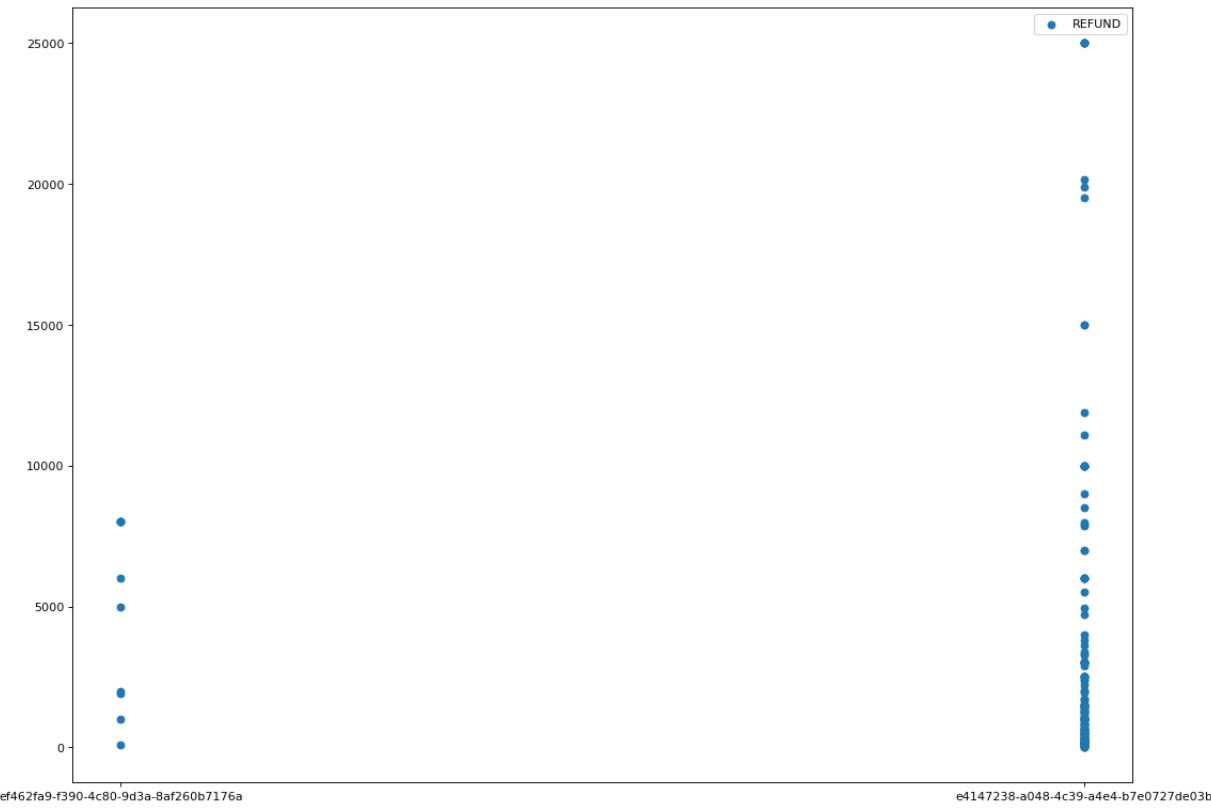
OTHER 18

Name: externalParty.transactionCategory, dtype: int64



OTHER 35

Name: externalParty.transactionCategory, dtype: int64



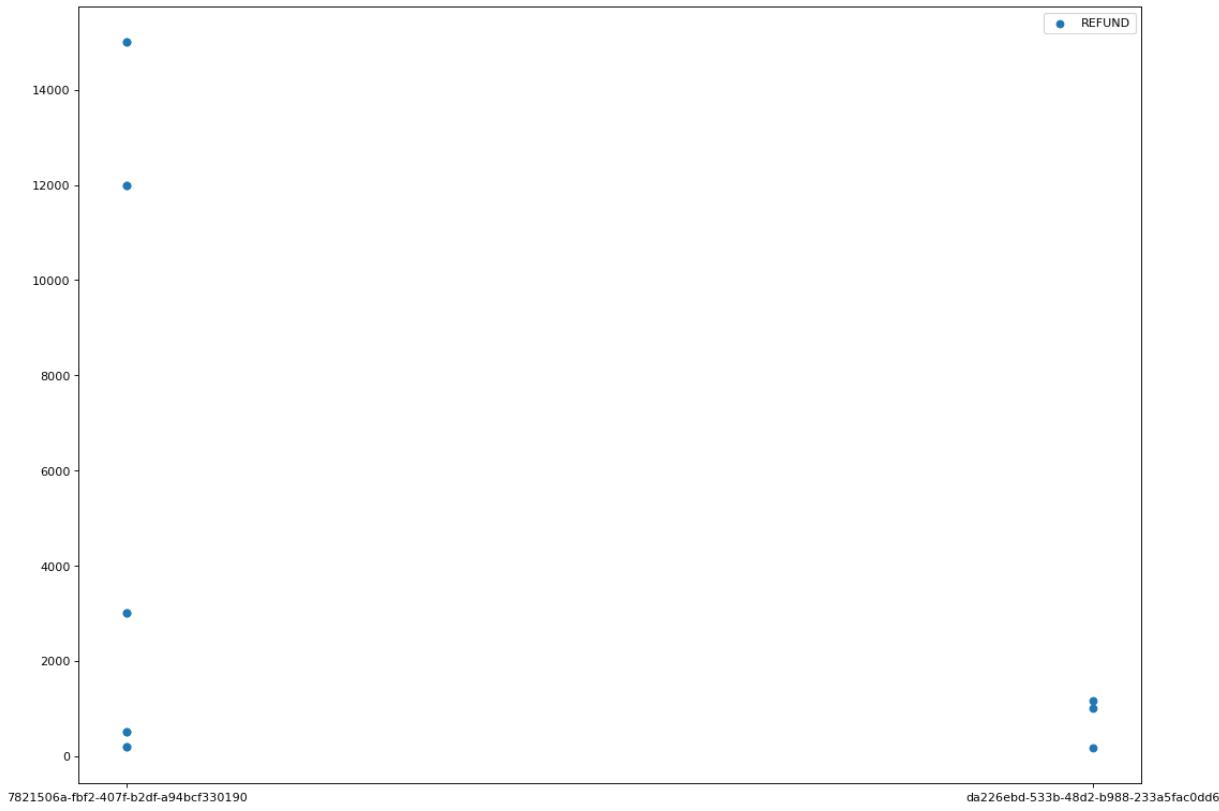
OTHER	93
GROCERIES	28
TRAVEL	13
LIFESTYLE	9
SHOPPING	4

Name: externalParty.transactionCategory, dtype: int64

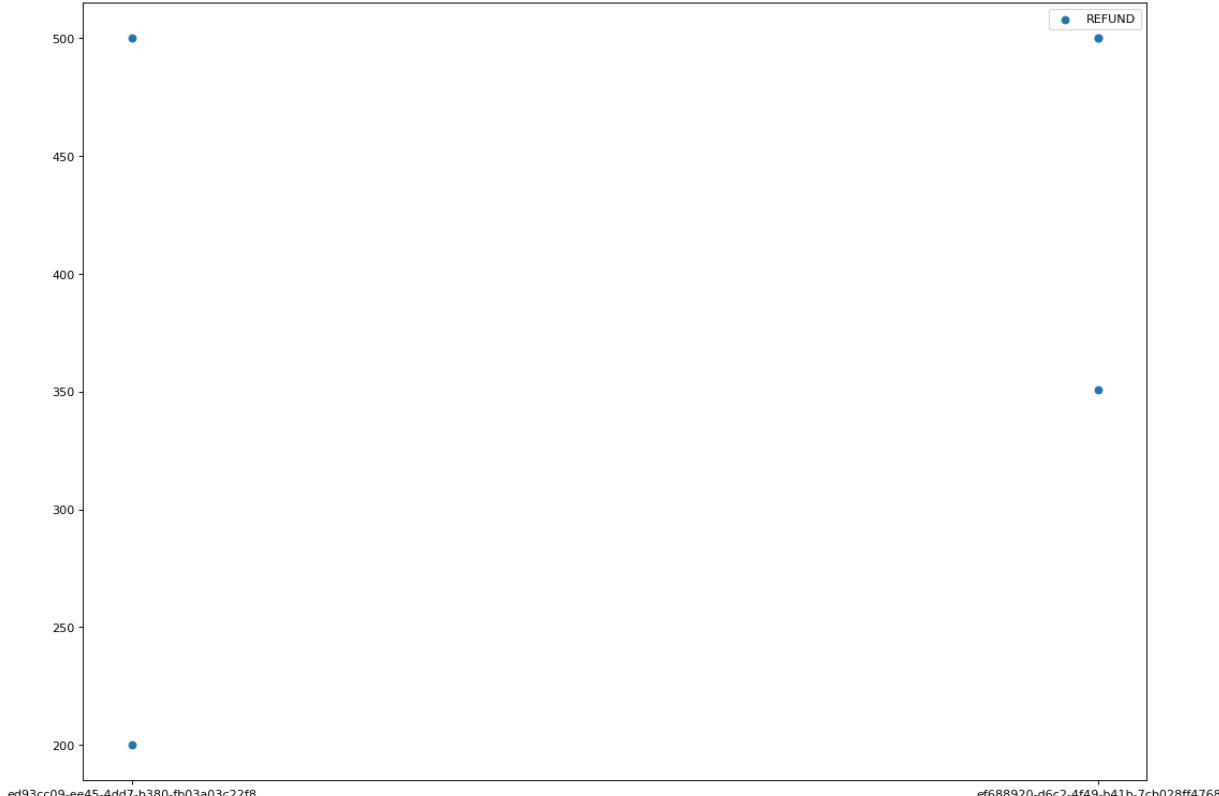


OTHER	36
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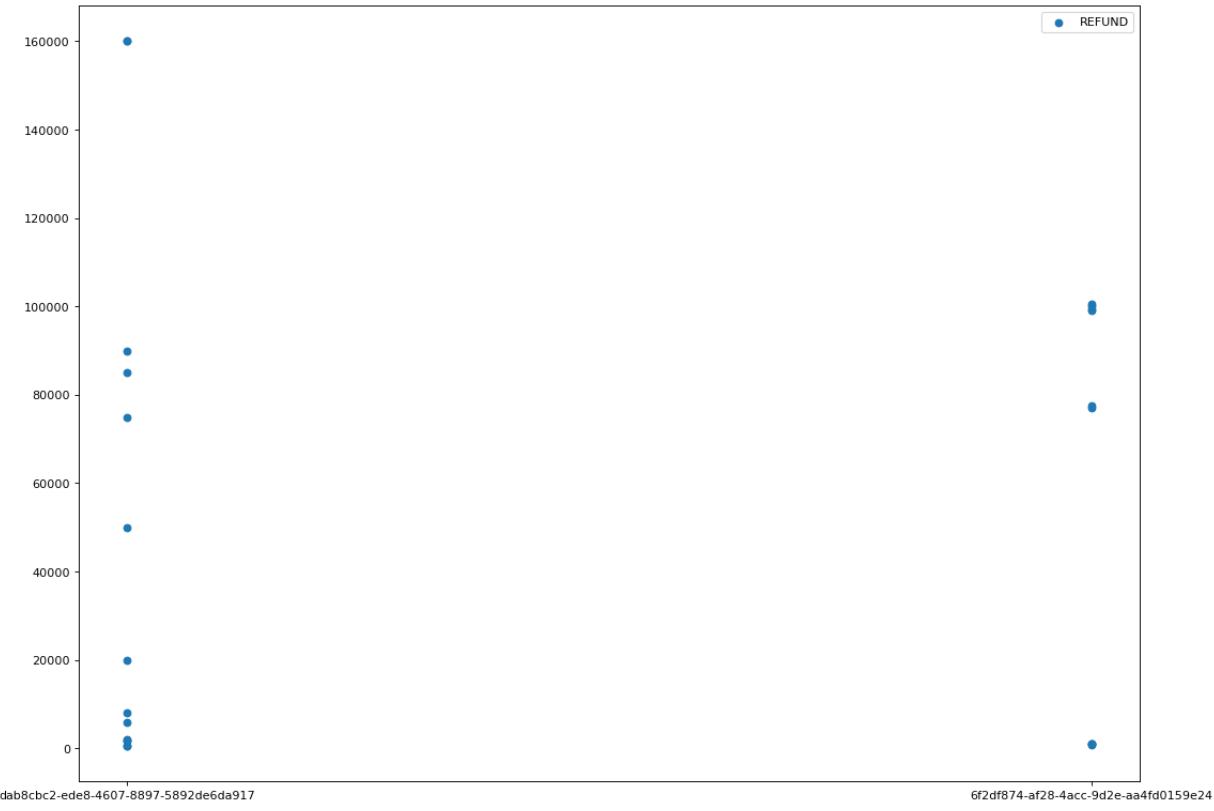
Name: externalParty.transactionCategory, dtype: int64



OTHER 13
Name: externalParty.transactionCategory, dtype: int64



OTHER 5
Name: externalParty.transactionCategory, dtype: int64



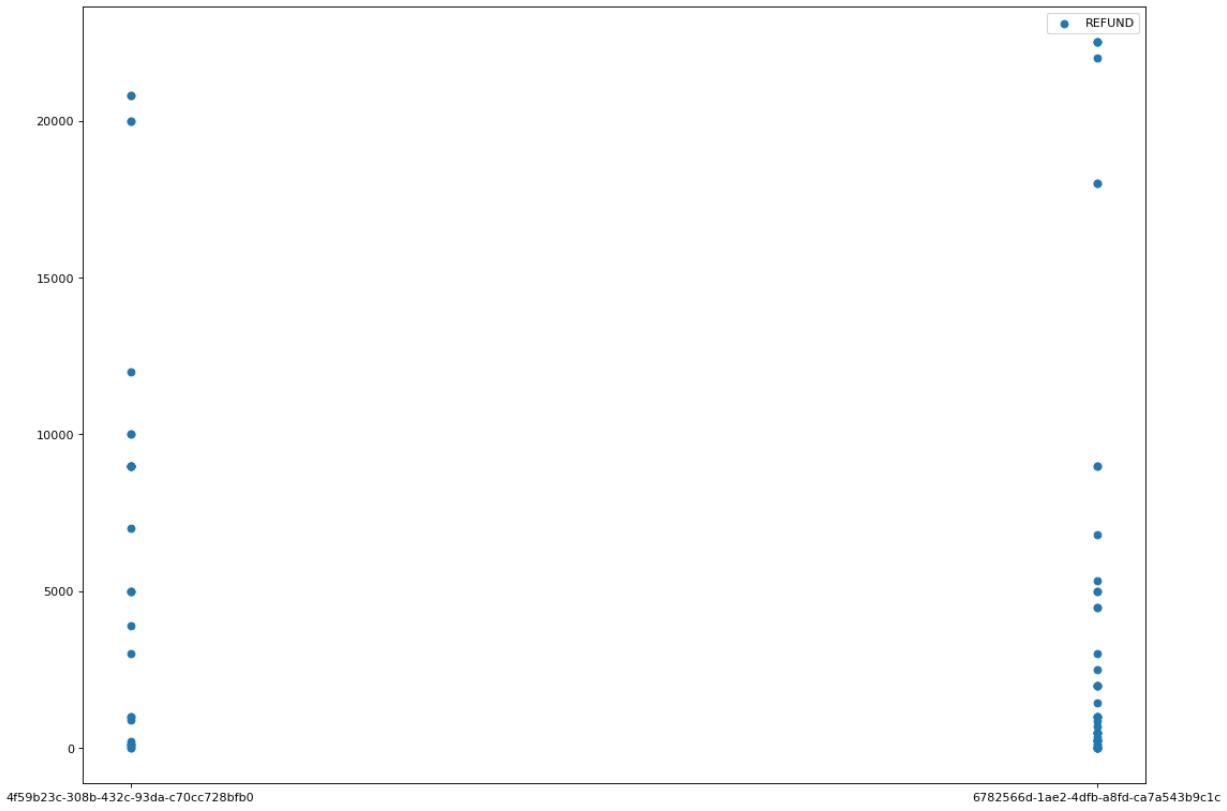
OTHER 24

Name: externalParty.transactionCategory, dtype: int64



OTHER 29

Name: externalParty.transactionCategory, dtype: int64

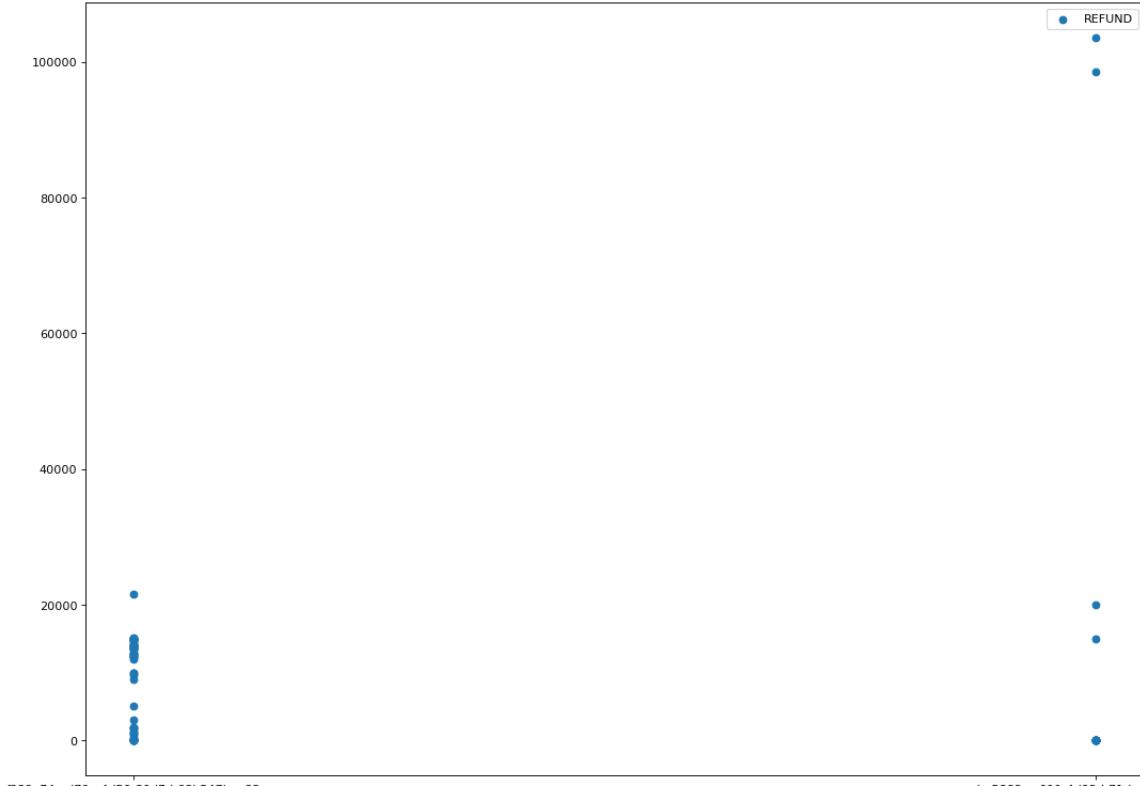


4f59b23c-308b-432c-93da-c70cc728fb0

6782566d-1ae2-4dfb-a8fd-ca7a543b9c1c

OTHER	71
SHOPPING	1
TRAVEL	1

Name: externalParty.transactionCategory, dtype: int64

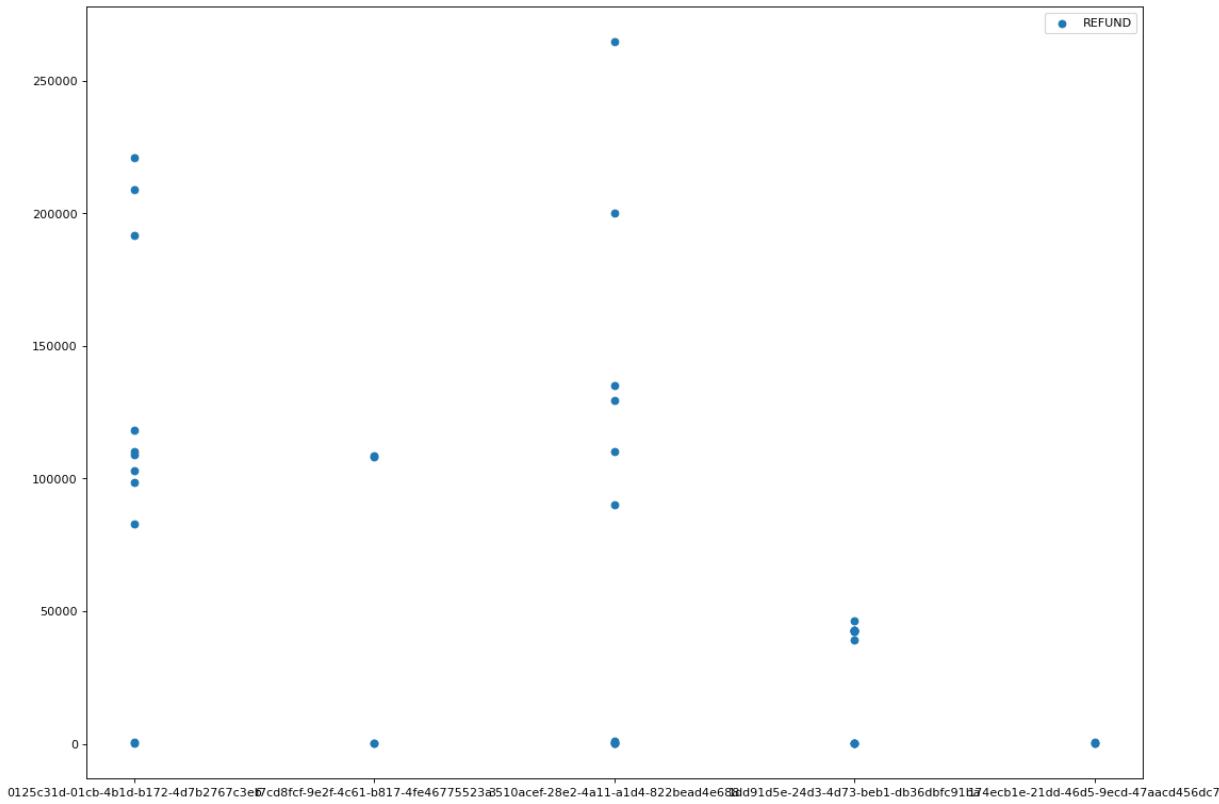


f989a74e-d70e-4d50-80d7-b68b547bae83

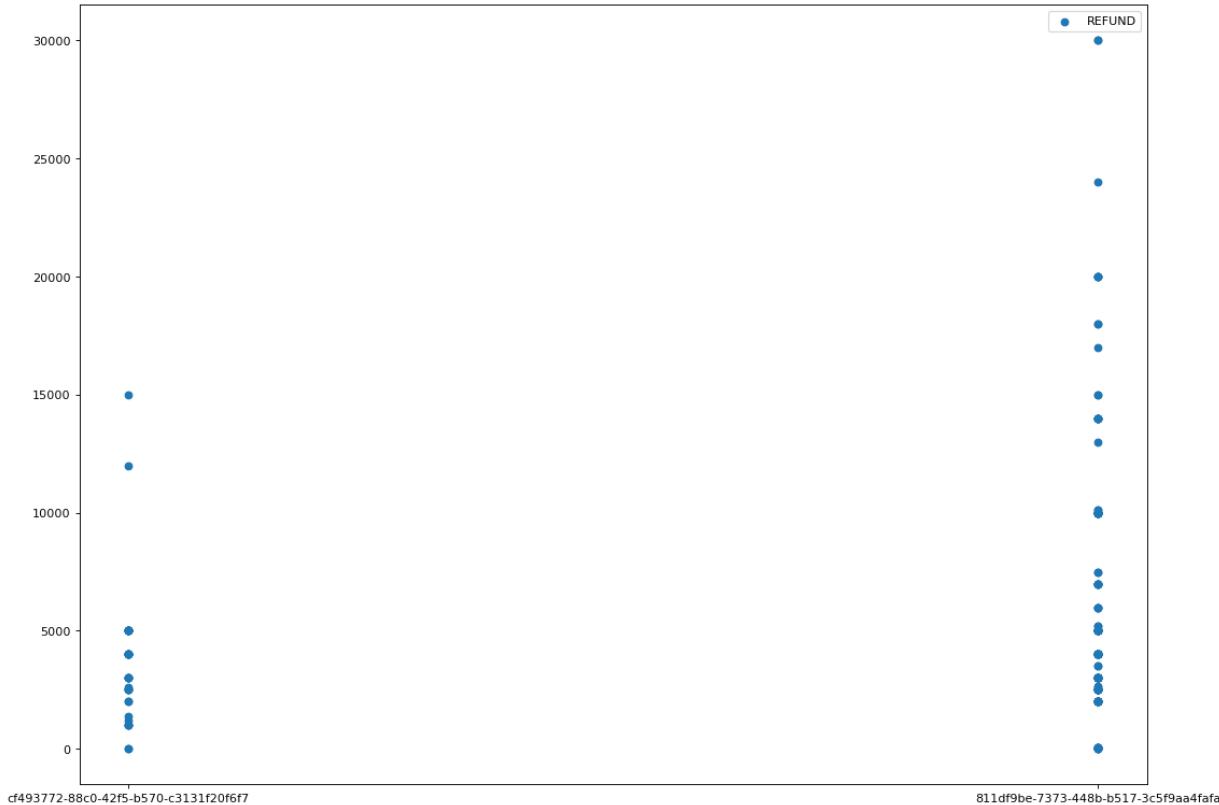
aba5883c-c011-4d92-b71d-aa0b050caaf9

OTHER 109

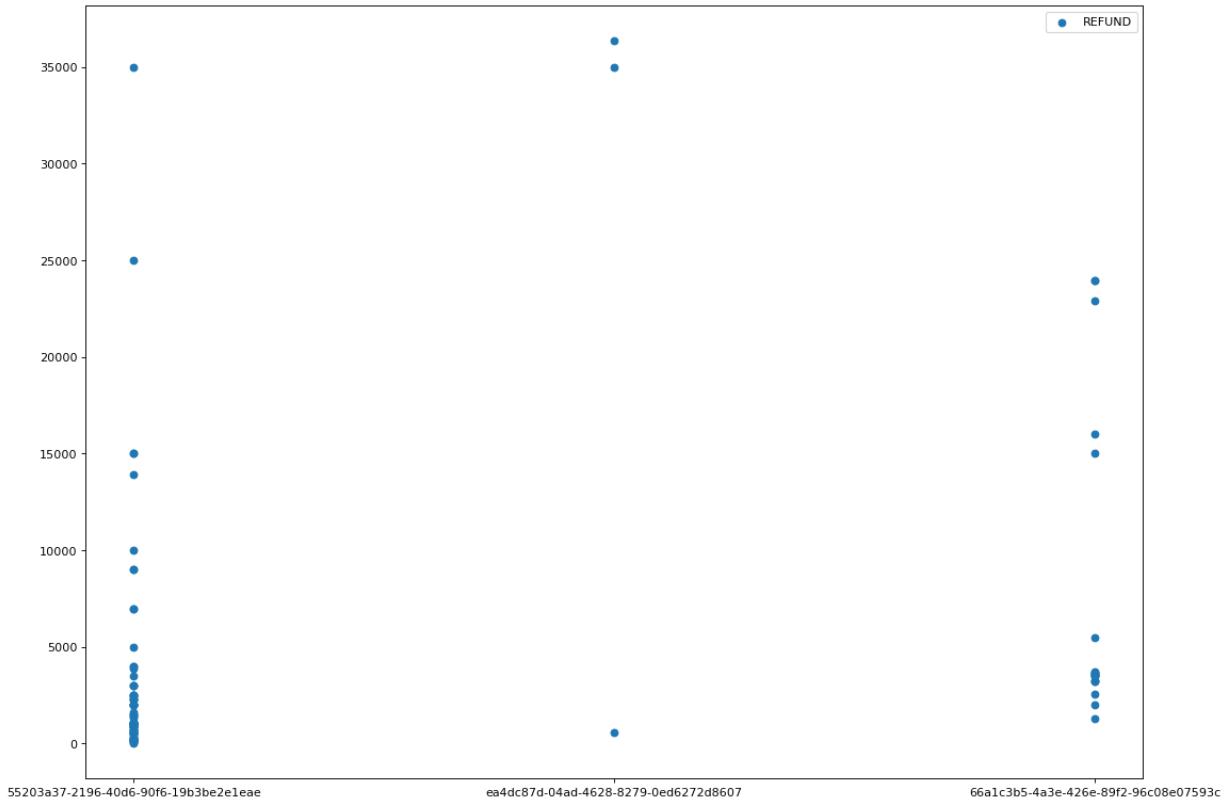
Name: externalParty.transactionCategory, dtype: int64



OTHER 41
Name: externalParty.transactionCategory, dtype: int64

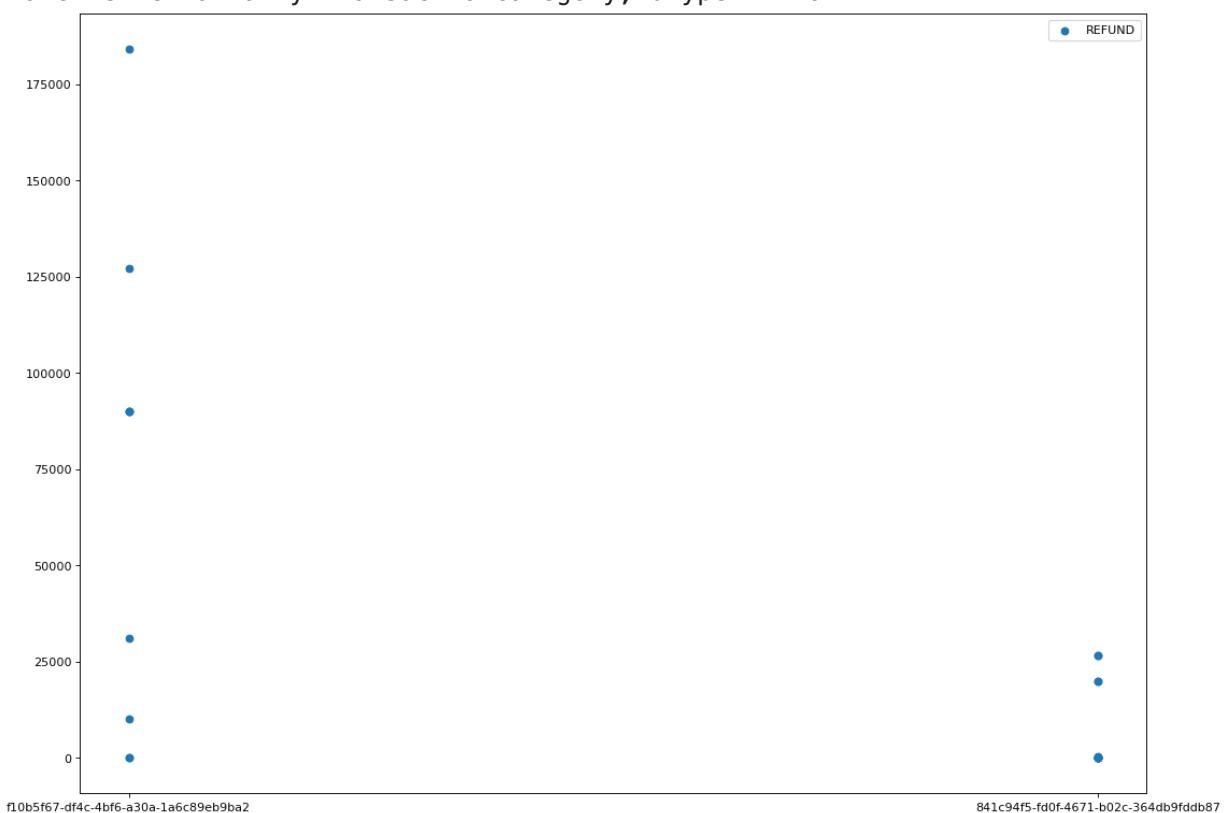


OTHER 226
Name: externalParty.transactionCategory, dtype: int64

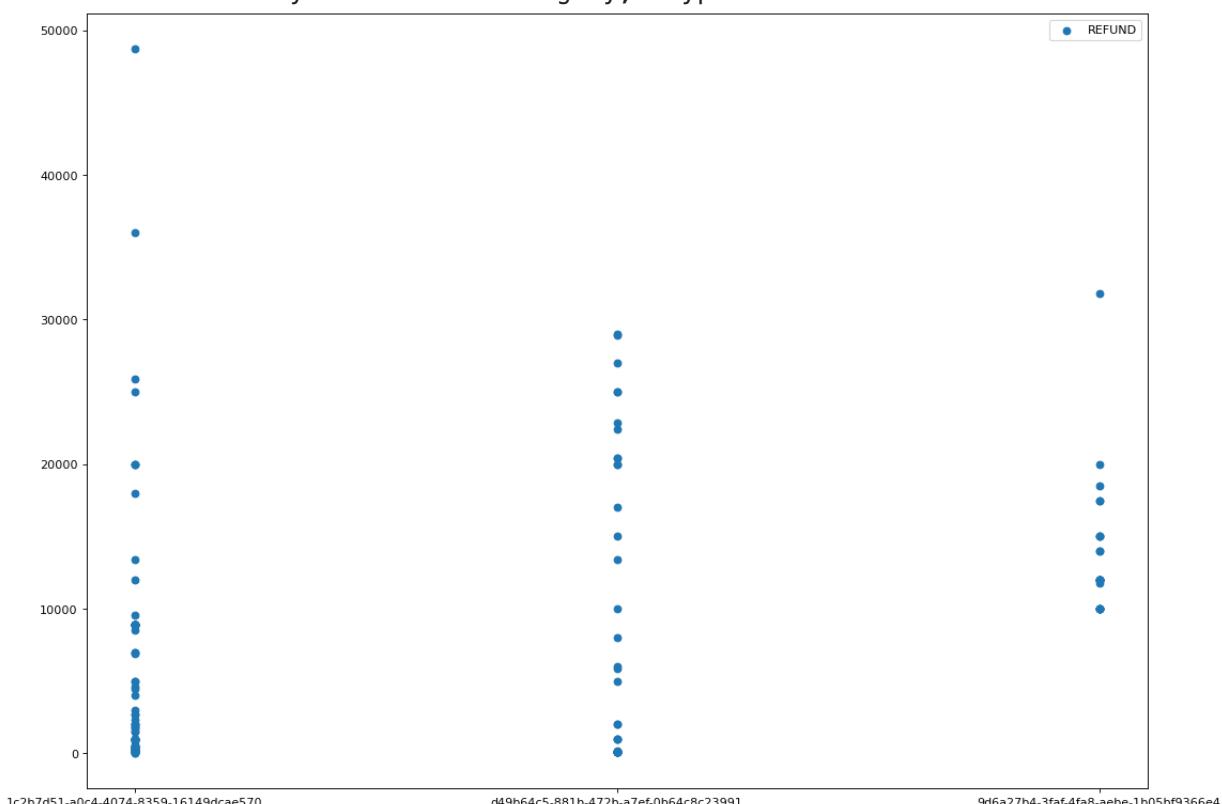
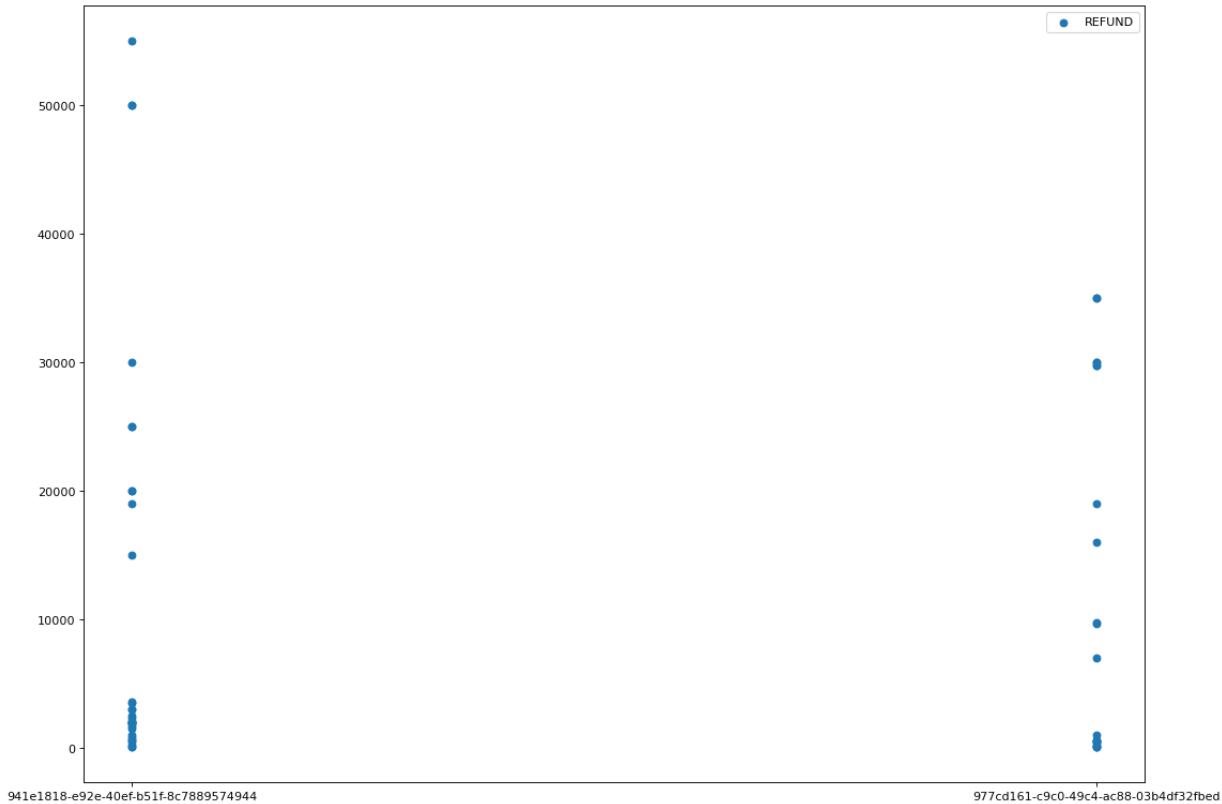


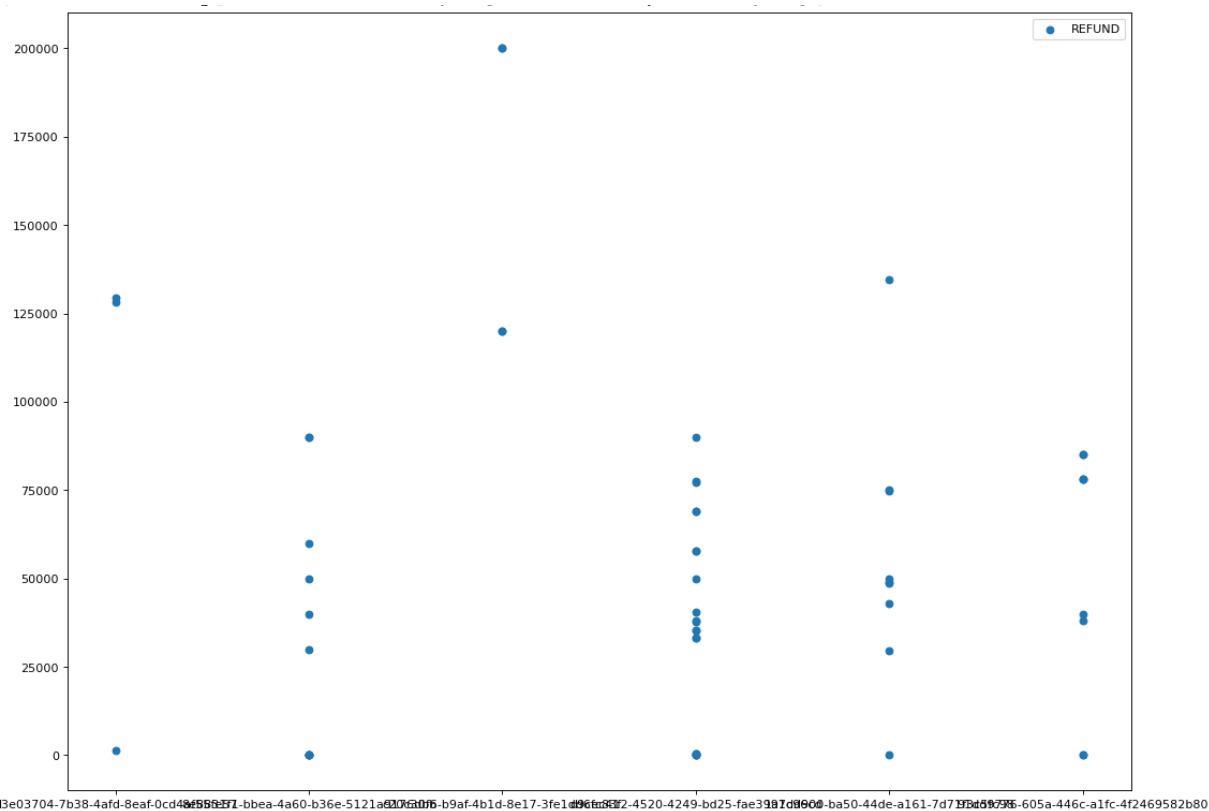
Name: externalParty.transactionCategory, dtype: int64

Category	Count
OTHER	84
TRAVEL	15
LIFESTYLE	6
GROCERIES	4
SHOPPING	3



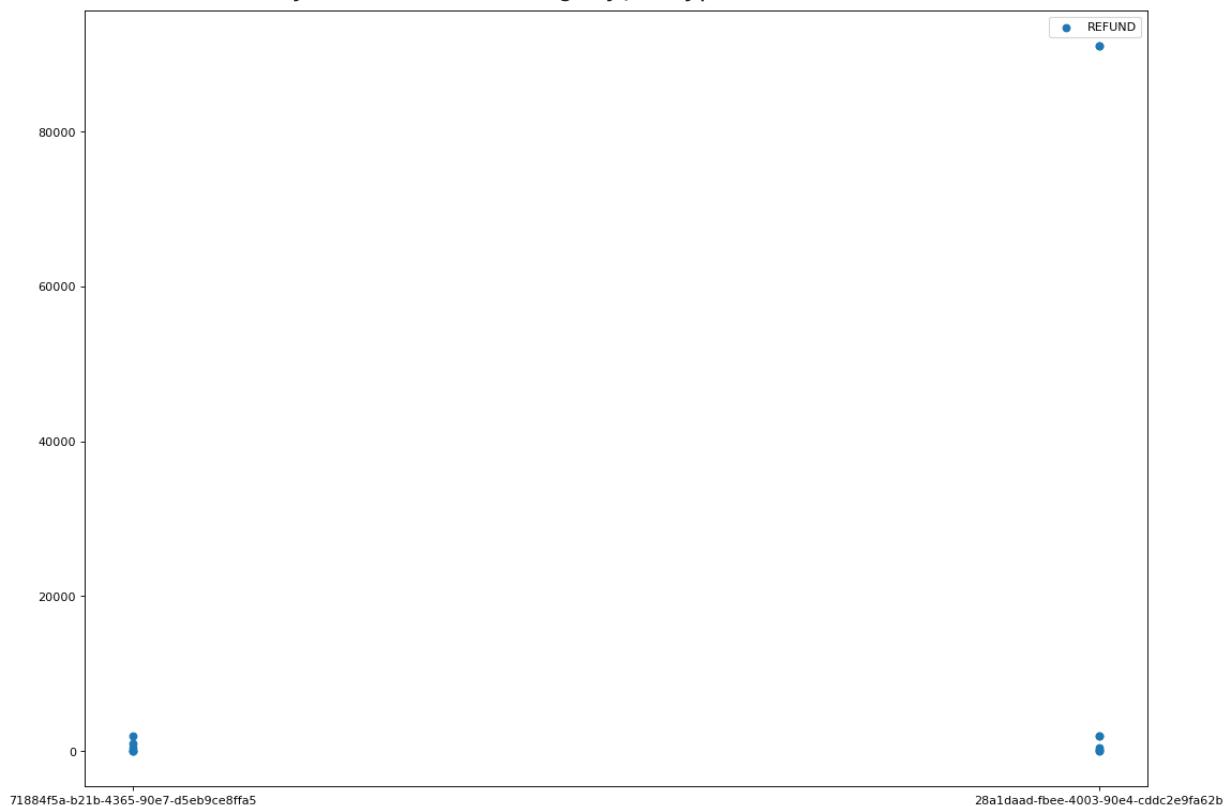
Name: externalParty.transactionCategory, dtype: int64





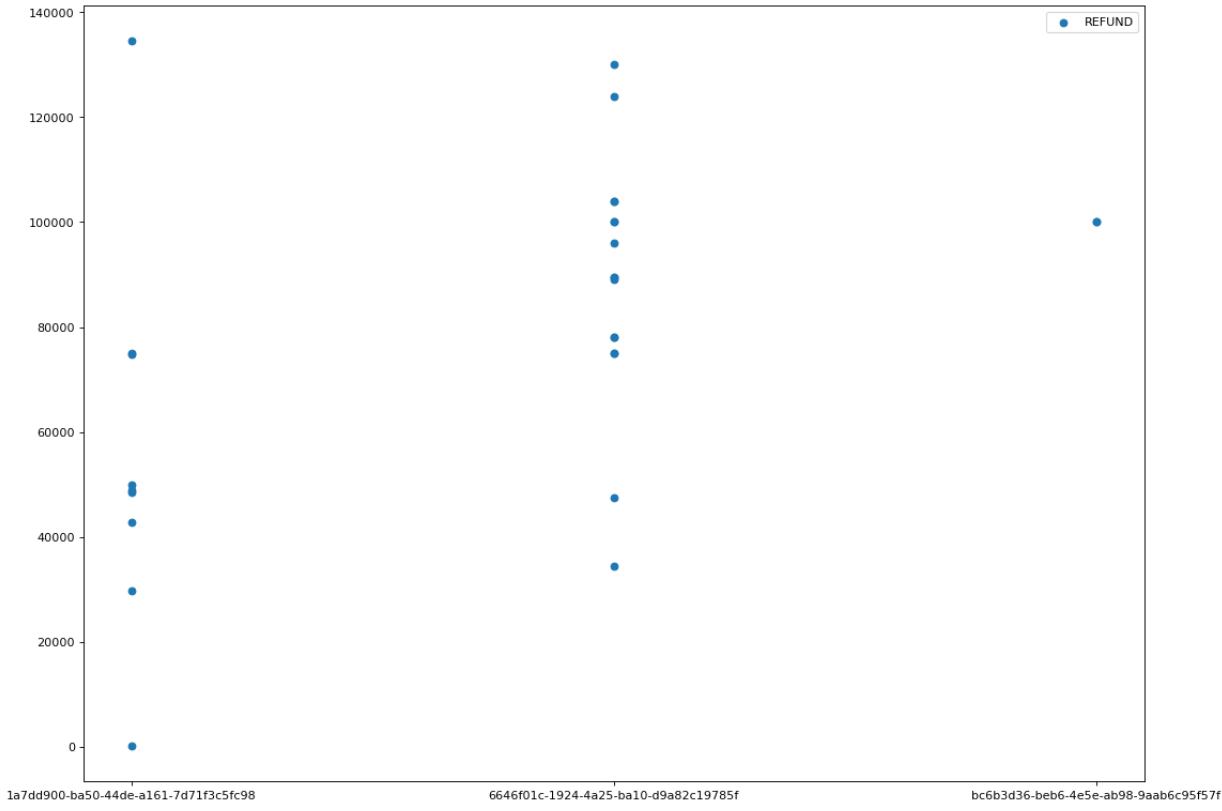
OTHER 57

Name: externalParty.transactionCategory, dtype: int64



OTHER 14

Name: externalParty.transactionCategory, dtype: int64



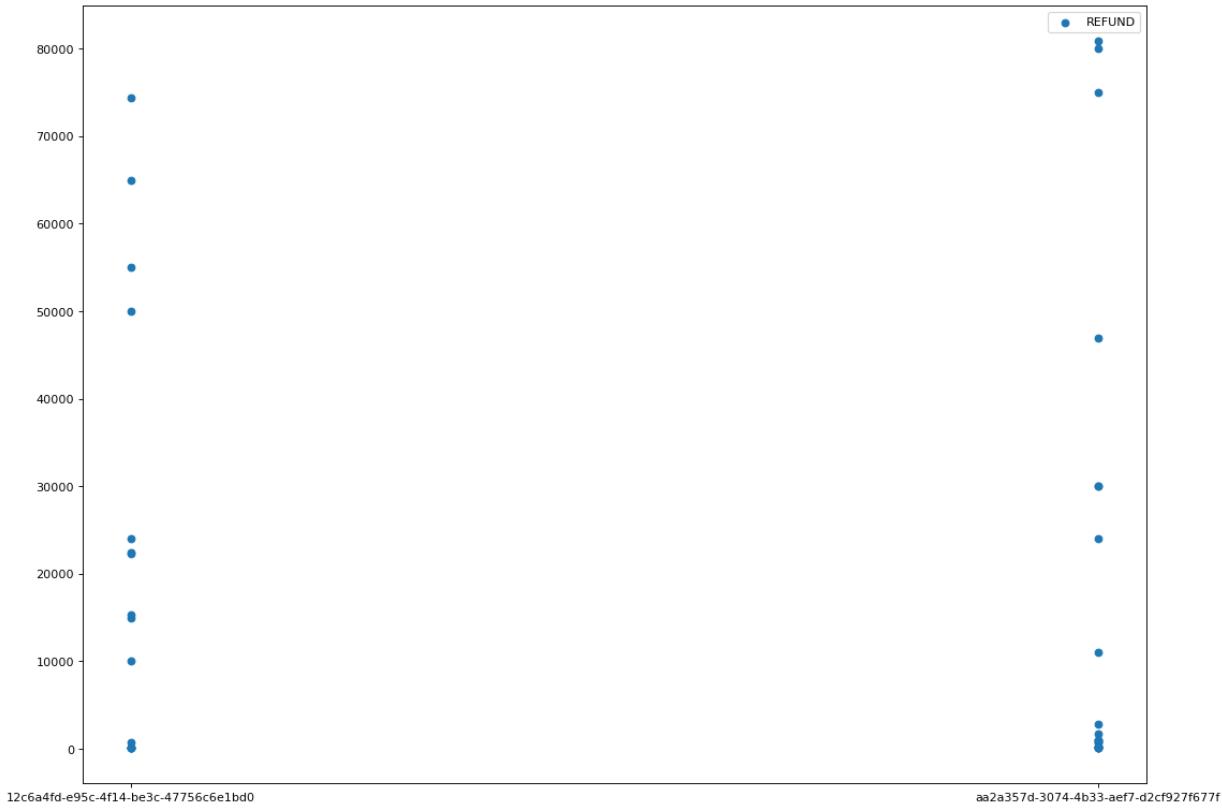
OTHER 27

Name: externalParty.transactionCategory, dtype: int64

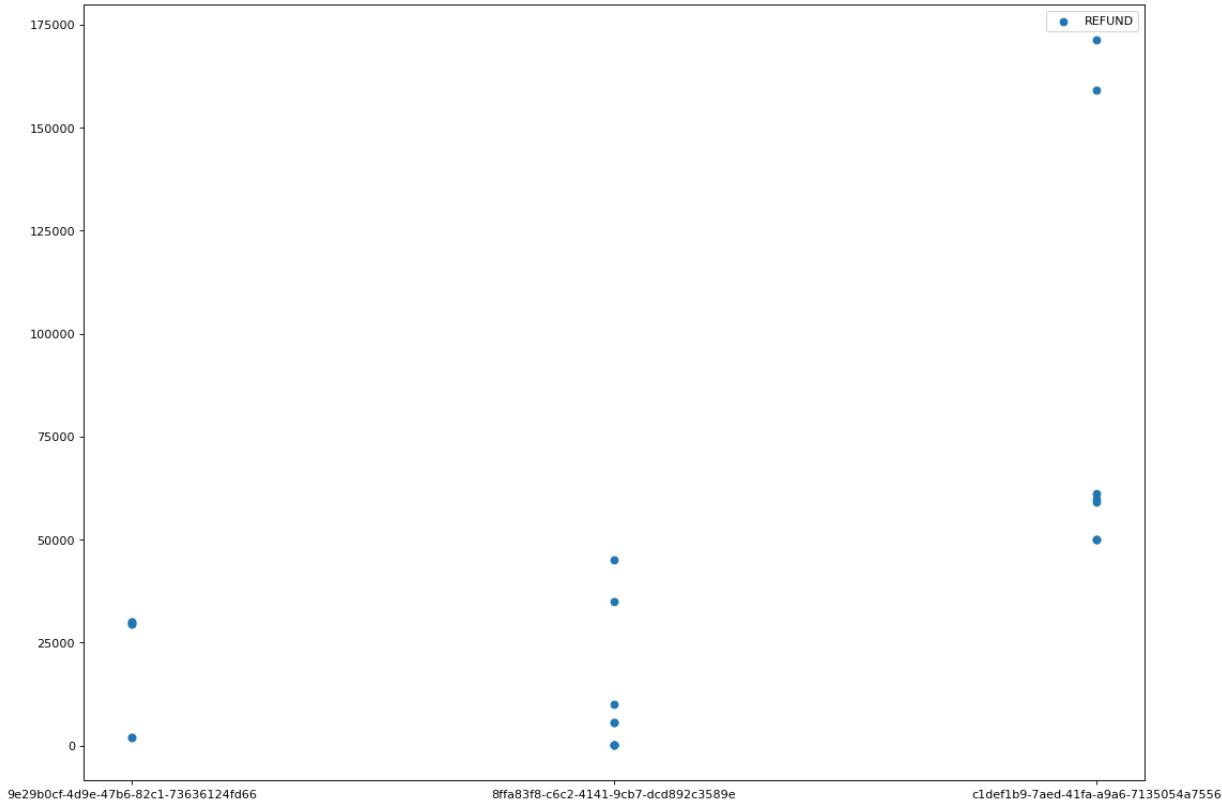


OTHER 88

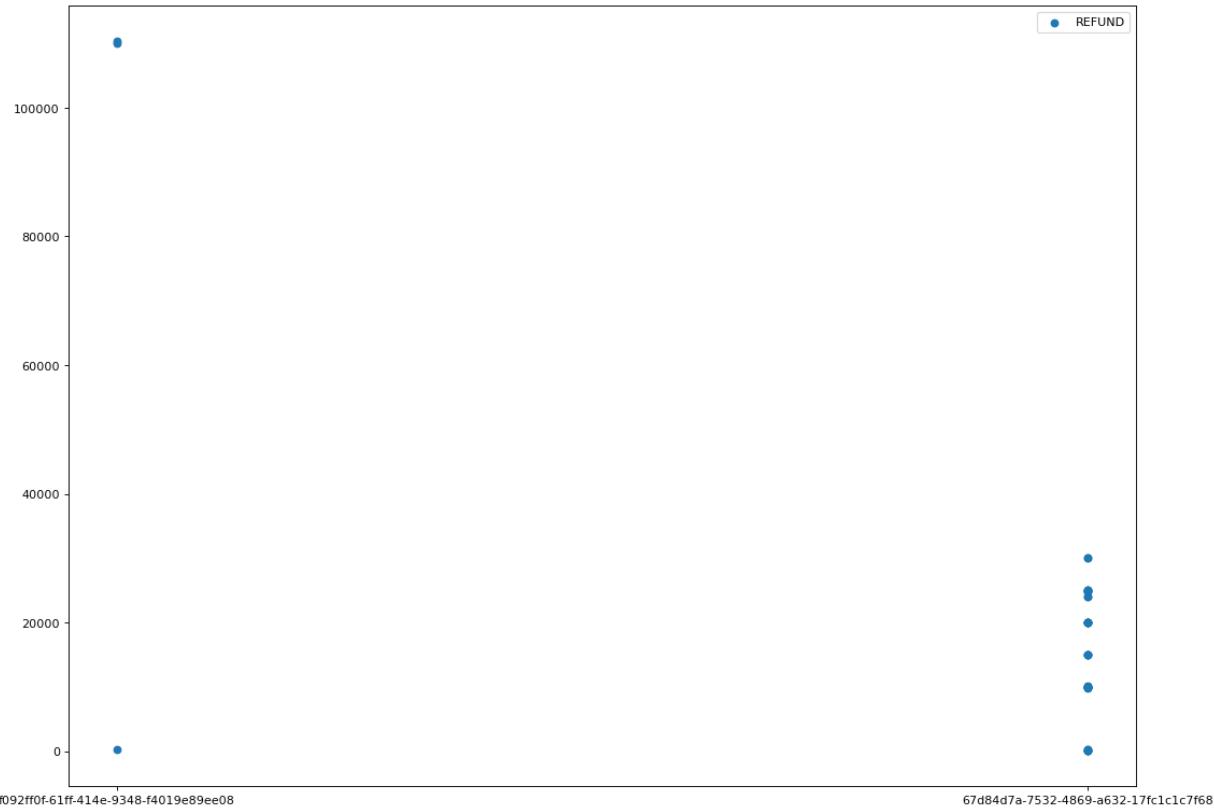
Name: externalParty.transactionCategory, dtype: int64



OTHER 38
Name: externalParty.transactionCategory, dtype: int64

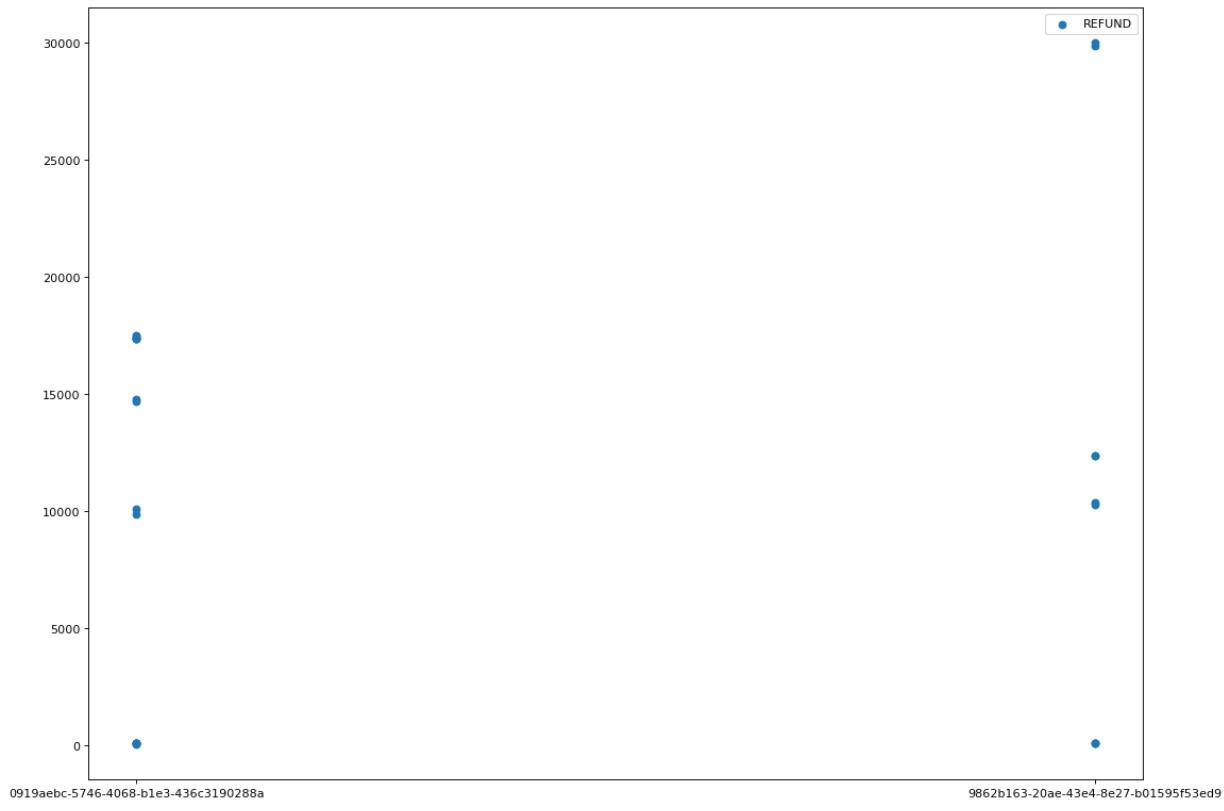


OTHER 23
Name: externalParty.transactionCategory, dtype: int64



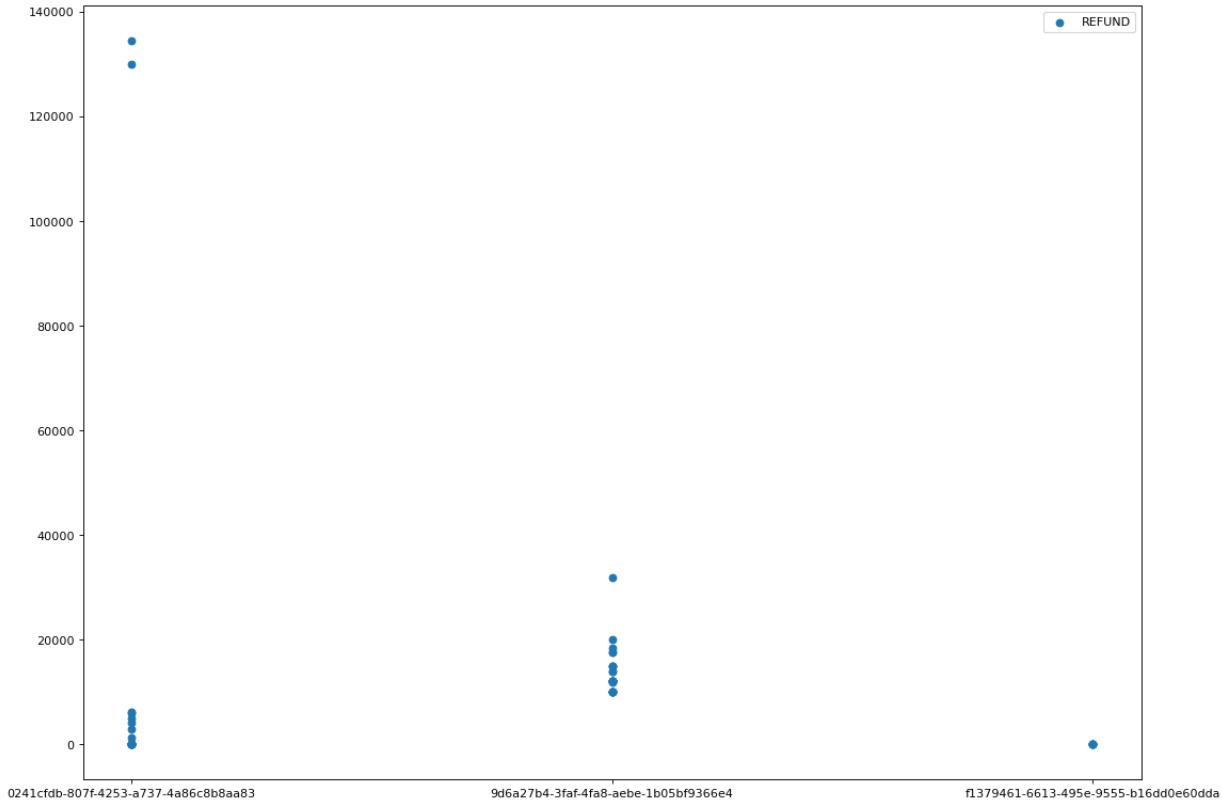
OTHER 43

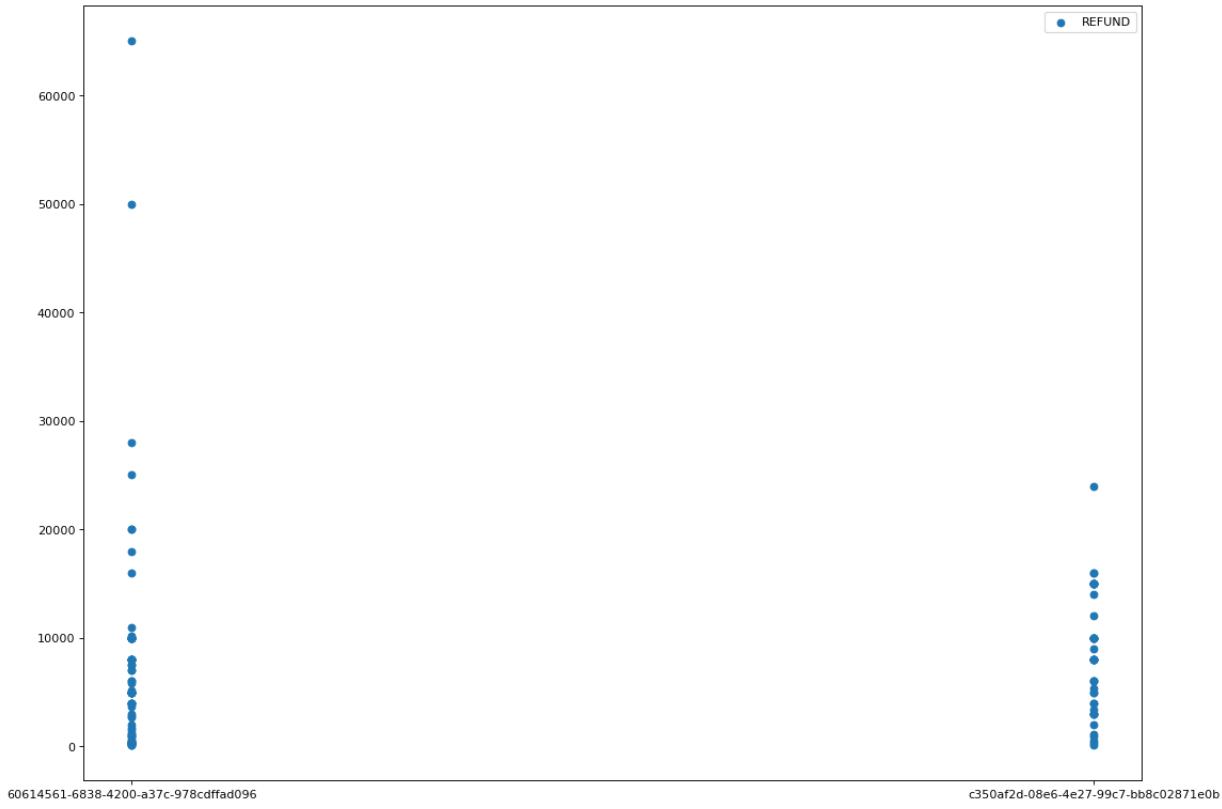
Name: externalParty.transactionCategory, dtype: int64



OTHER 25

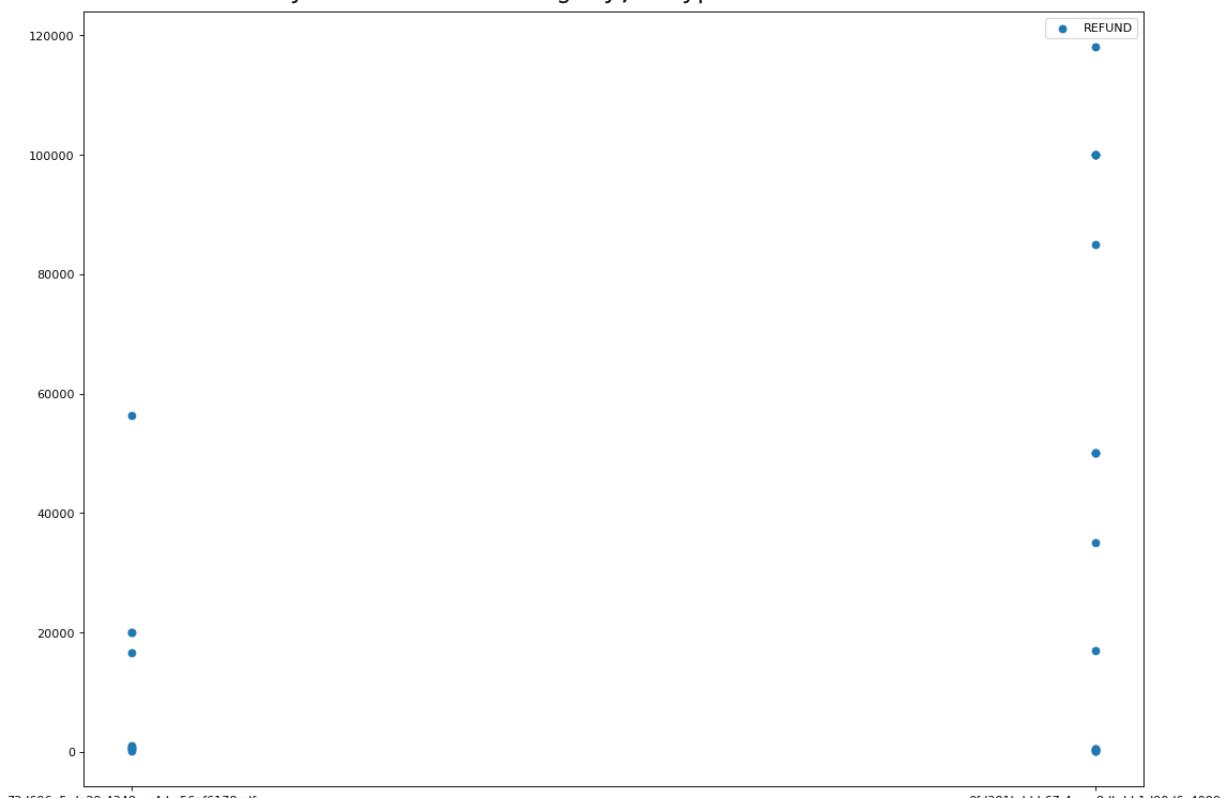
Name: externalParty.transactionCategory, dtype: int64





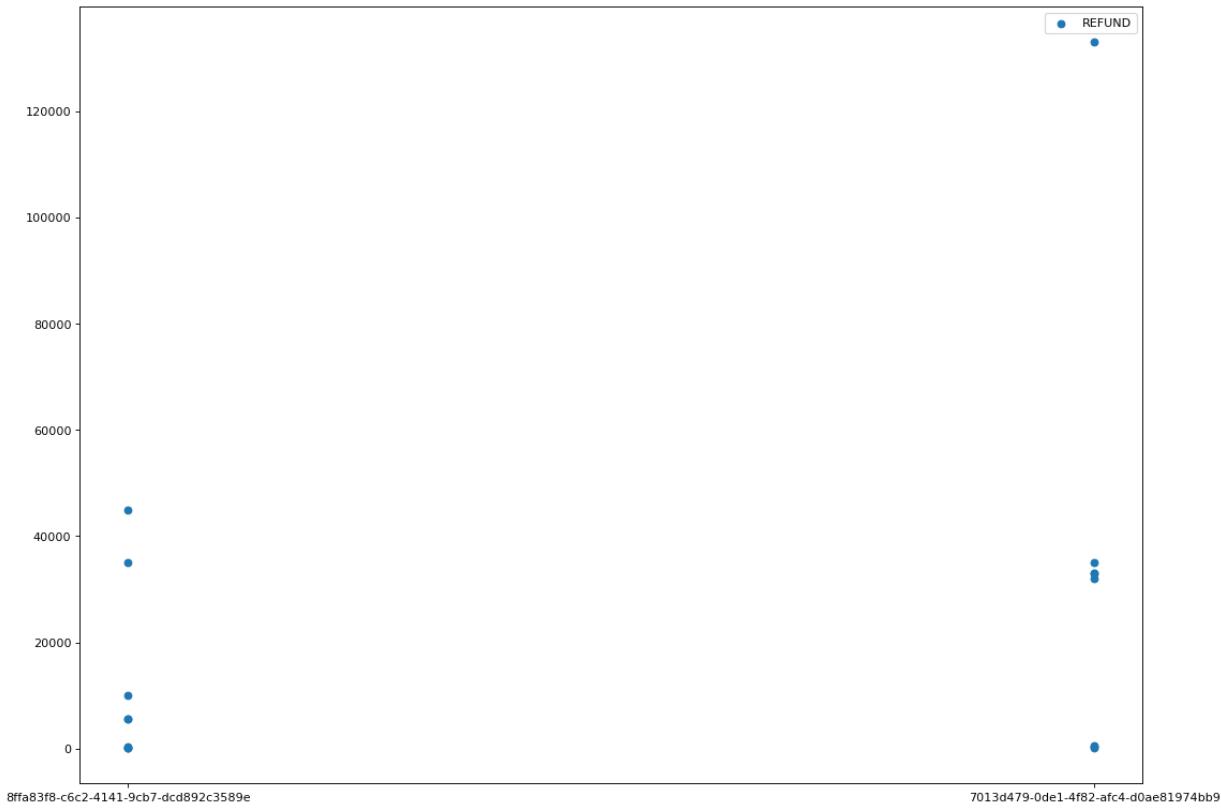
OTHER	96
GROCERIES	8
TRAVEL	8
LIFESTYLE	6
SHOPPING	4

Name: externalParty.transactionCategory, dtype: int64



OTHER	27
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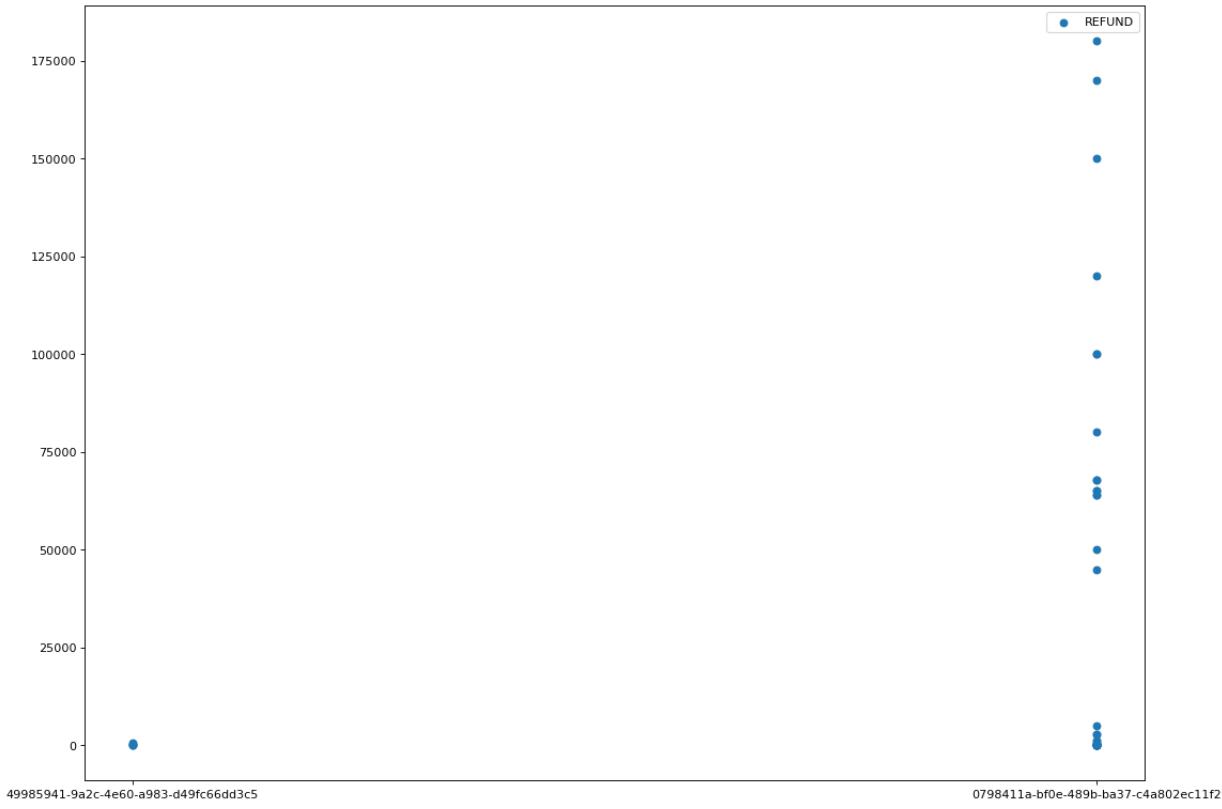
Name: externalParty.transactionCategory, dtype: int64



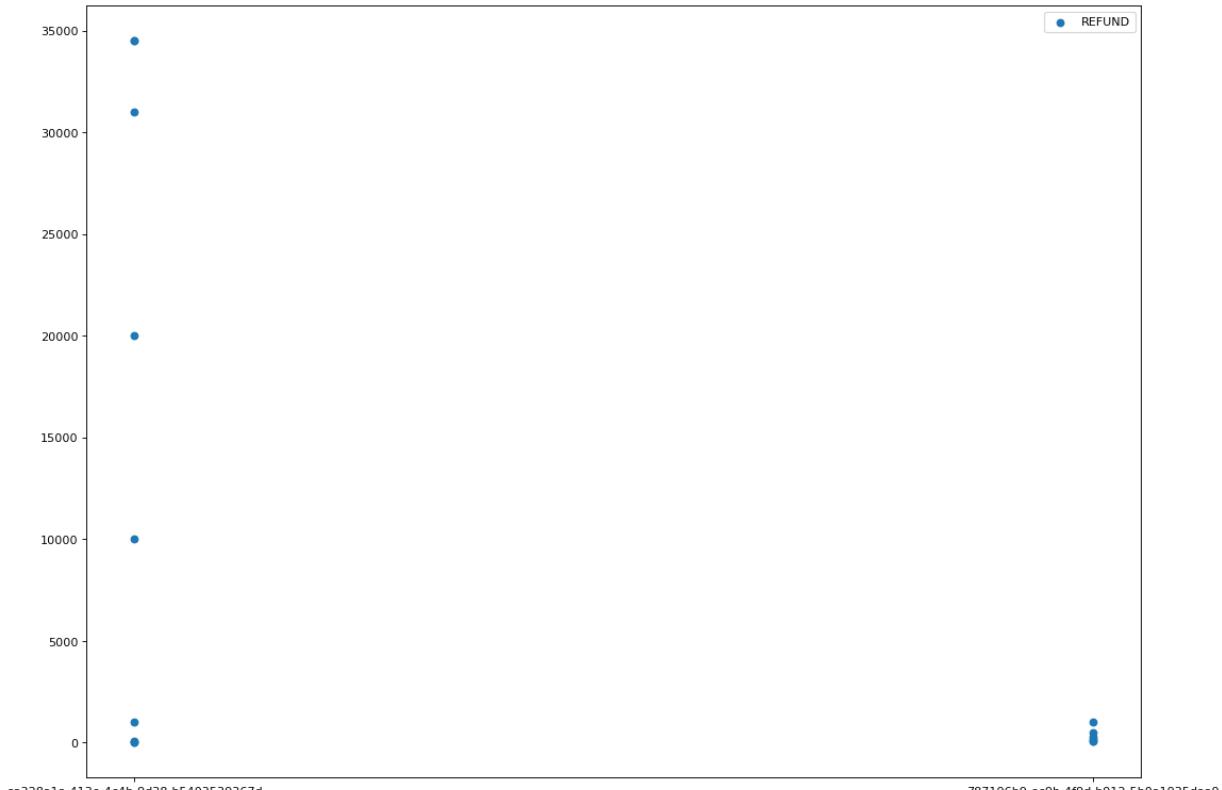
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OTHER    17  
Name: externalParty.transactionCategory, dtype: int64
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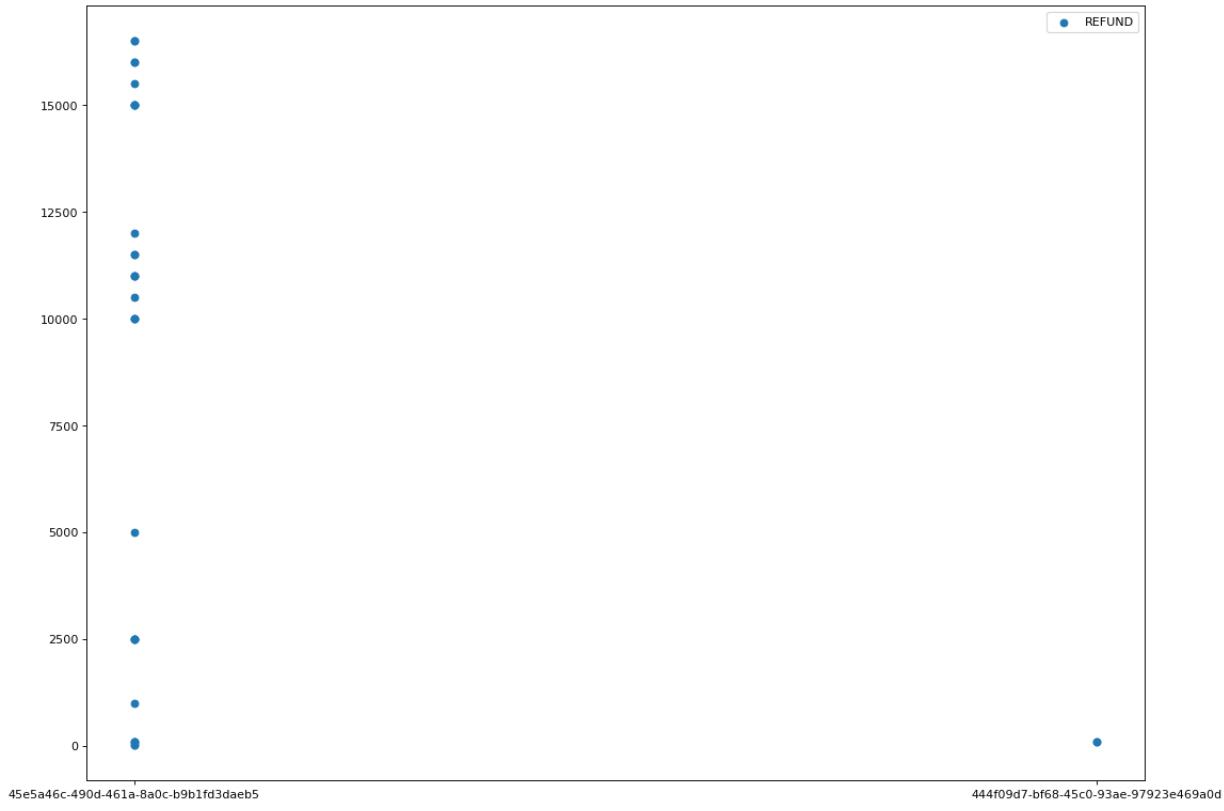
OTHER 21
Name: externalParty.transactionCategory, dtype: int64



OTHER 53
Name: externalParty.transactionCategory, dtype: int64

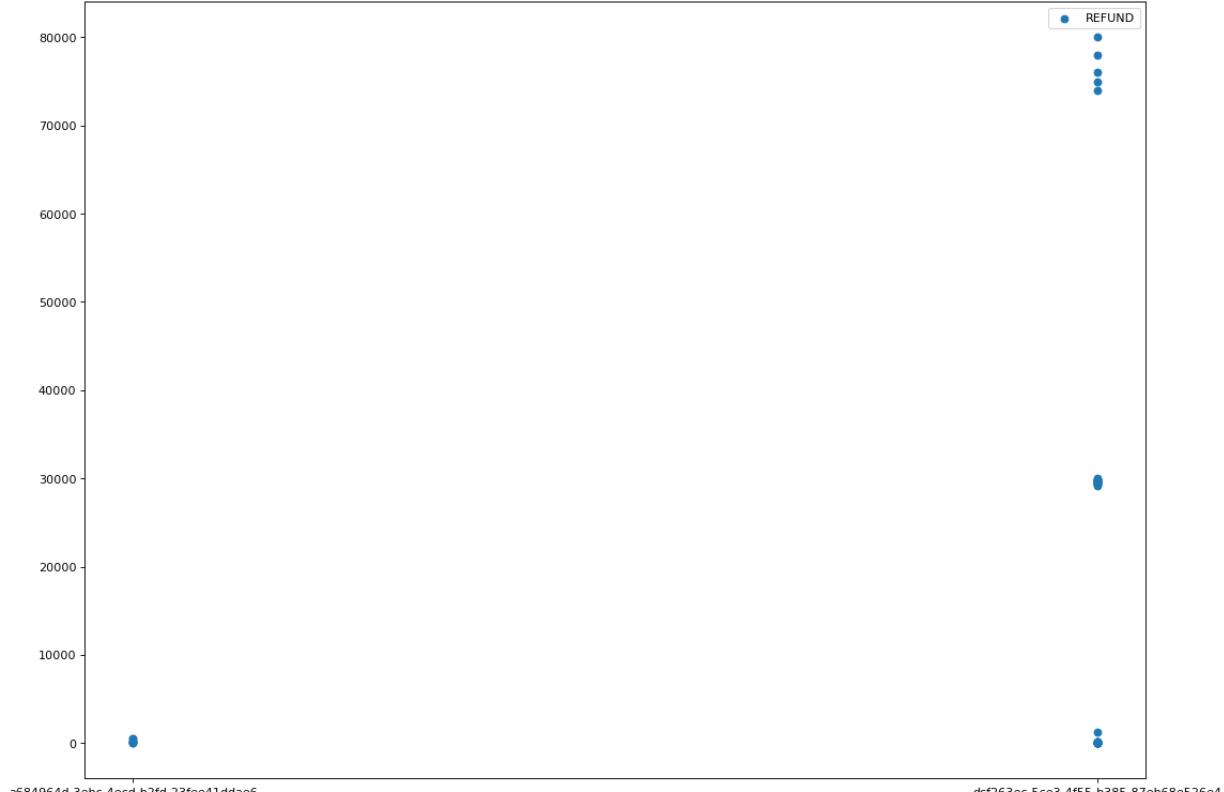


OTHER 15
Name: externalParty.transactionCategory, dtype: int64



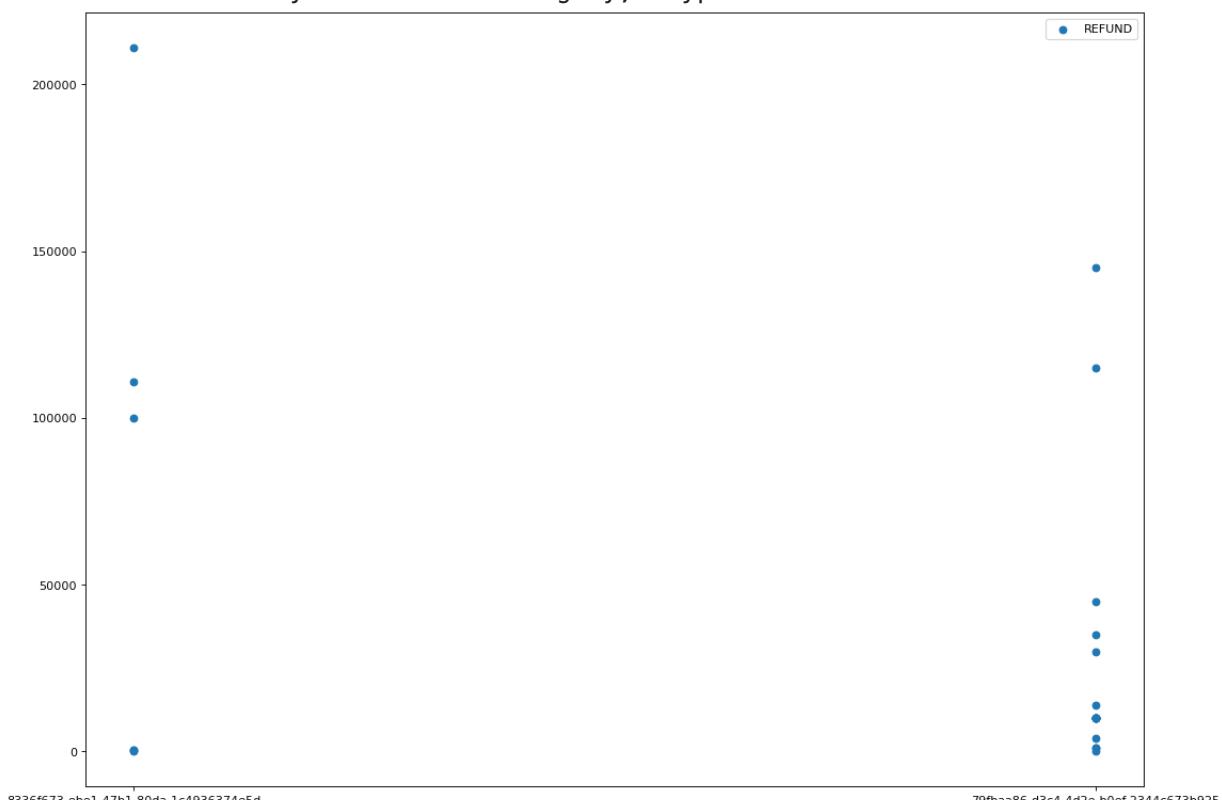
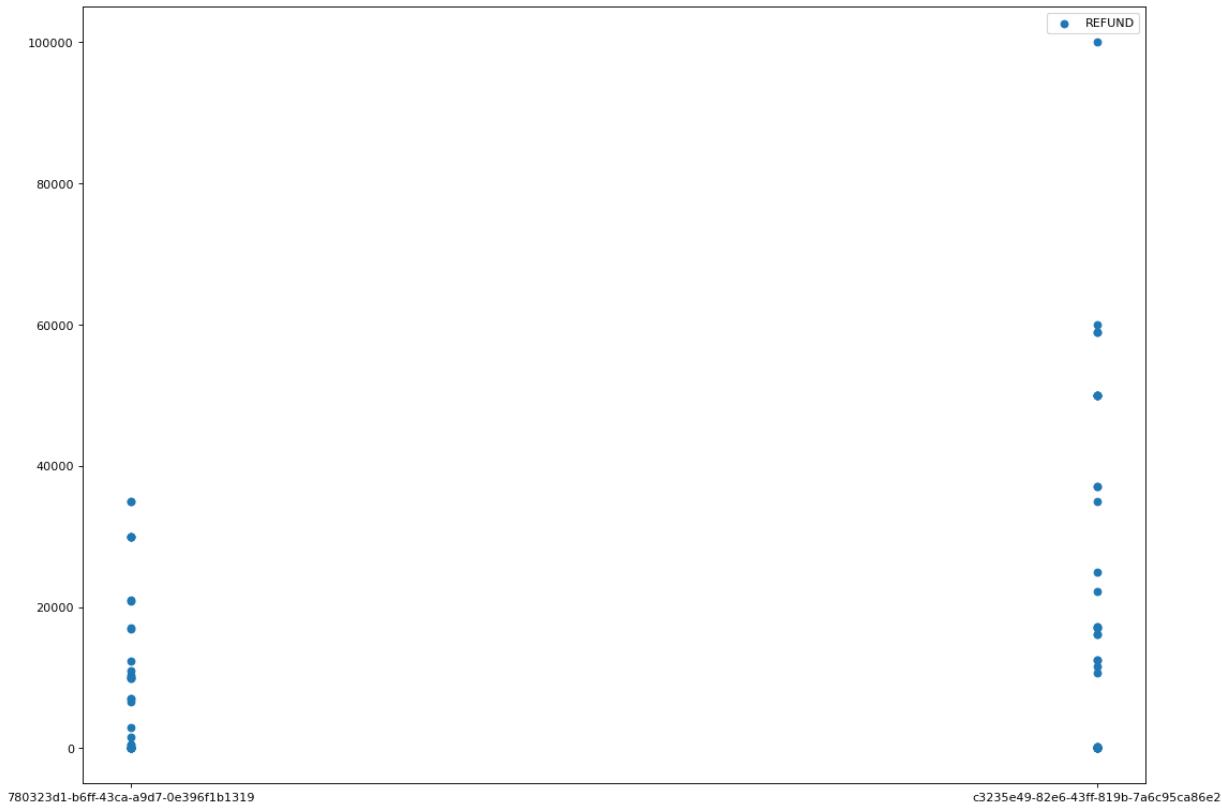
OTHER 32

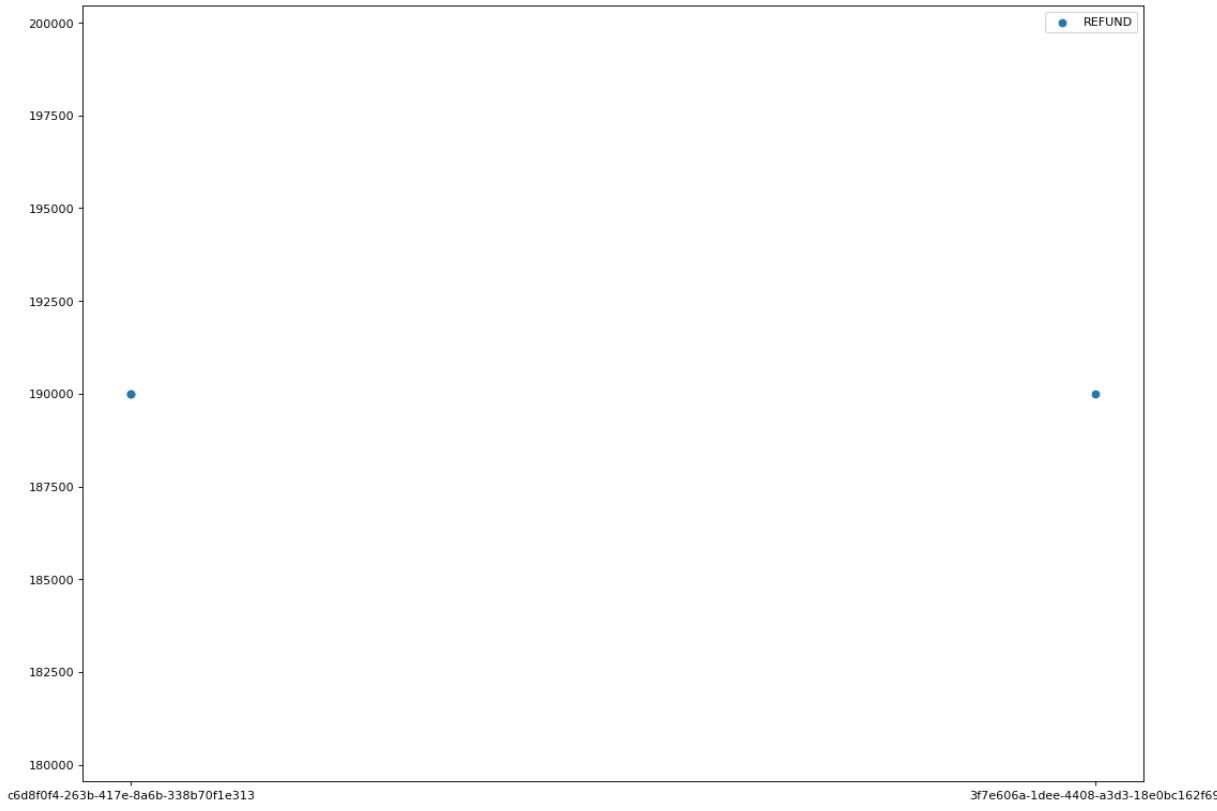
Name: externalParty.transactionCategory, dtype: int64



OTHER 49

Name: externalParty.transactionCategory, dtype: int64





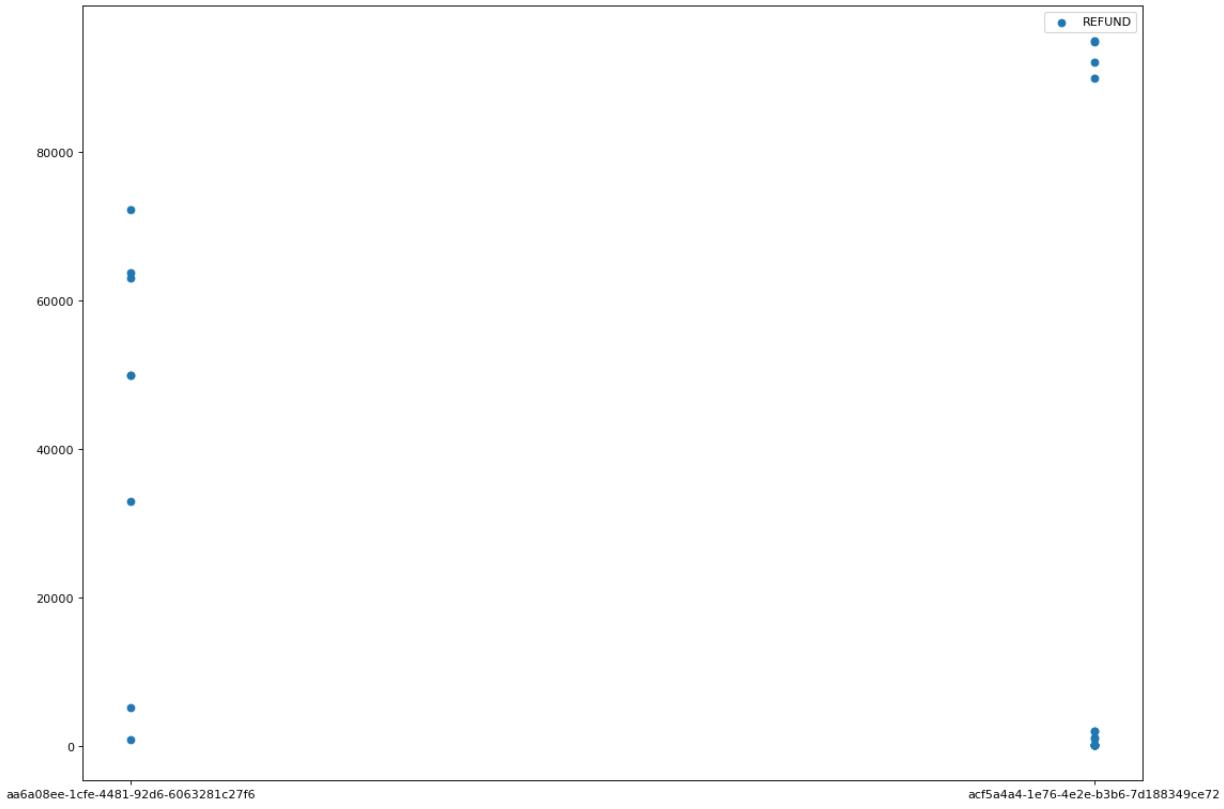
OTHER 3

Name: externalParty.transactionCategory, dtype: int64



OTHER 72

Name: externalParty.transactionCategory, dtype: int64



OTHER 25

Name: externalParty.transactionCategory, dtype: int64

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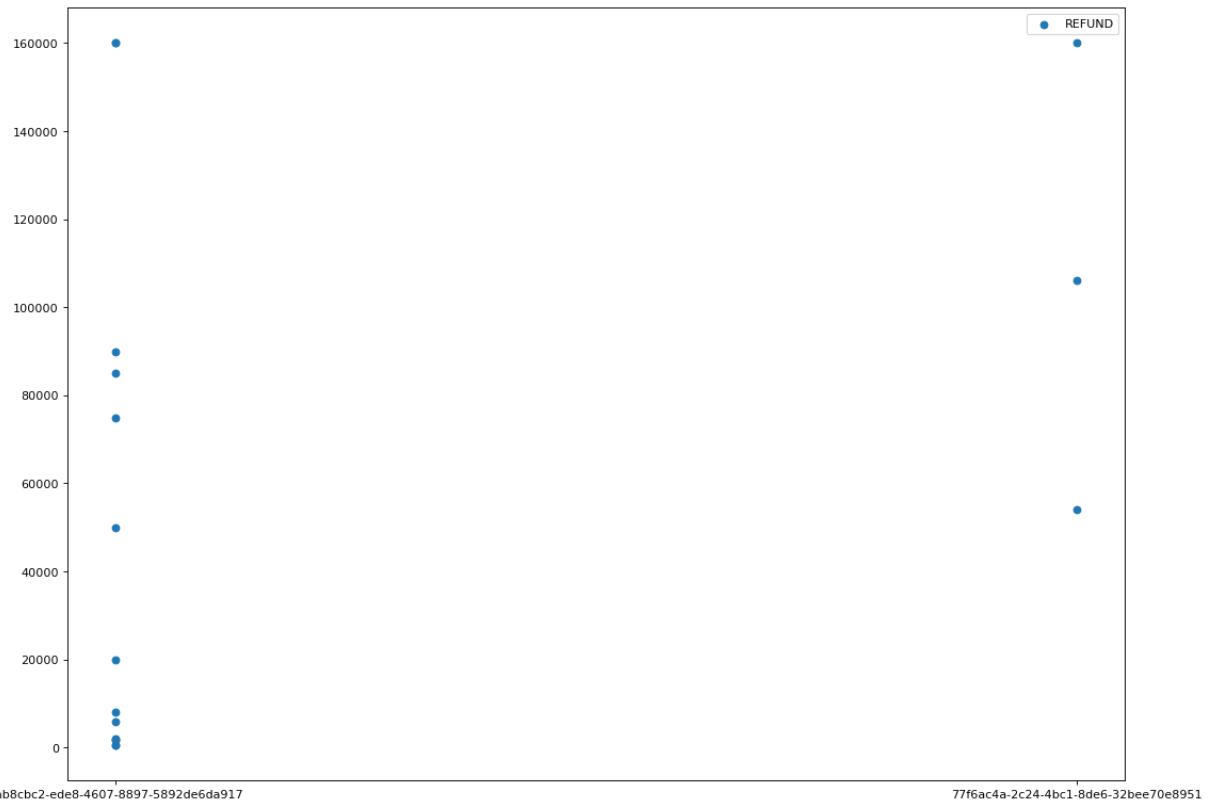
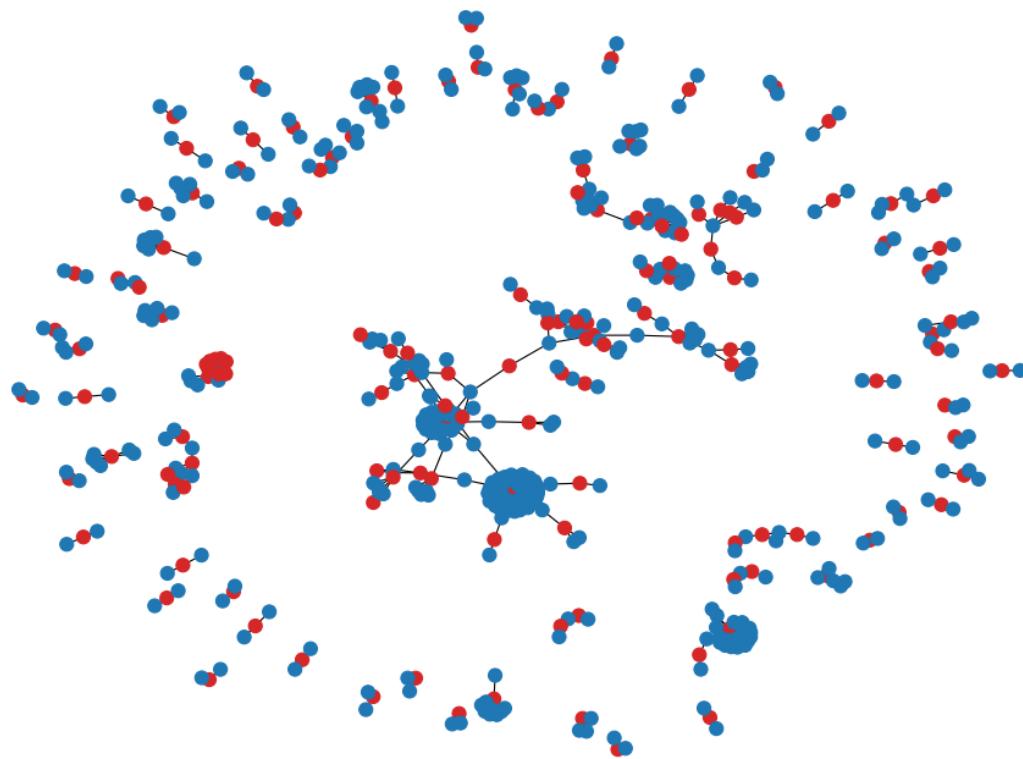
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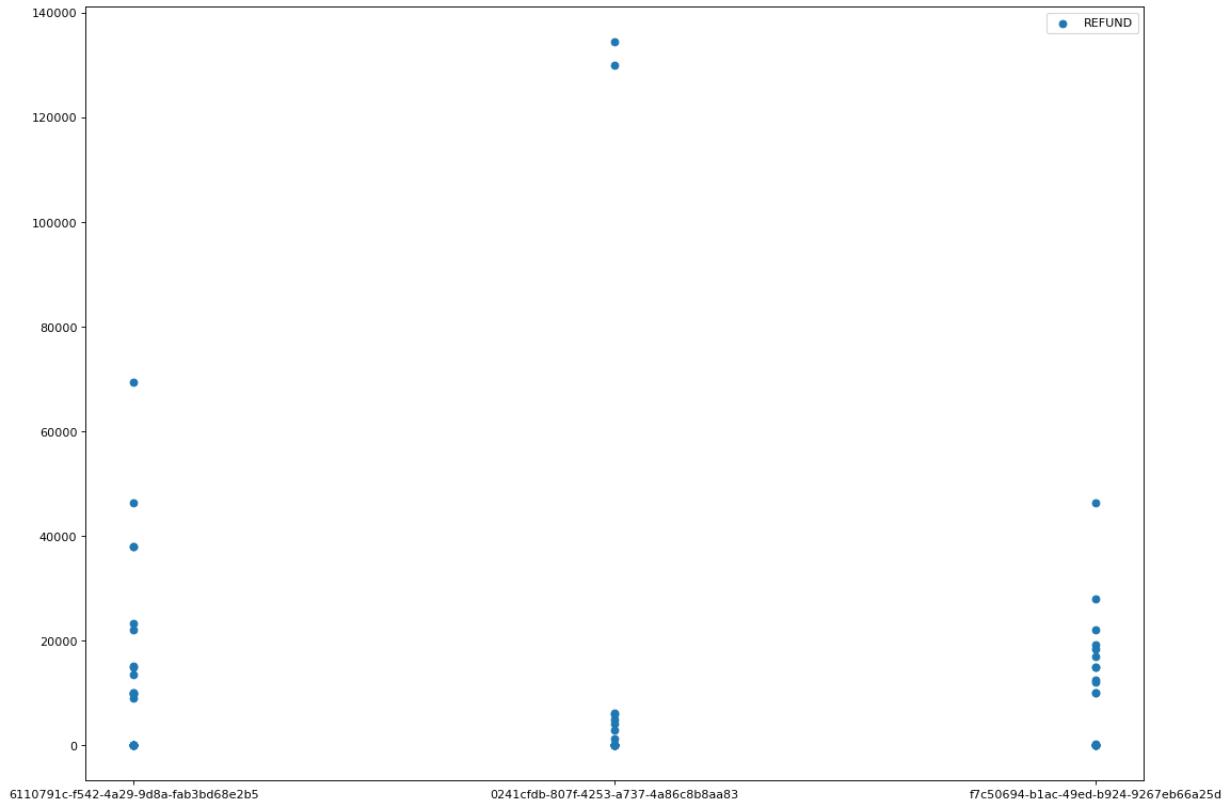
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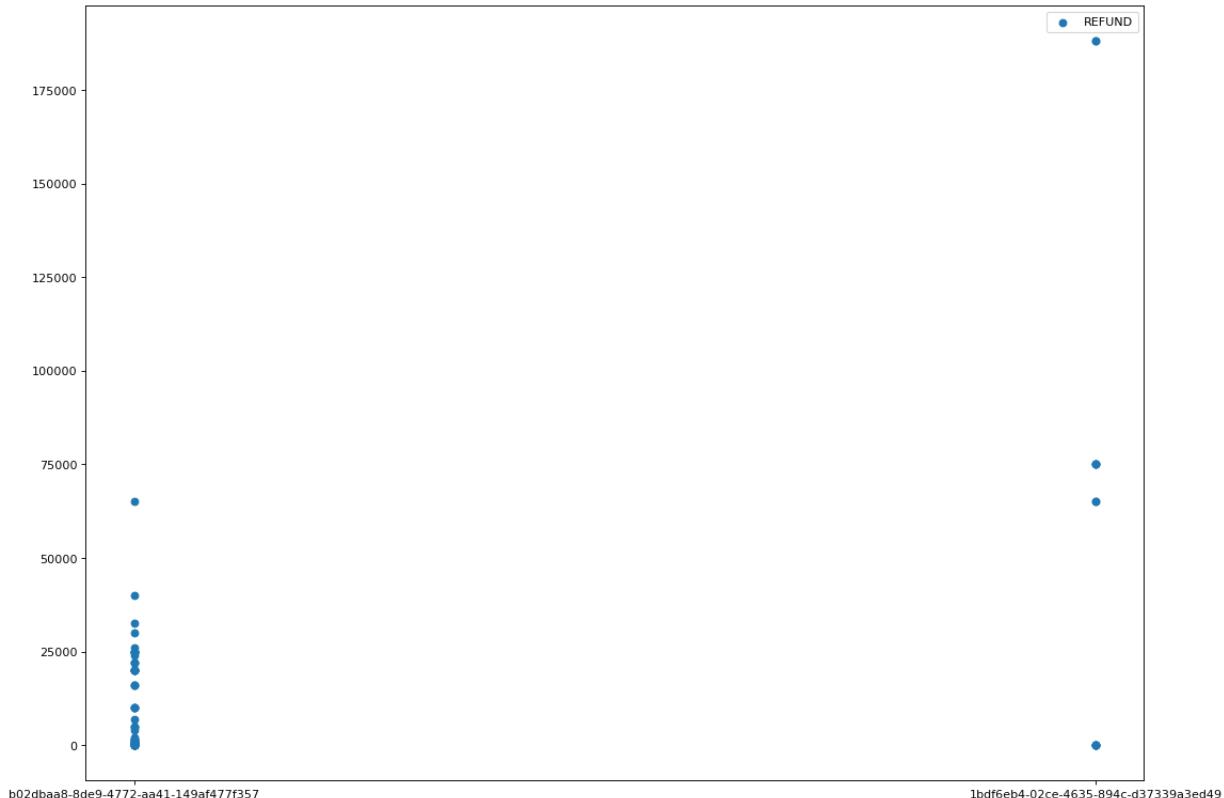
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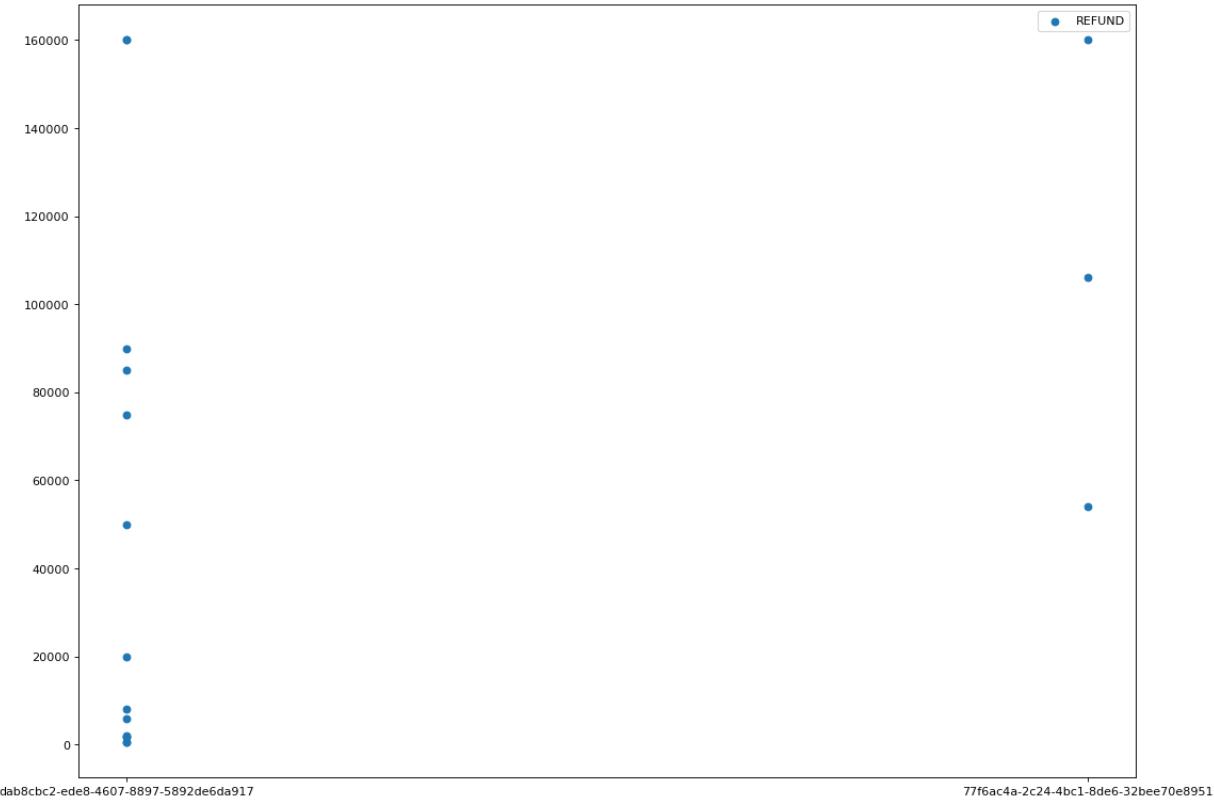


OTHER 66

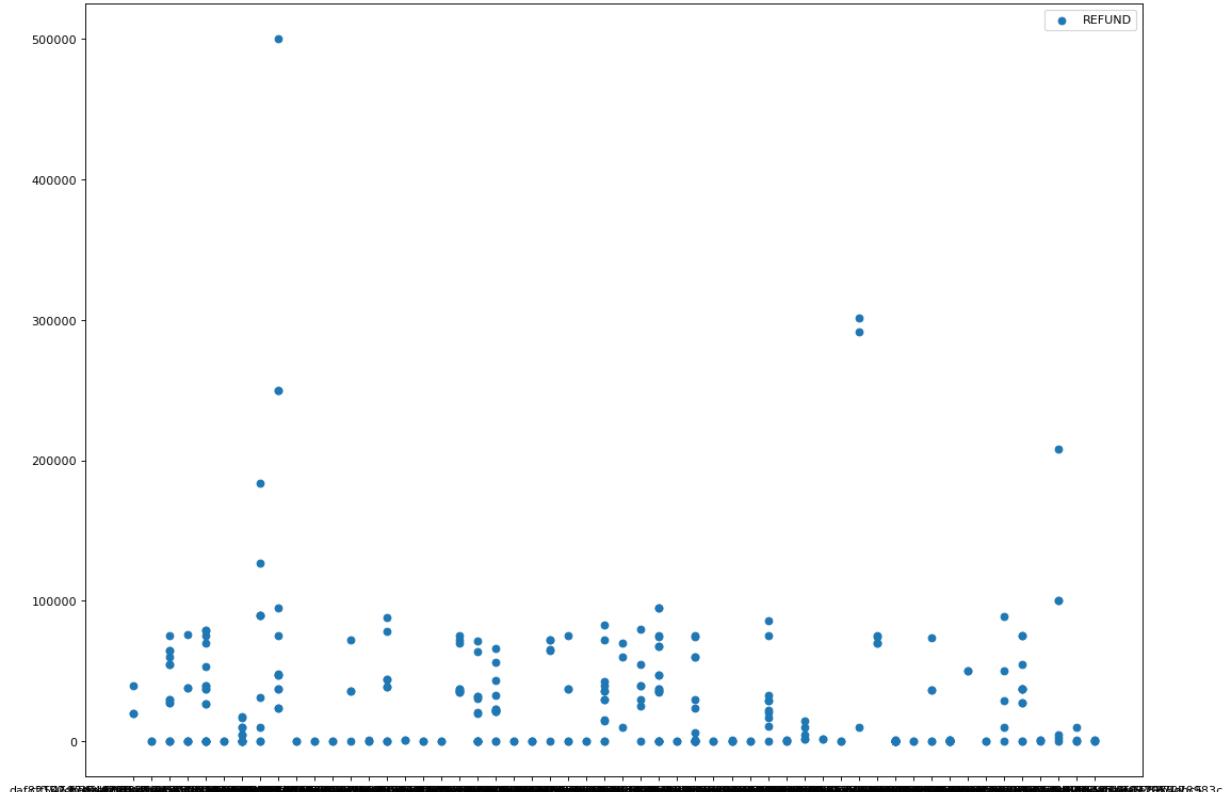
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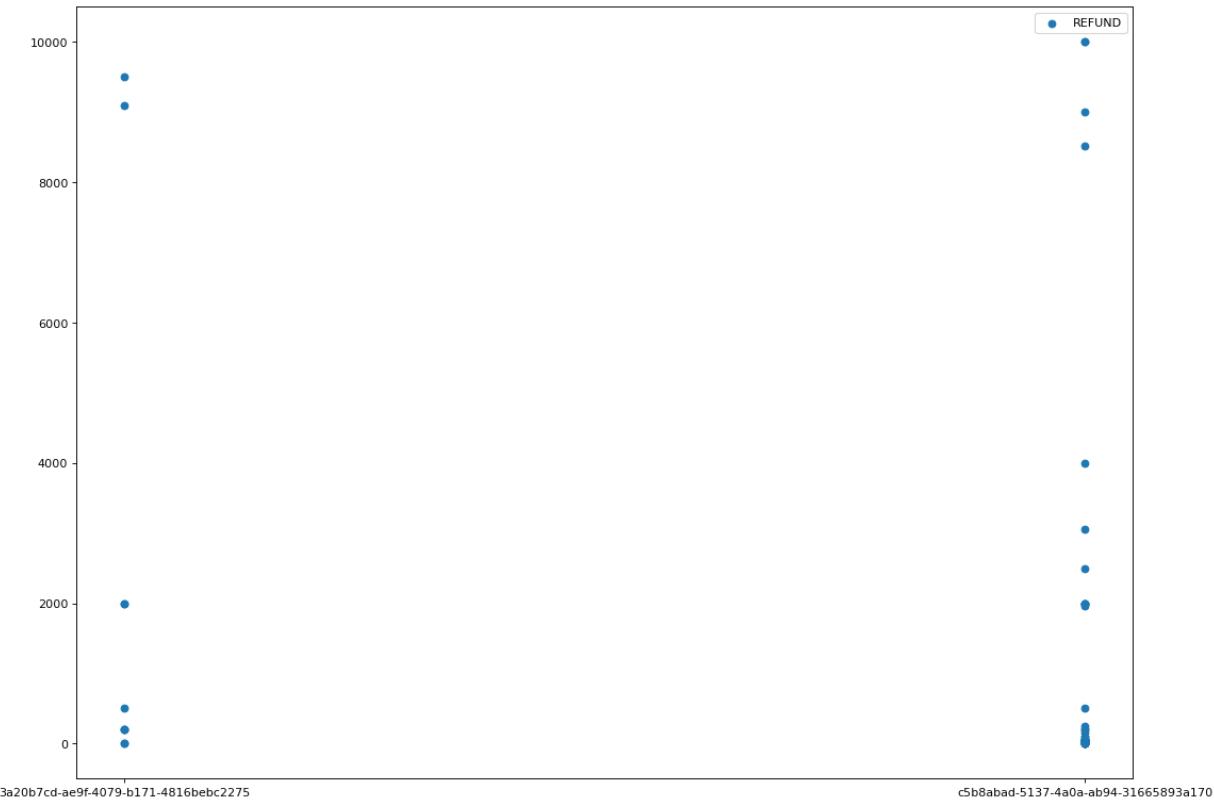
OTHER	77
LIFESTYLE	5
GROCERIES	5
TRAVEL	1



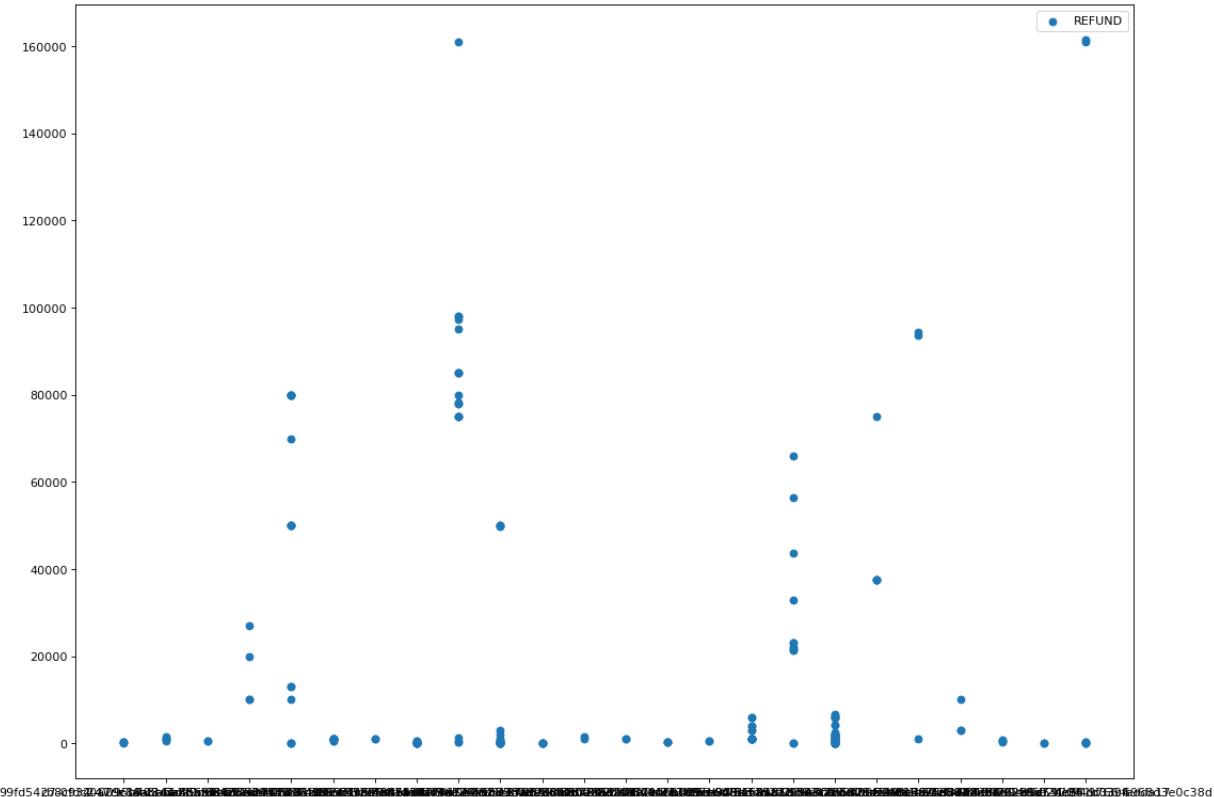
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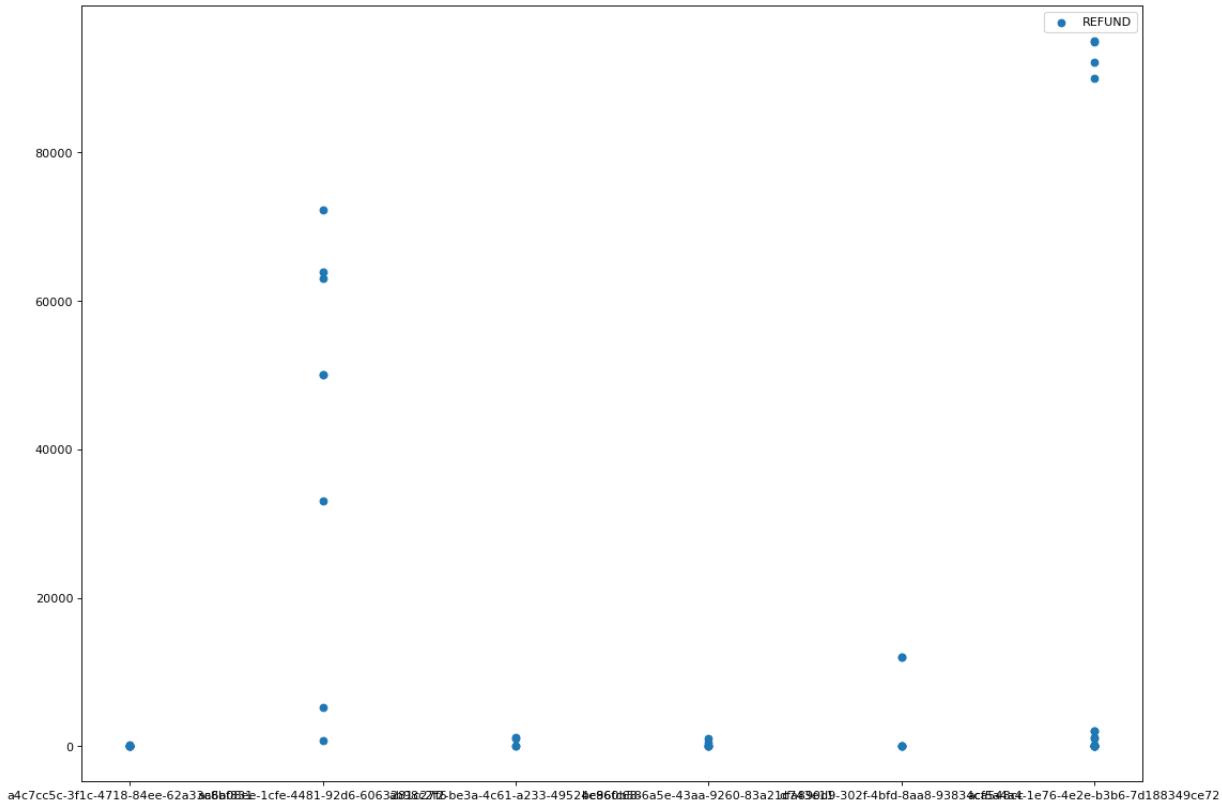
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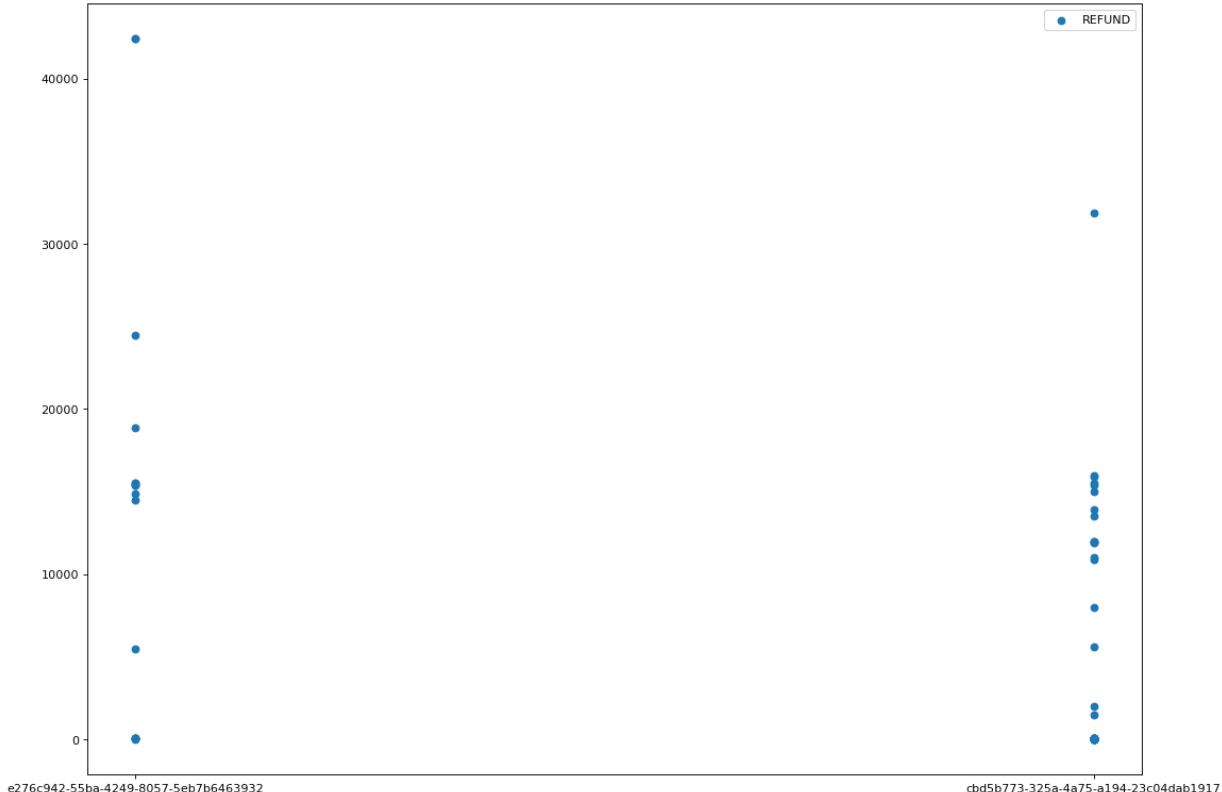
OTHER 49
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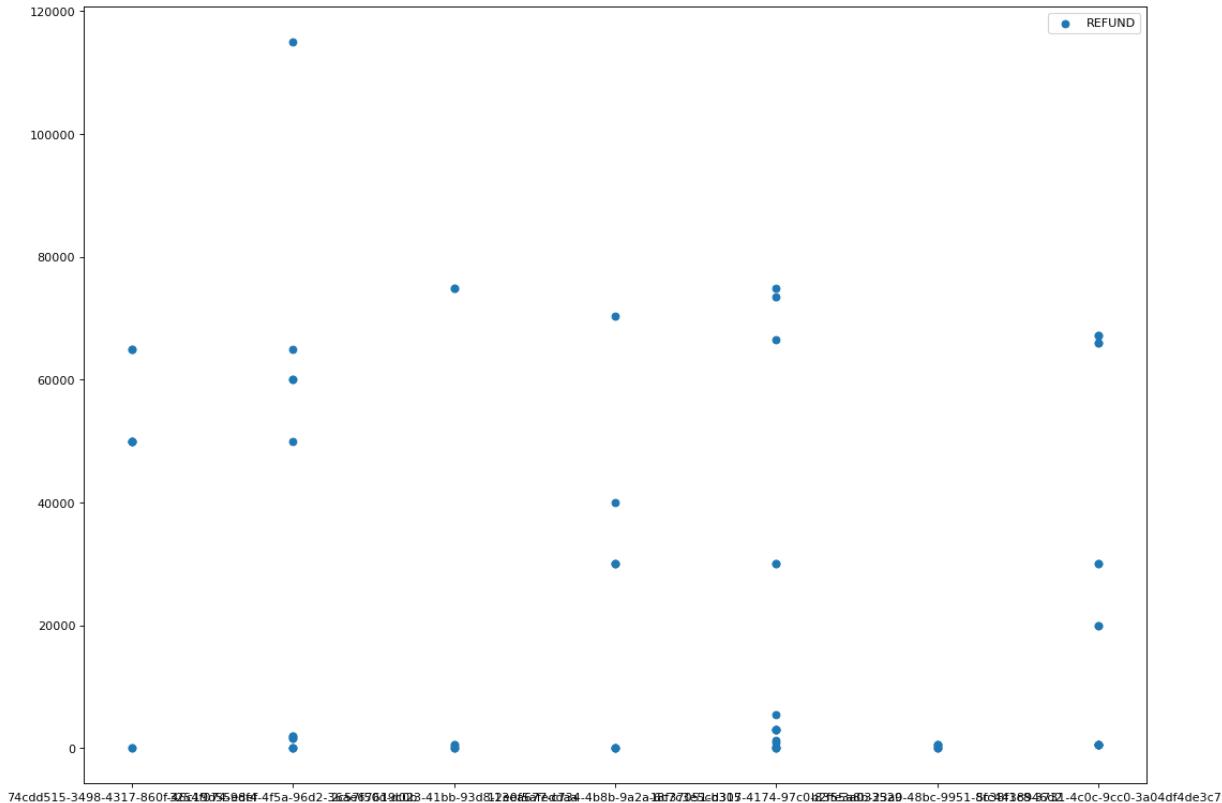
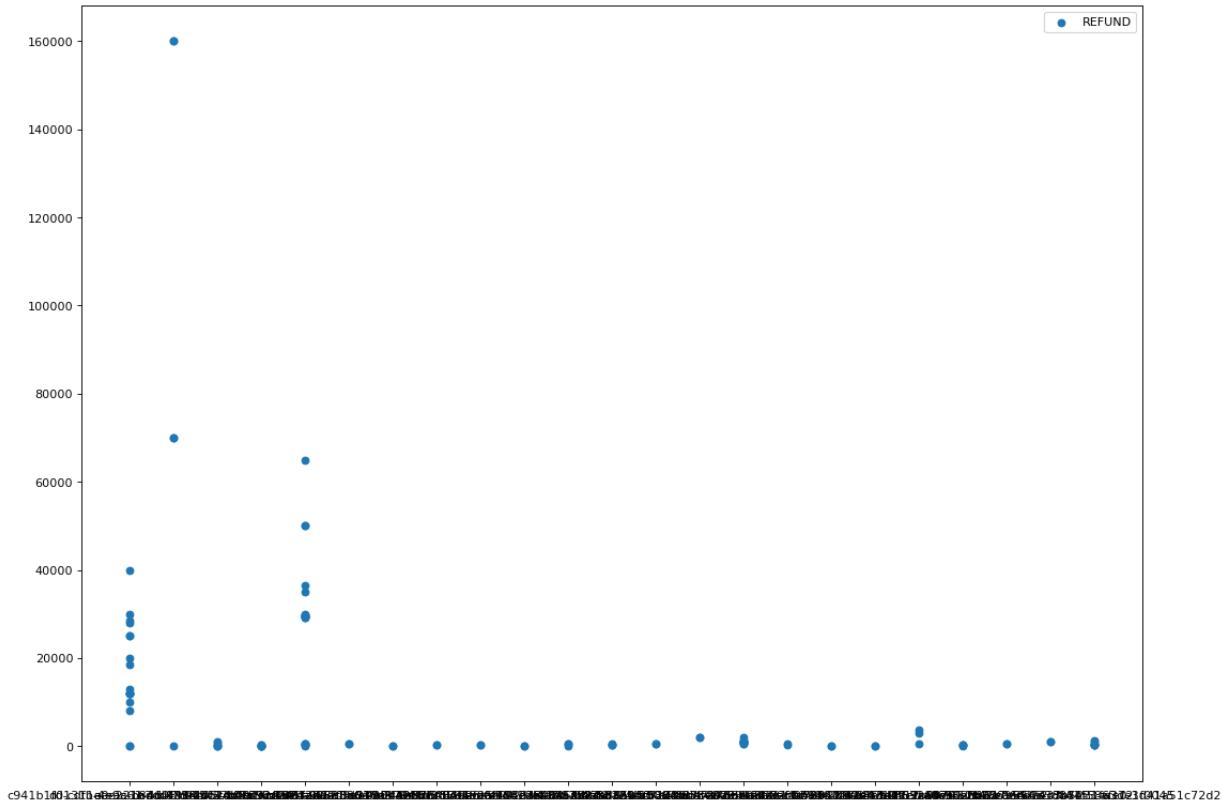
OTHER 197
LIFESTYLE 4
TRAVEL 3
GROCERIES 2
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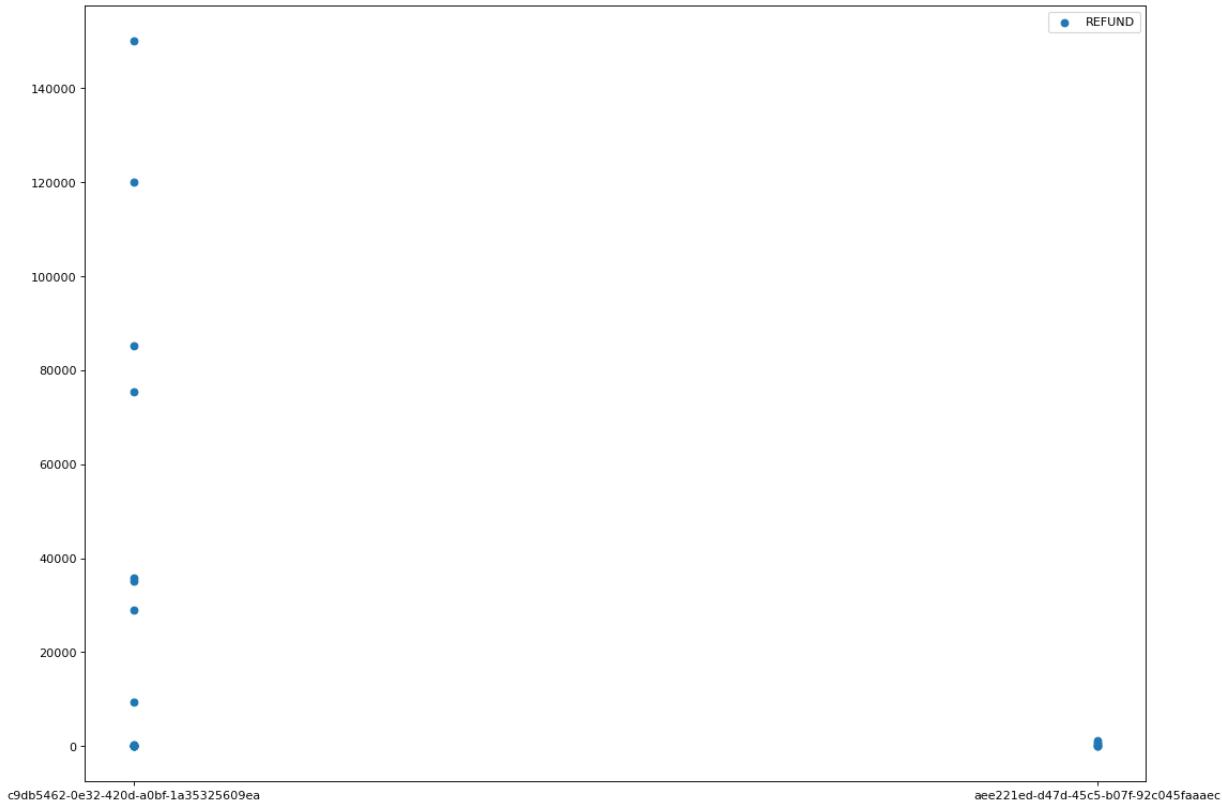


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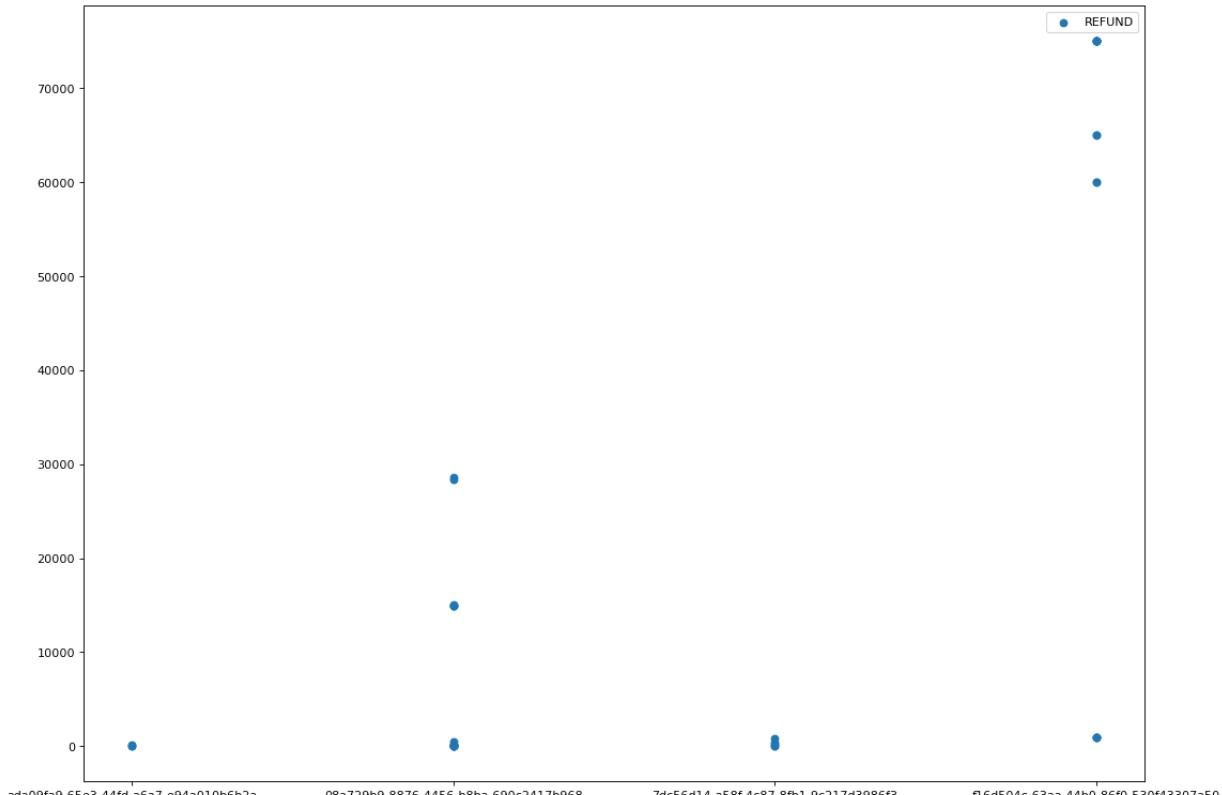
OTHER 60
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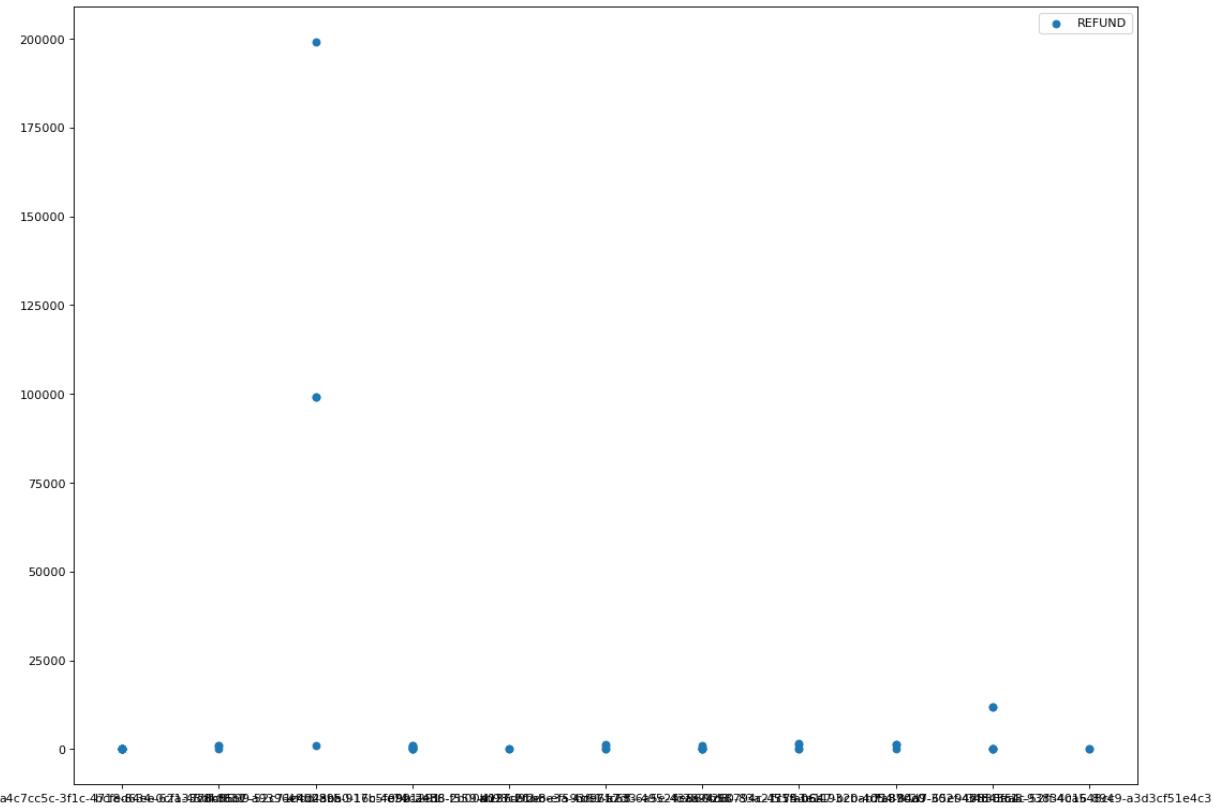
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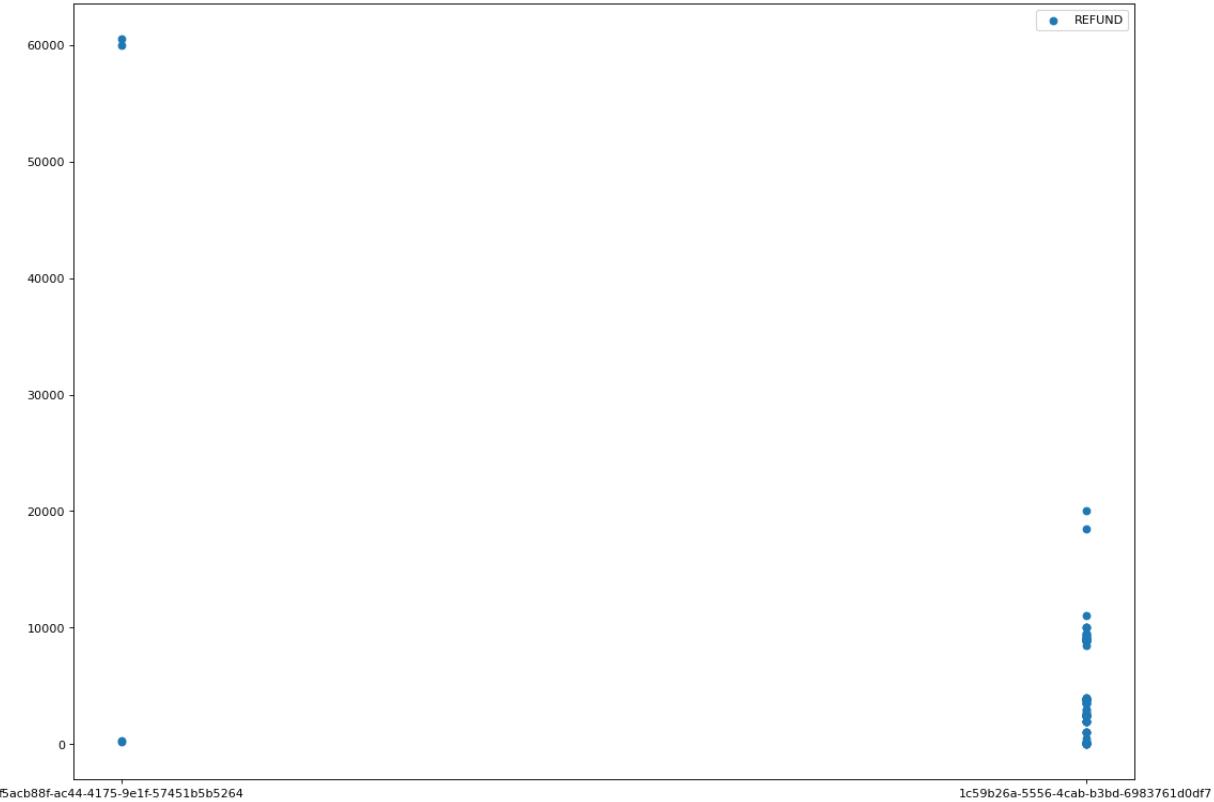


OTHER 37

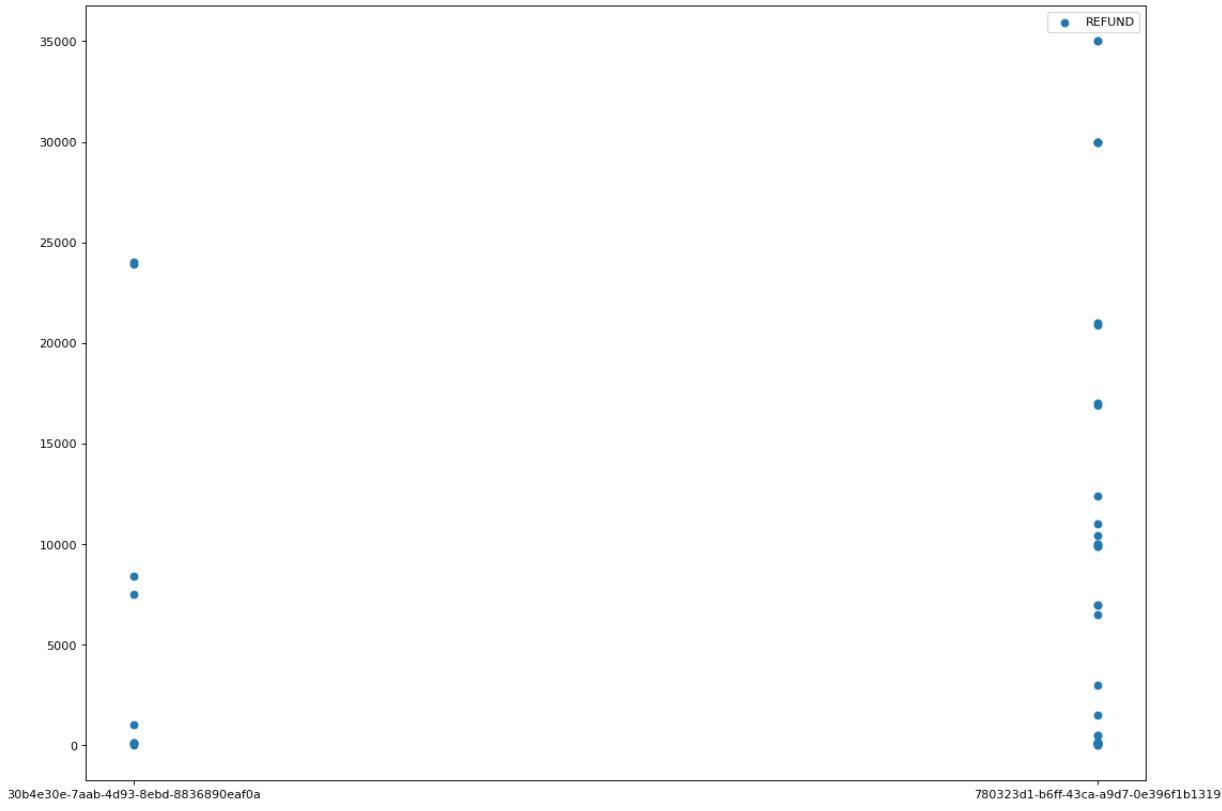
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OTHER 51
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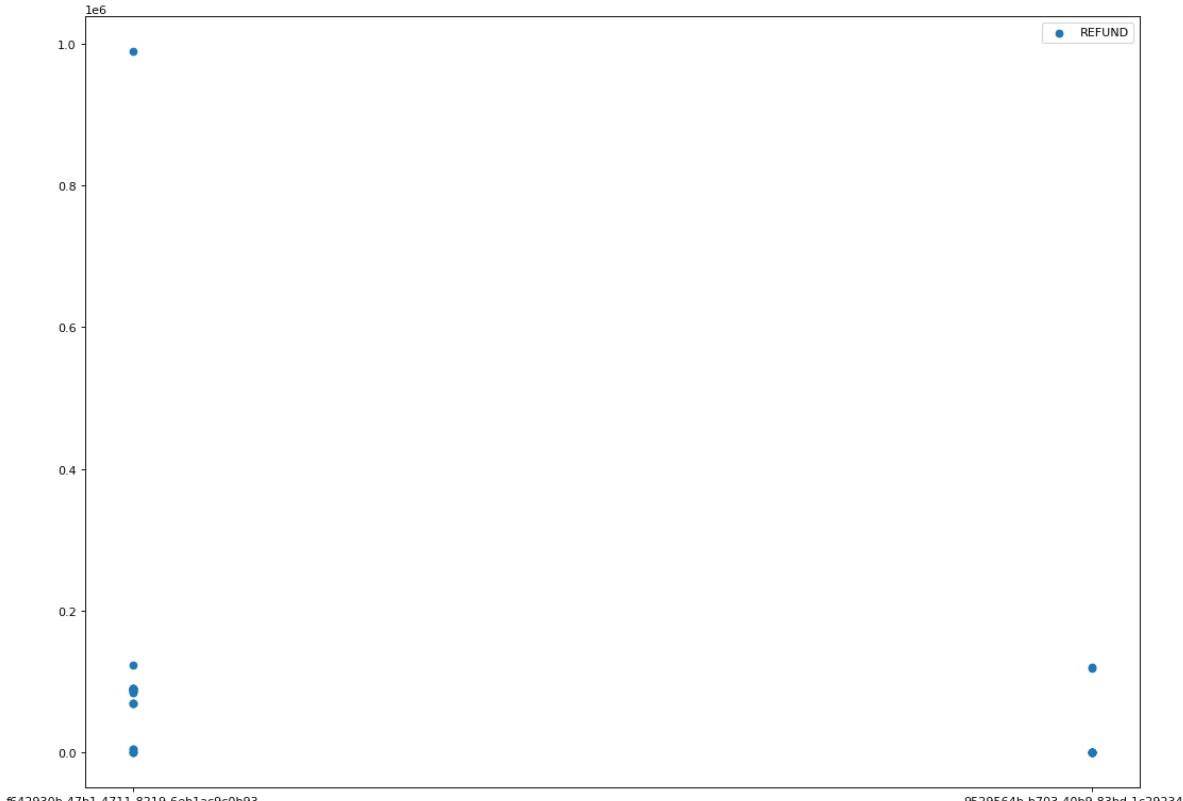


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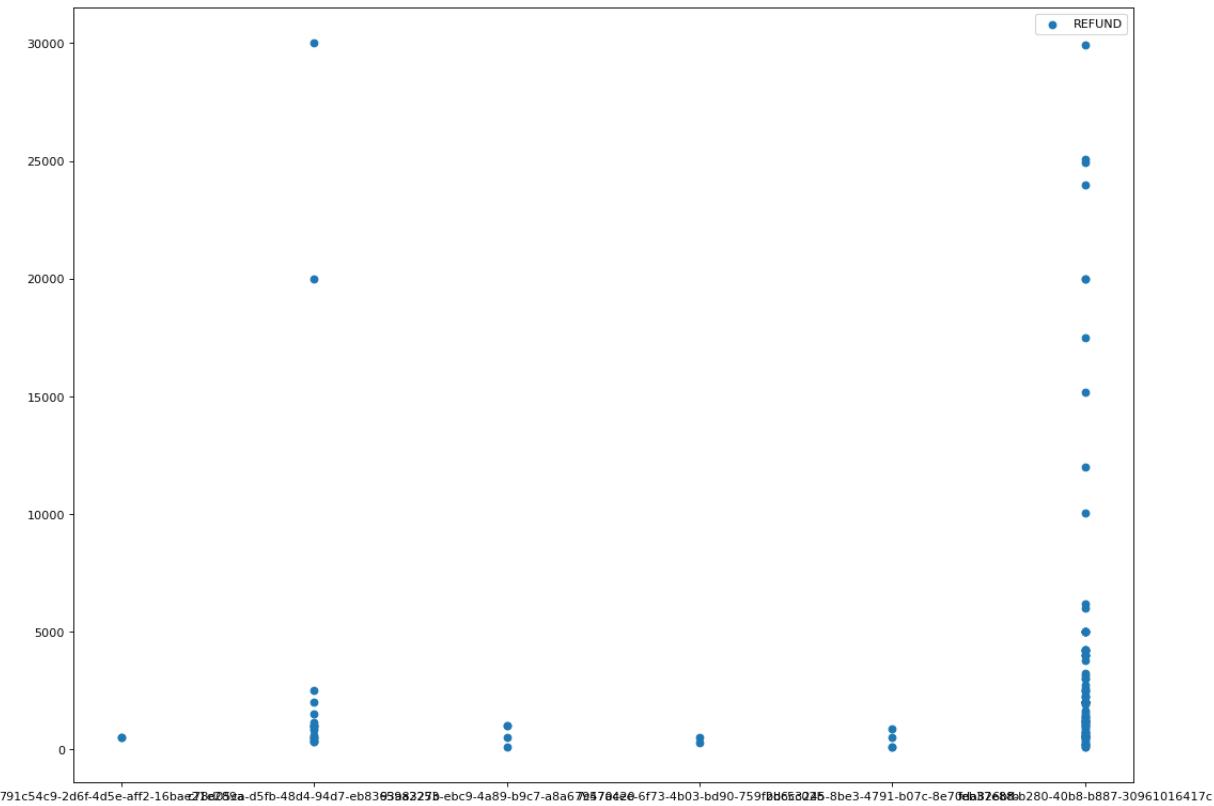
OTHER 47
GROCERIES 2

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OTHER 31

Name: externalParty.transactionCategory, dtype: int64



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TRAVEL	40
GROCERIES	14
LIFESTYLE	12
SHOPPING	3

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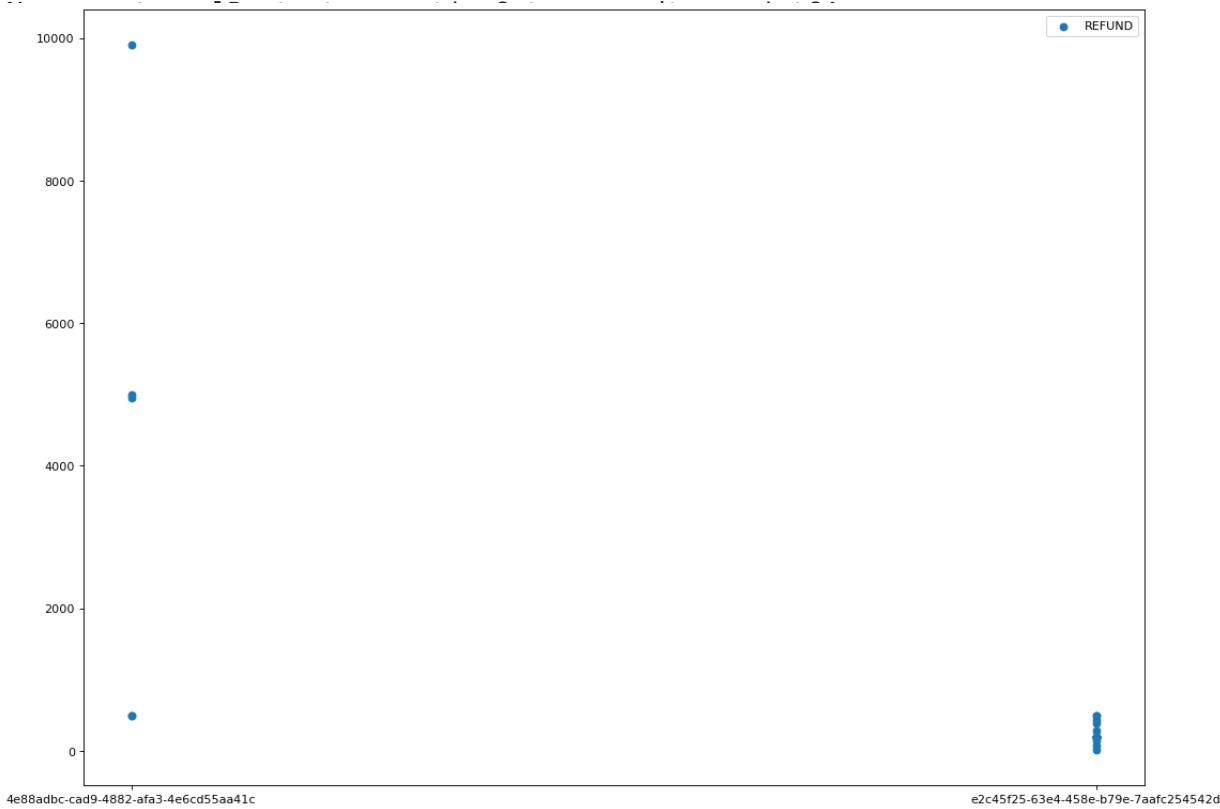


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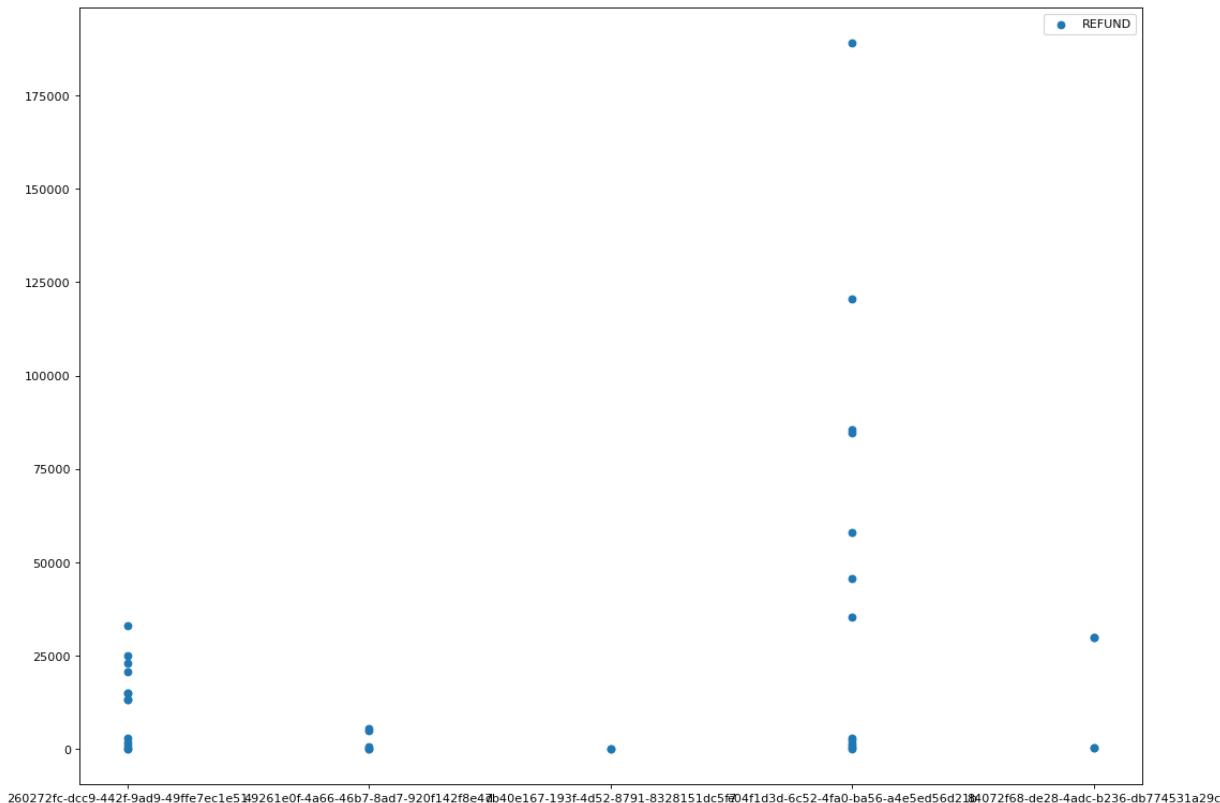
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LIFESTYLE	5

GROCERIES 3
TRAVEL 2
SHOPPING 1



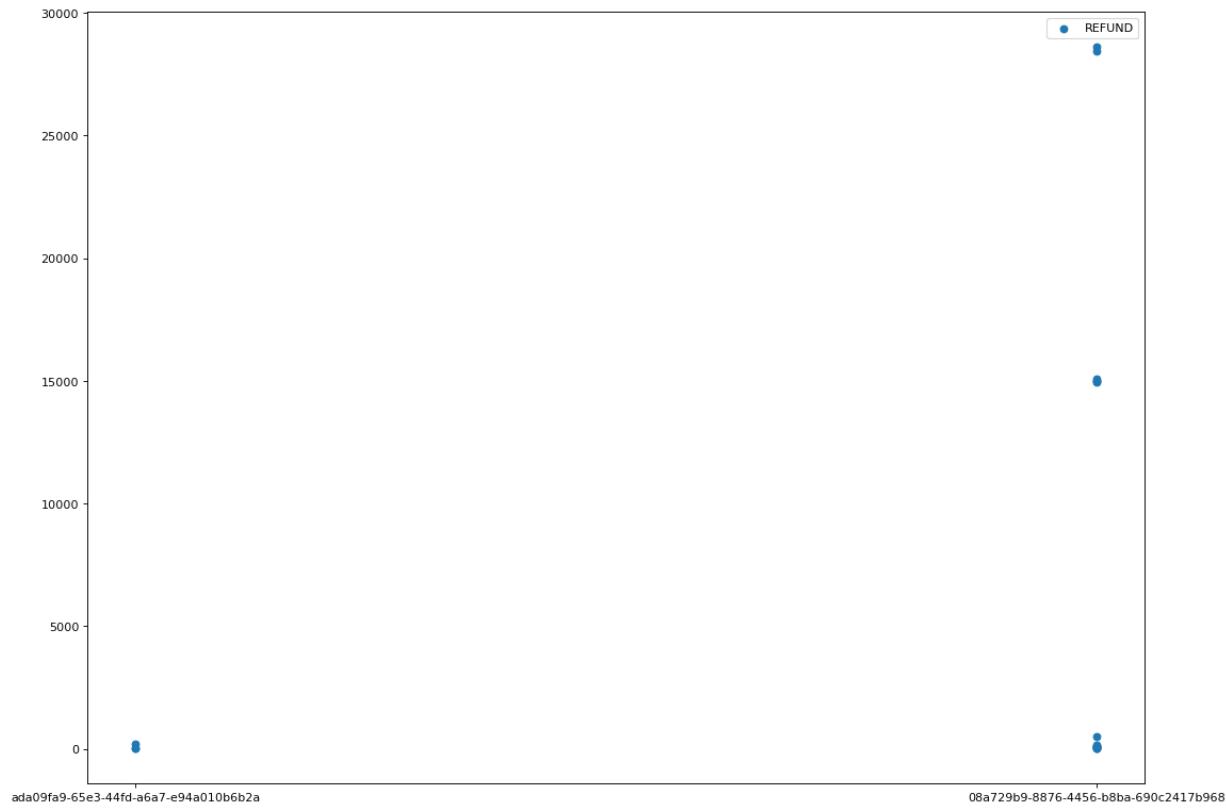
OTHER 18
SUBSCRIPTION 2
GROCERIES 1
TRAVEL 1

Name: externalParty.transactionCategory, dtype: int64



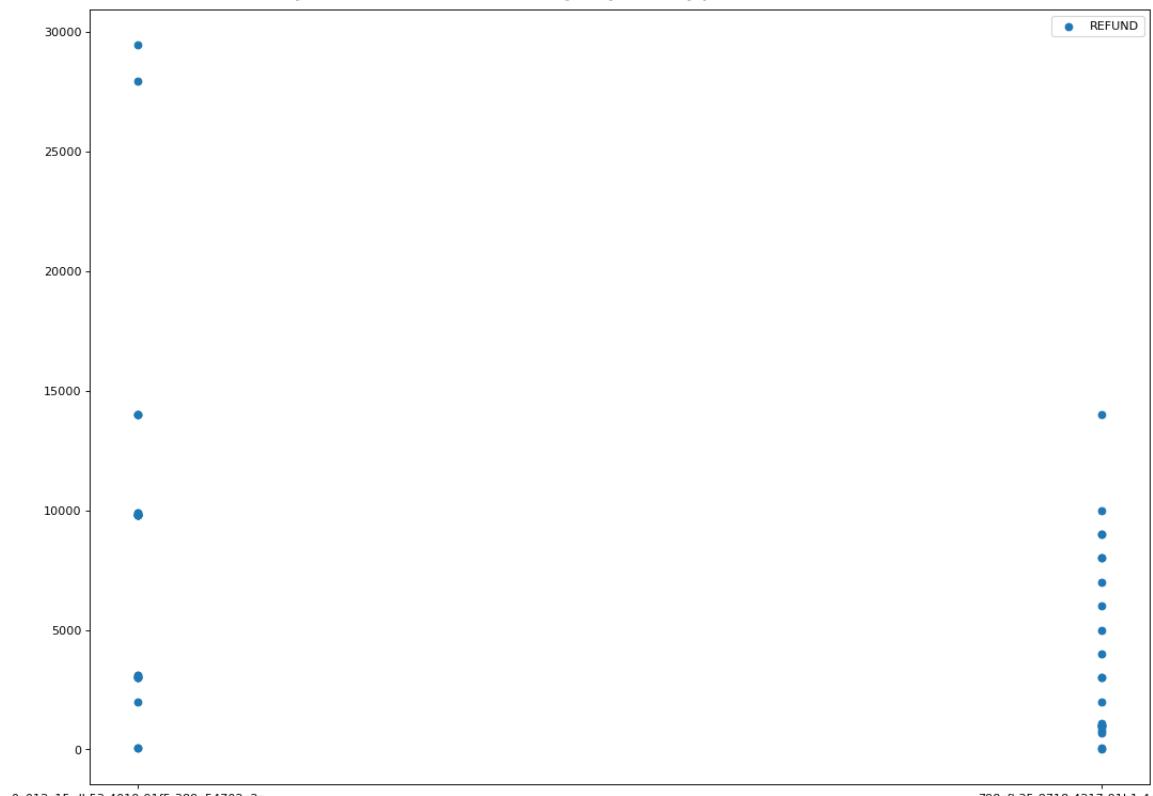
OTHER 37

Name: externalParty.transactionCategory, dtype: int64



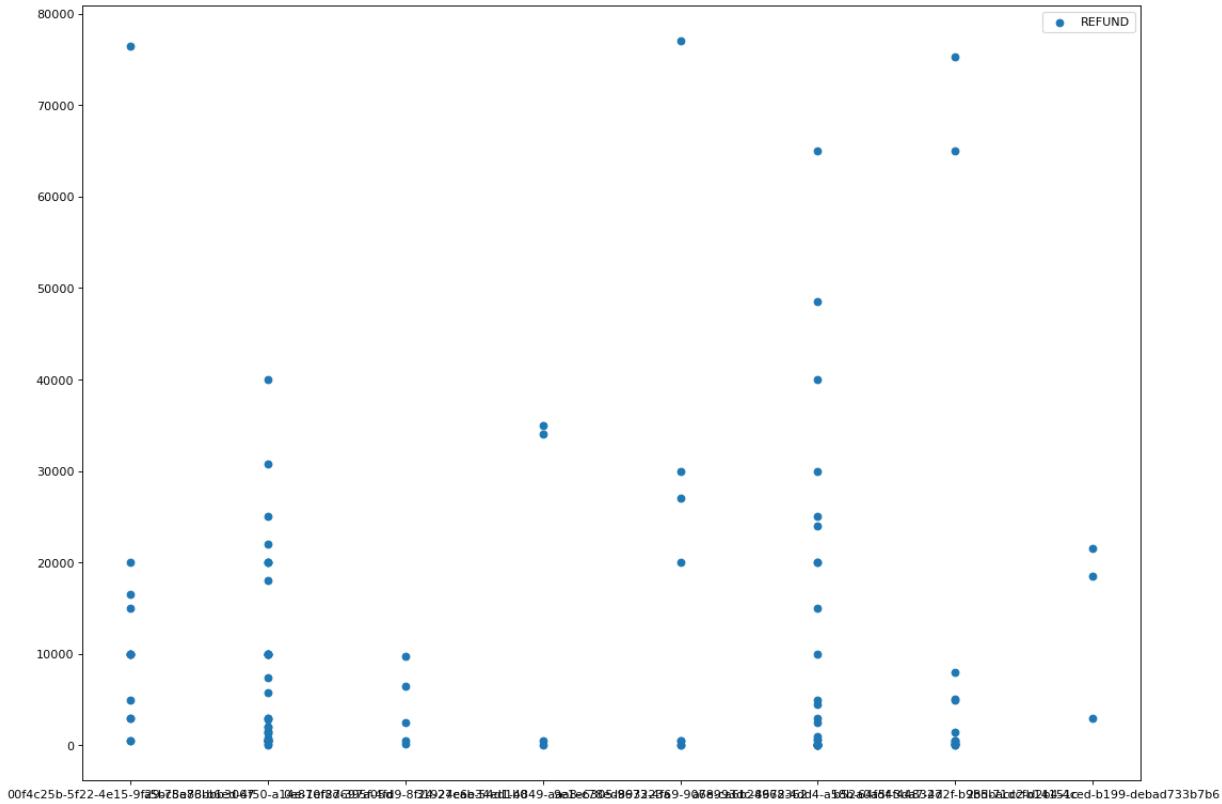
OTHER 18

Name: externalParty.transactionCategory, dtype: int64



OTHER 45

Name: externalParty.transactionCategory, dtype: int64



00f4c25b-5f22-4e15-9fa5-628a88bbd208750-a10e8210f2d695f06d9-8f2924e6a34ff110049-a0a2e62805d90232069-9a068995fd2807236214-a3524035456562332f-b2855bd2fd24854ced-b199-debad733b7b6

OTHER	96
GROCERIES	4
TRAVEL	3
LIFESTYLE	2
SHOPPING	1

Name: externalParty.transactionCategory, dtype: int64

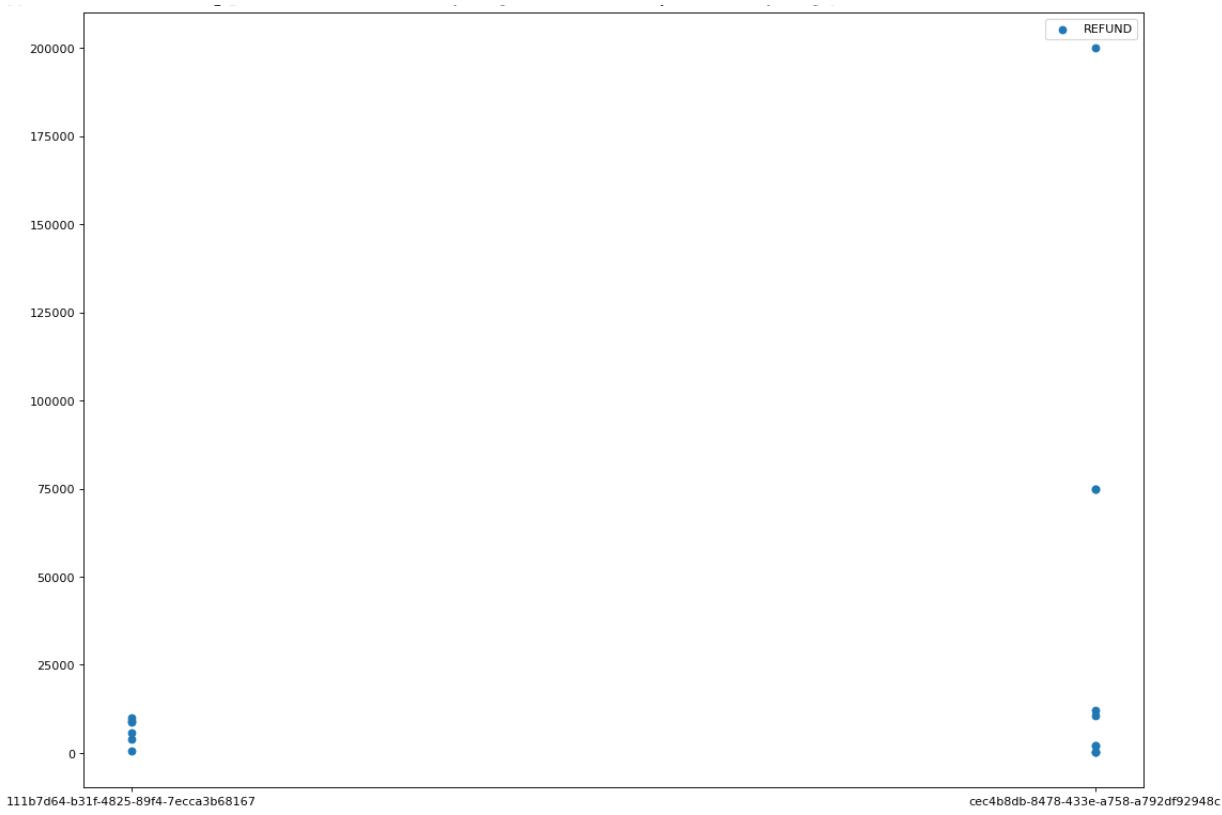


f989a74e-d70e-4d50-80d7-b68b547bae83

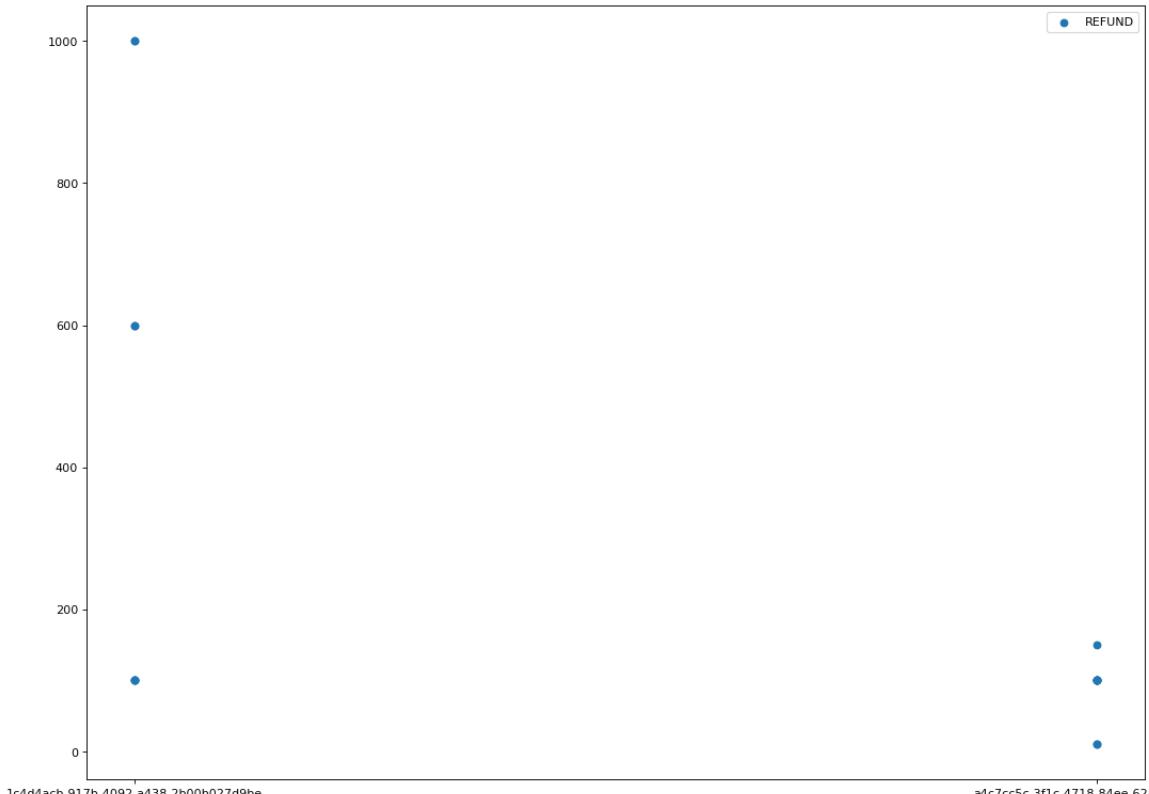
da9c7fad-cc01-4dcf-881d-6f3a0fc88d24

OTHER	141
LIFESTYLE	9

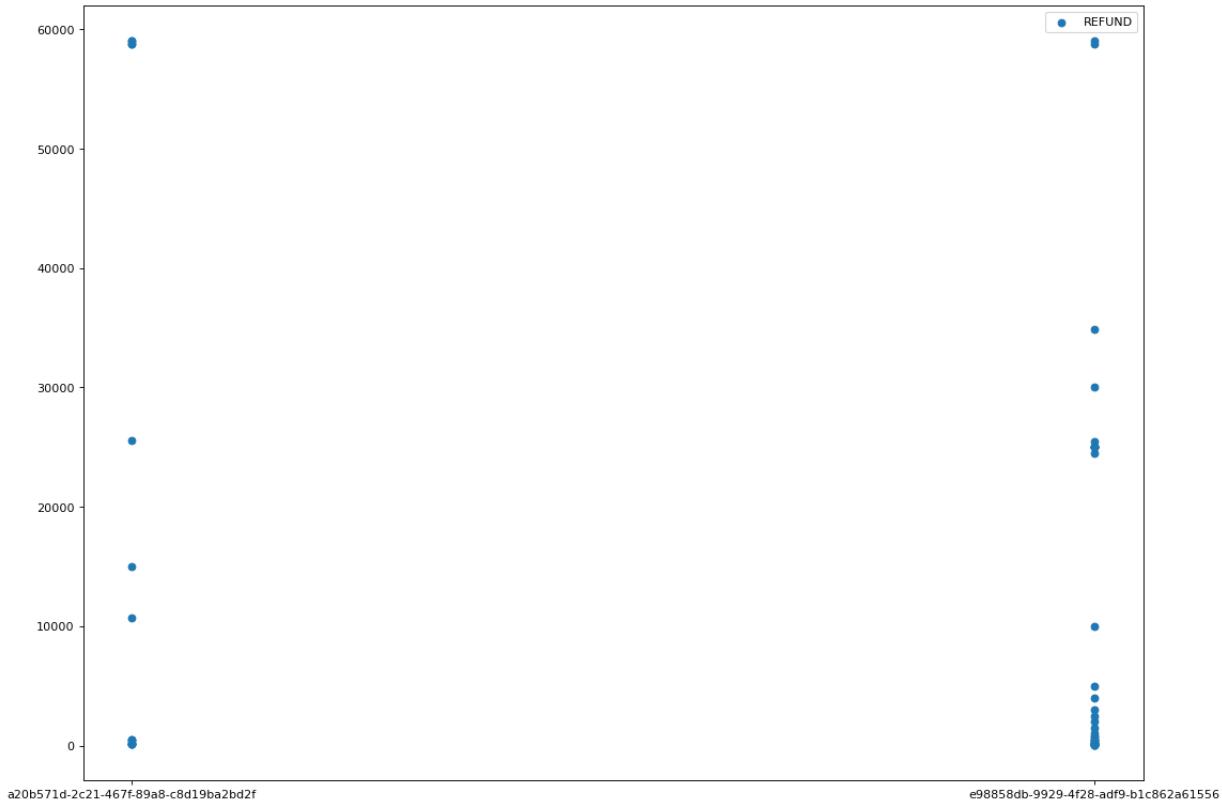
TRAVEL	6
GROCERIES	3
SHOPPING	1



```
OTHER    16  
Name: externalParty.transactionCategory, dtype: int64
```

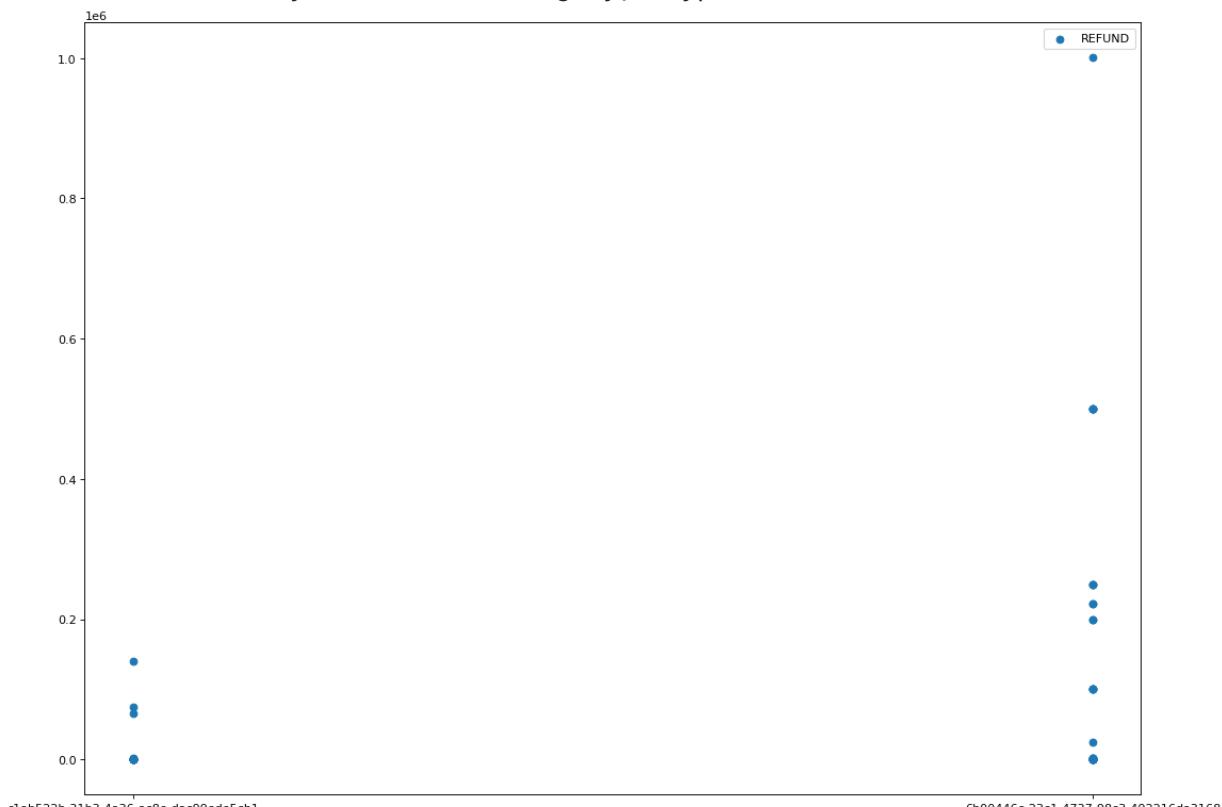


OTHER 17
Name: externalParty.transactionCategory, dtype: int64



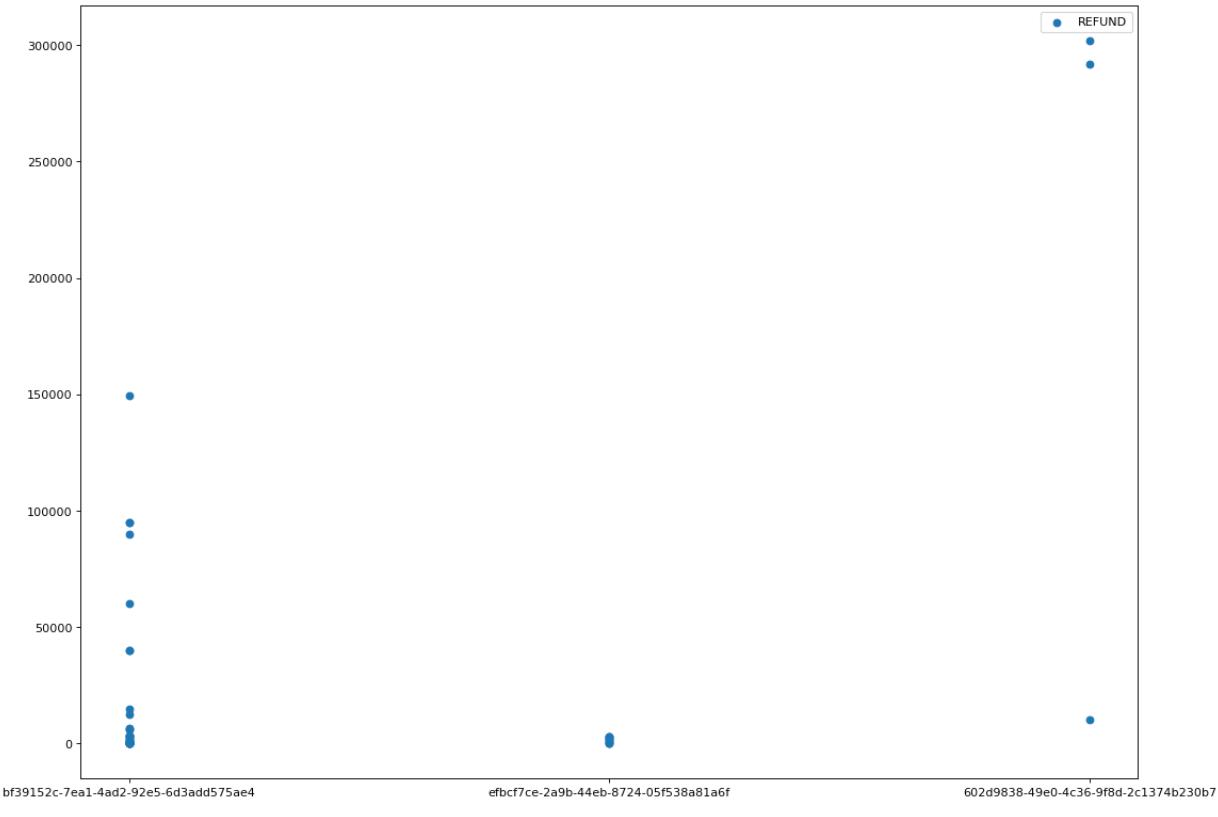
OTHER	44
GROCERIES	5
TRAVEL	2
SHOPPING	1
LIFESTYLE	1

Name: externalParty.transactionCategory, dtype: int64



OTHER	52
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Name: externalParty.transactionCategory, dtype: int64

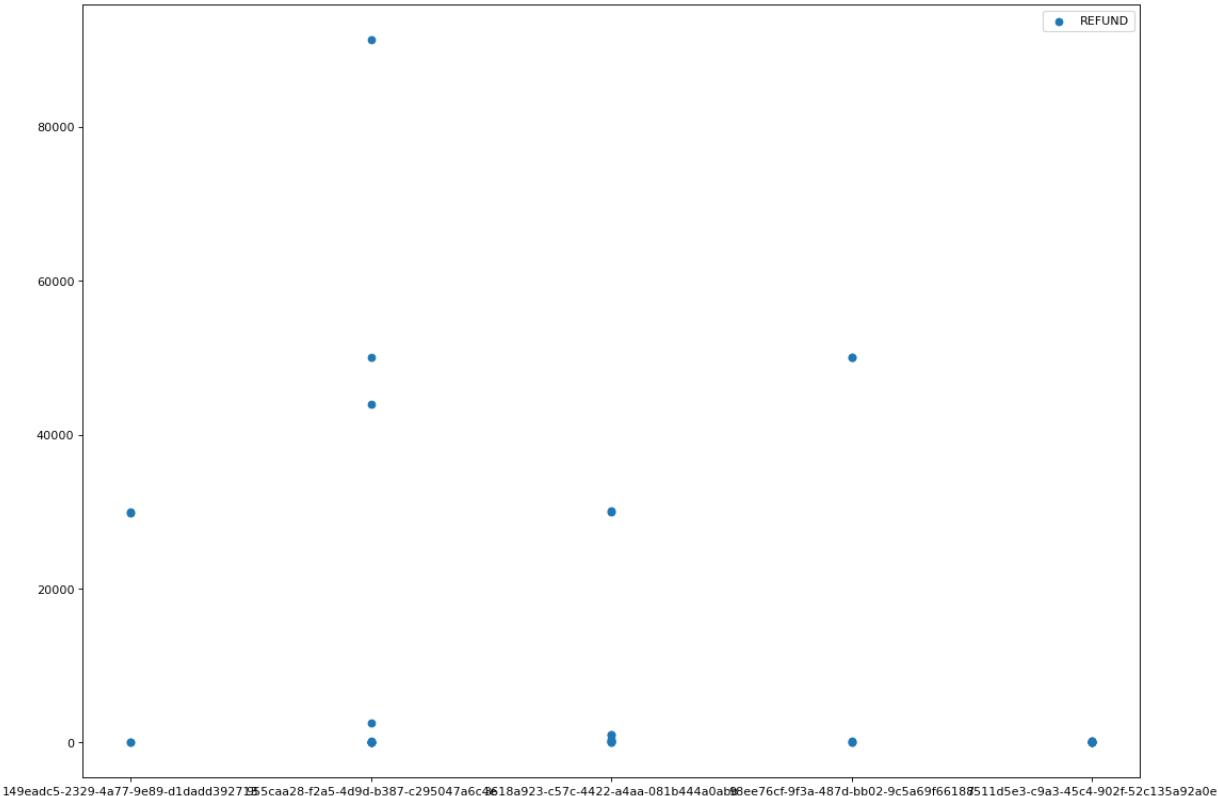


OTHER 32

TRAVEL 12

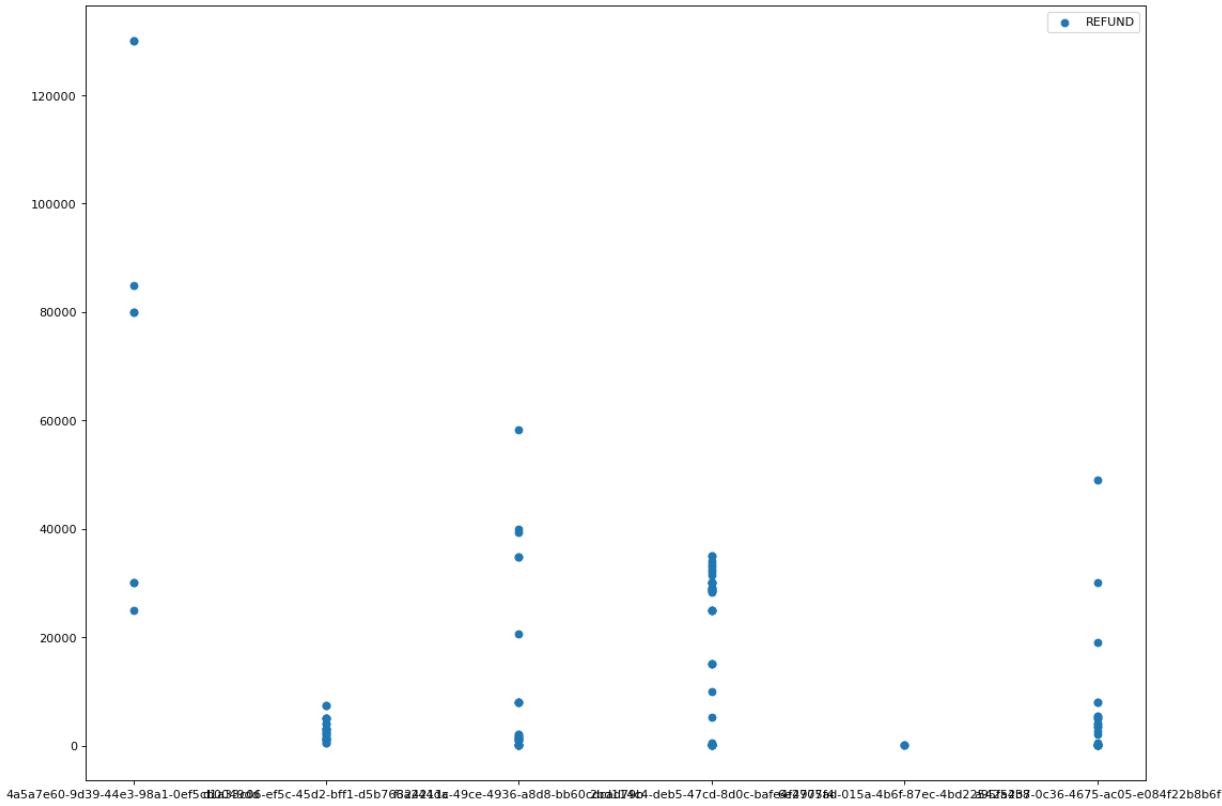
LIFESTYLE 4

Name: externalParty.transactionCategory, dtype: int64

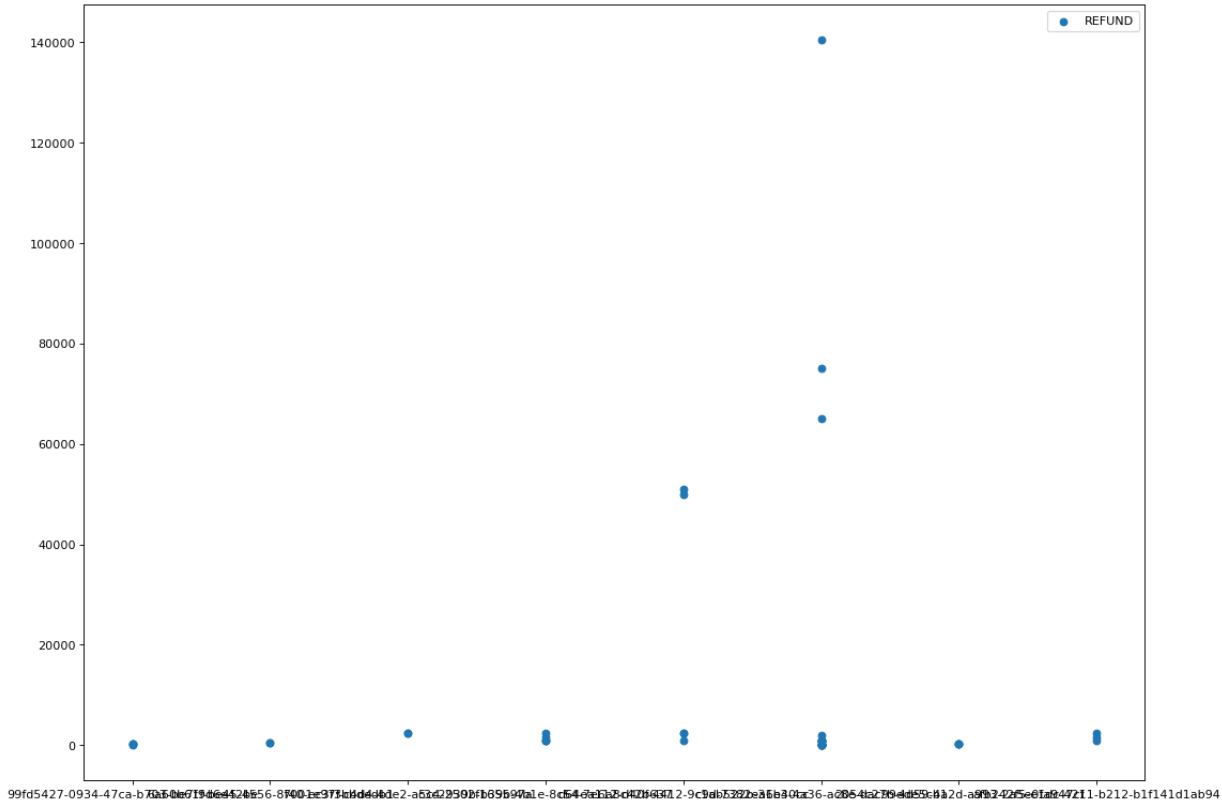


OTHER 41

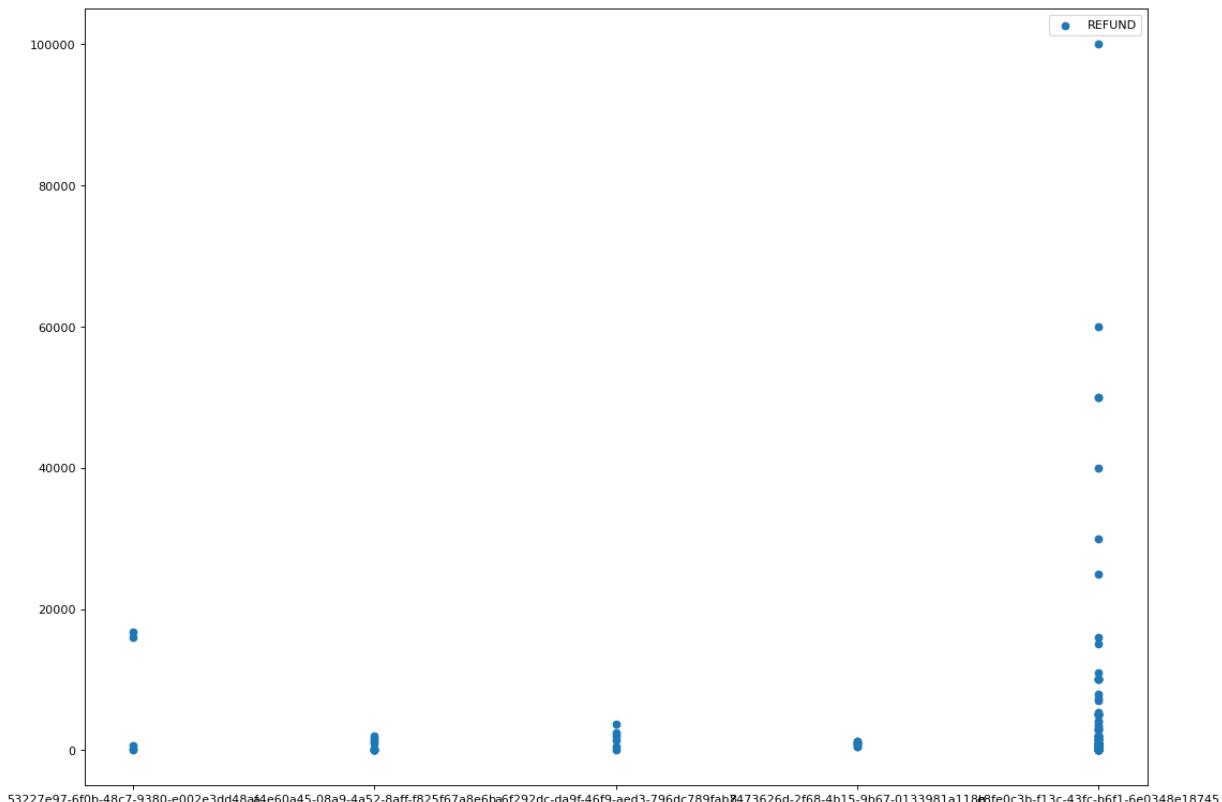
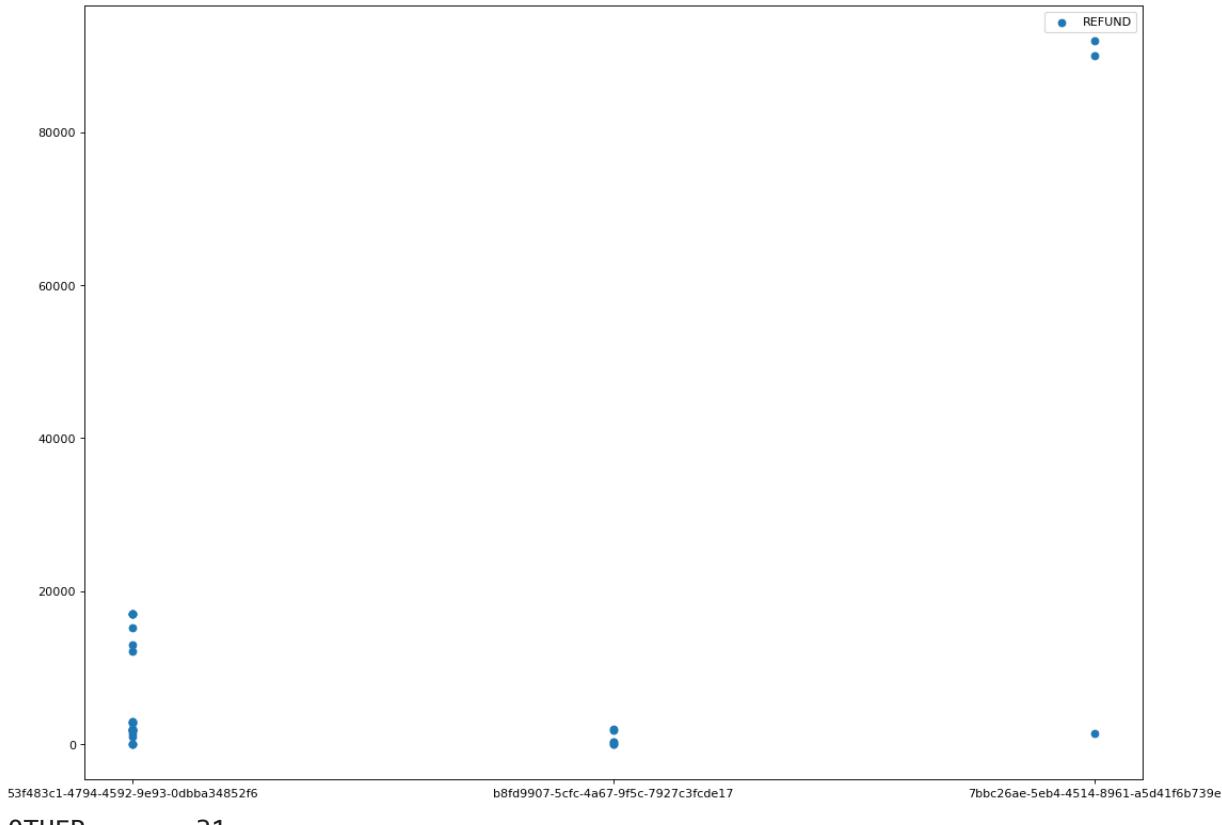
Name: externalParty.transactionCategory, dtype: int64

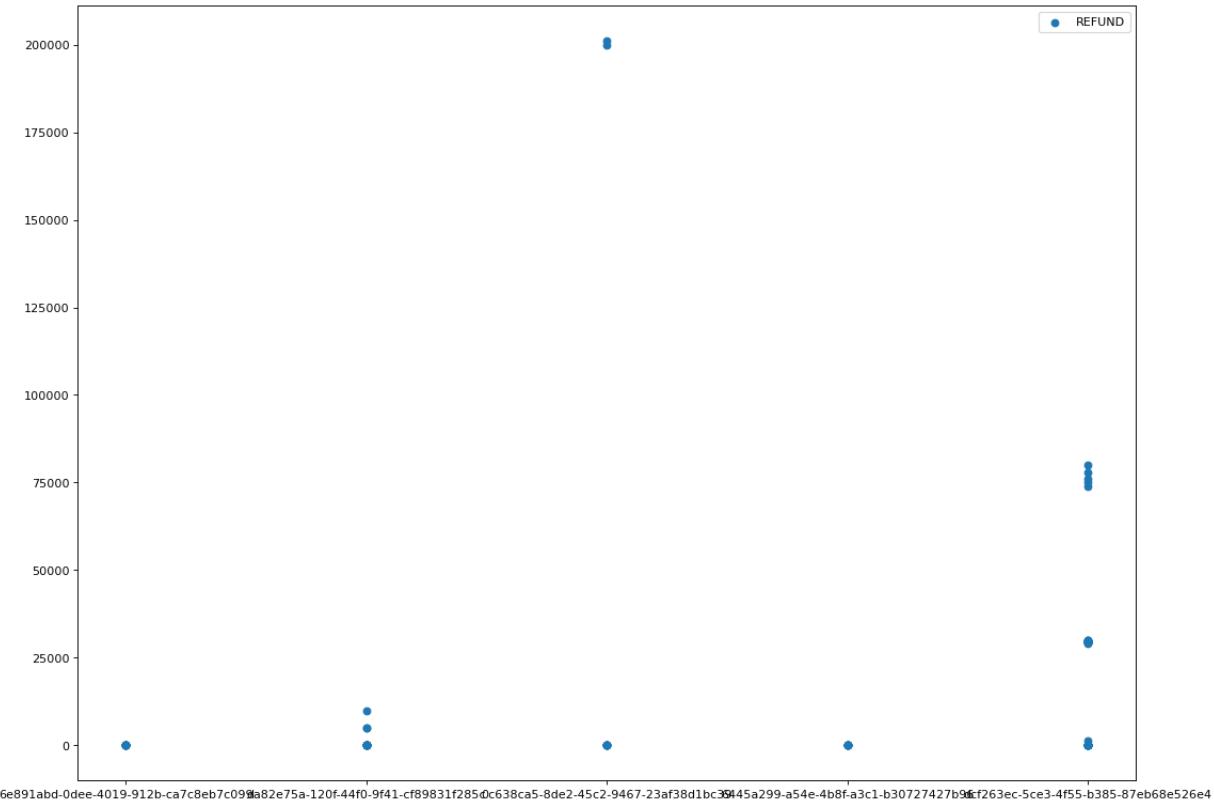


OTHER 135
Name: externalParty.transactionCategory, dtype: int64

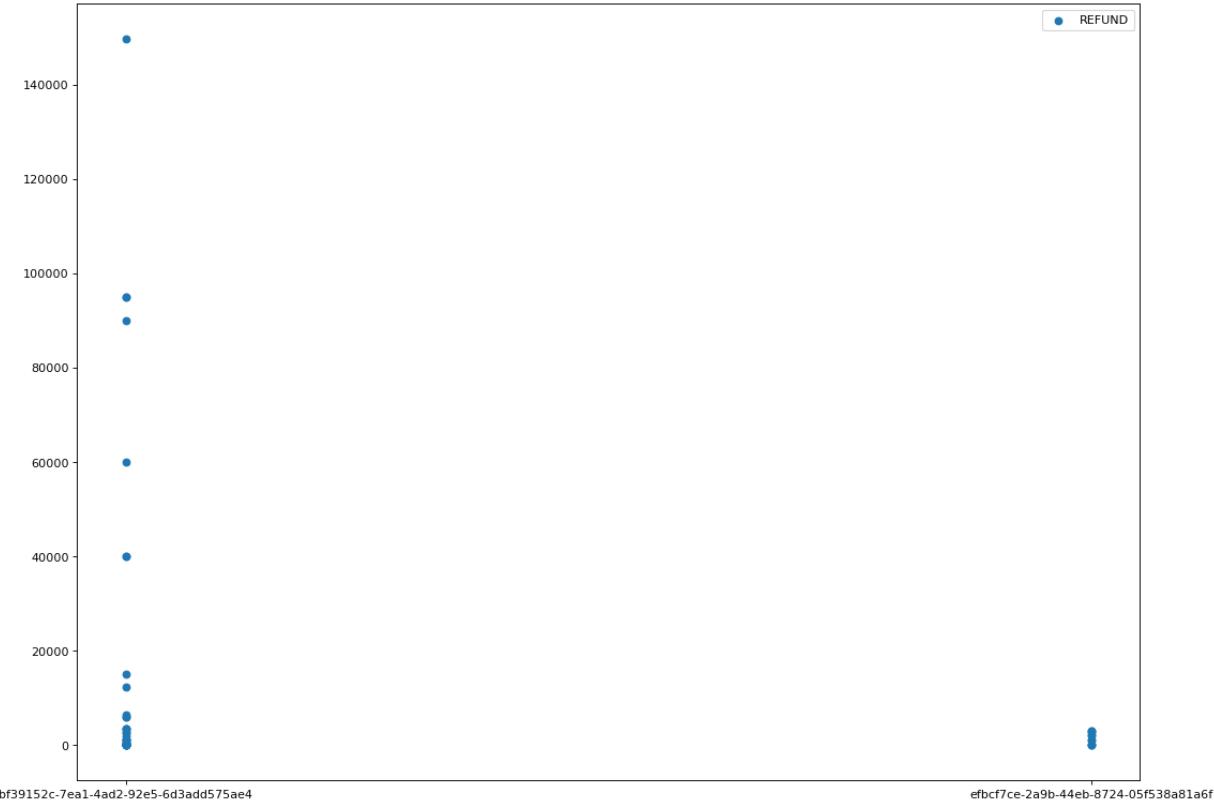


OTHER 43
Name: externalParty.transactionCategory, dtype: int64

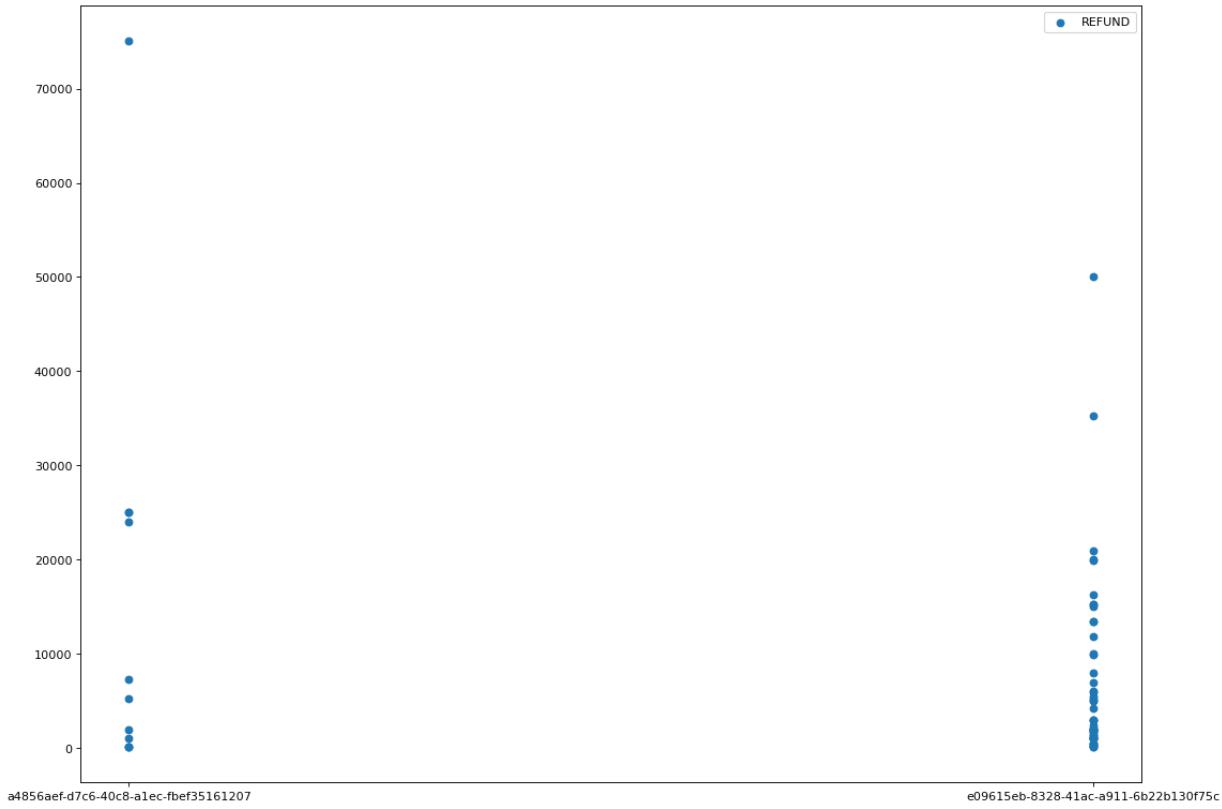




6e891abd-0dee-4019-912b-ca7c8eb7c099a82e75a-120f-44f0-9f41-cf89831f285dc638ca5-8de2-45c2-9467-23af38d1bc39445a299-a54e-4b8f-a3c1-b30727427b96ff263ec-5ce3-4f55-b385-87eb68e526e4
OTHER 86
Name: externalParty.transactionCategory, dtype: int64

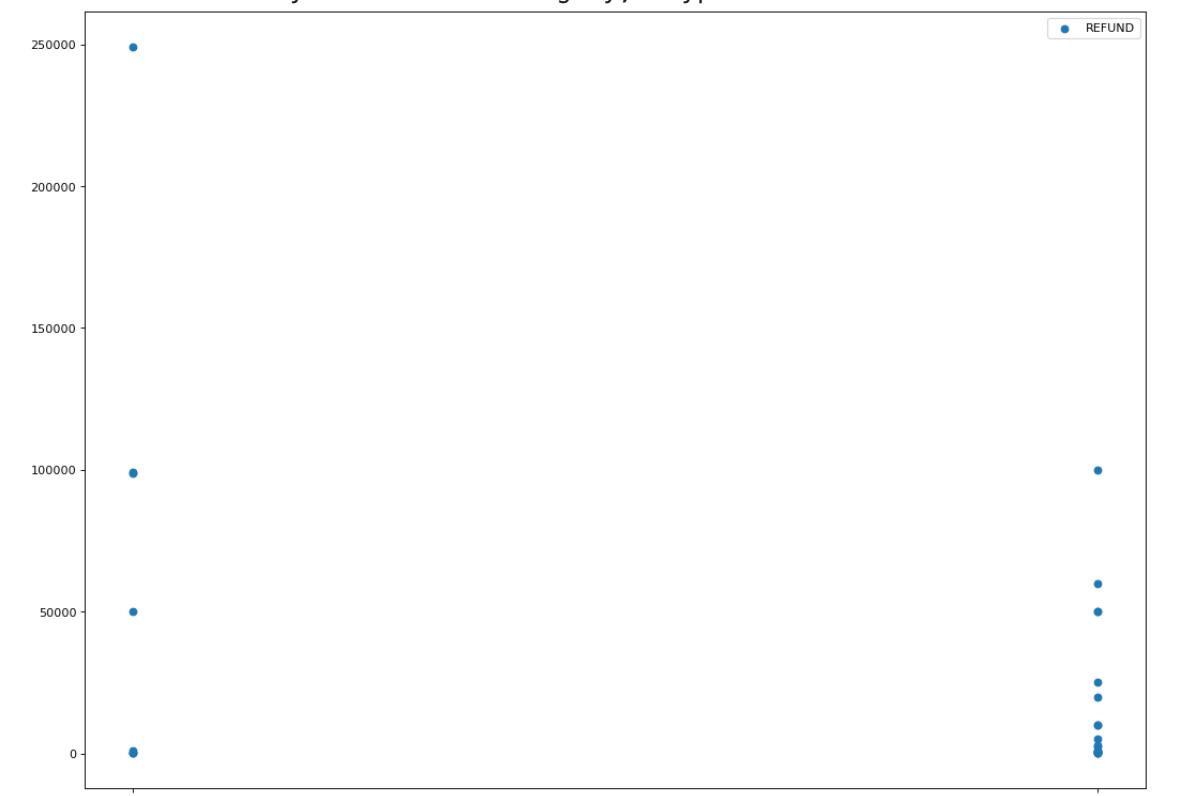


bf39152c-7ea1-4ad2-92e5-6d3add575ae4
OTHER 29
TRAVEL 12
LIFESTYLE 4
Name: externalParty.transactionCategory, dtype: int64



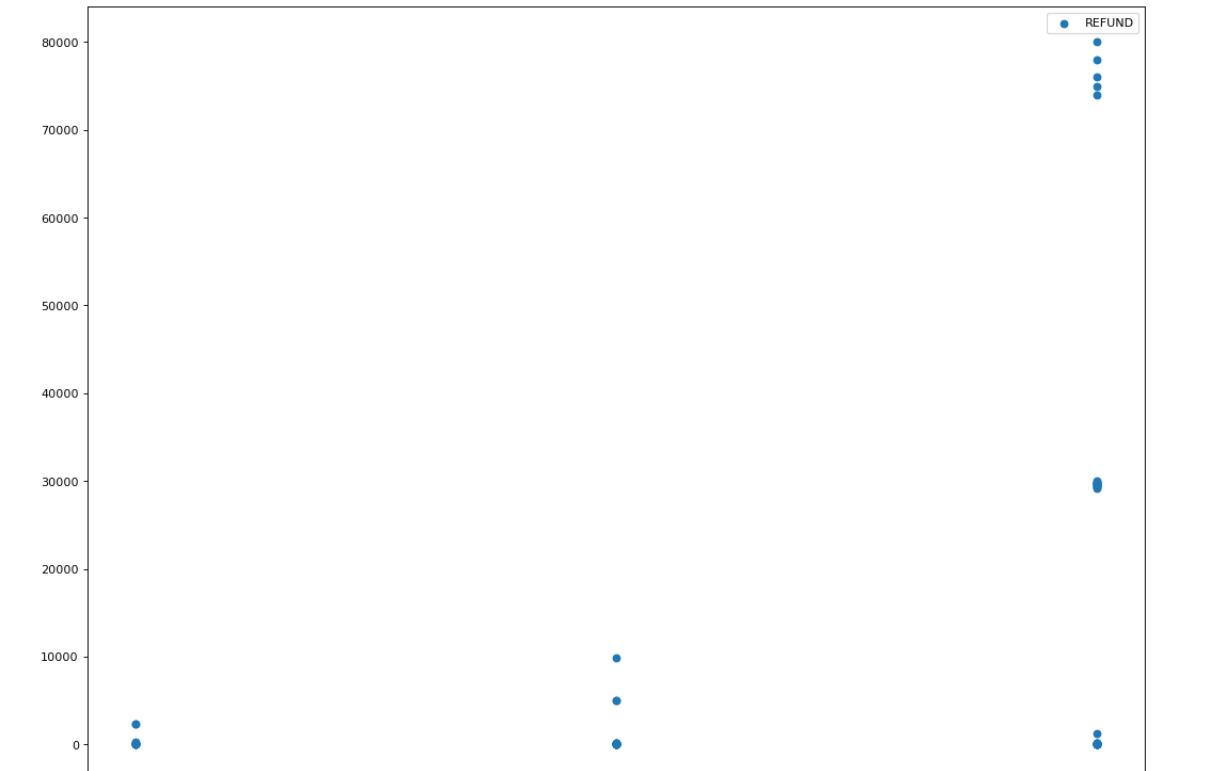
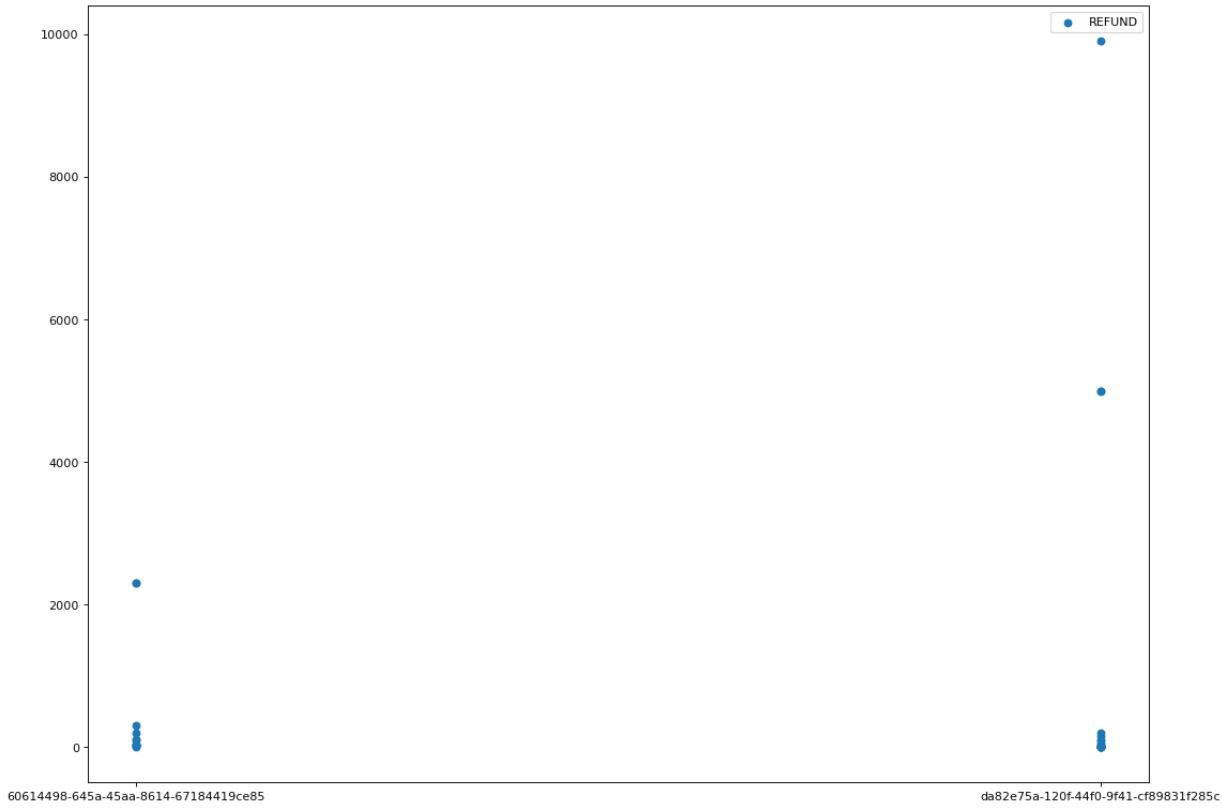
OTHER	39
SHOPPING	9
LIFESTYLE	6
TRAVEL	5
GROCERIES	2

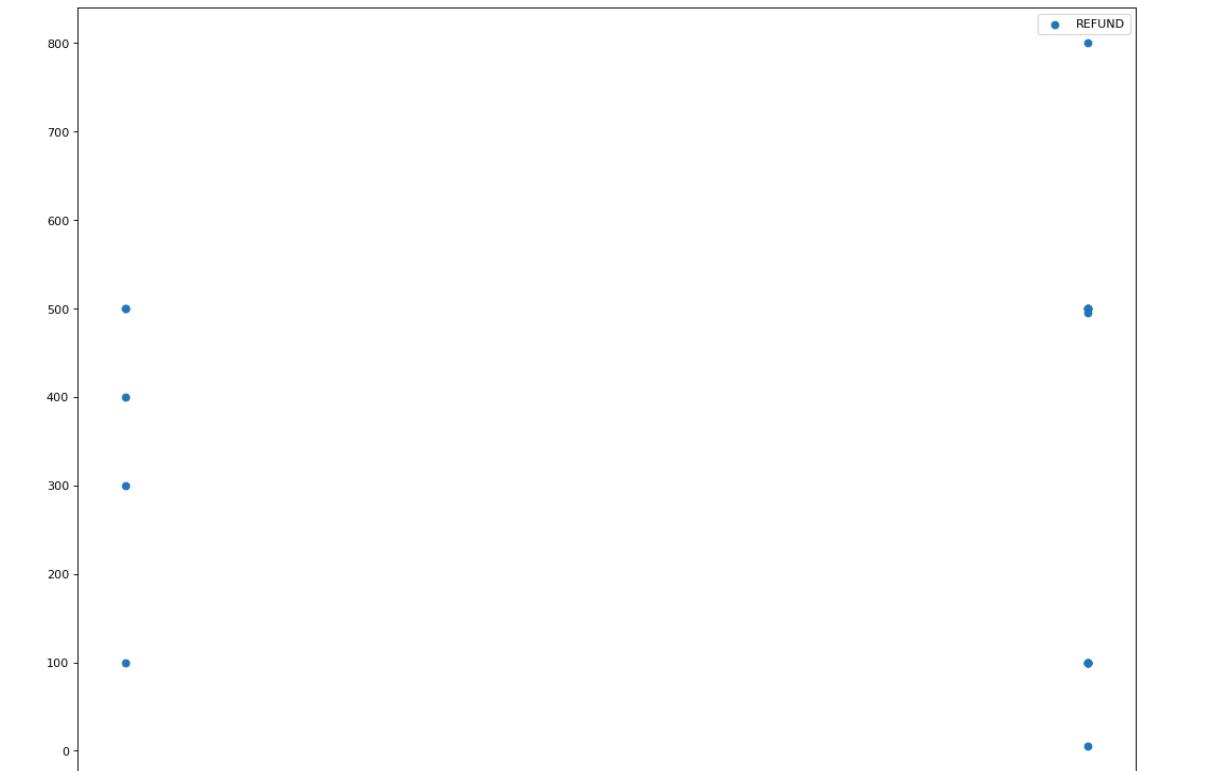
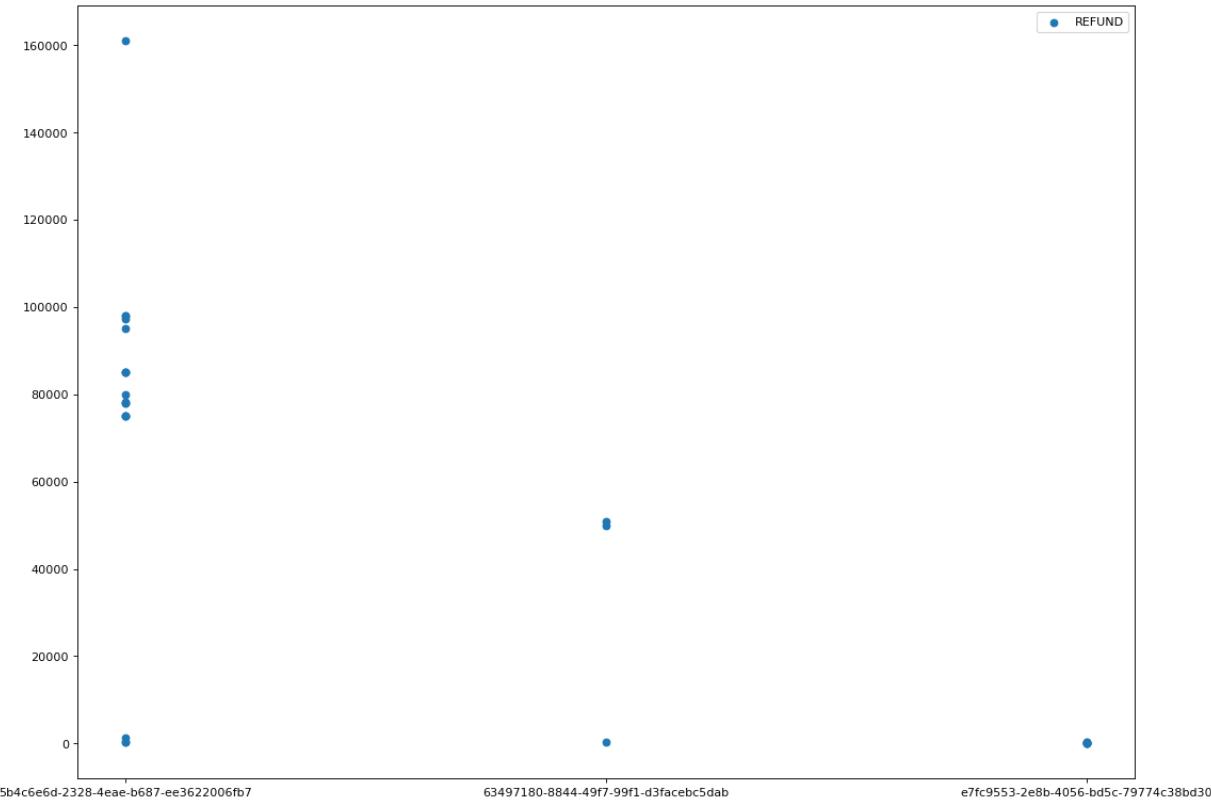
Name: externalParty.transactionCategory, dtype: int64

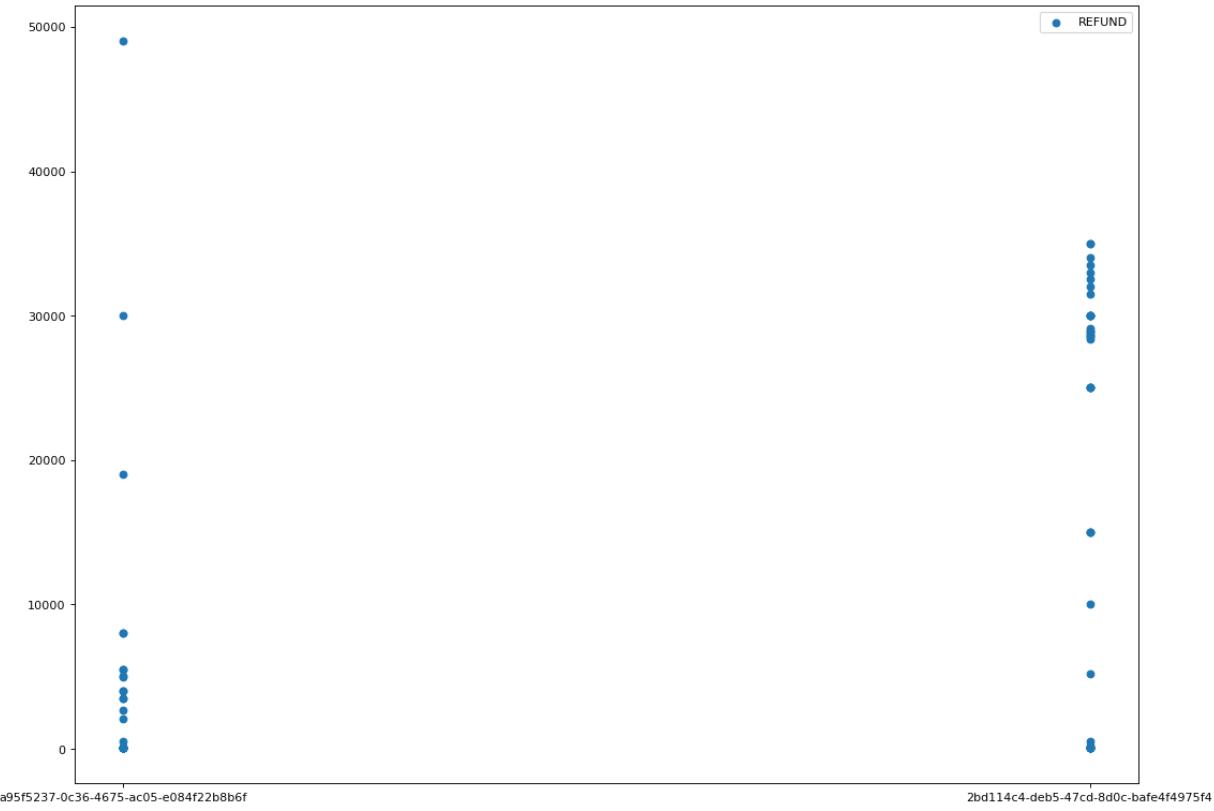


OTHER 27

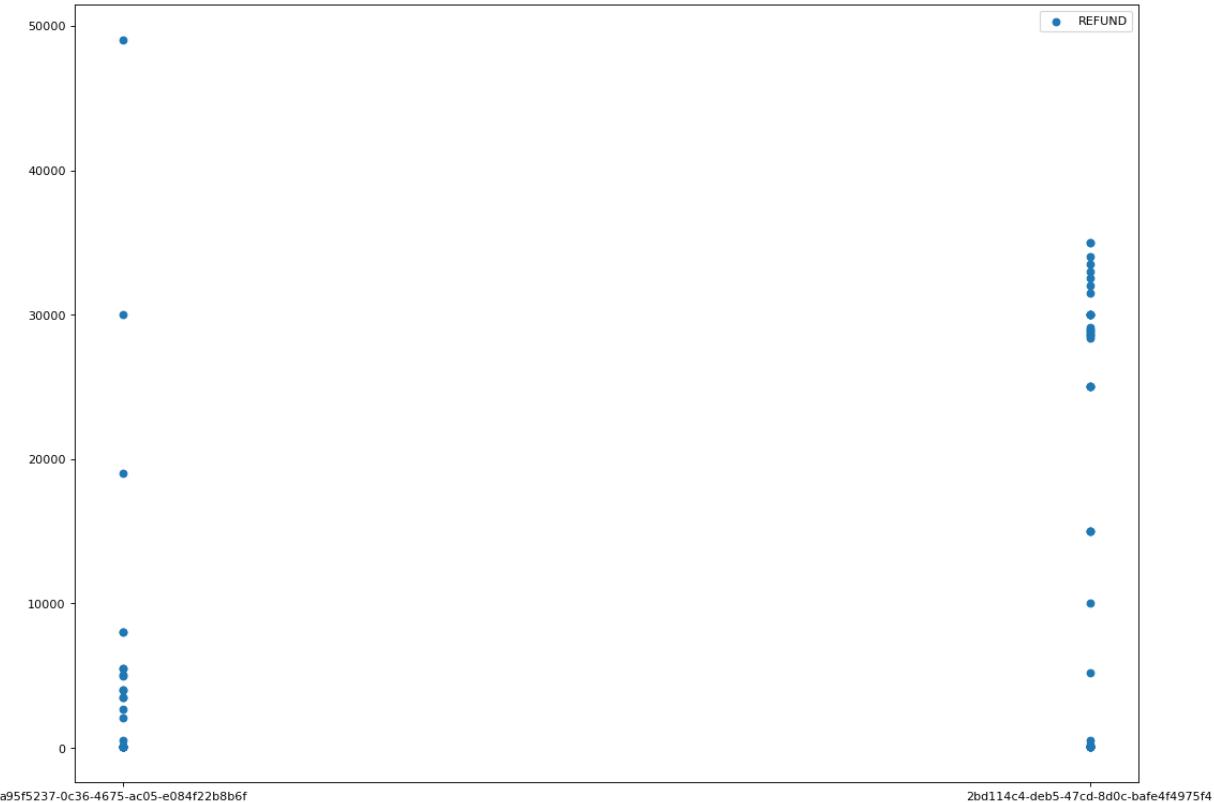
Name: externalParty.transactionCategory, dtype: int64



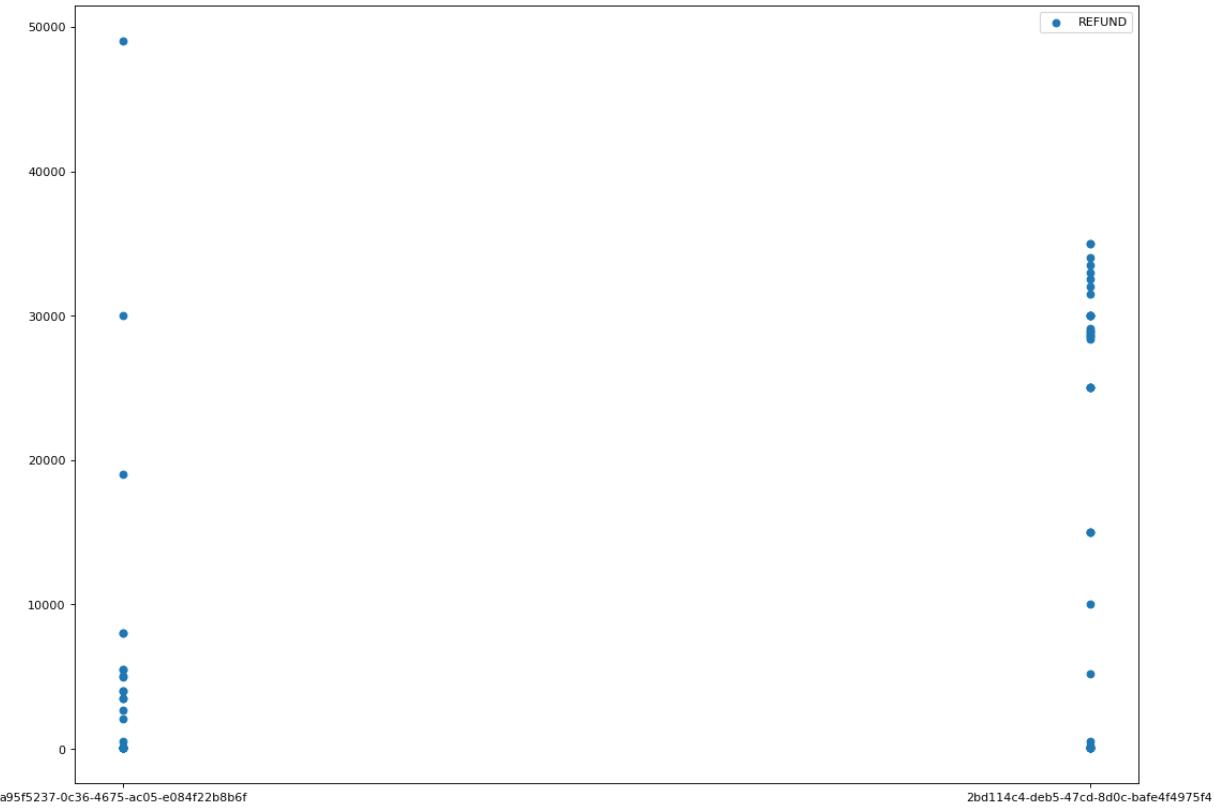




OTHER 74
Name: externalParty.transactionCategory, dtype: int64

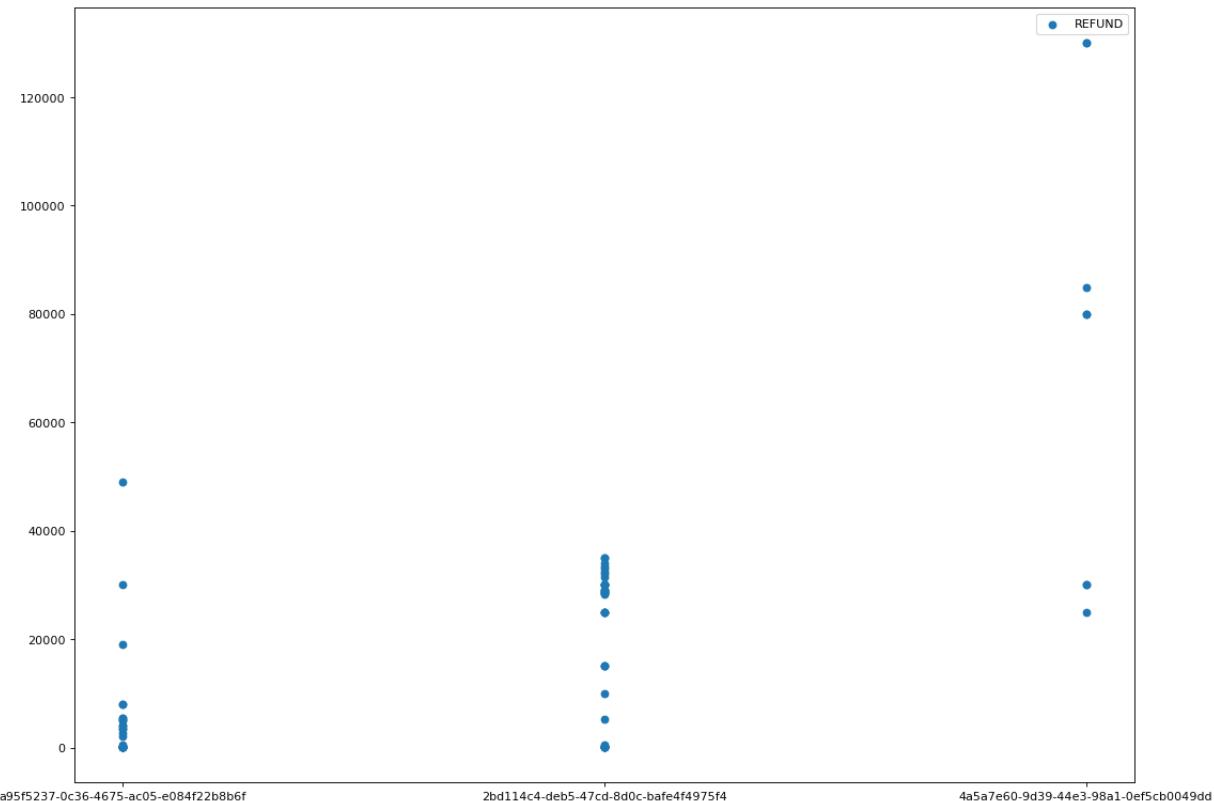


OTHER 74
Name: externalParty.transactionCategory, dtype: int64



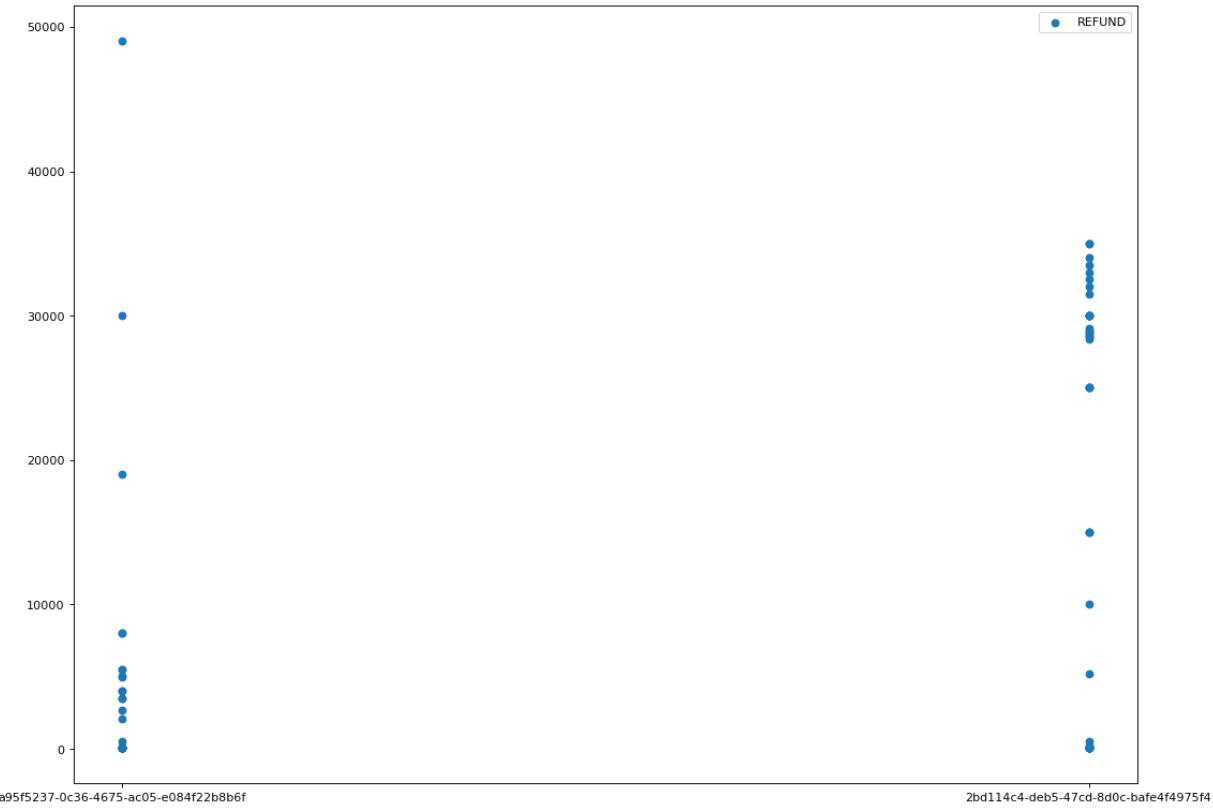
OTHER 74

Name: externalParty.transactionCategory, dtype: int64

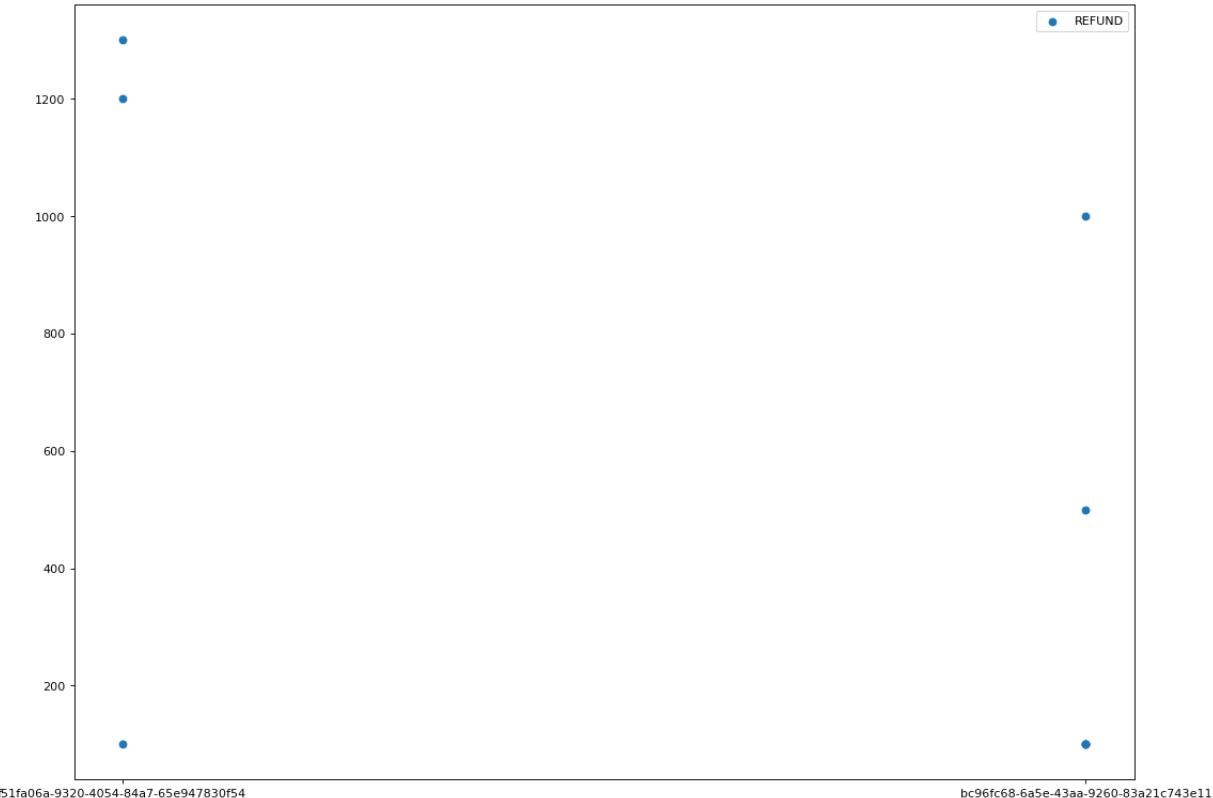


OTHER 82

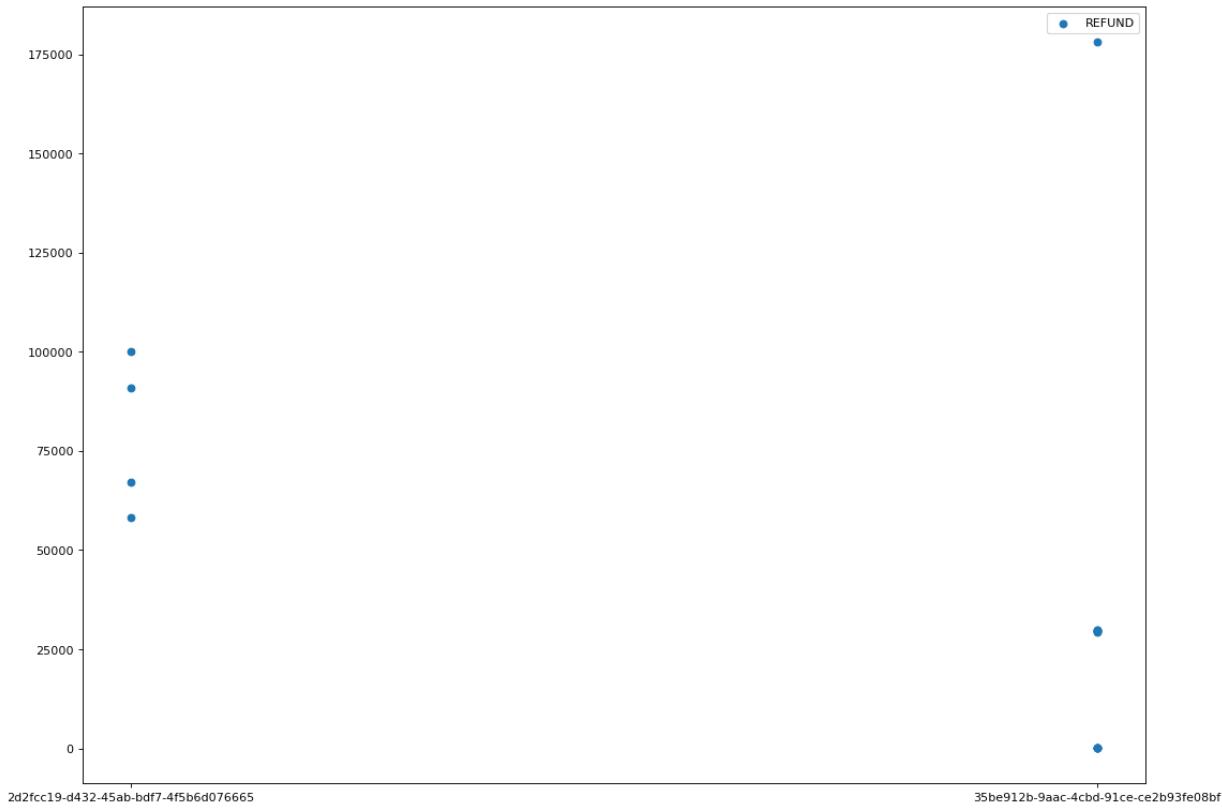
Name: externalParty.transactionCategory, dtype: int64



OTHER 74
Name: externalParty.transactionCategory, dtype: int64



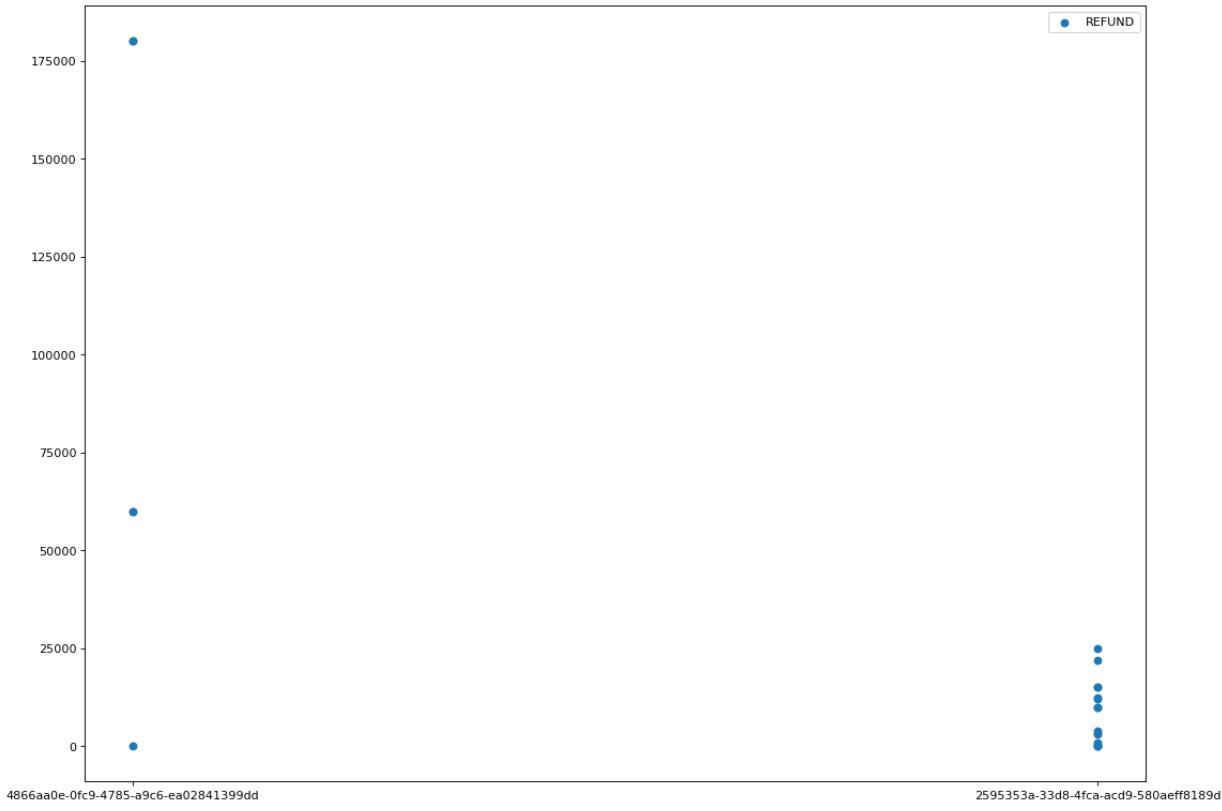
OTHER 9
Name: externalParty.transactionCategory, dtype: int64



OTHER 16
Name: externalParty.transactionCategory, dtype: int64



OTHER 30
Name: externalParty.transactionCategory, dtype: int64



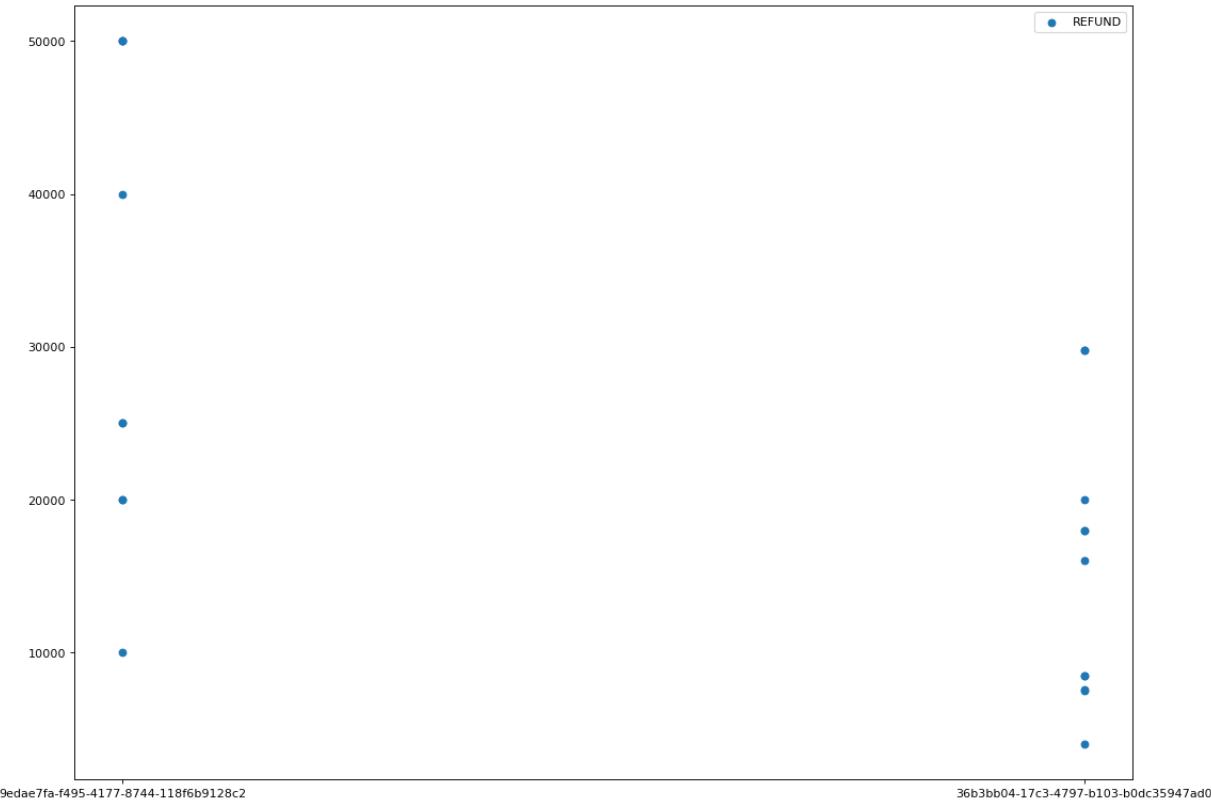
OTHER 21

Name: externalParty.transactionCategory, dtype: int64



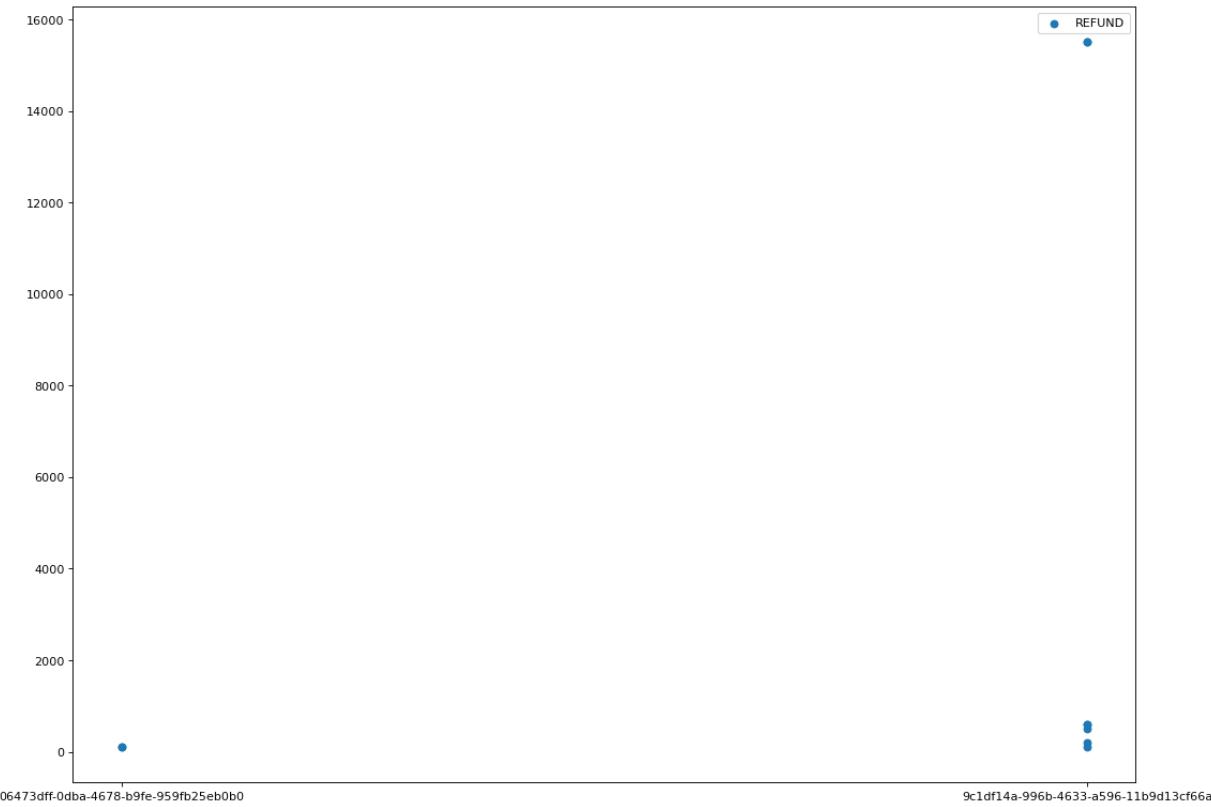
OTHER 80

Name: externalParty.transactionCategory, dtype: int64



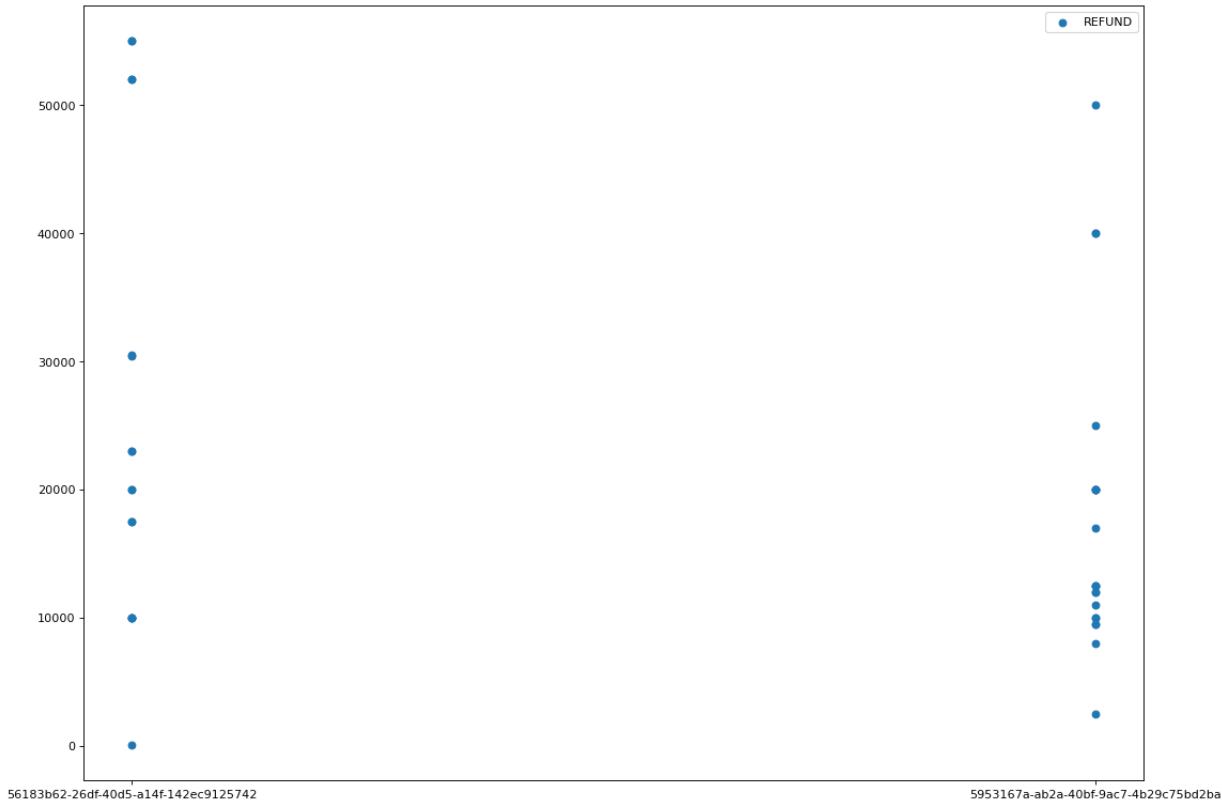
OTHER 20

Name: externalParty.transactionCategory, dtype: int64

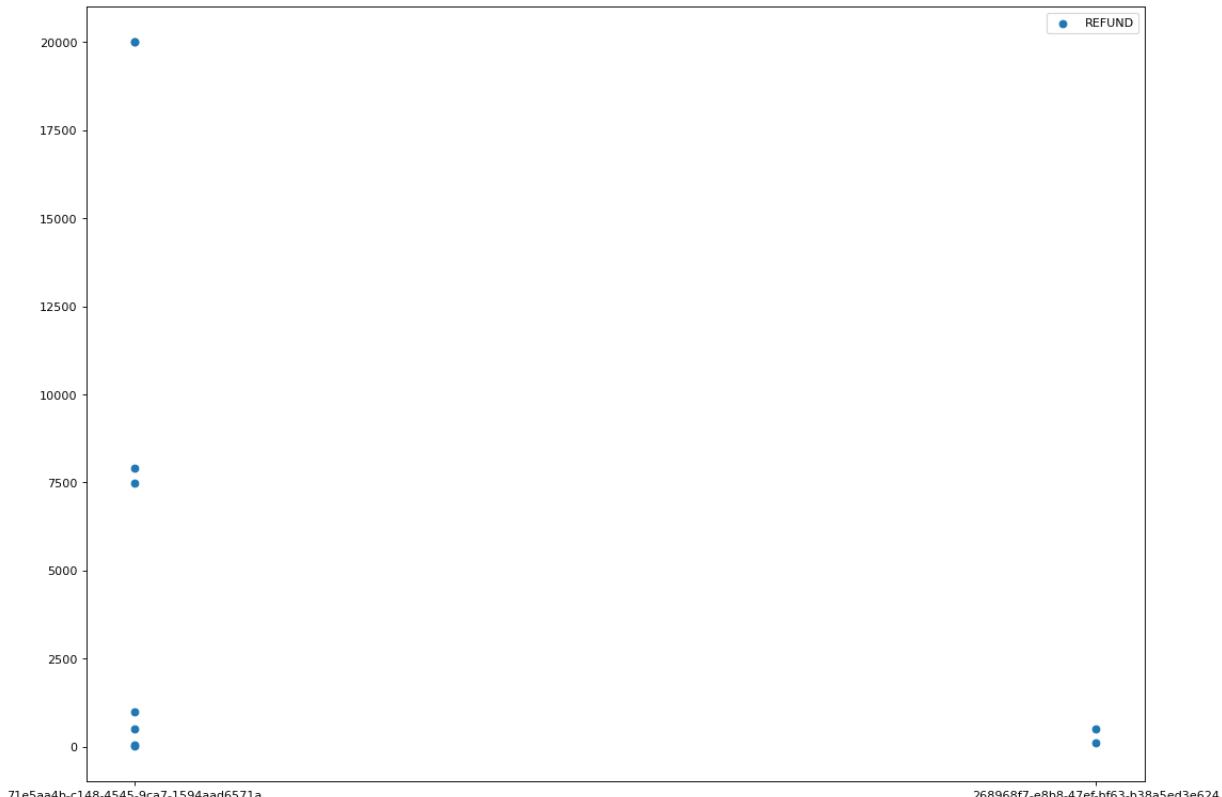


OTHER 9

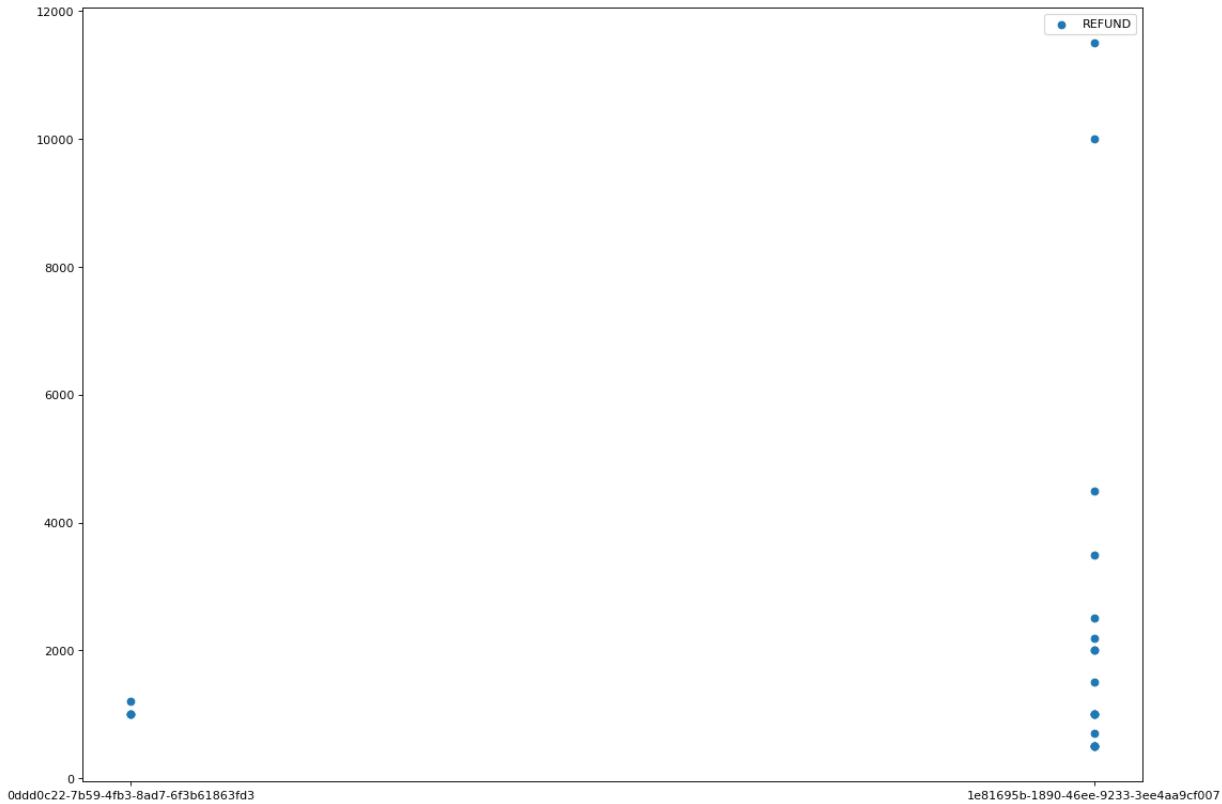
Name: externalParty.transactionCategory, dtype: int64



OTHER 38
Name: externalParty.transactionCategory, dtype: int64



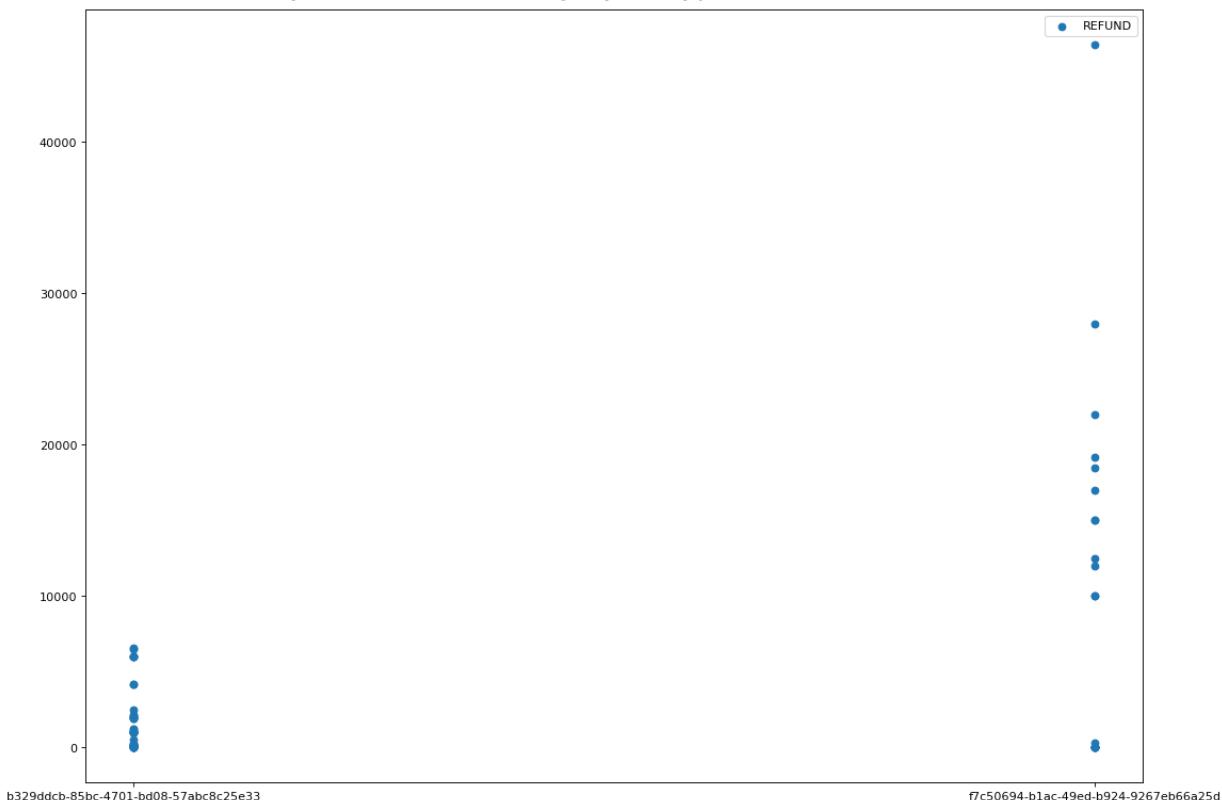
OTHER 10
Name: externalParty.transactionCategory, dtype: int64



OTHER 22

LIFESTYLE 1

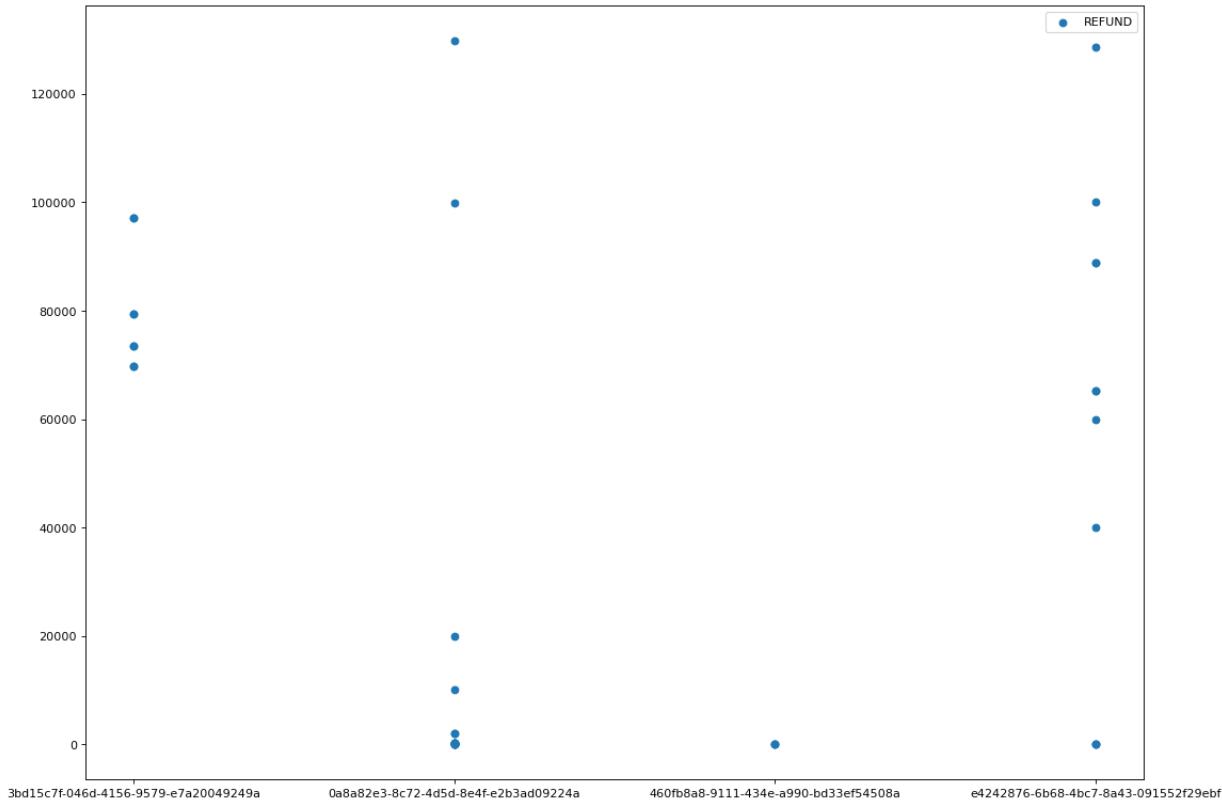
Name: externalParty.transactionCategory, dtype: int64



OTHER 63

LIFESTYLE 4

Name: externalParty.transactionCategory, dtype: int64



OTHER 39

Name: externalParty.transactionCategory, dtype: int64



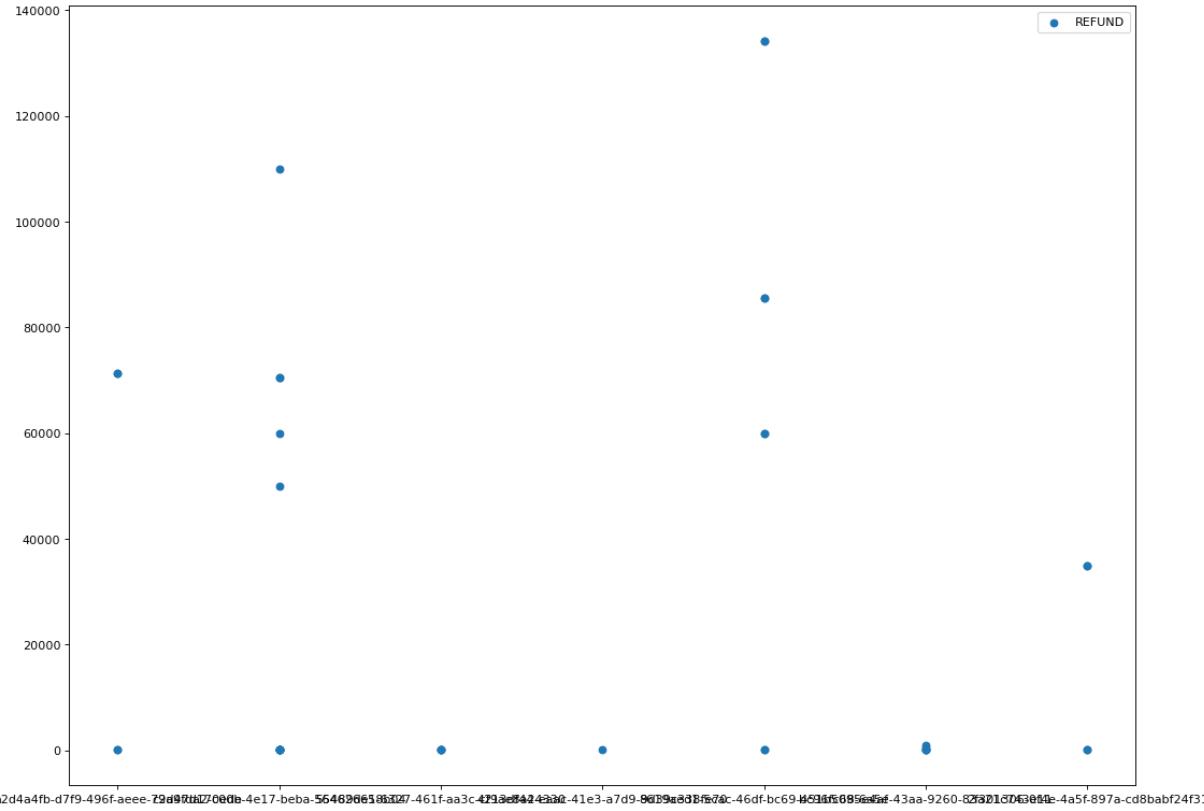
OTHER 43

TRAVEL 2

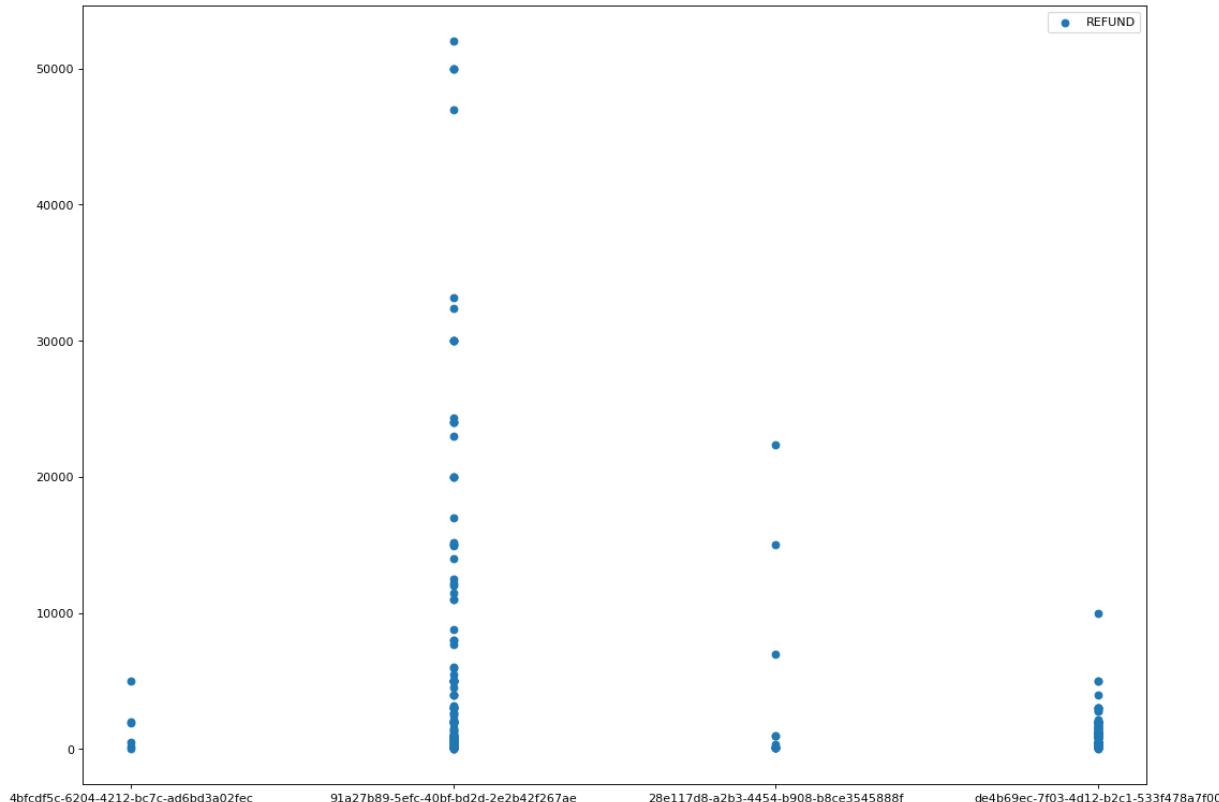
LIFESTYLE 2

GROCERIES 1

Name: externalParty.transactionCategory, dtype: int64



OTHER 40
Name: externalParty.transactionCategory, dtype: int64



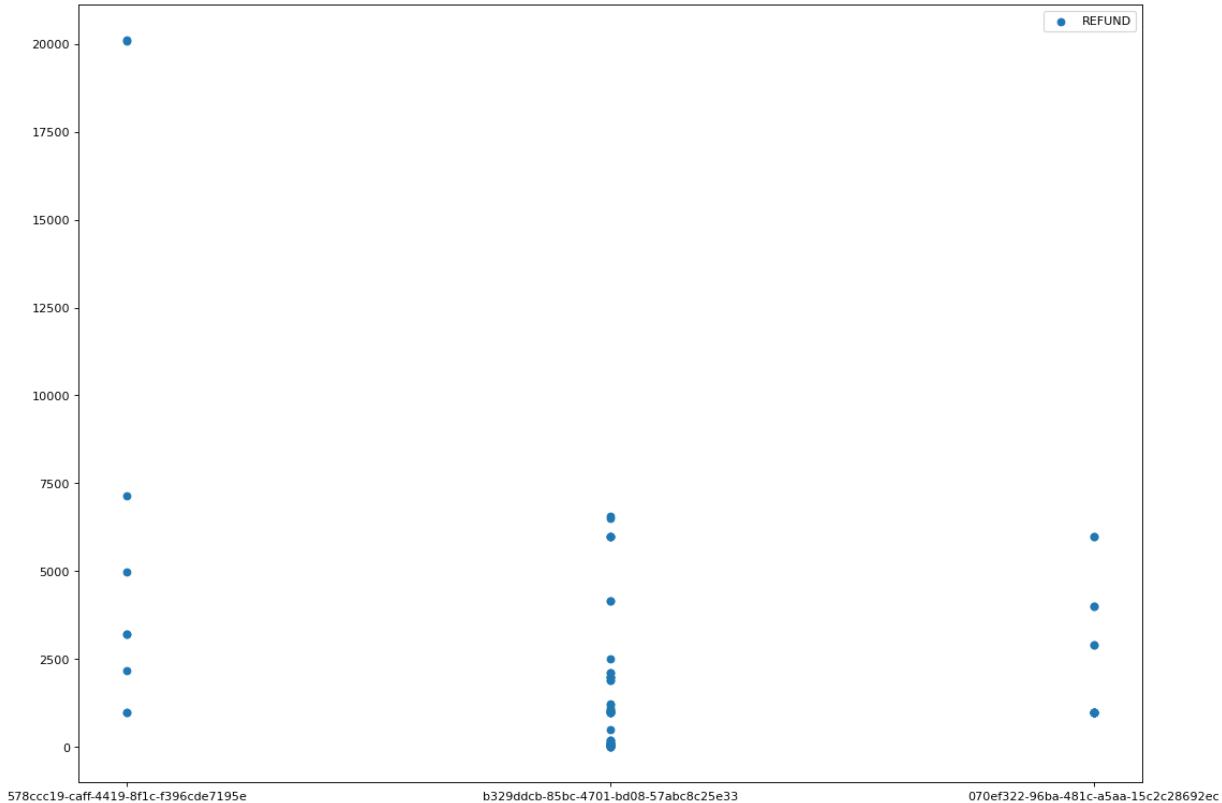
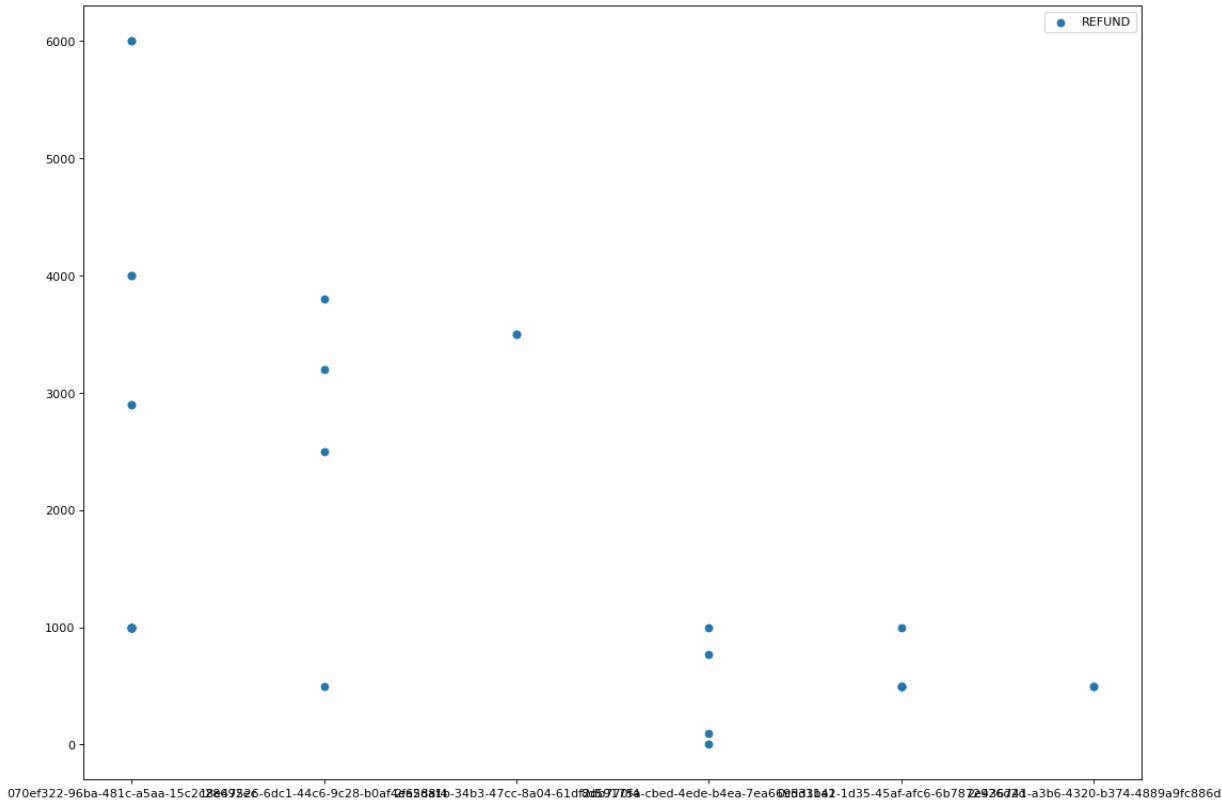
OTHER 217

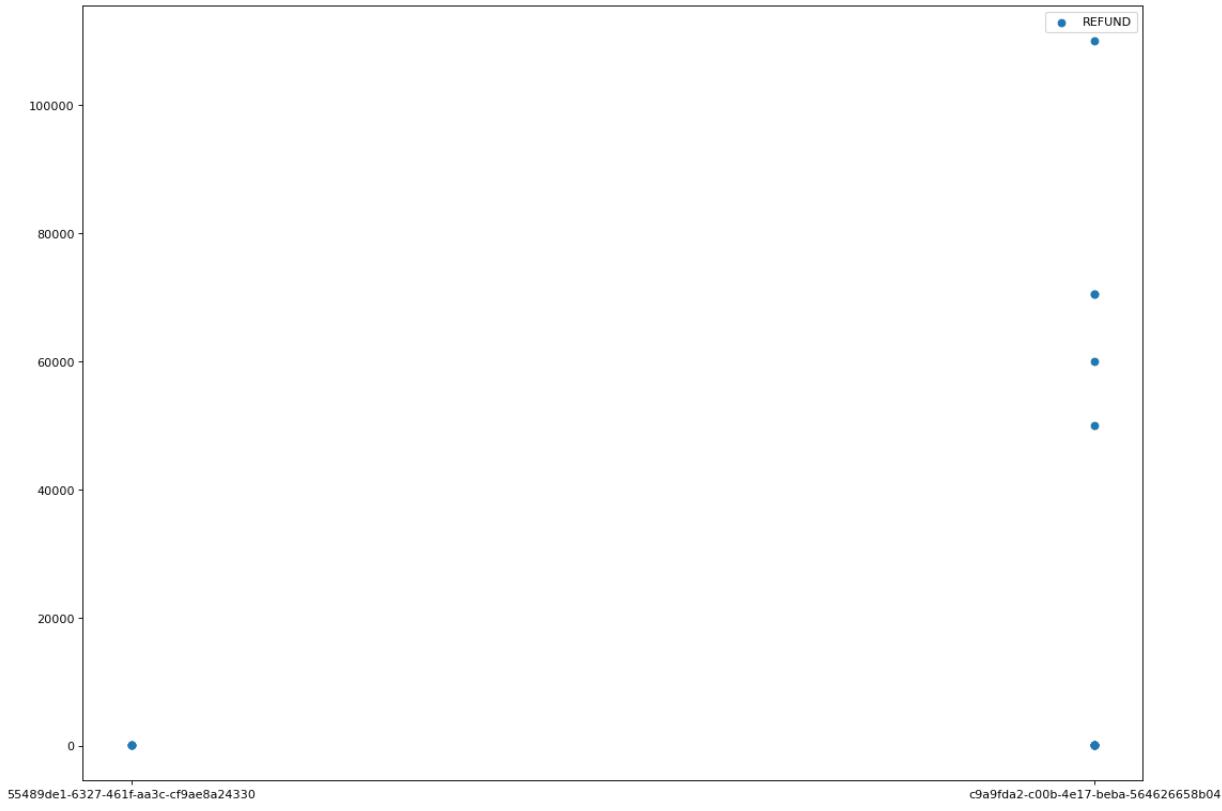
LIFESTYLE 18

GROCERIES 15

TRAVEL 12

Name: externalParty.transactionCategory, dtype: int64





OTHER 17

Name: externalParty.transactionCategory, dtype: int64



OTHER 58

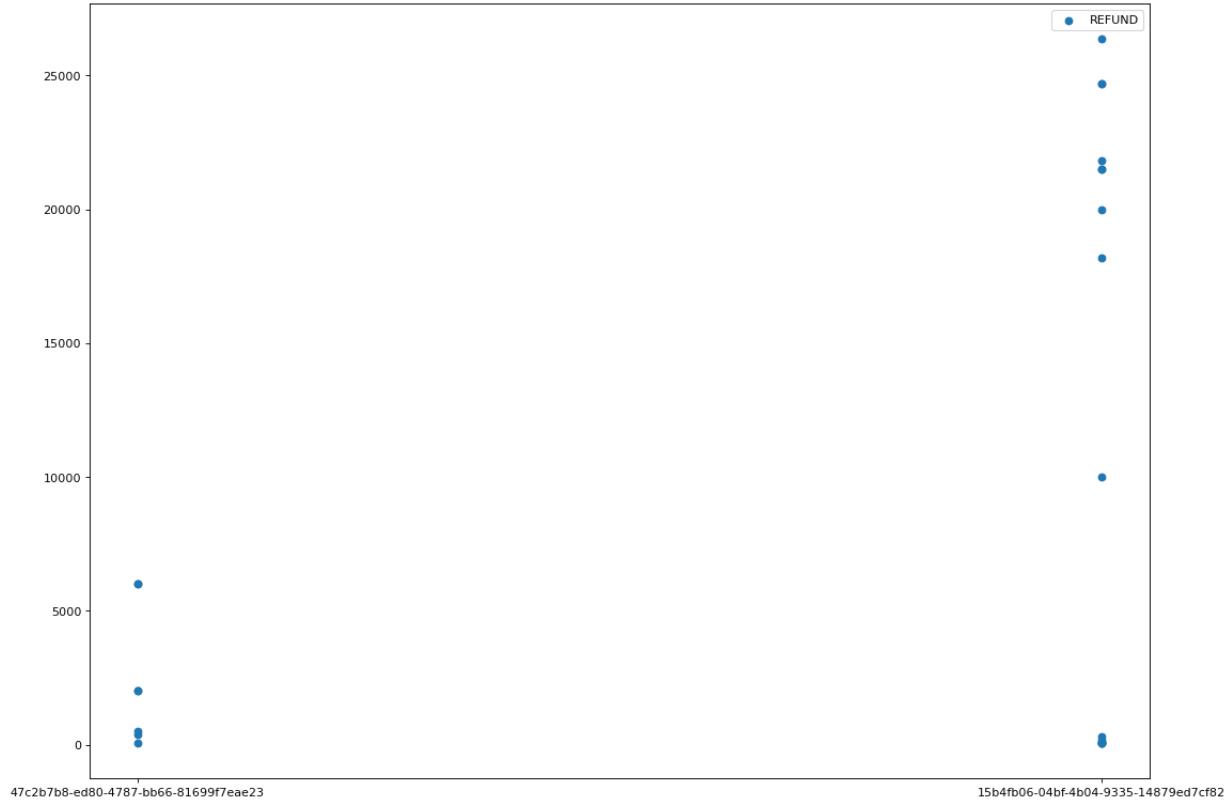
TRAVEL 34

GROCERIES 6

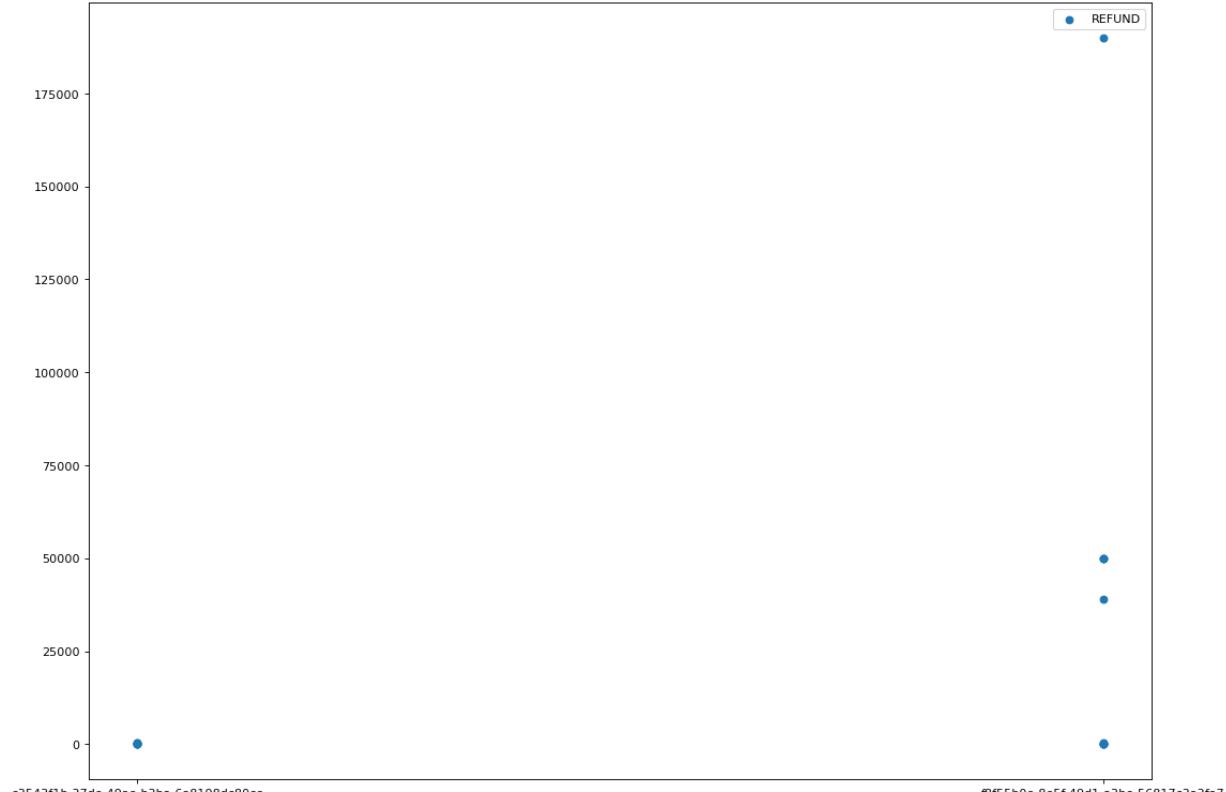
SHOPPING 5

LIFESTYLE 4

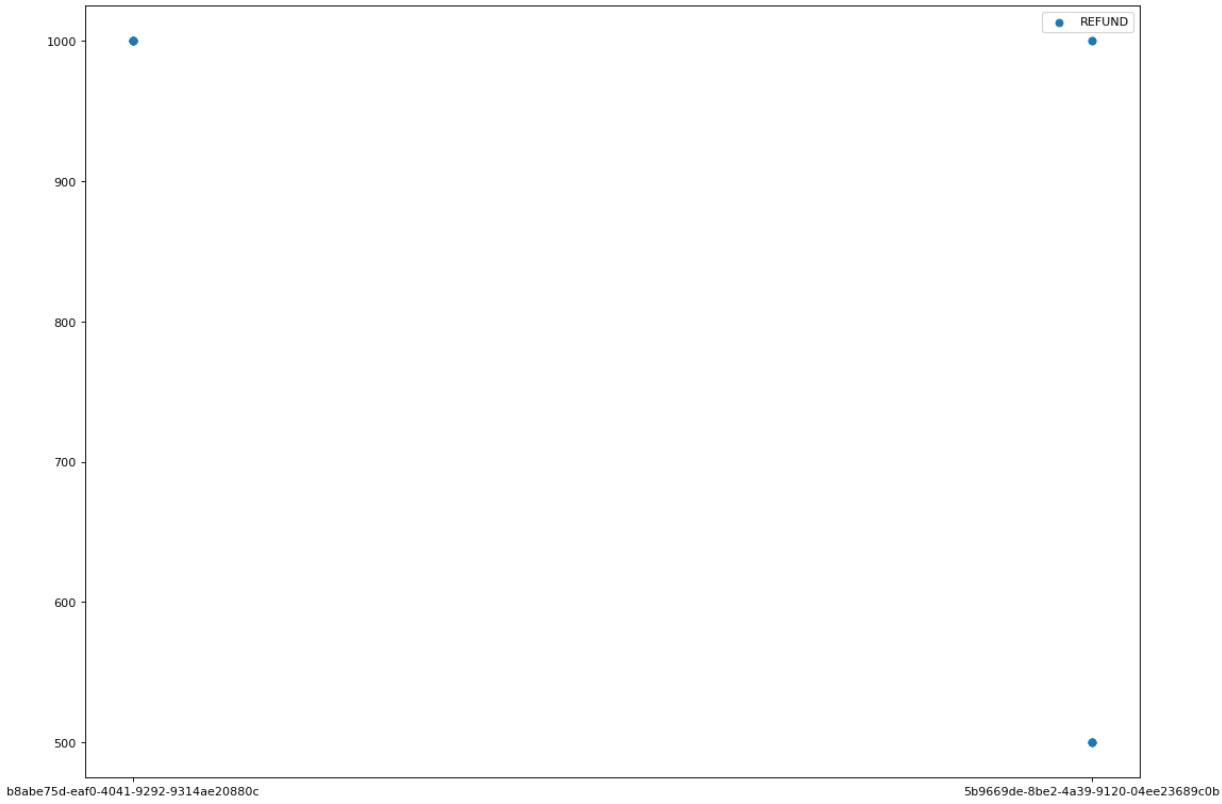
Name: externalParty.transactionCategory, dtype: int64



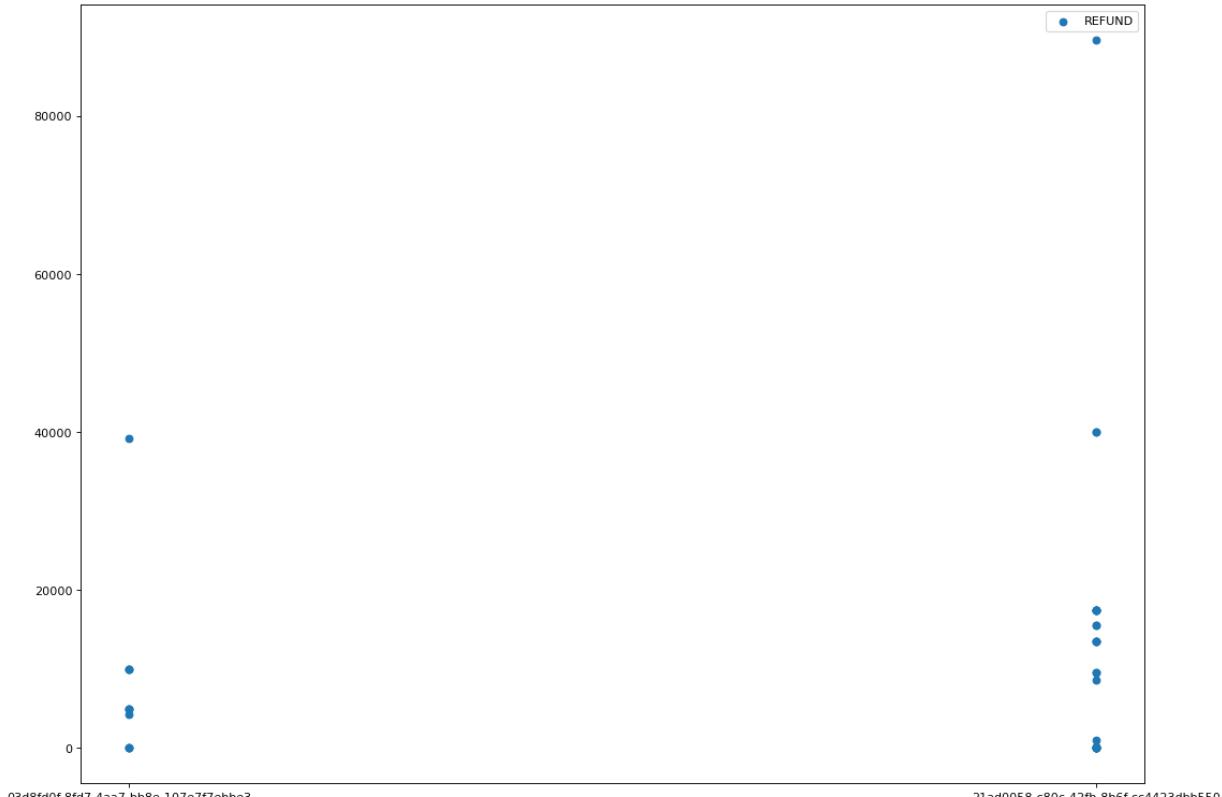
OTHER 23
Name: externalParty.transactionCategory, dtype: int64



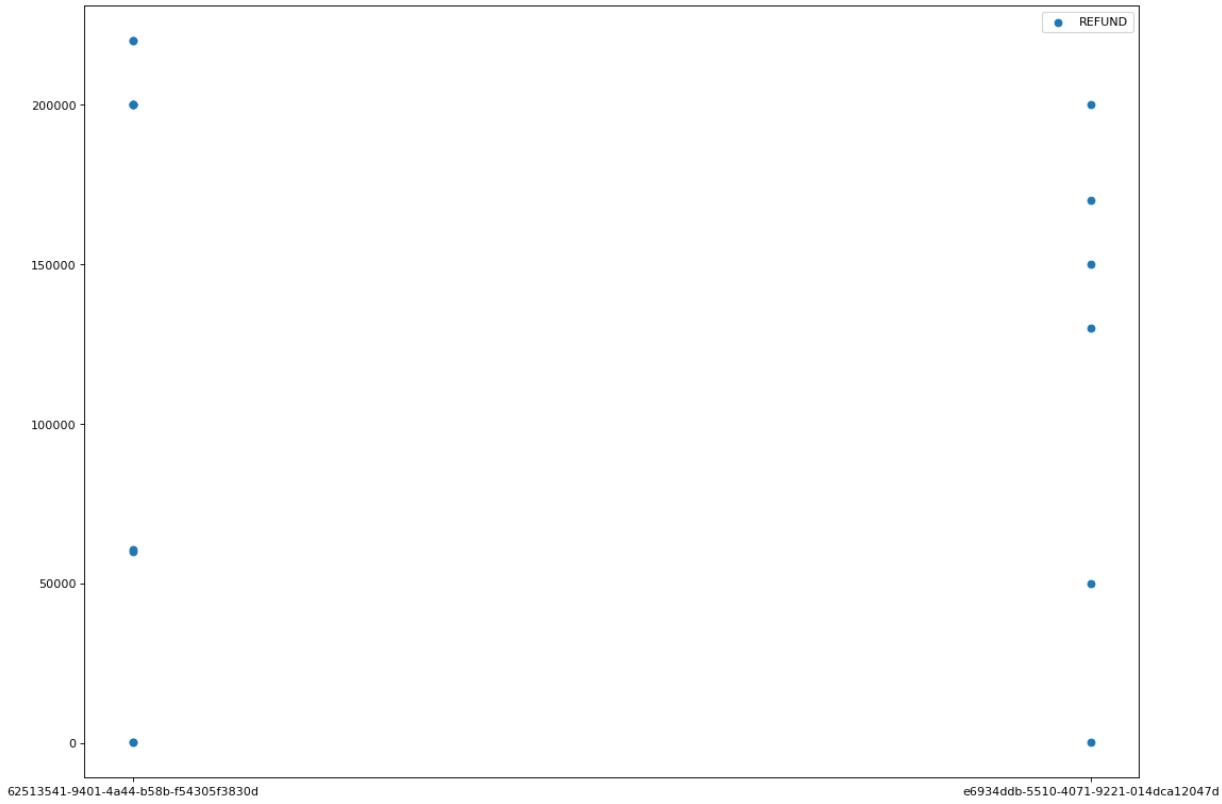
OTHER 18
Name: externalParty.transactionCategory, dtype: int64



OTHER 12
Name: externalParty.transactionCategory, dtype: int64

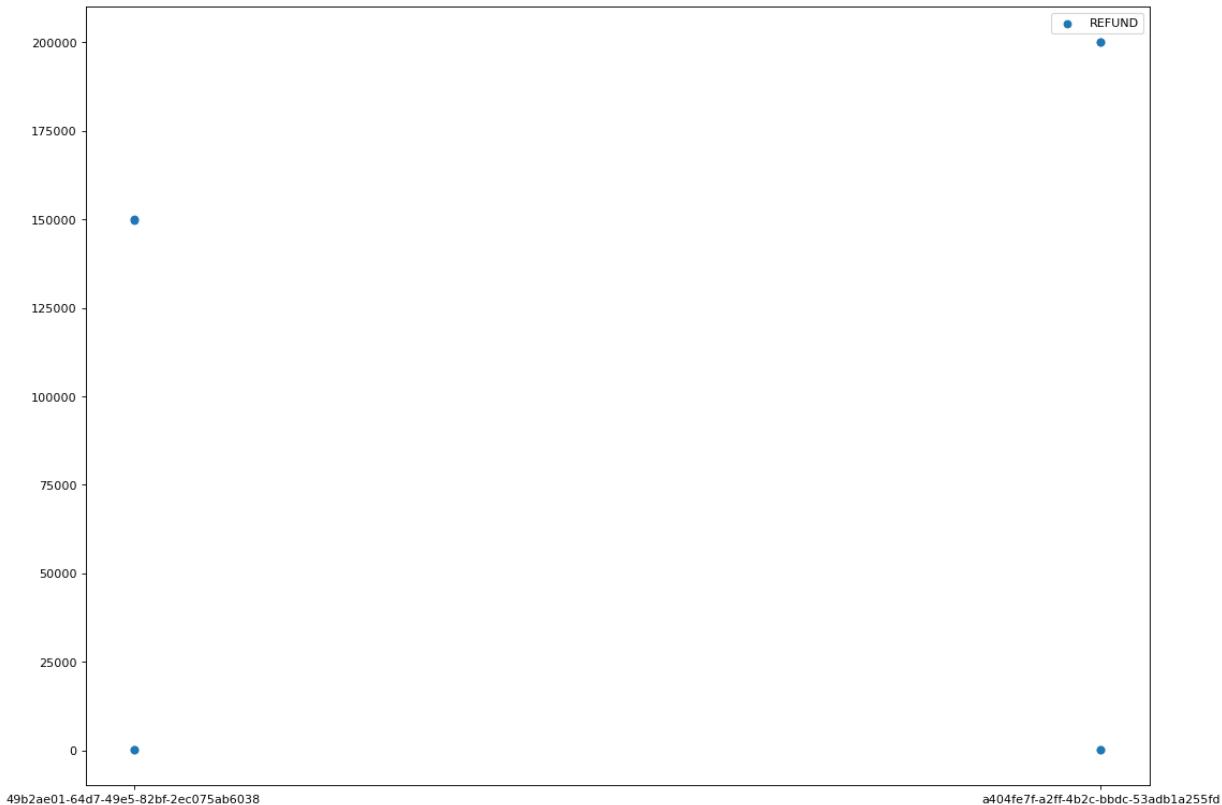


OTHER 38
Name: externalParty.transactionCategory, dtype: int64



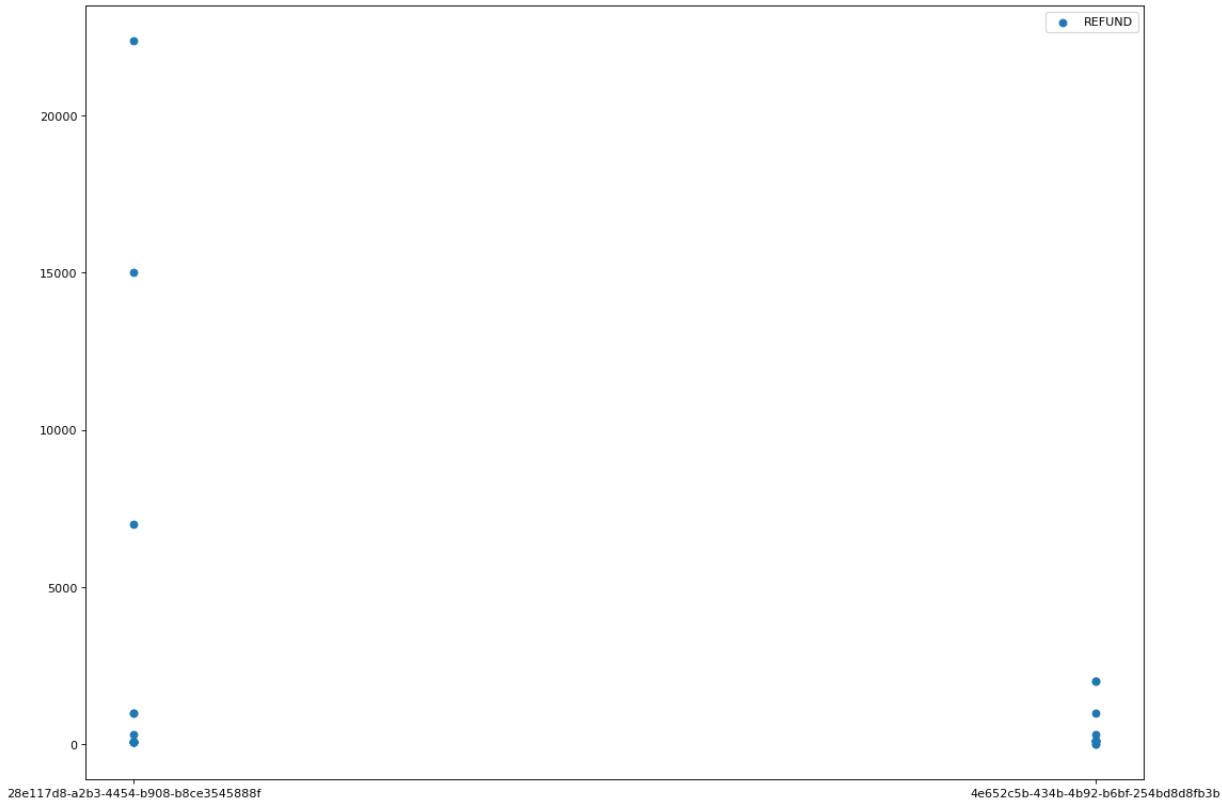
OTHER 16

Name: externalParty.transactionCategory, dtype: int64



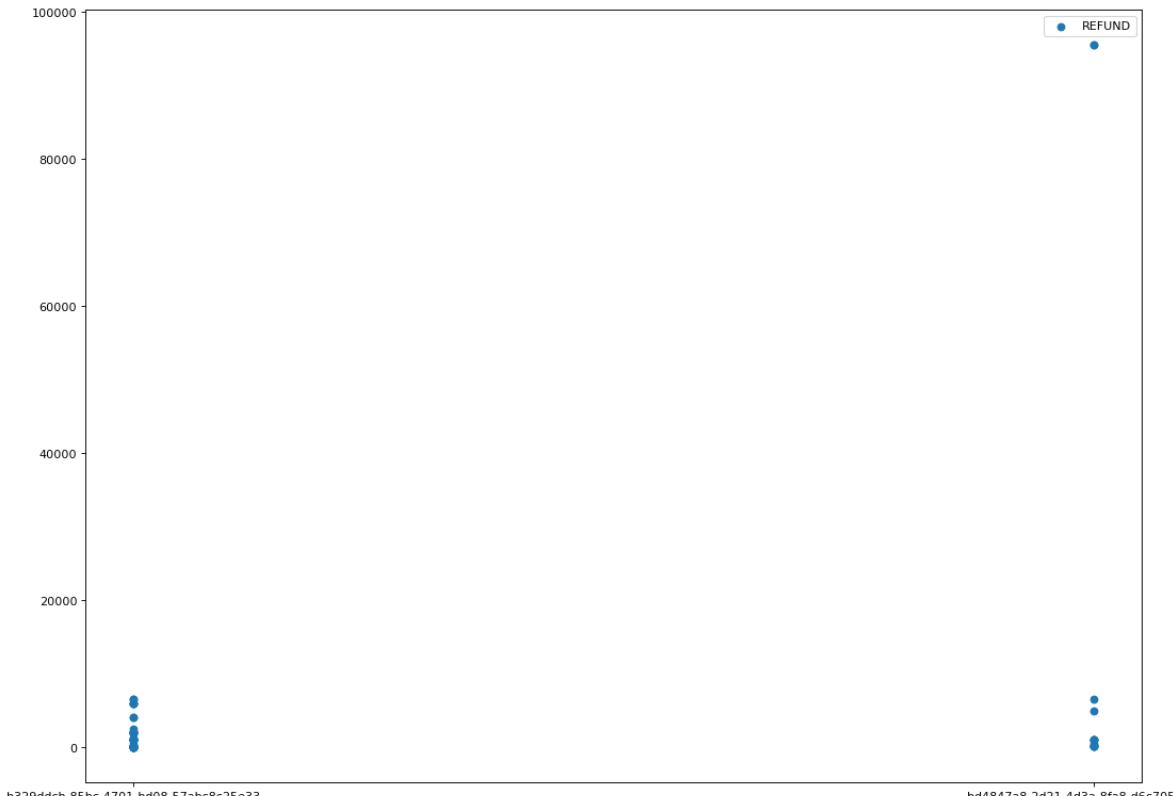
OTHER 8

Name: externalParty.transactionCategory, dtype: int64



OTHER 26

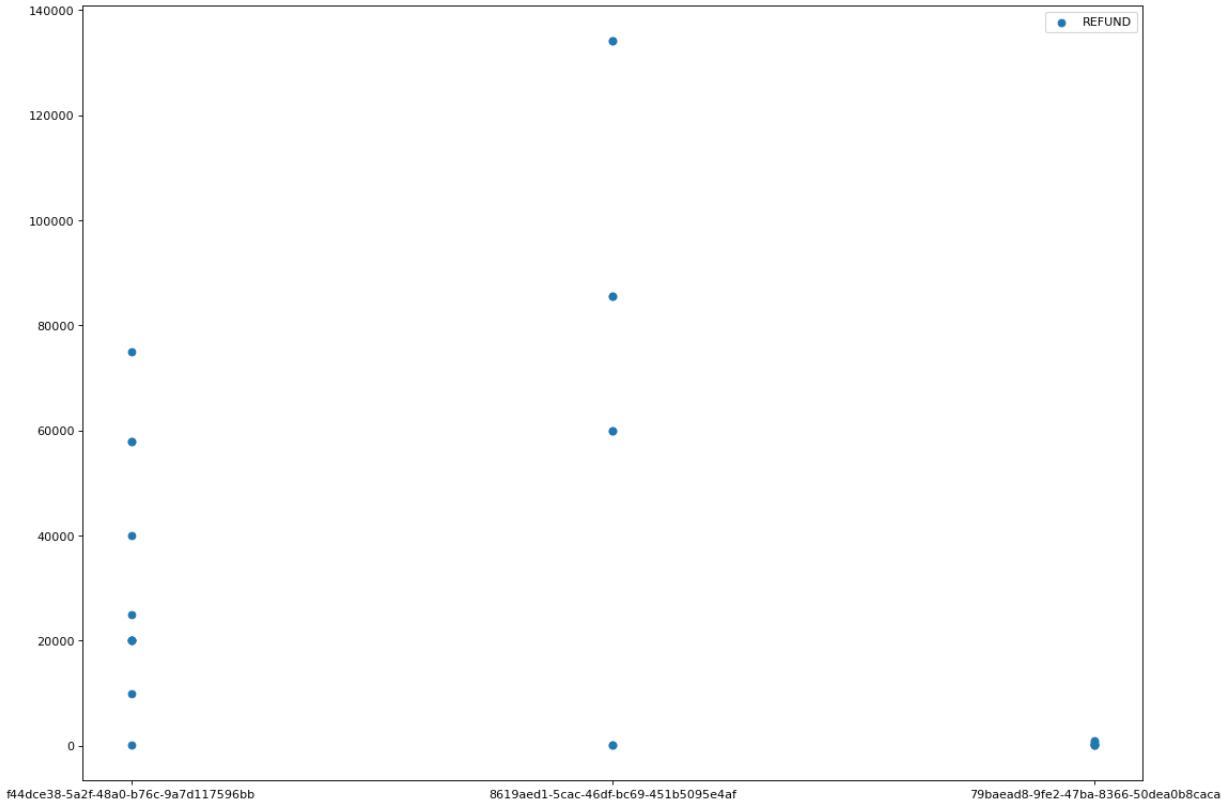
Name: externalParty.transactionCategory, dtype: int64



OTHER 57

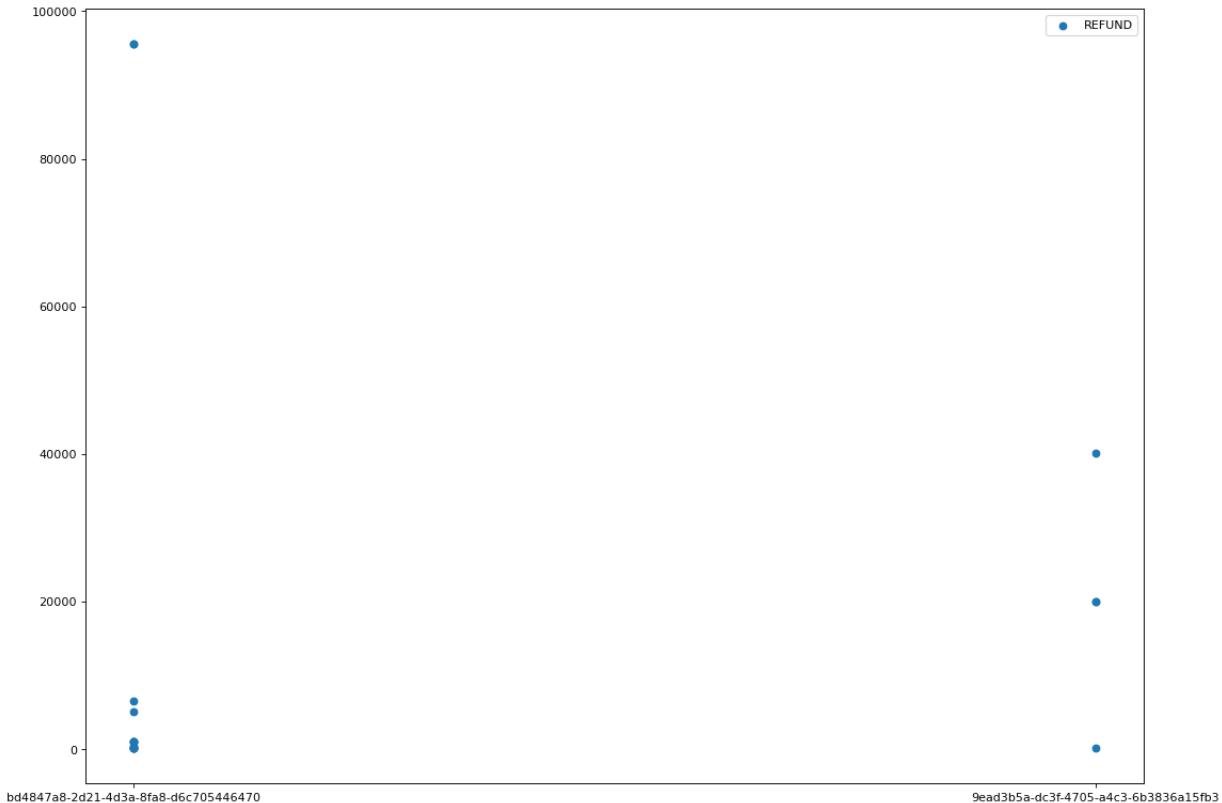
LIFESTYLE 4

Name: externalParty.transactionCategory, dtype: int64



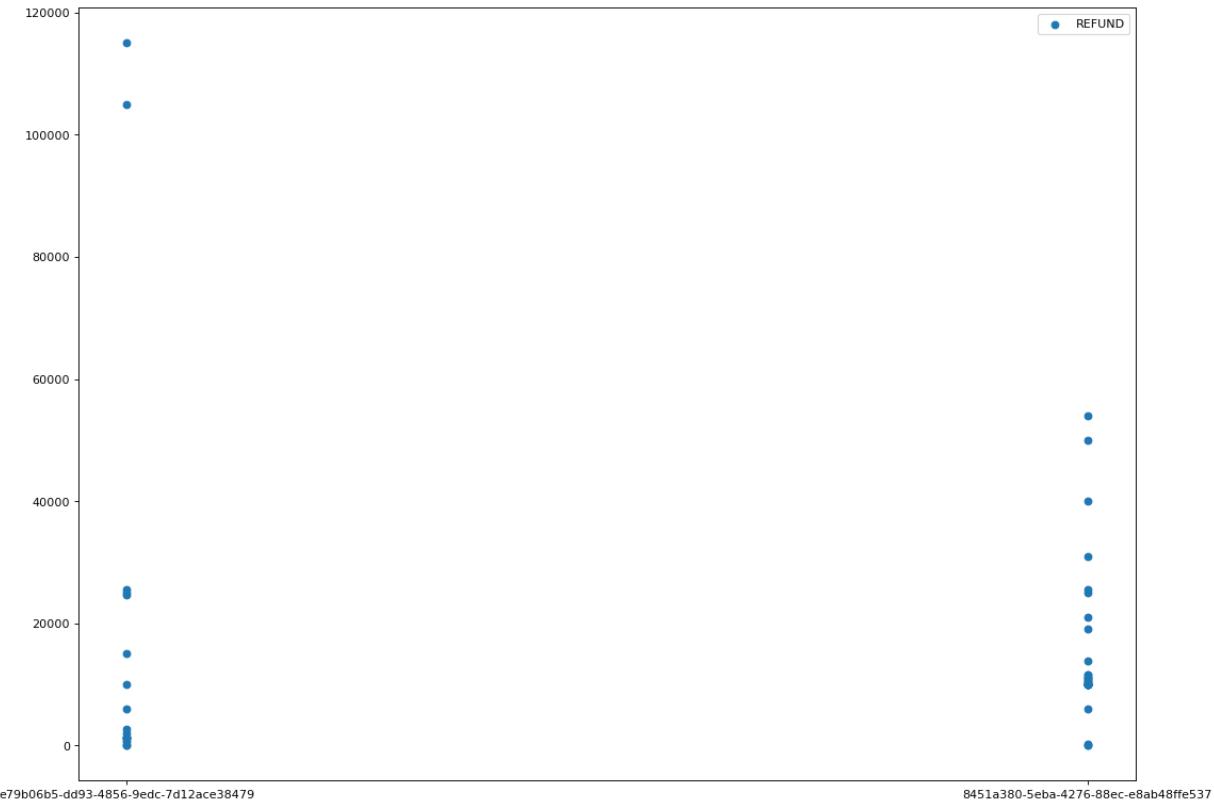
OTHER 26

Name: externalParty.transactionCategory, dtype: int64



OTHER 18

Name: externalParty.transactionCategory, dtype: int64



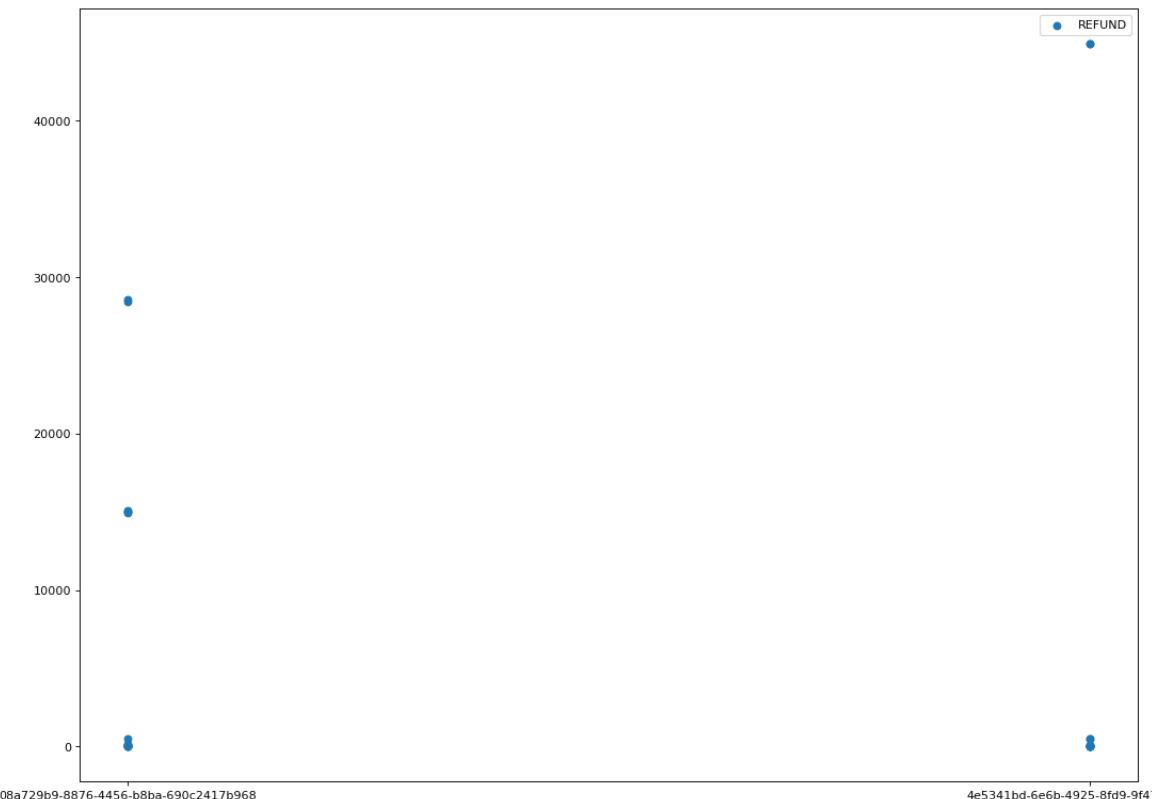
OTHER 47

LIFESTYLE 1

TRAVEL 1

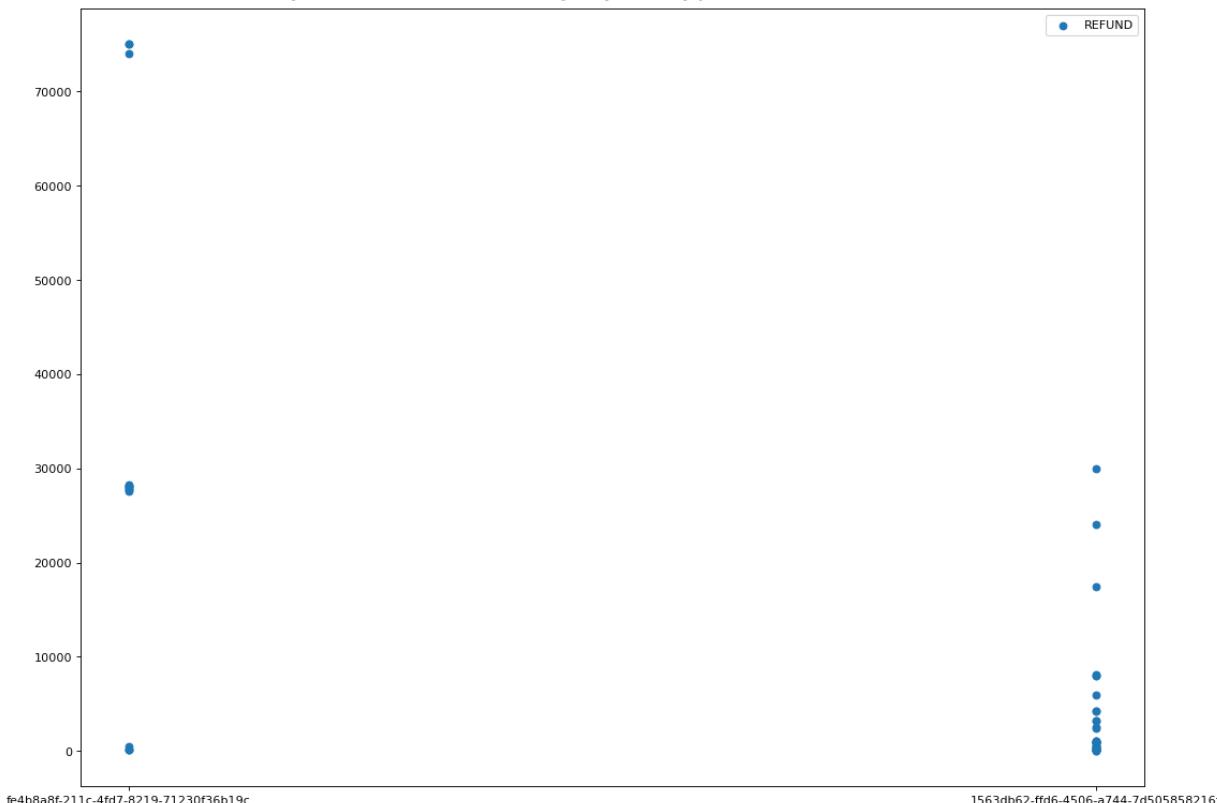
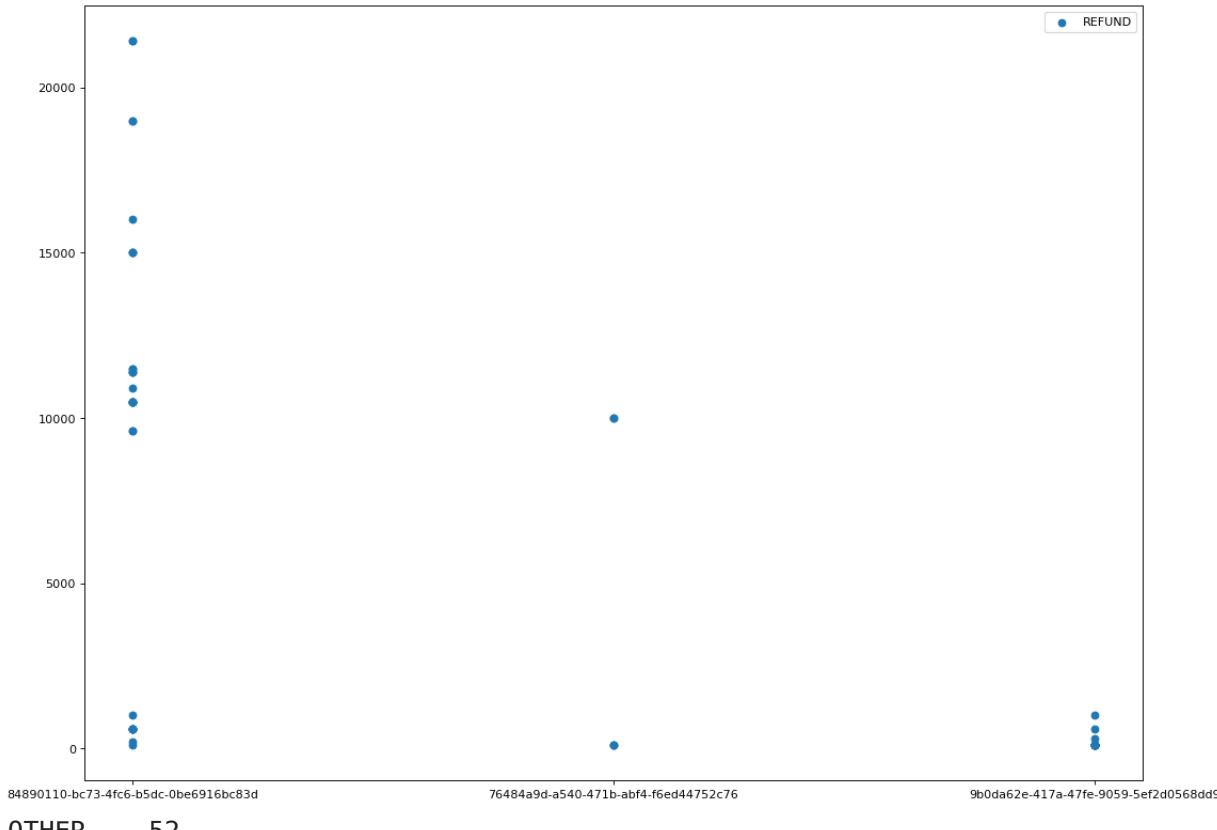
GROCERIES 1

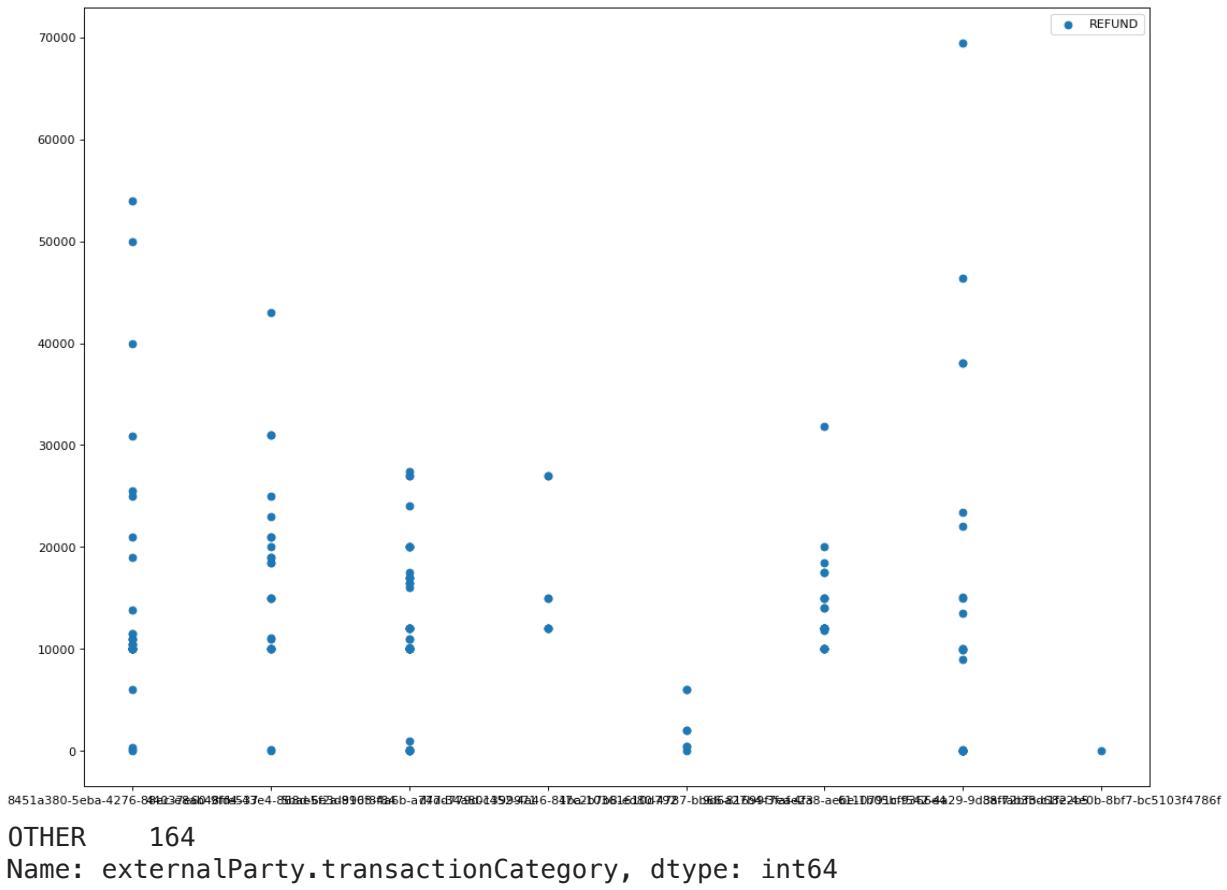
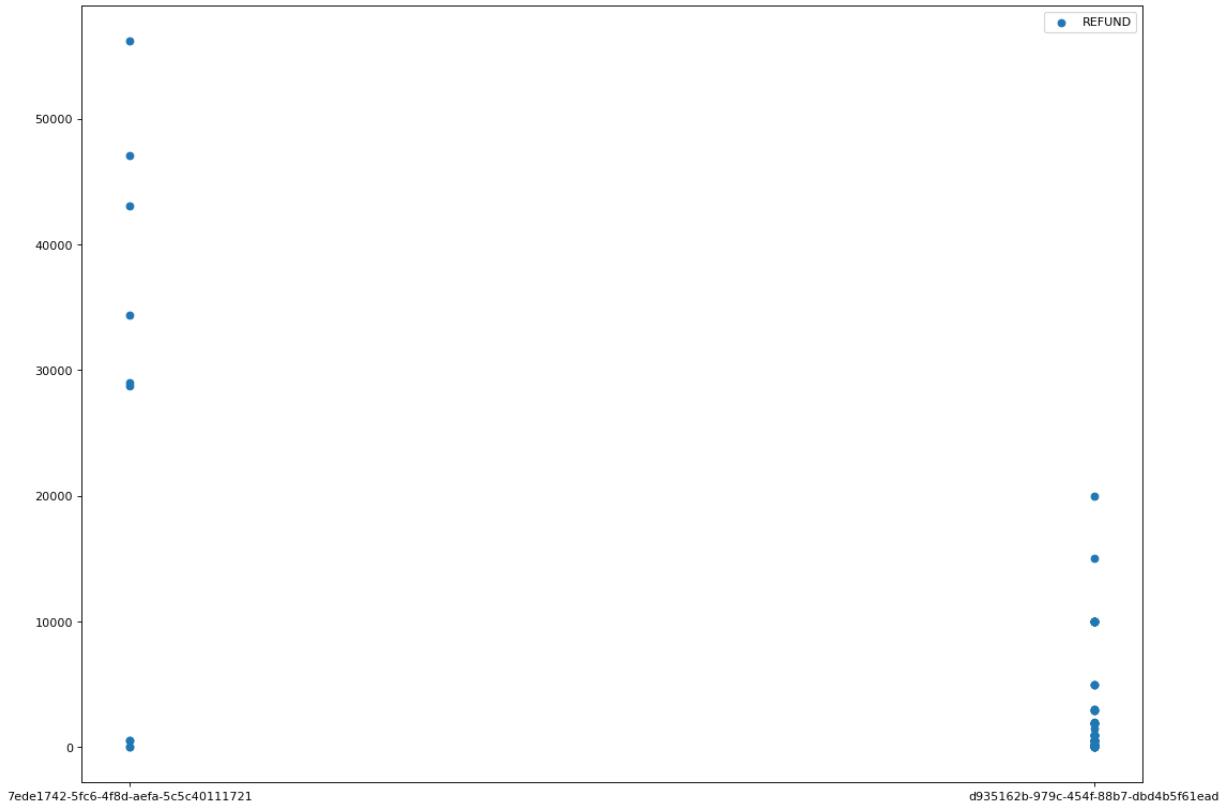
Name: externalParty.transactionCategory, dtype: int64

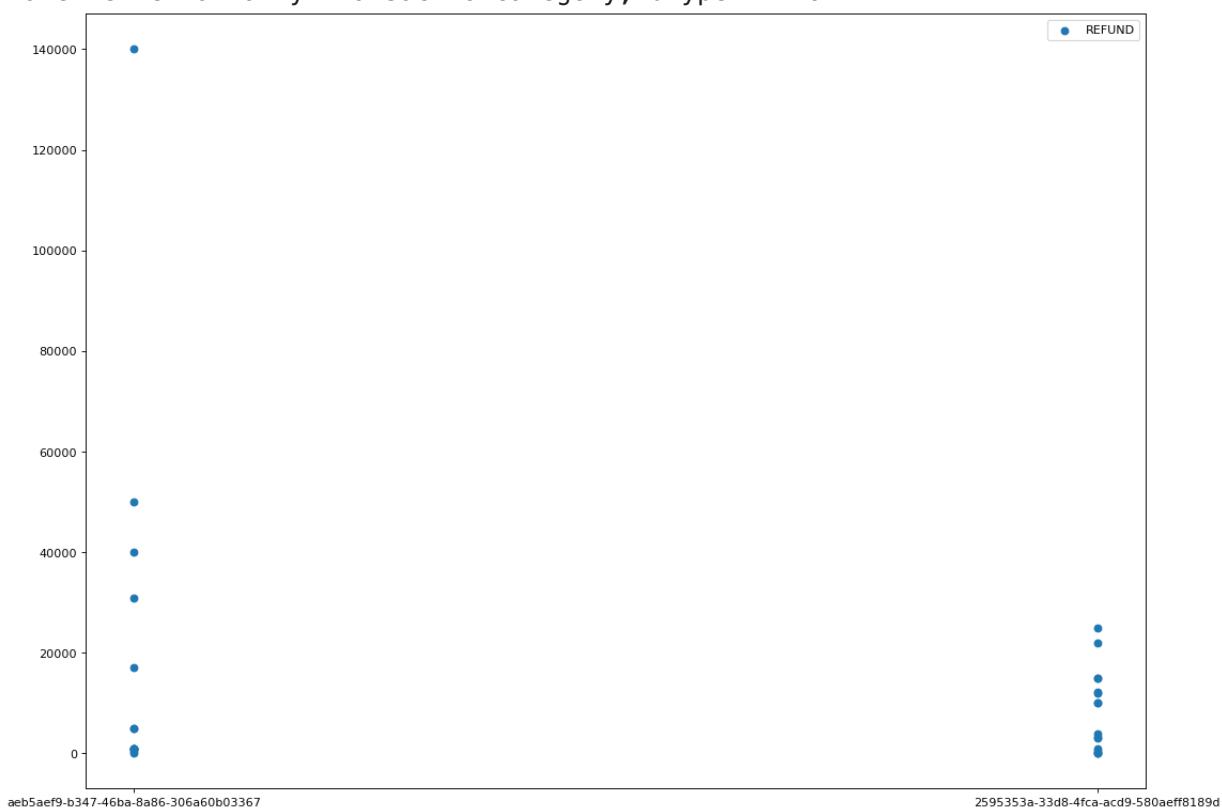
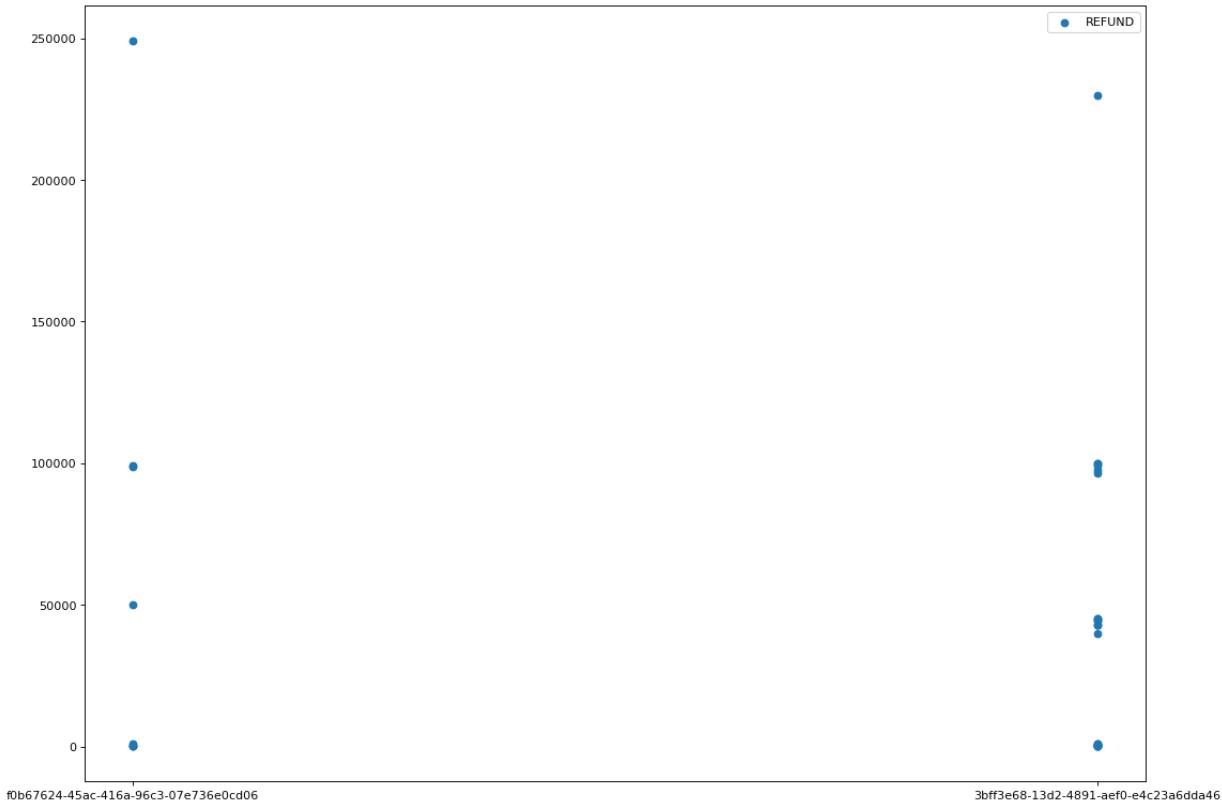


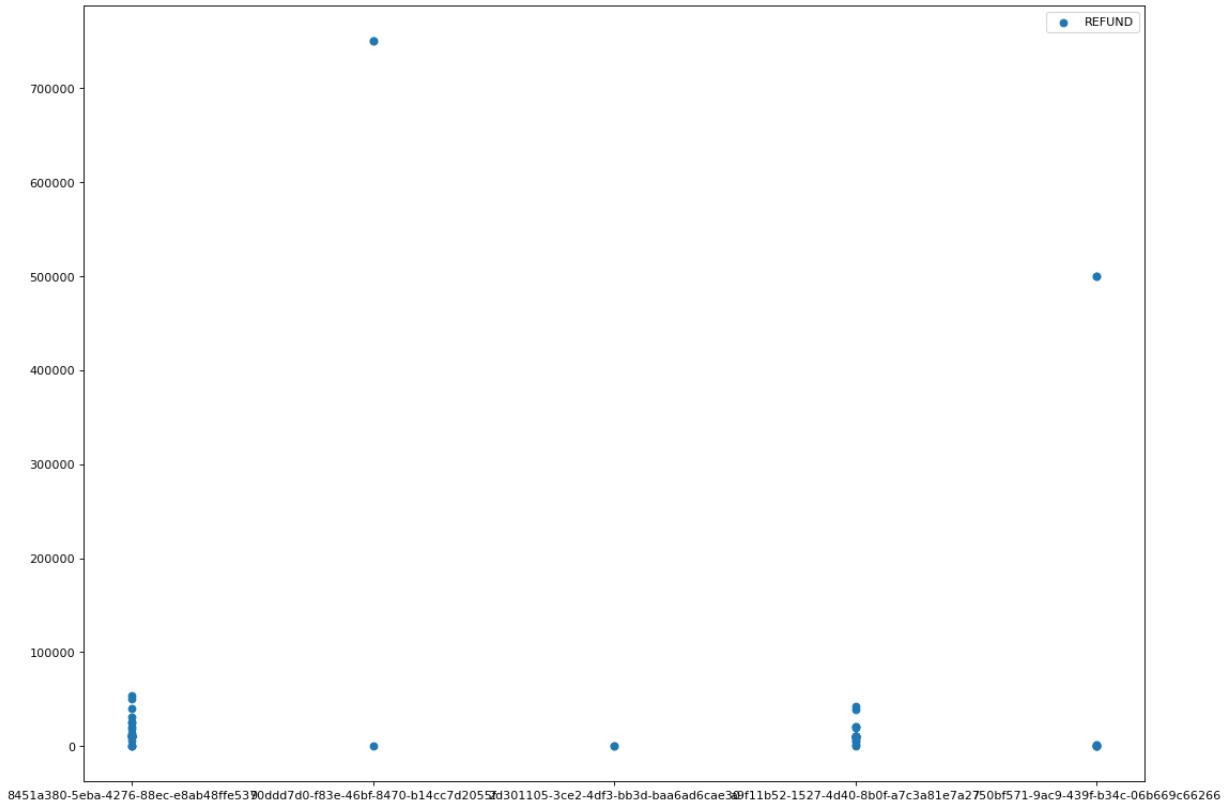
OTHER 30

Name: externalParty.transactionCategory, dtype: int64



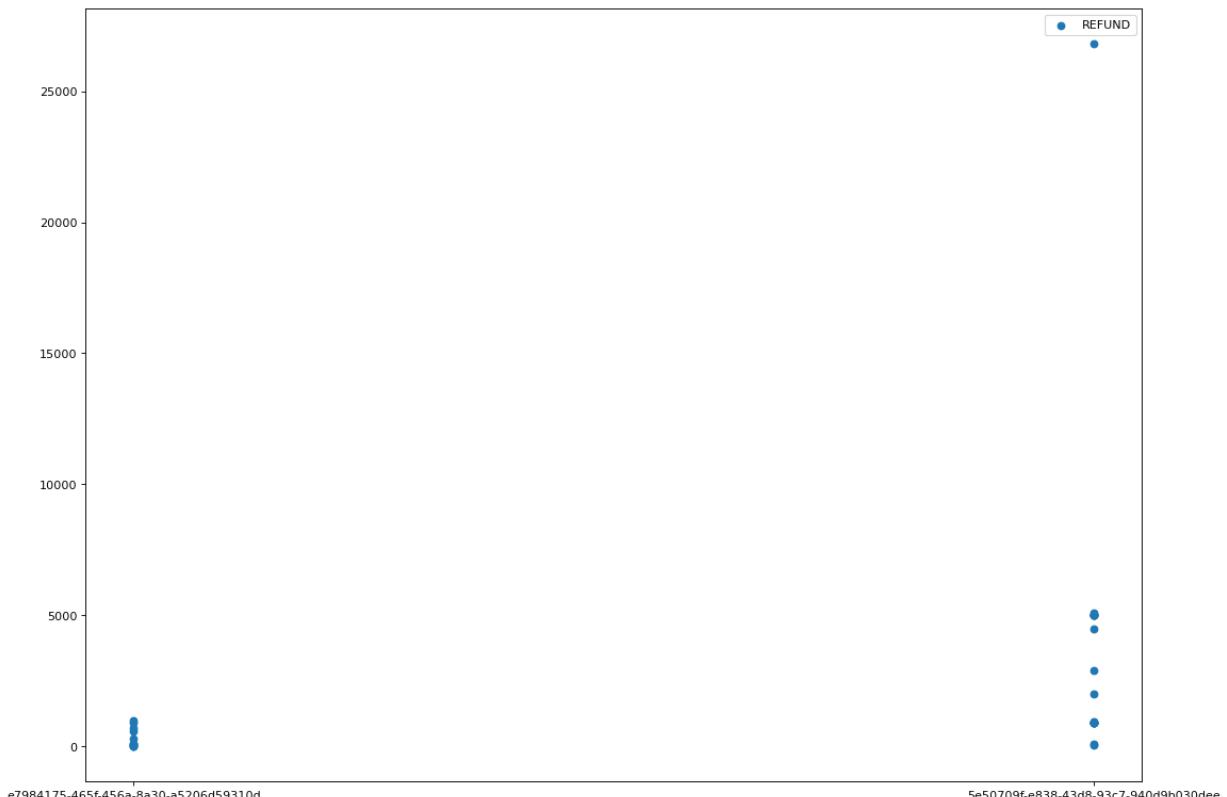






OTHER 64

Name: externalParty.transactionCategory, dtype: int64

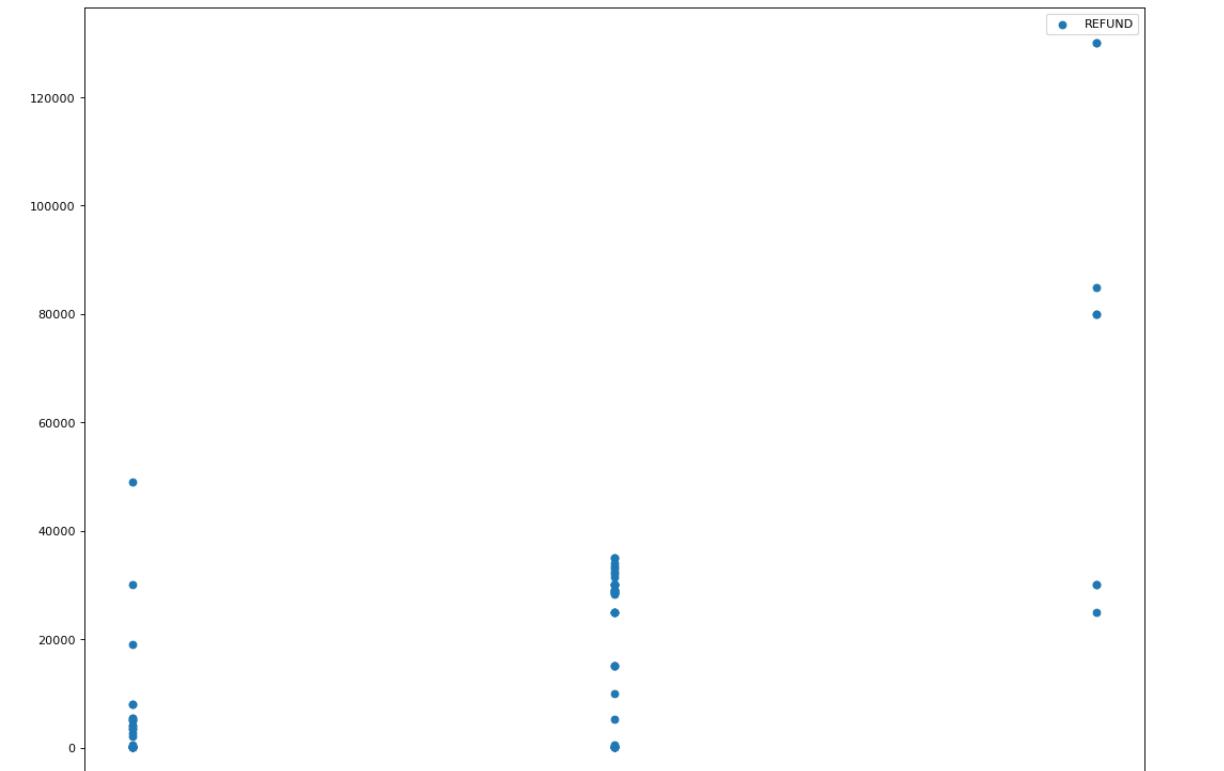
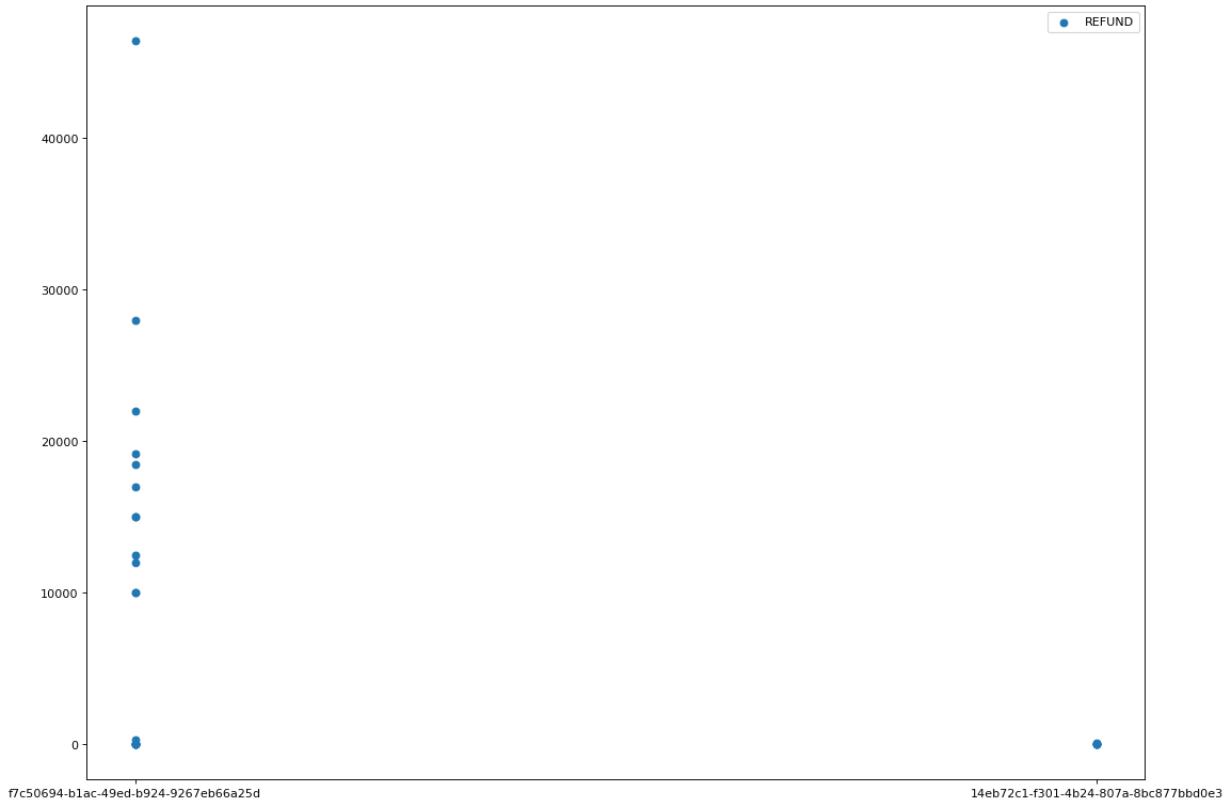


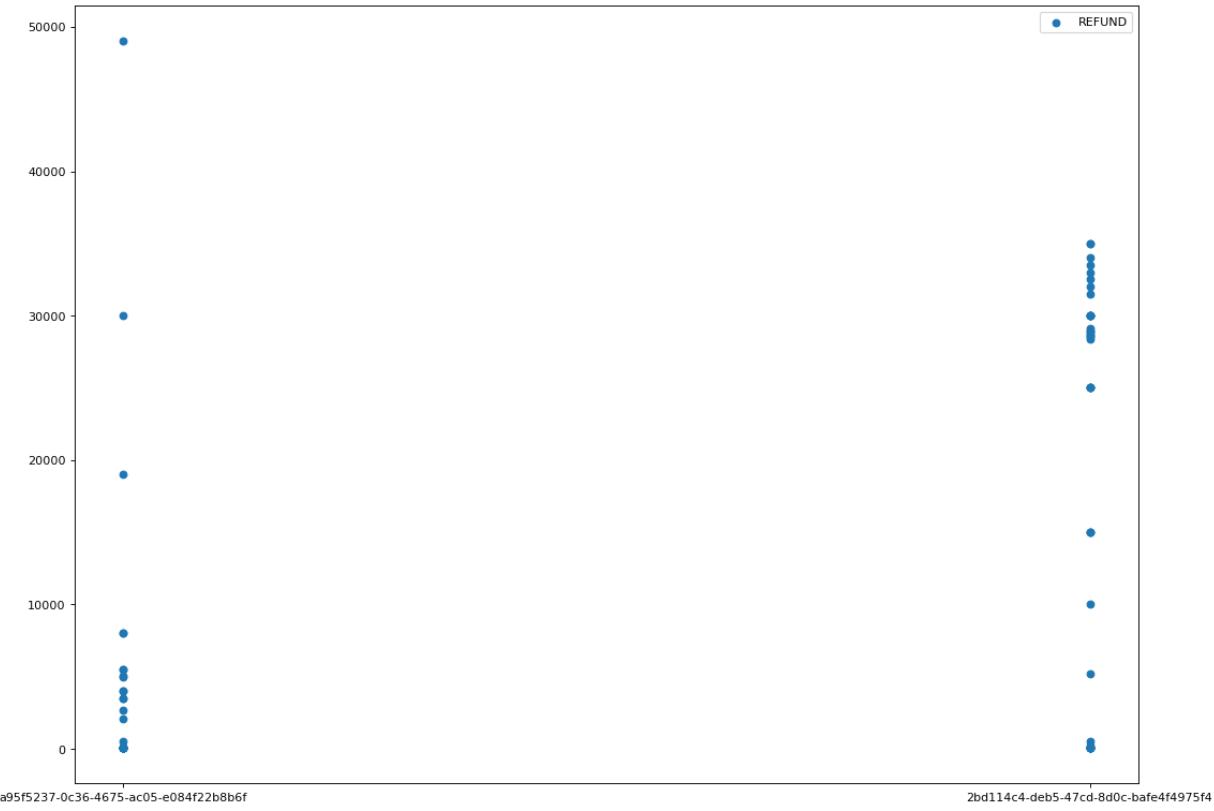
OTHER 29

GROCERIES 2

SHOPPING 1

Name: externalParty.transactionCategory, dtype: int64

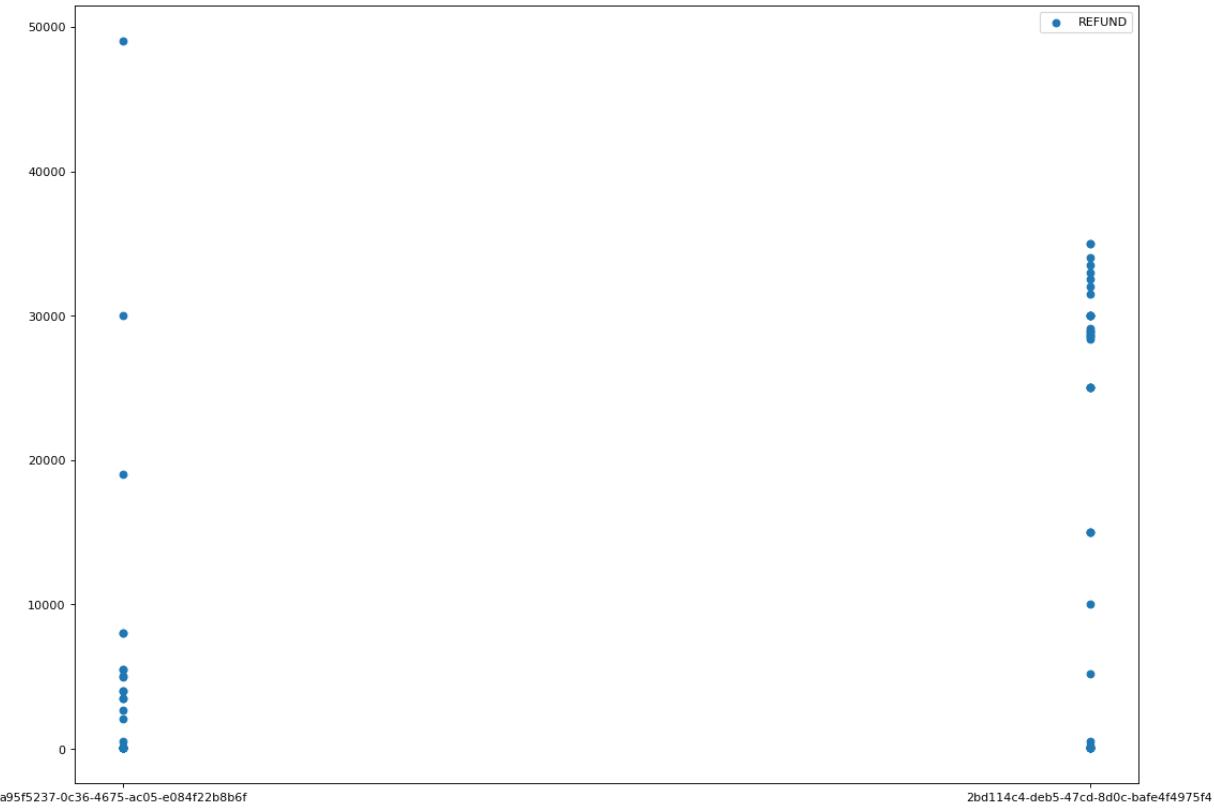




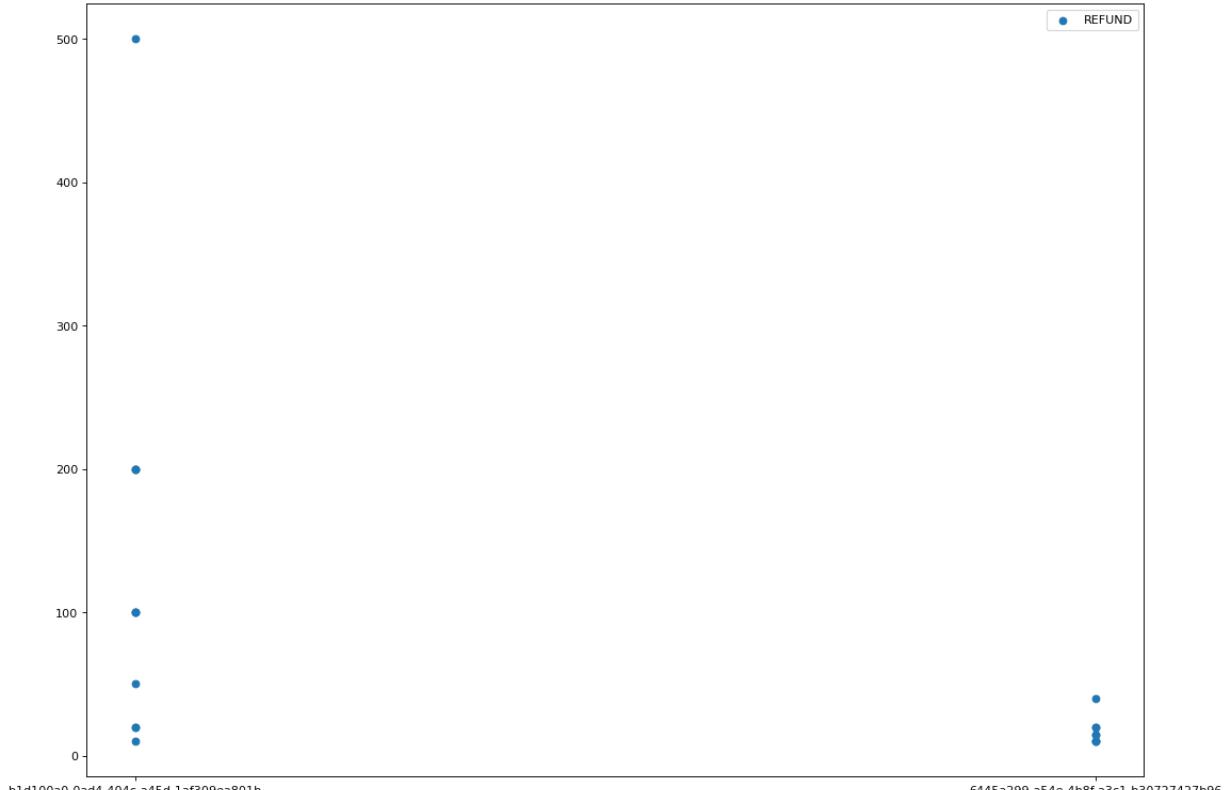
OTHER 74
Name: externalParty.transactionCategory, dtype: int64



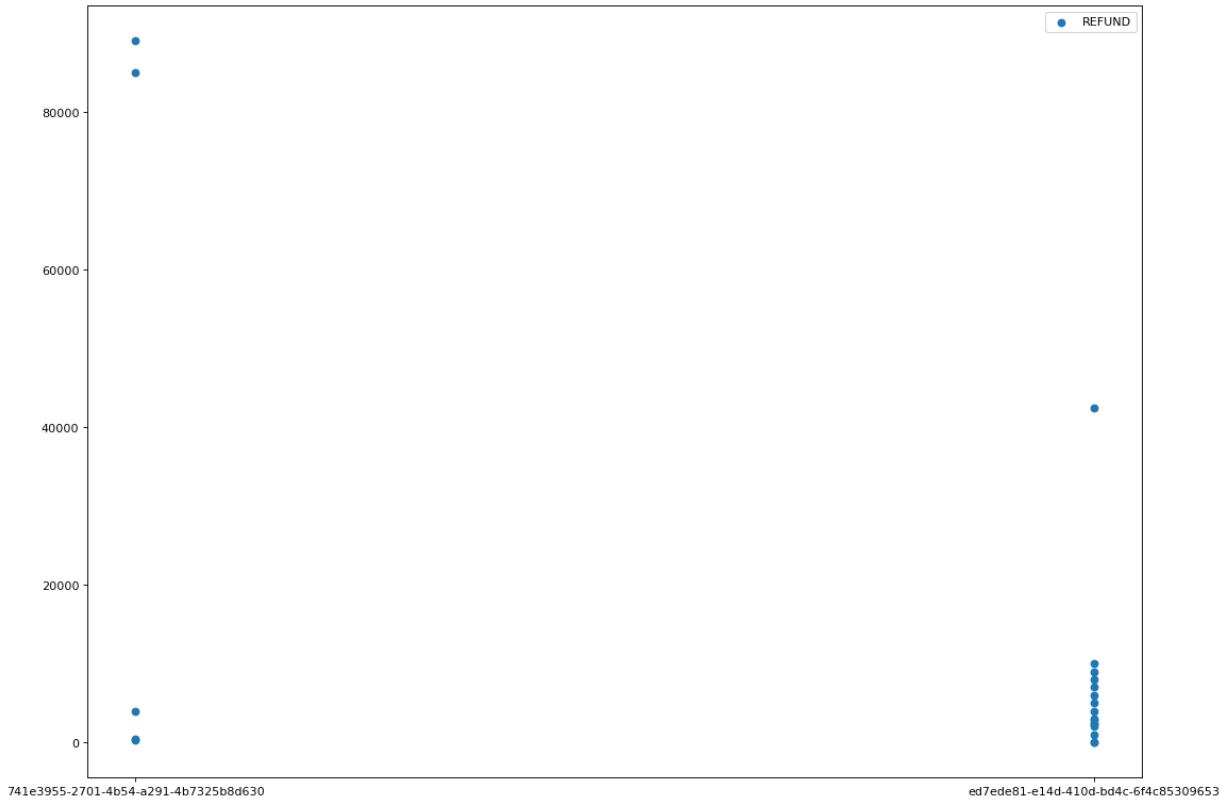
OTHER 10
Name: externalParty.transactionCategory, dtype: int64



OTHER 74
Name: externalParty.transactionCategory, dtype: int64

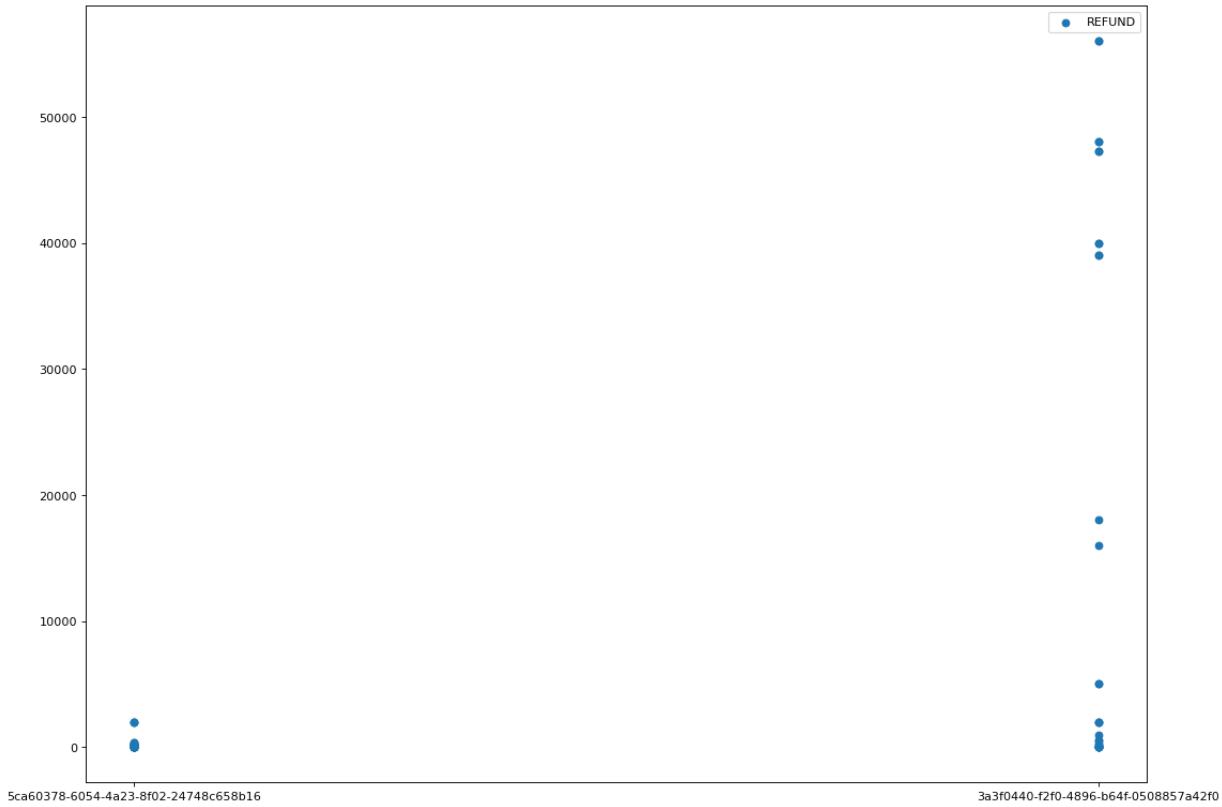


OTHER 19
Name: externalParty.transactionCategory, dtype: int64



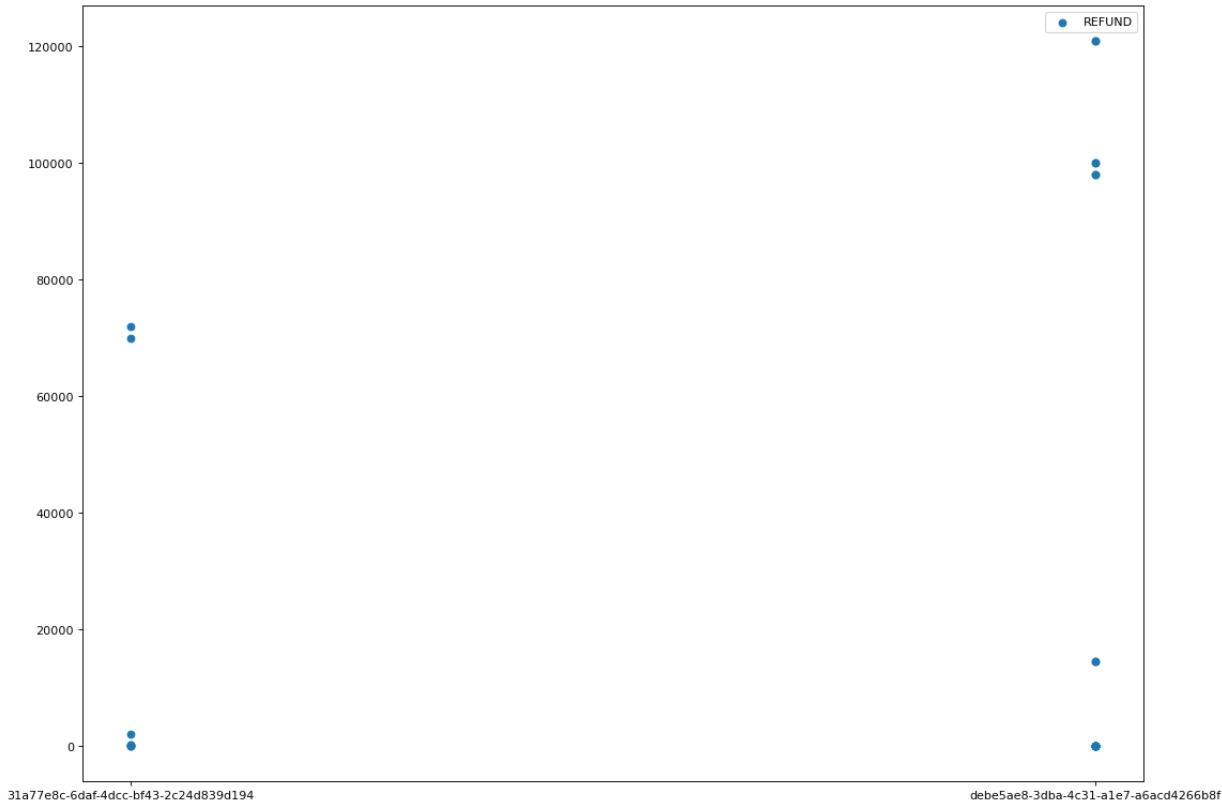
OTHER 21

Name: externalParty.transactionCategory, dtype: int64



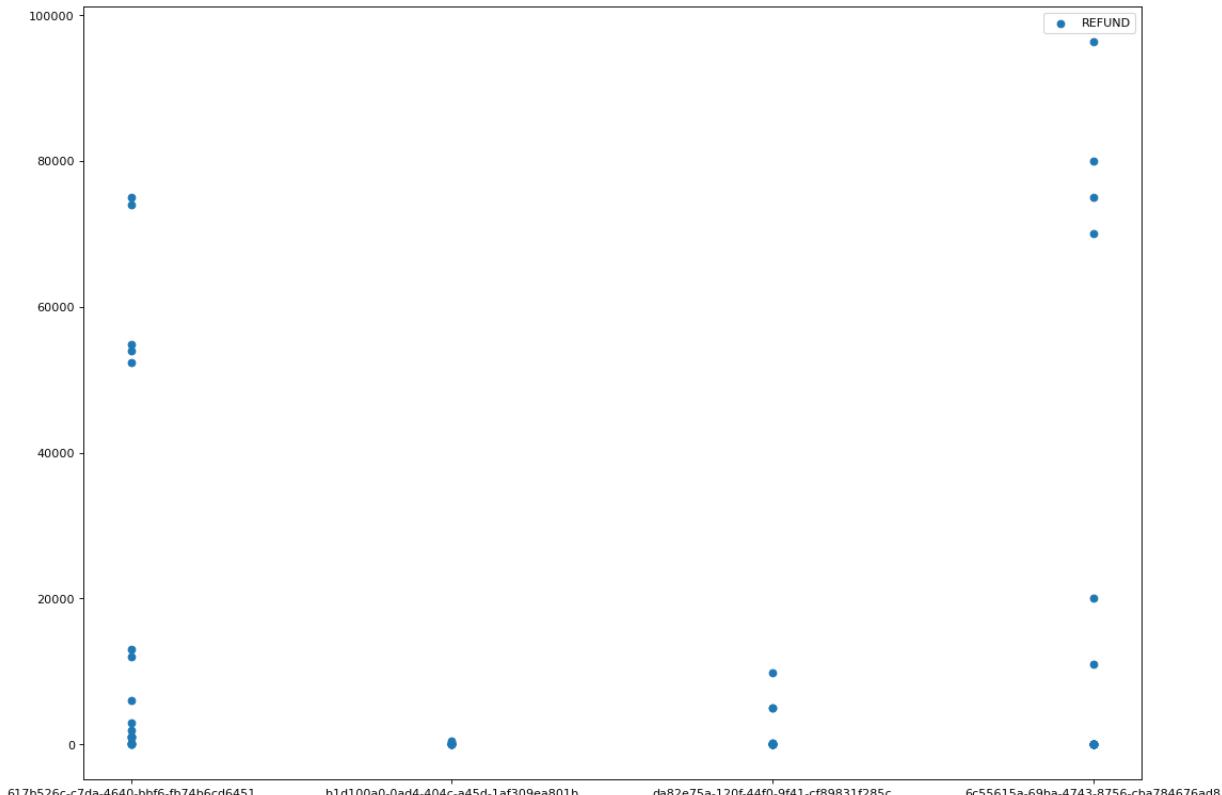
OTHER 94

Name: externalParty.transactionCategory, dtype: int64



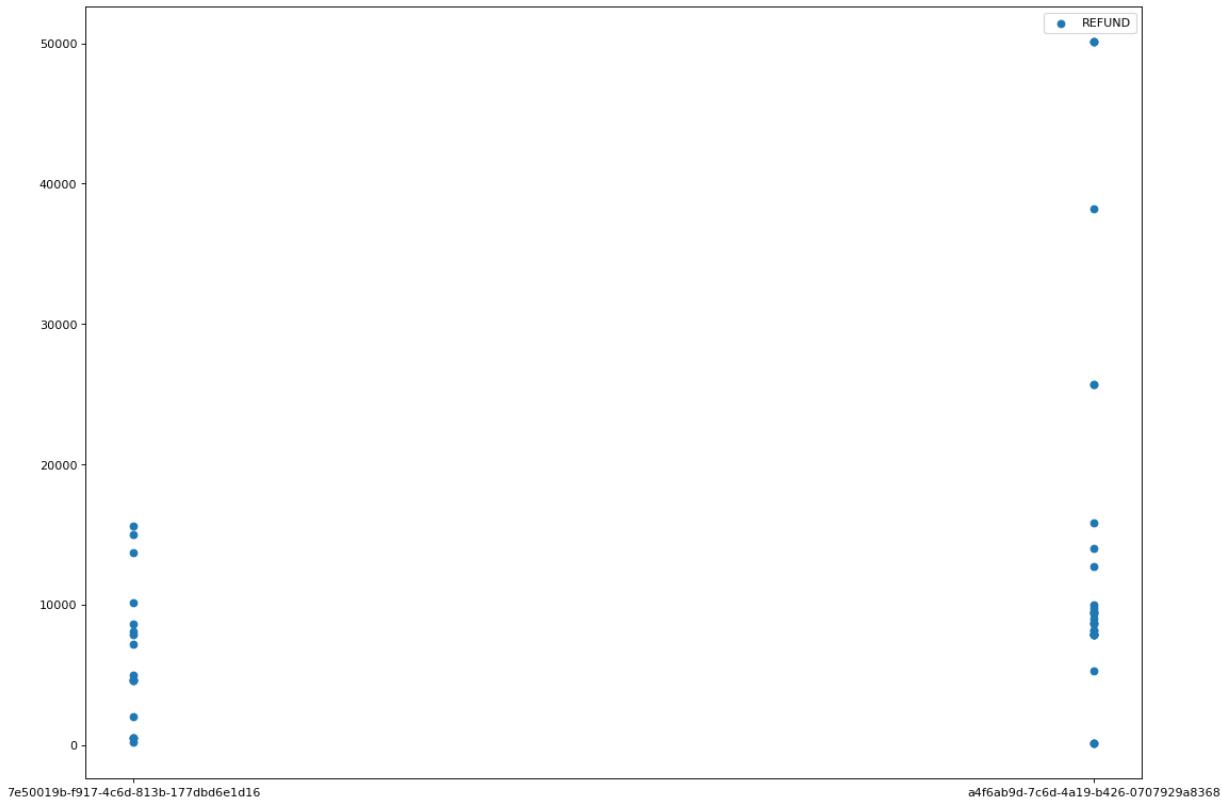
OTHER 29

Name: externalParty.transactionCategory, dtype: int64



OTHER 68

Name: externalParty.transactionCategory, dtype: int64



7e50019b-f917-4c6d-813b-177dbd6e1d16

a4f6ab9d-7c6d-4a19-b426-0707929a8368

OTHER 46

SHOPPING 3

Name: externalParty.transactionCategory, dtype: int64



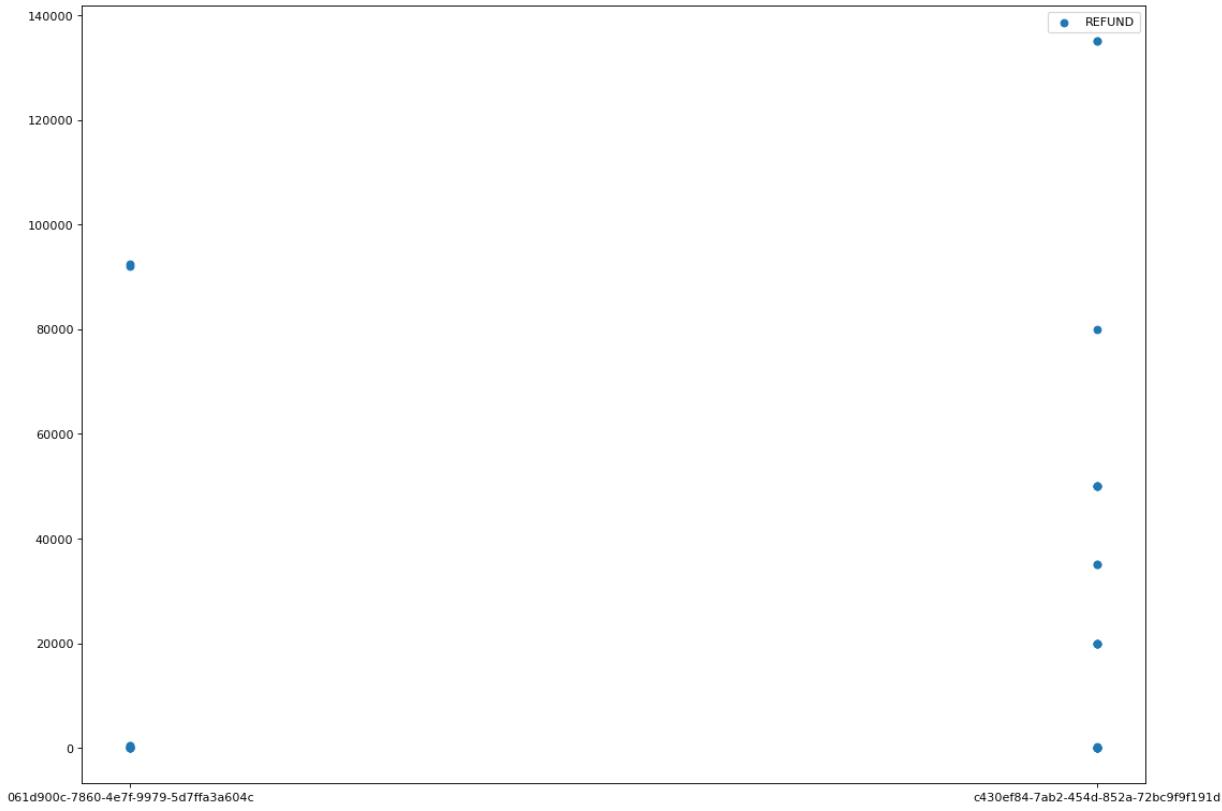
7ca92fb0-0274-4434-88a1-9689c257dc35

8d809041-69e8-46cd-85a5-5e652302fcfb

f16d504c-63aa-44b0-86f0-530f43307a50

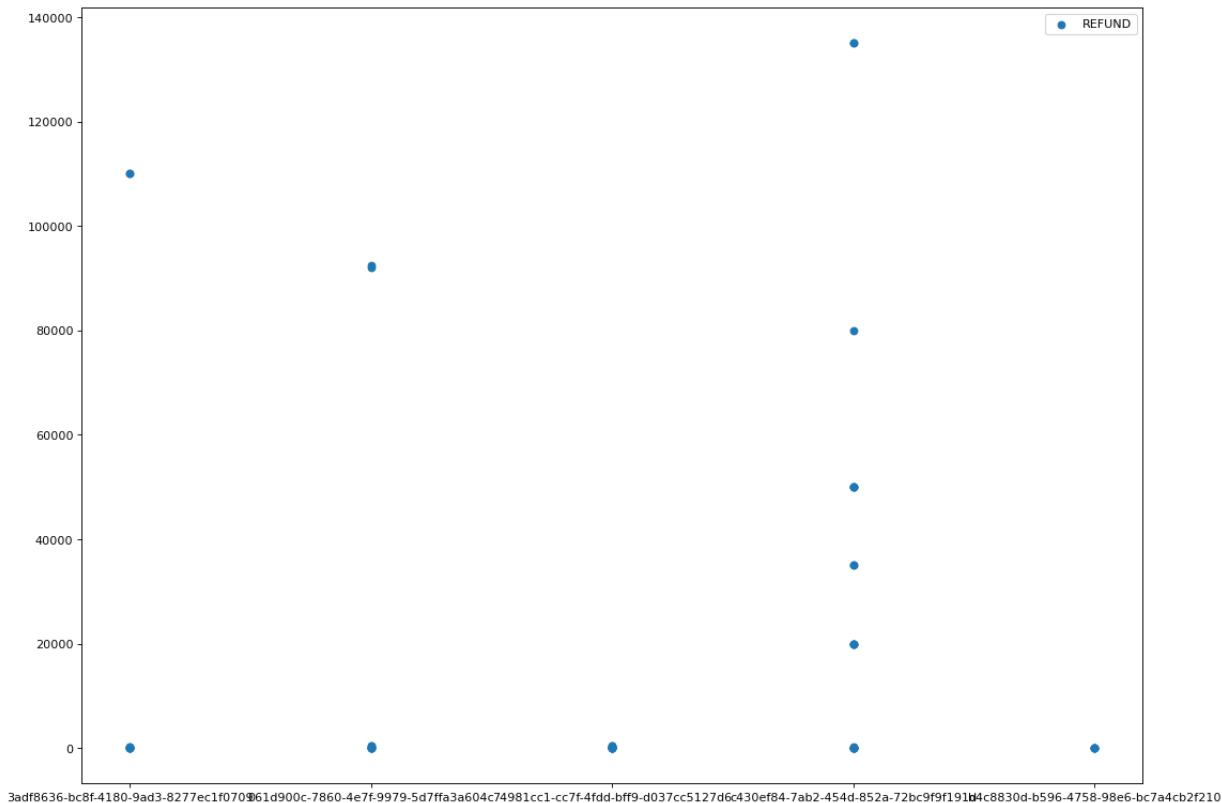
OTHER 31

Name: externalParty.transactionCategory, dtype: int64



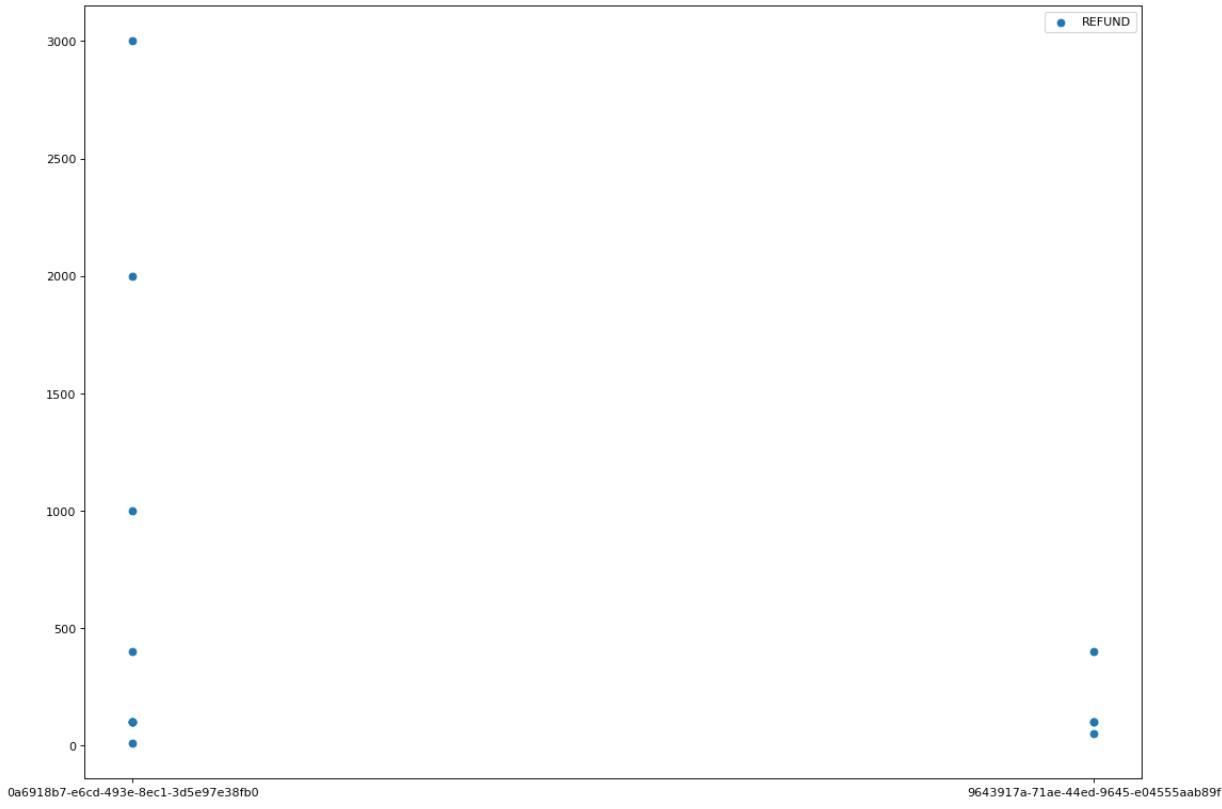
OTHER 30

Name: externalParty.transactionCategory, dtype: int64

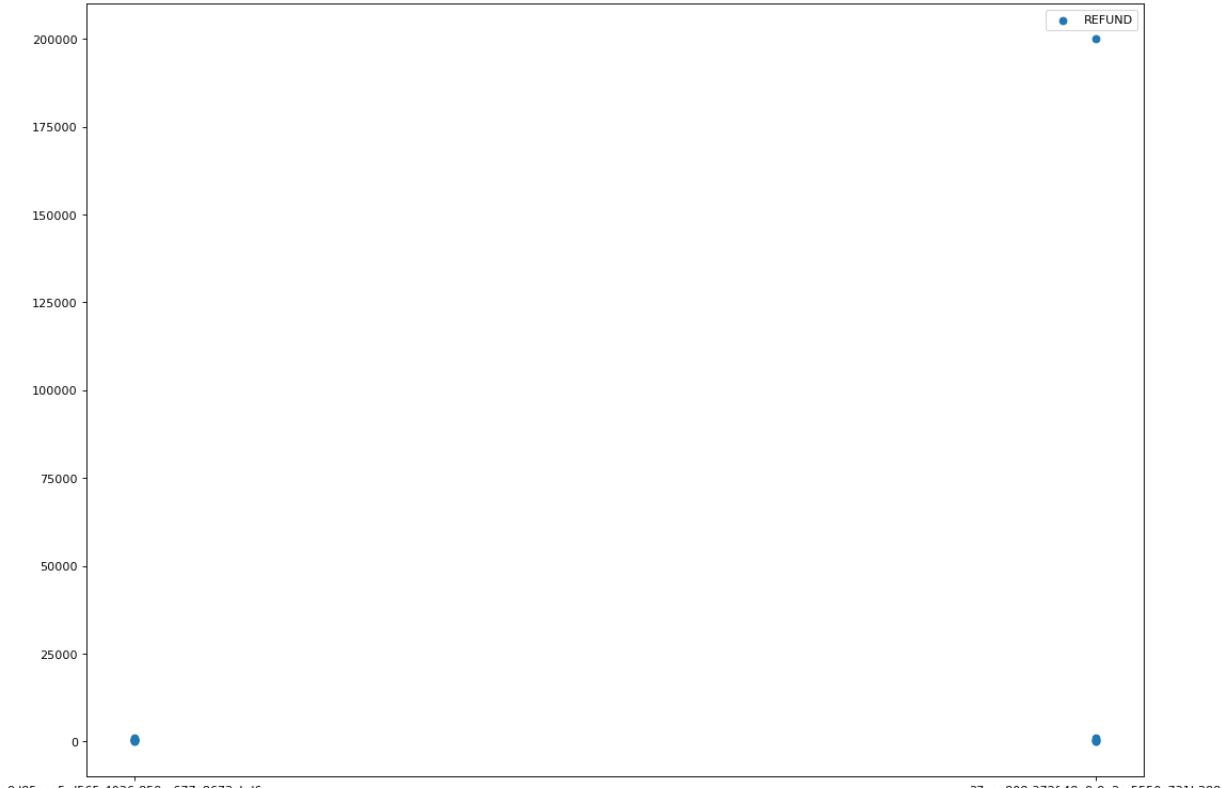


OTHER 55

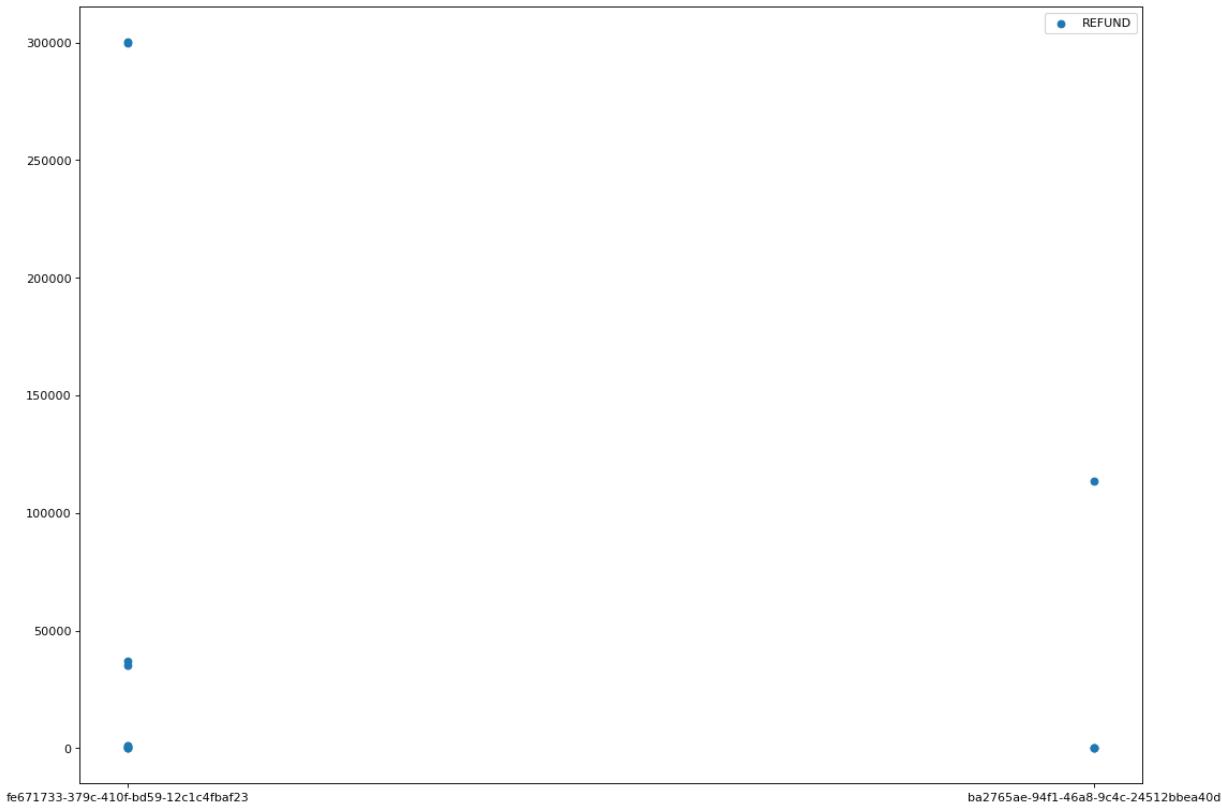
Name: externalParty.transactionCategory, dtype: int64



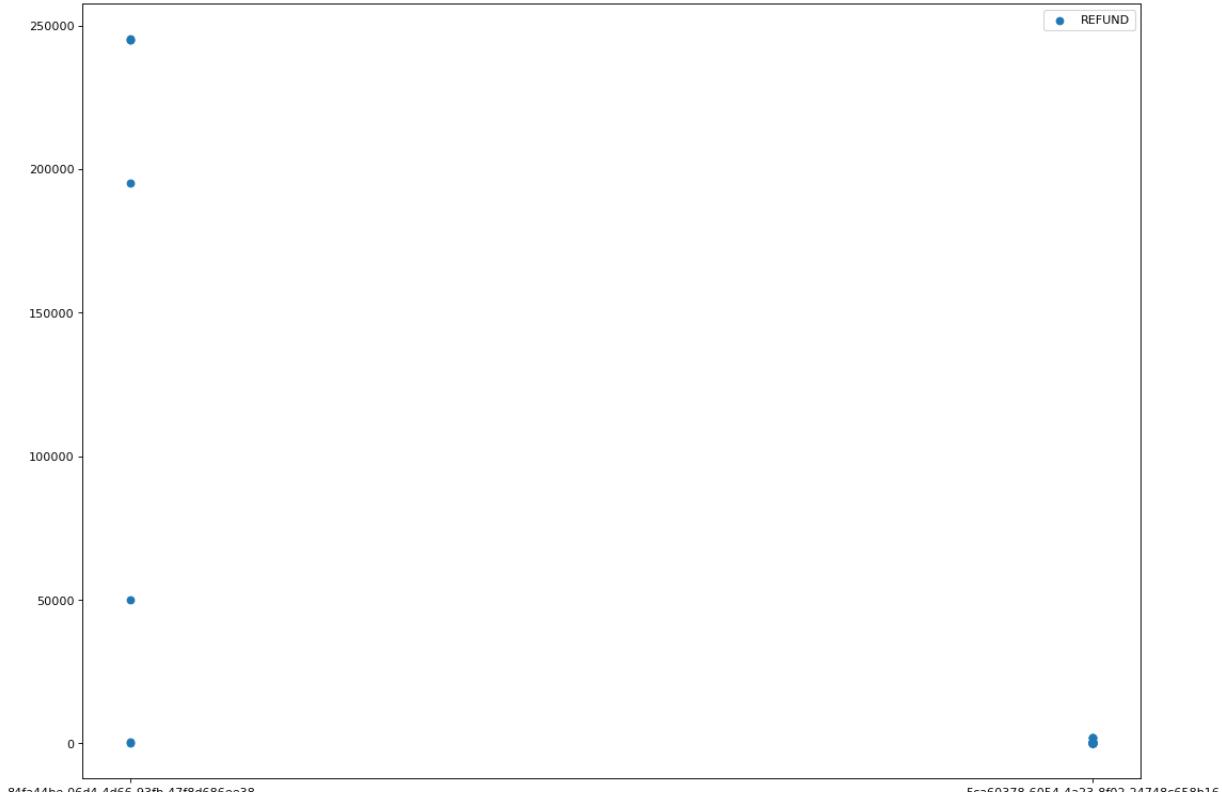
OTHER 13
Name: externalParty.transactionCategory, dtype: int64



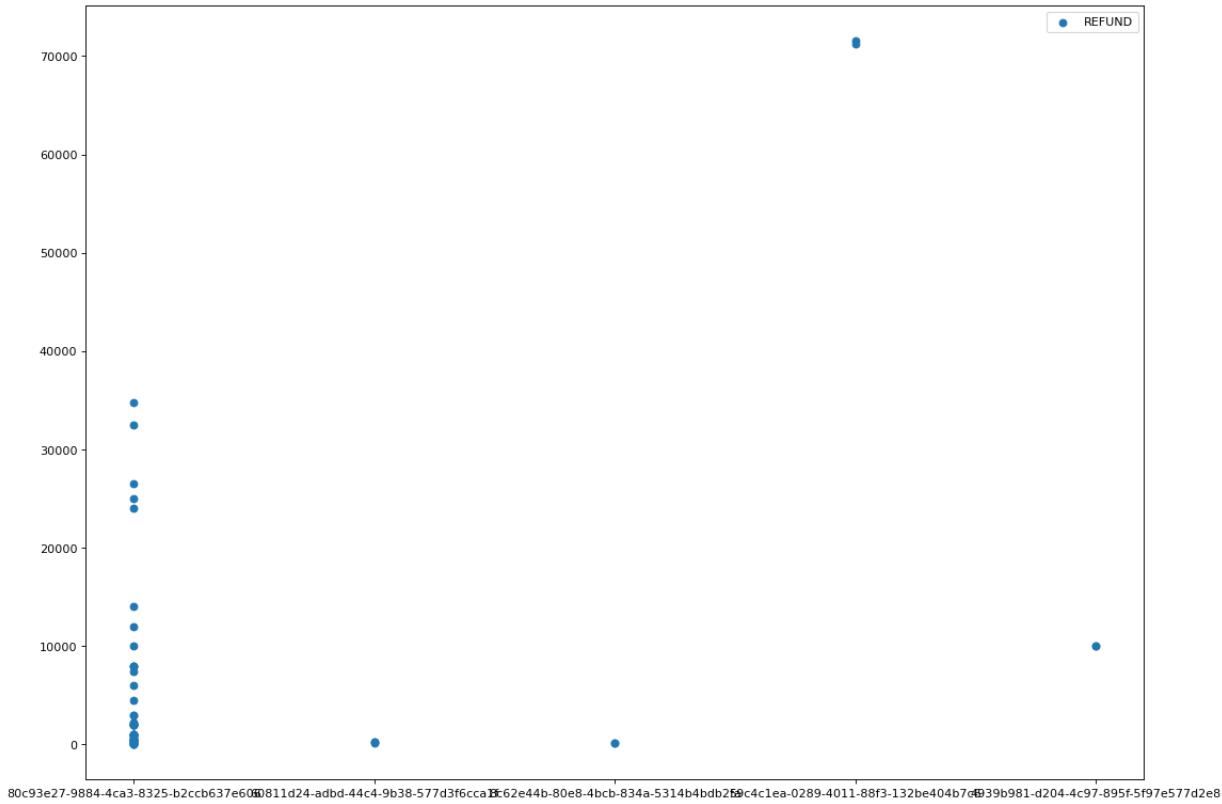
OTHER 15
Name: externalParty.transactionCategory, dtype: int64



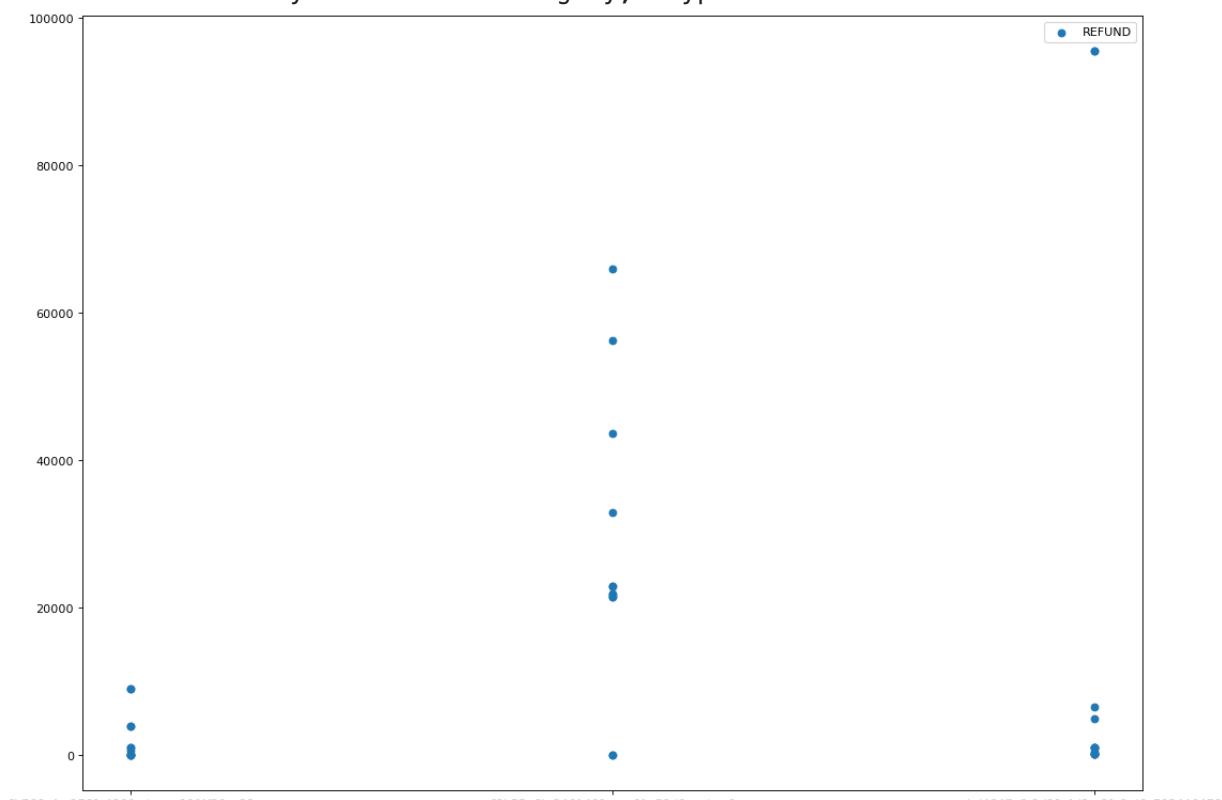
OTHER 13
Name: externalParty.transactionCategory, dtype: int64



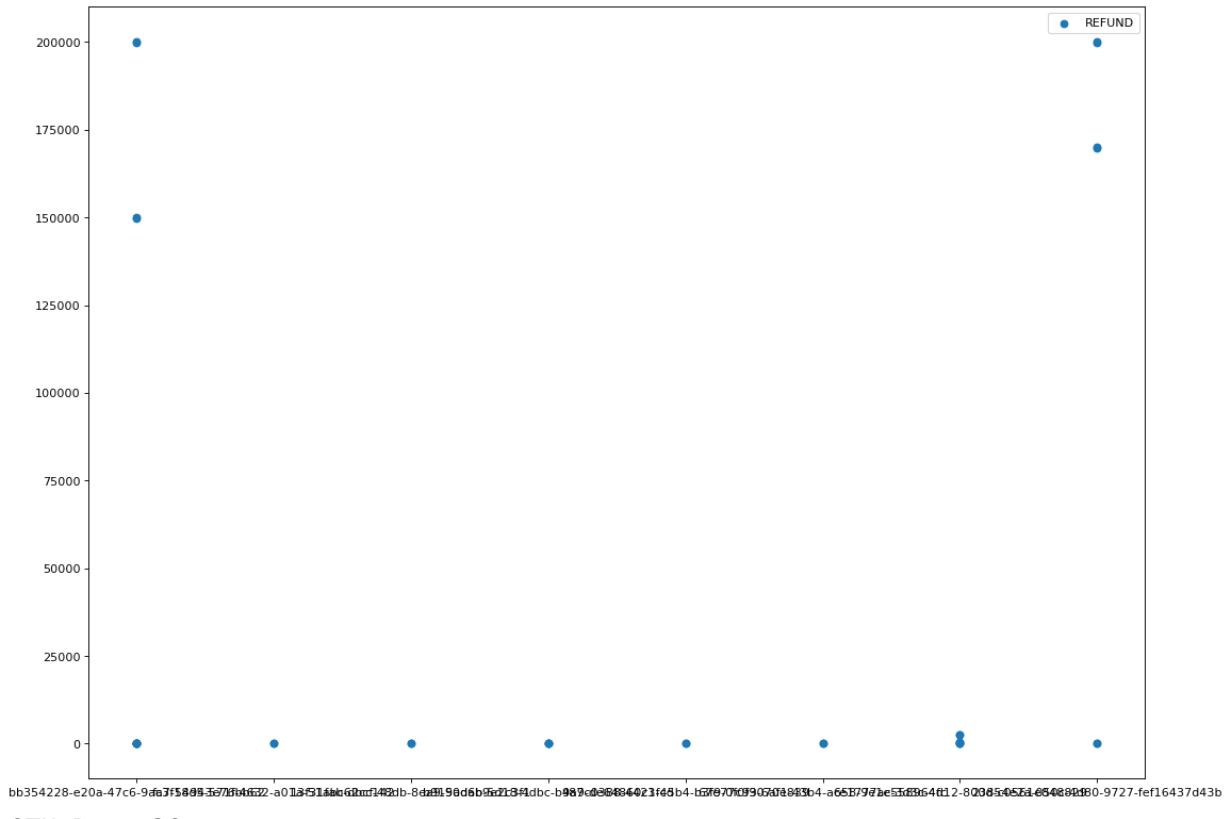
OTHER 72
Name: externalParty.transactionCategory, dtype: int64



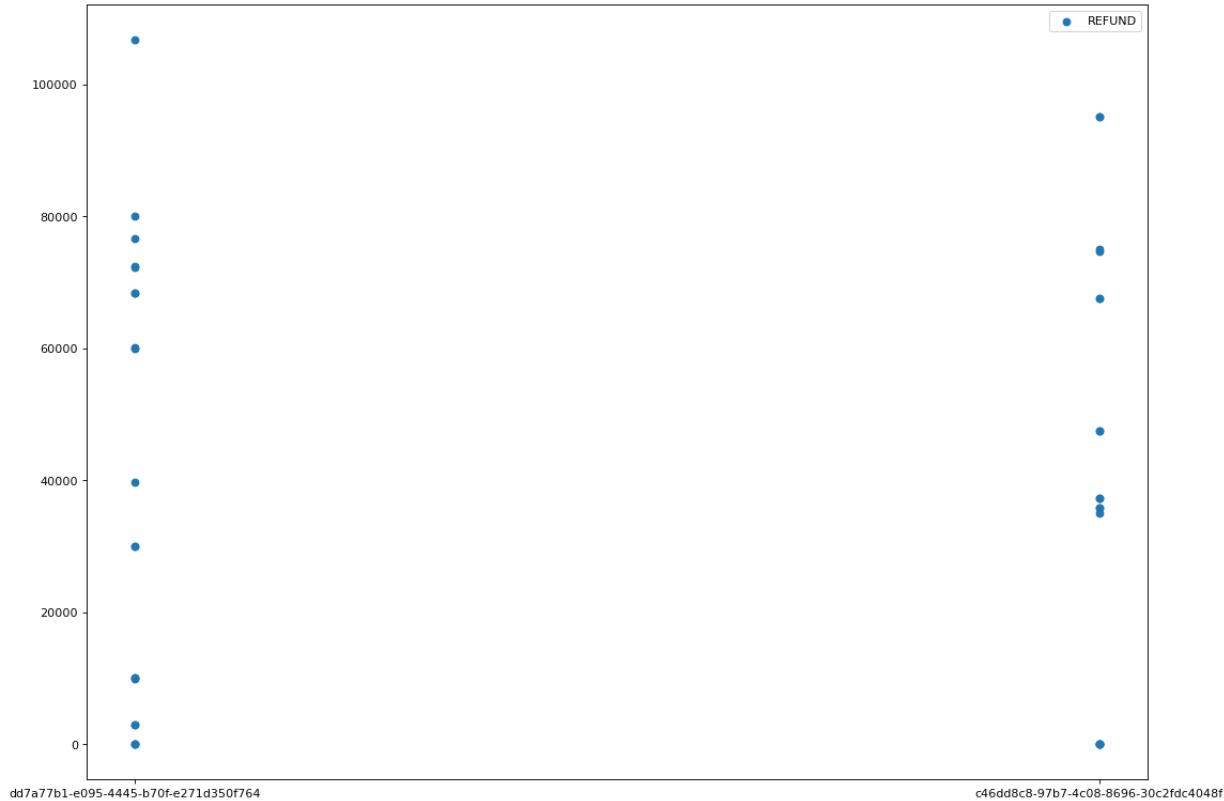
Name: externalParty.transactionCategory, dtype: int64



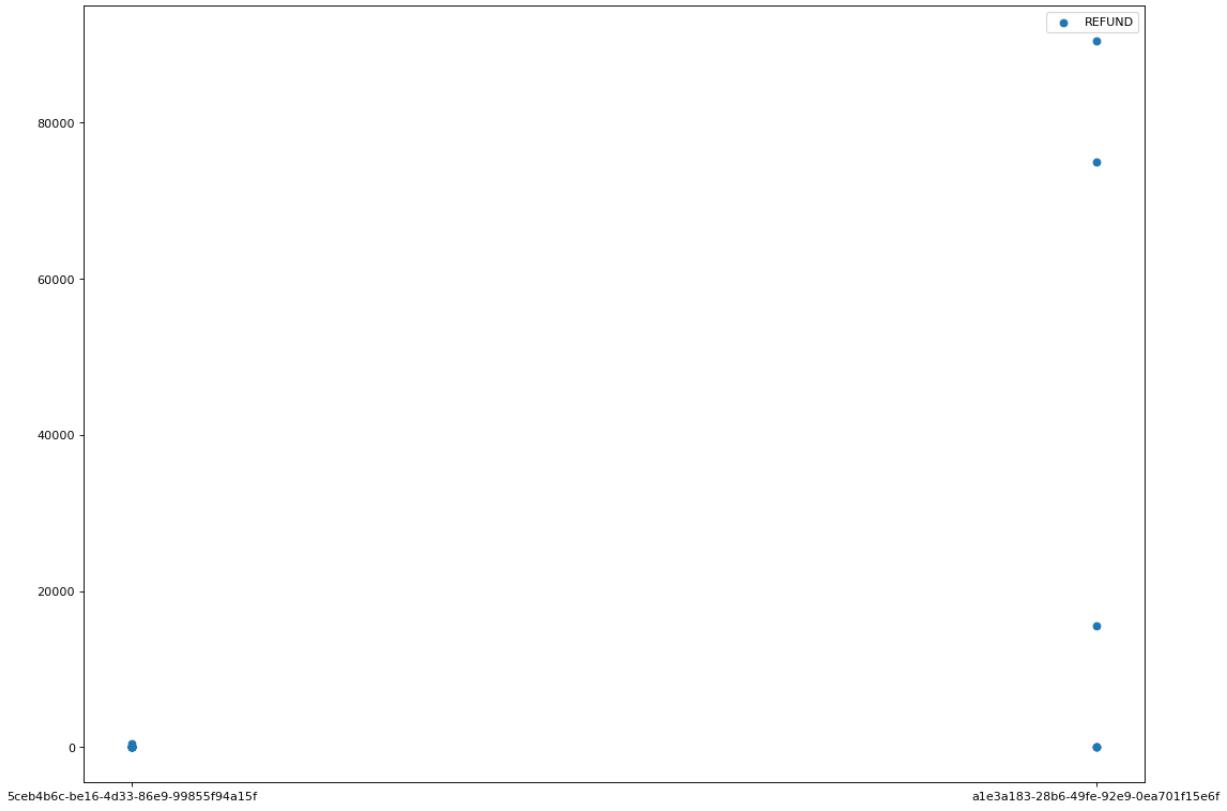
Name: externalParty.transactionCategory, dtype: int64



OTHER 36
Name: externalParty.transactionCategory, dtype: int64

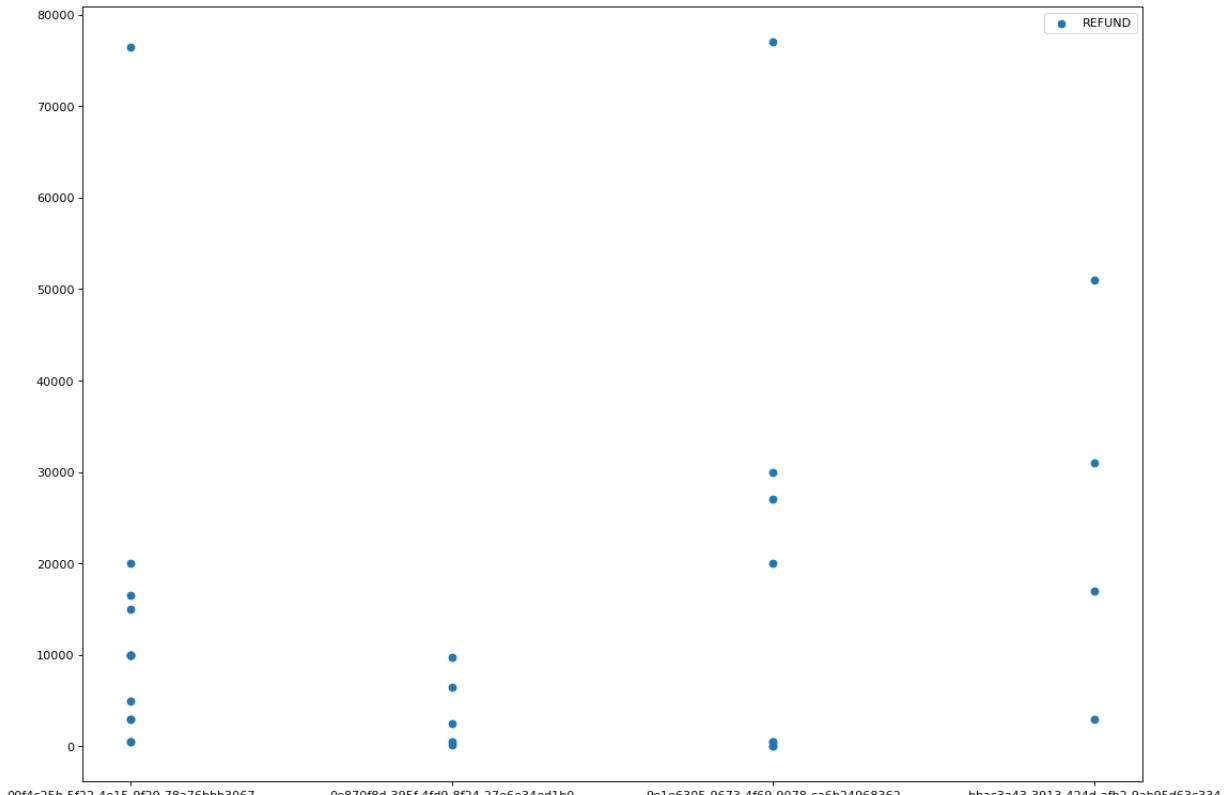


OTHER 38
Name: externalParty.transactionCategory, dtype: int64



OTHER 26

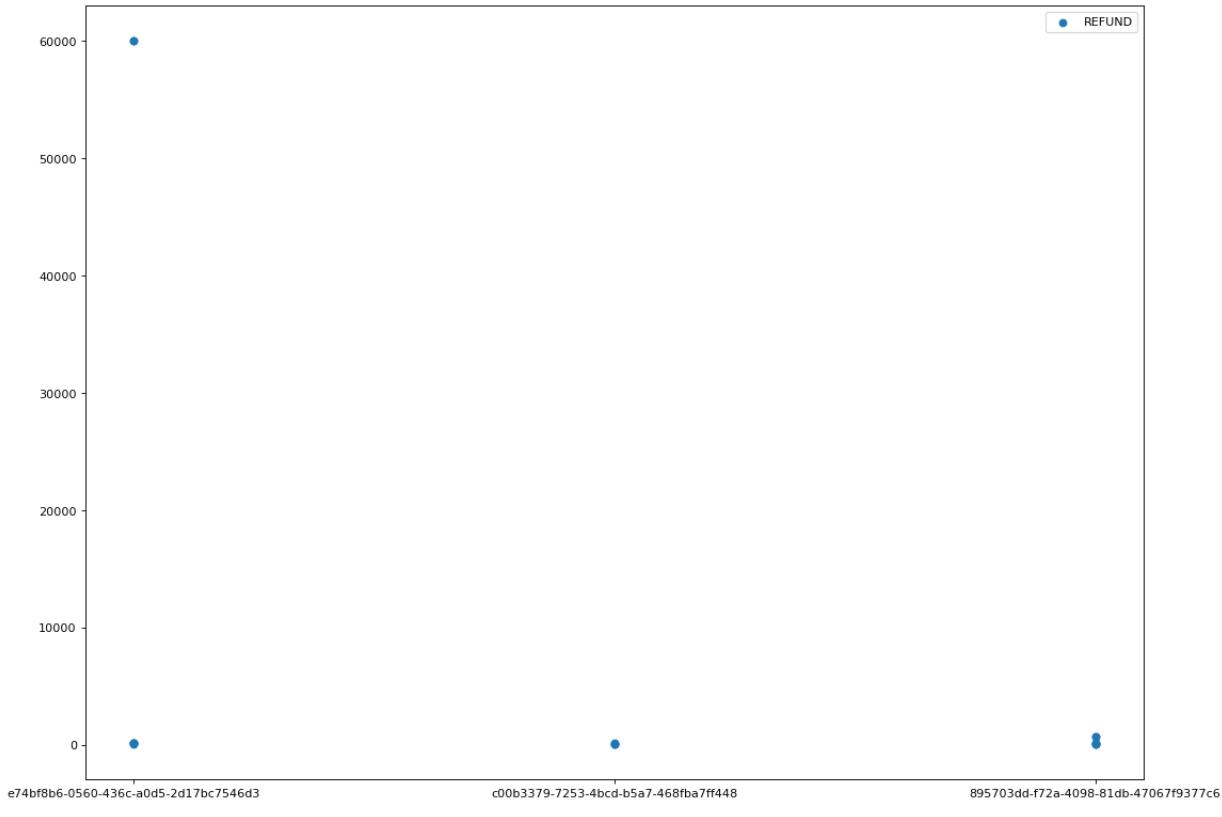
Name: externalParty.transactionCategory, dtype: int64



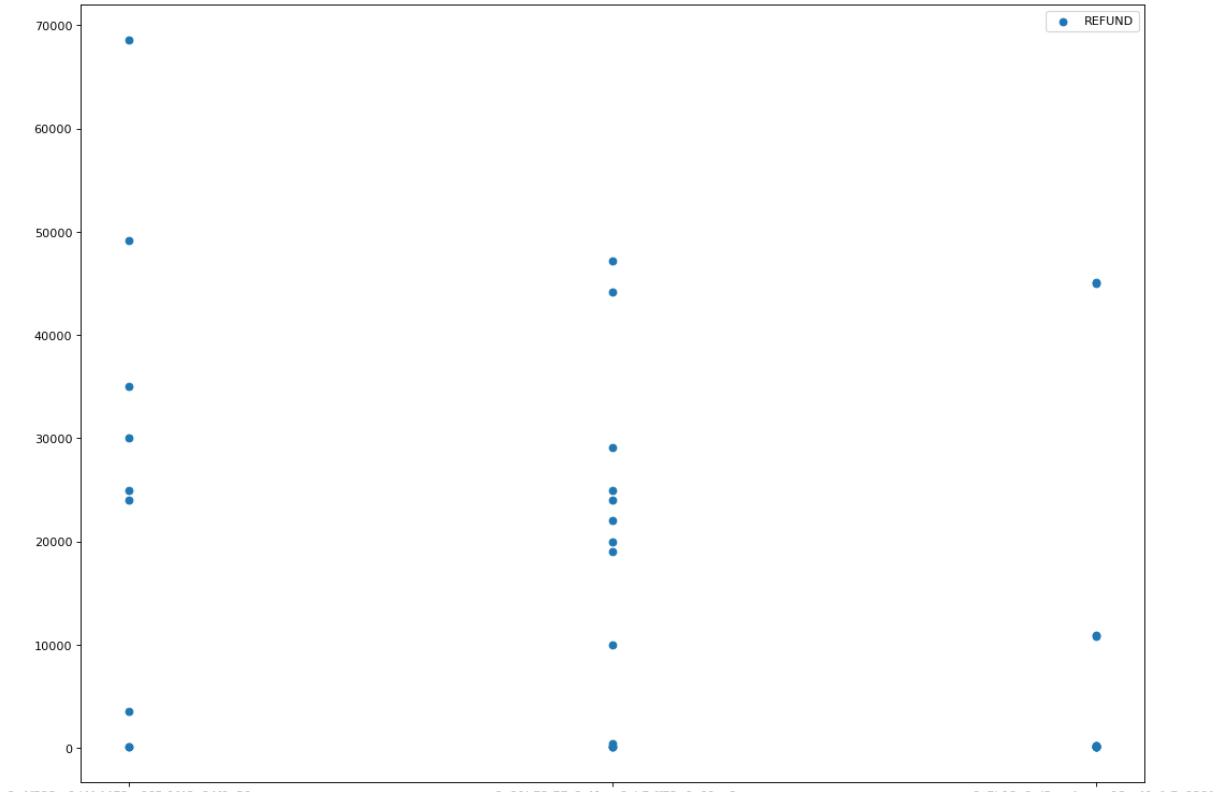
OTHER 29

TRAVEL 1

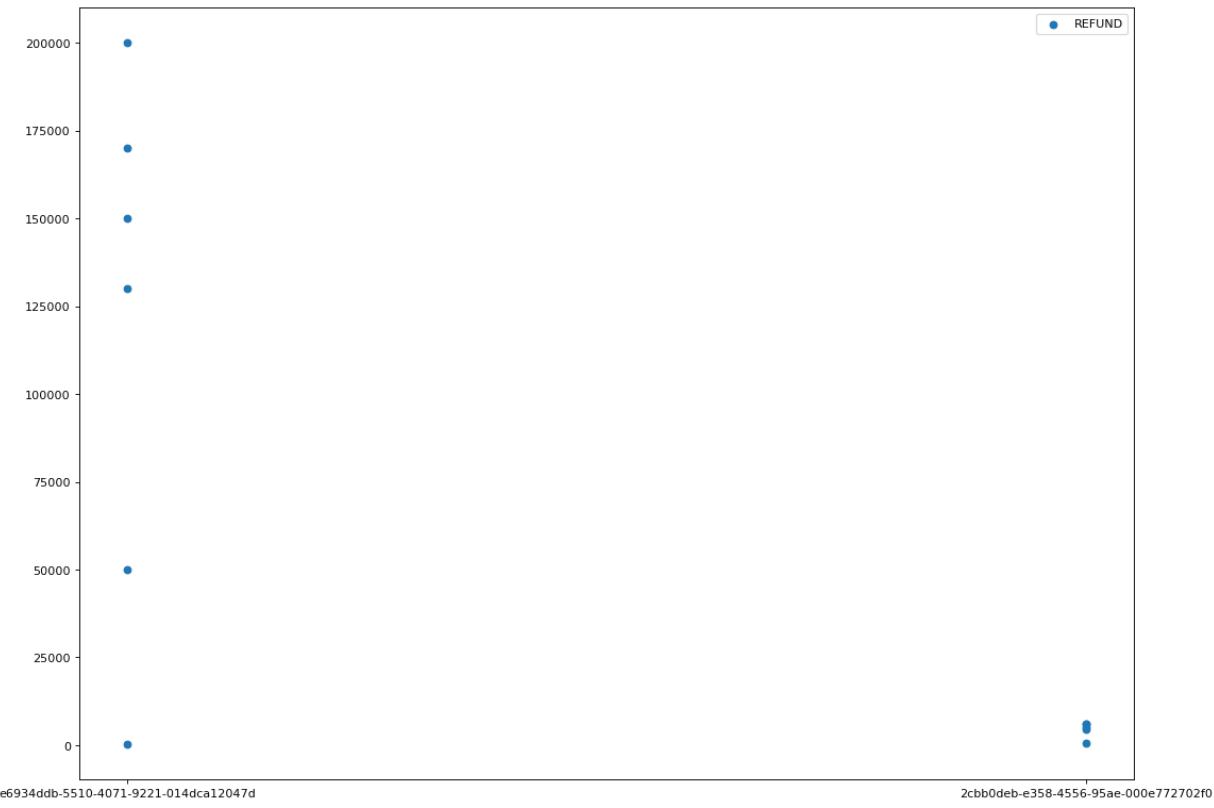
Name: externalParty.transactionCategory, dtype: int64



OTHER 18
Name: externalParty.transactionCategory, dtype: int64



OTHER 34
Name: externalParty.transactionCategory, dtype: int64



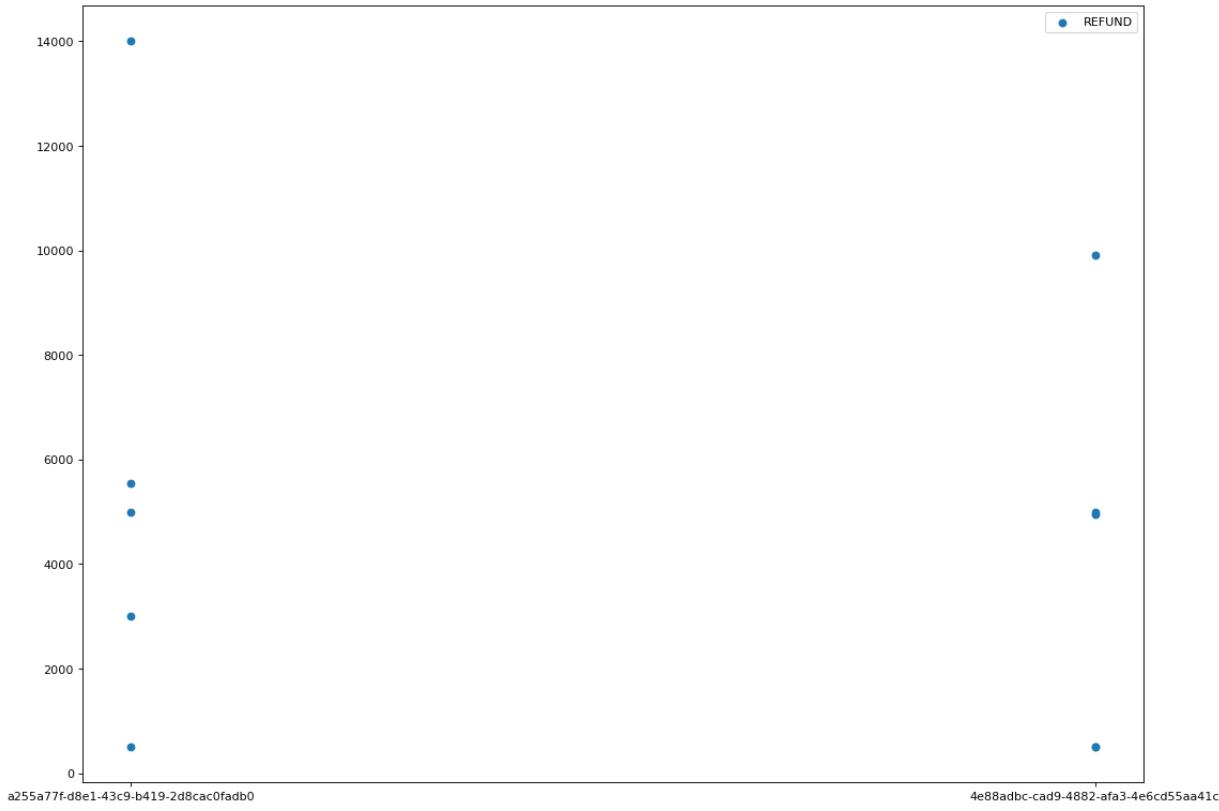
OTHER 11

Name: externalParty.transactionCategory, dtype: int64



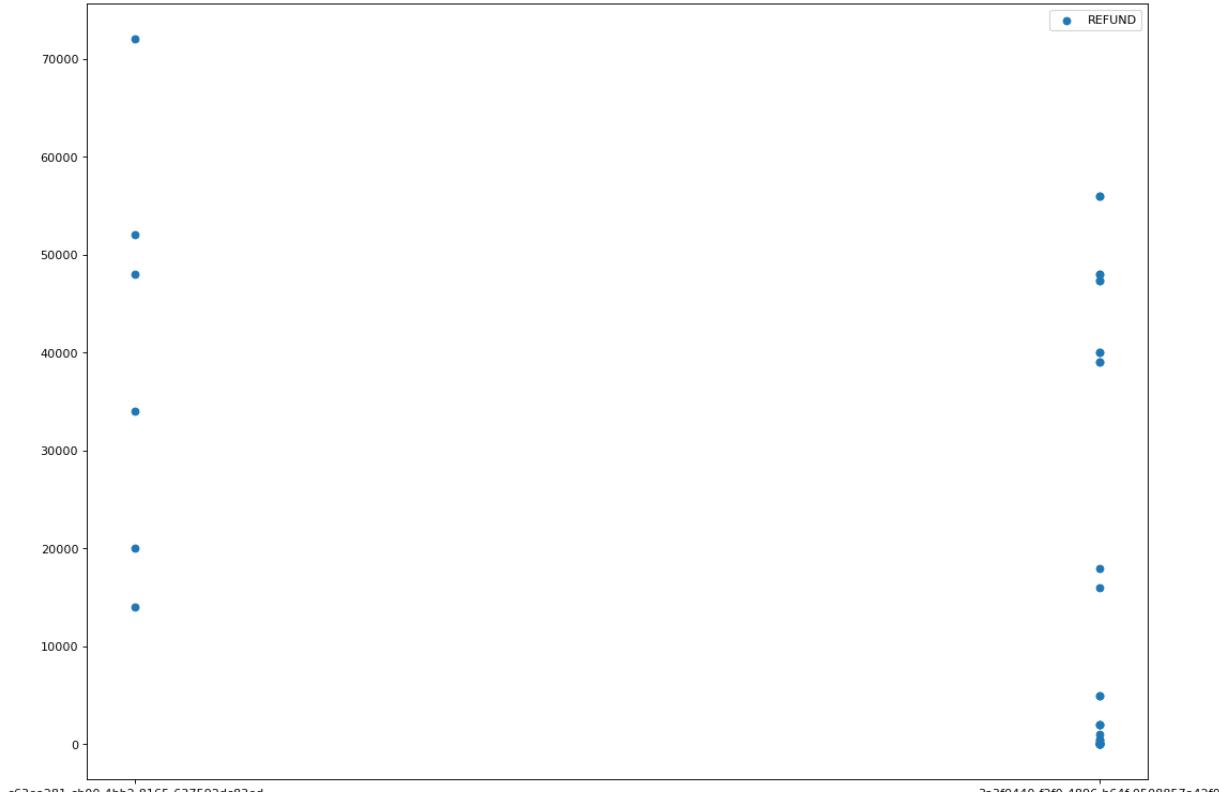
OTHER 11

Name: externalParty.transactionCategory, dtype: int64



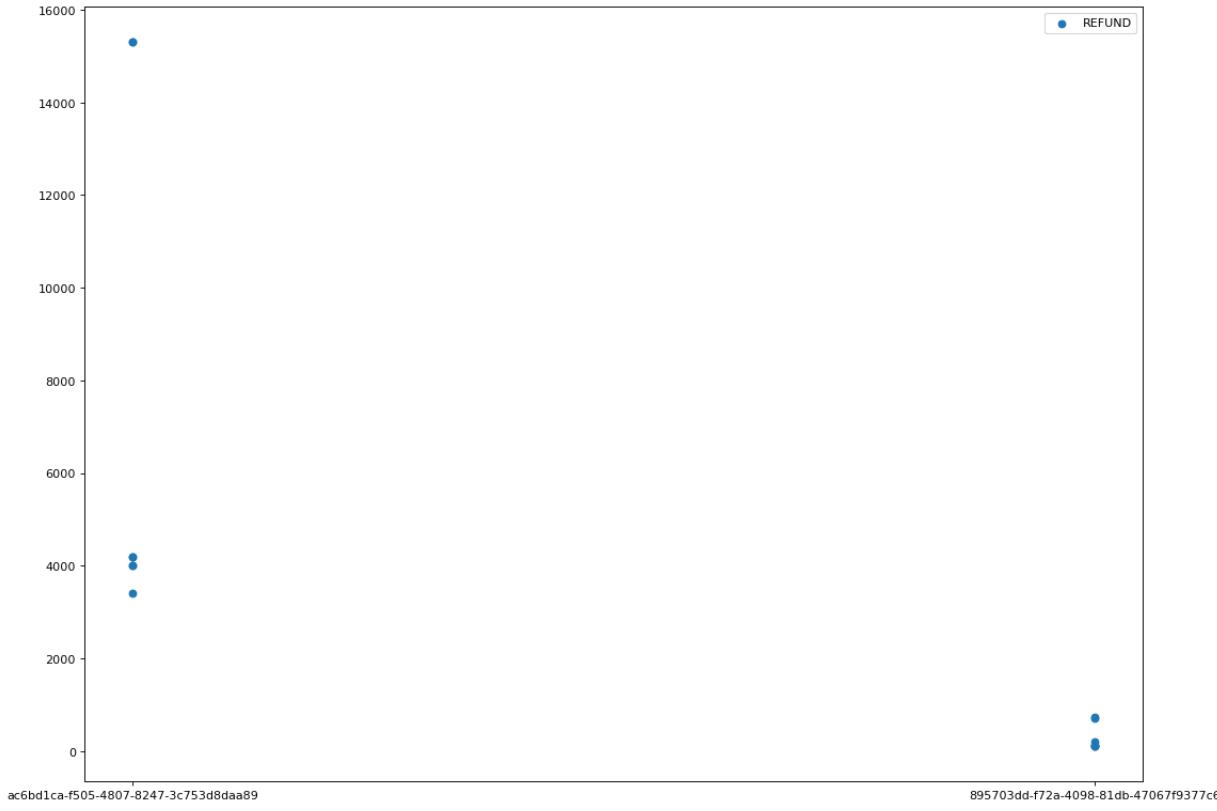
OTHER 10

Name: externalParty.transactionCategory, dtype: int64



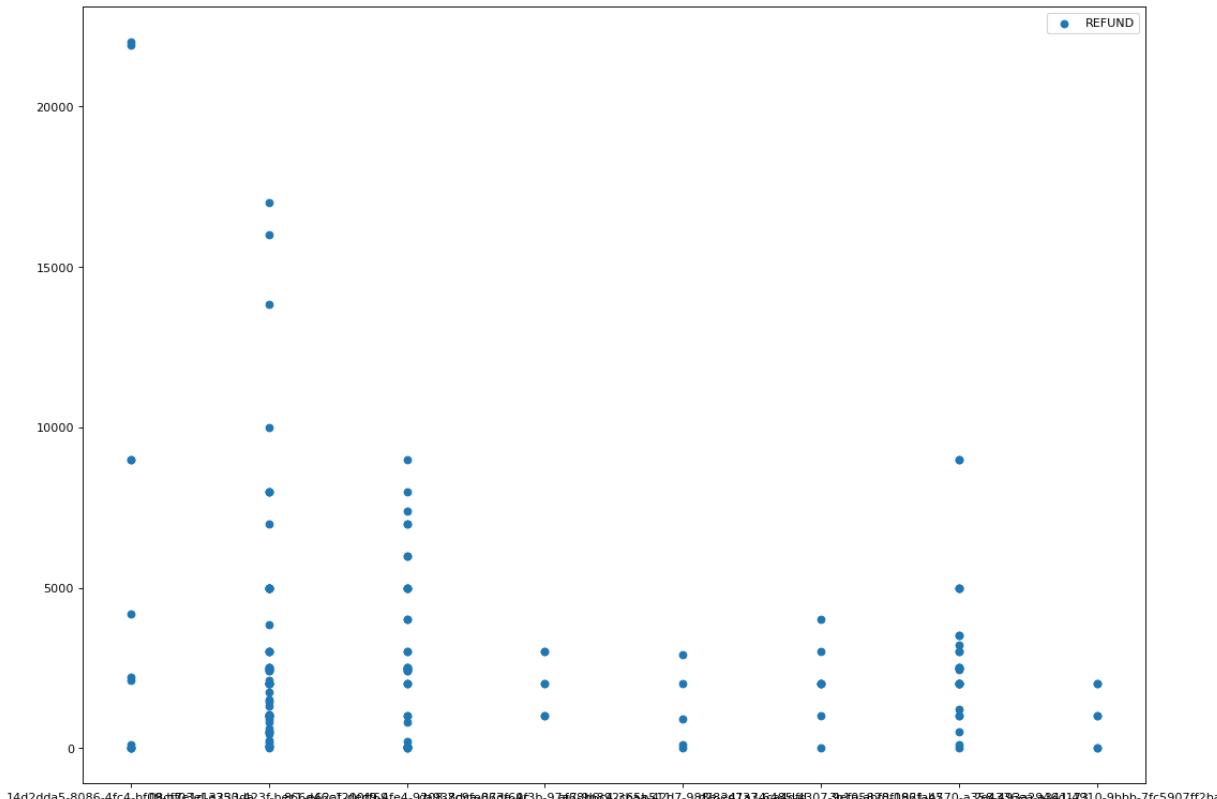
OTHER 35

Name: externalParty.transactionCategory, dtype: int64



OTHER 14

Name: externalParty.transactionCategory, dtype: int64



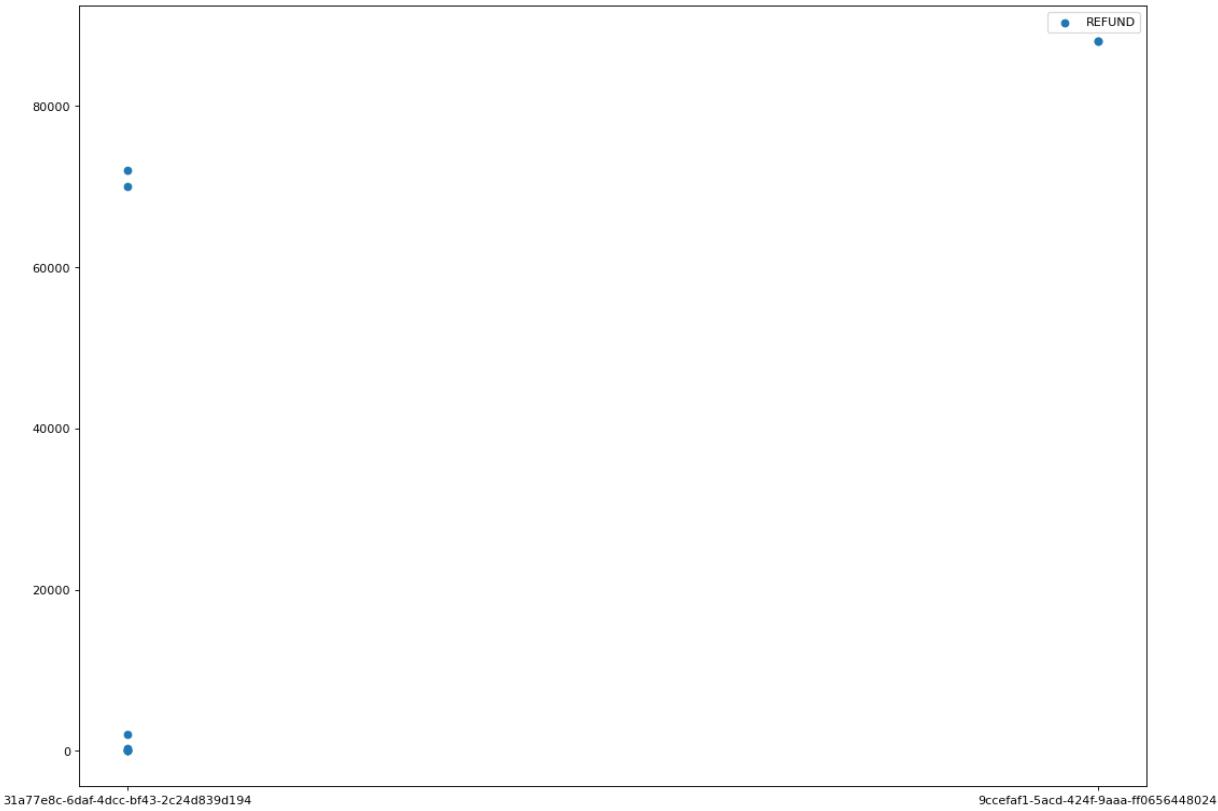
OTHER 151

TRAVEL 7

LIFESTYLE 4

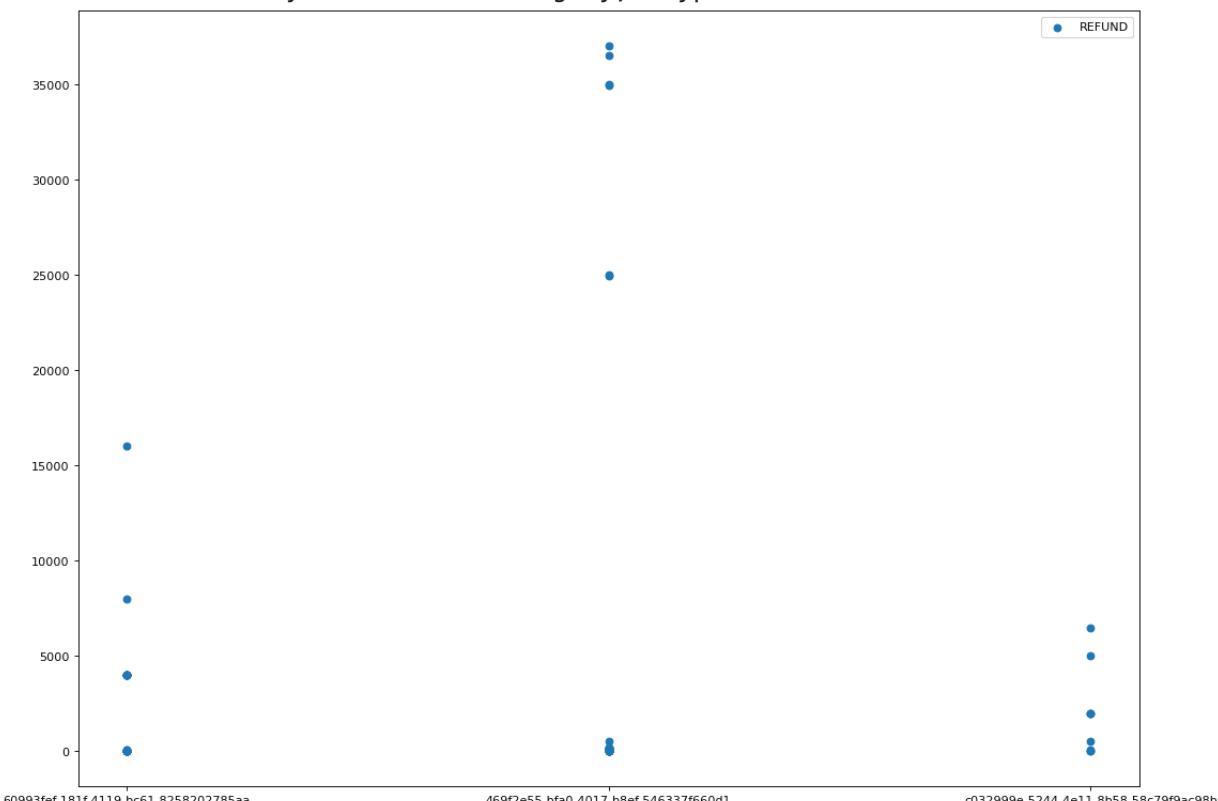
SHOPPING 1

Name: externalParty.transactionCategory, dtype: int64



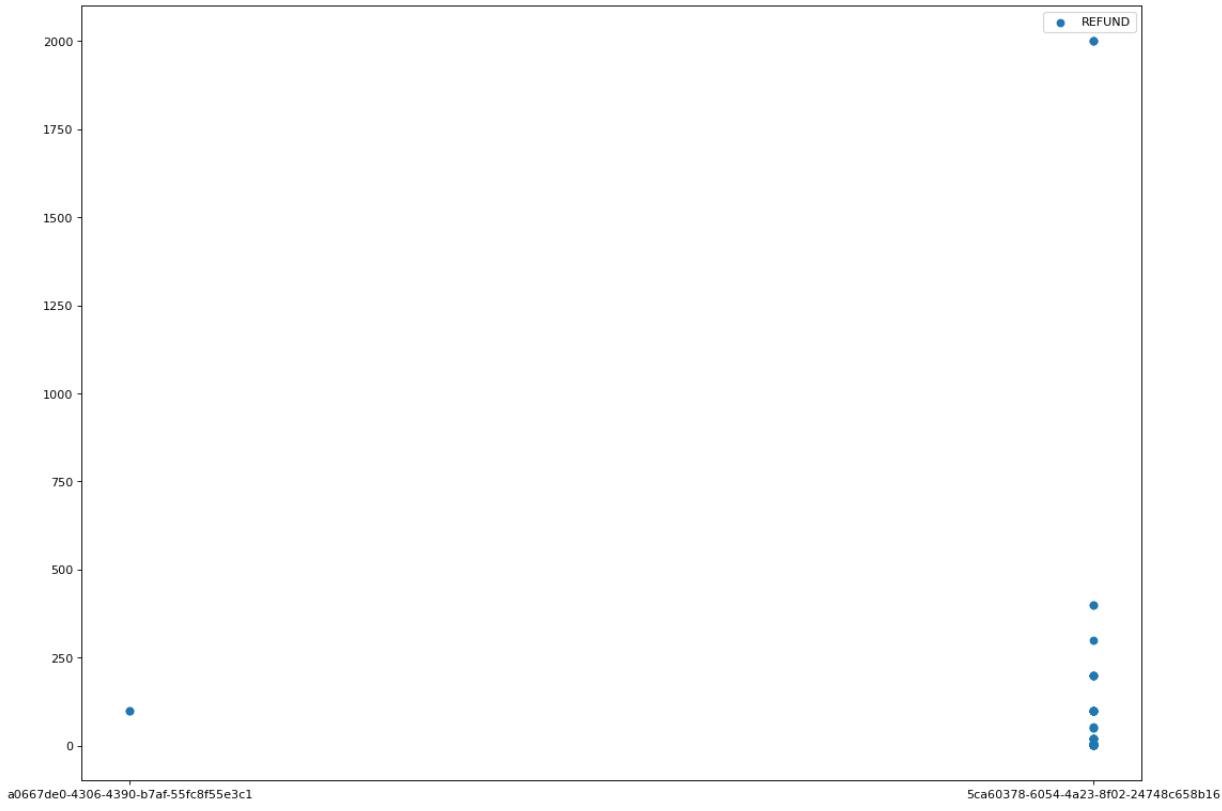
OTHER 10

Name: externalParty.transactionCategory, dtype: int64



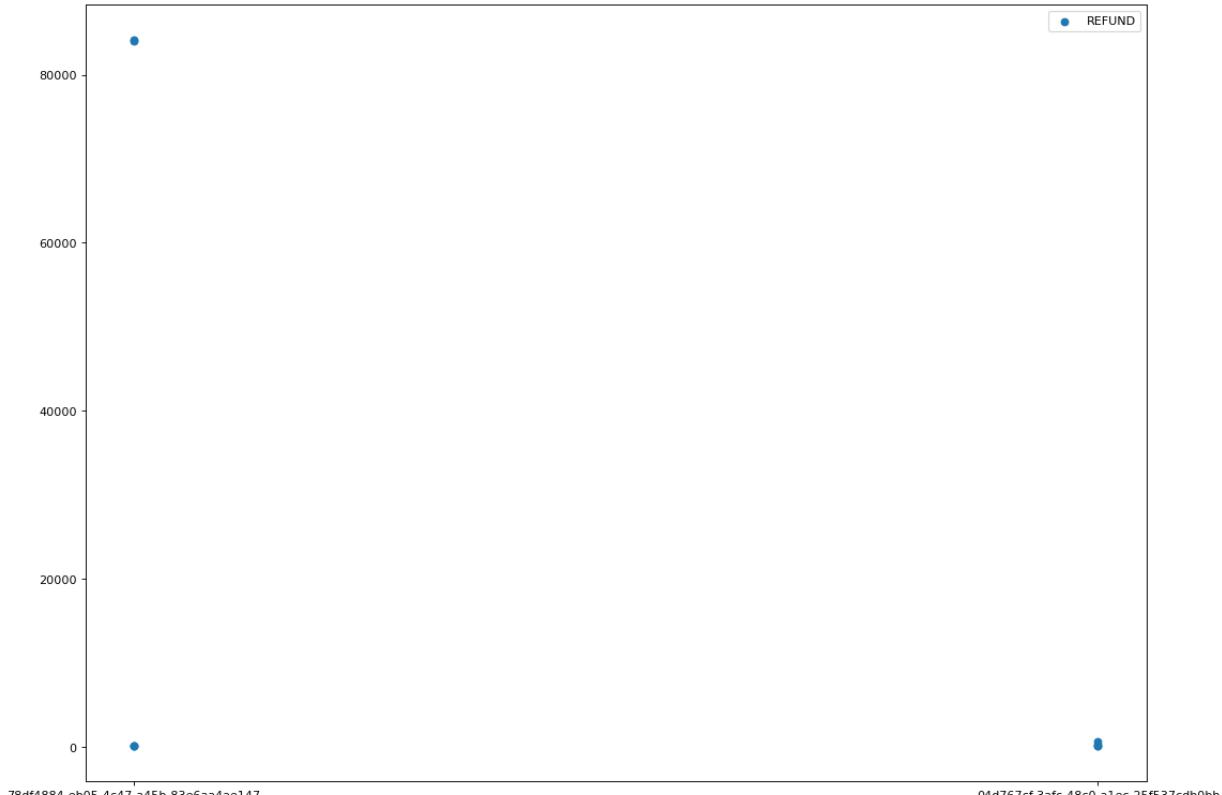
OTHER 60

Name: externalParty.transactionCategory, dtype: int64



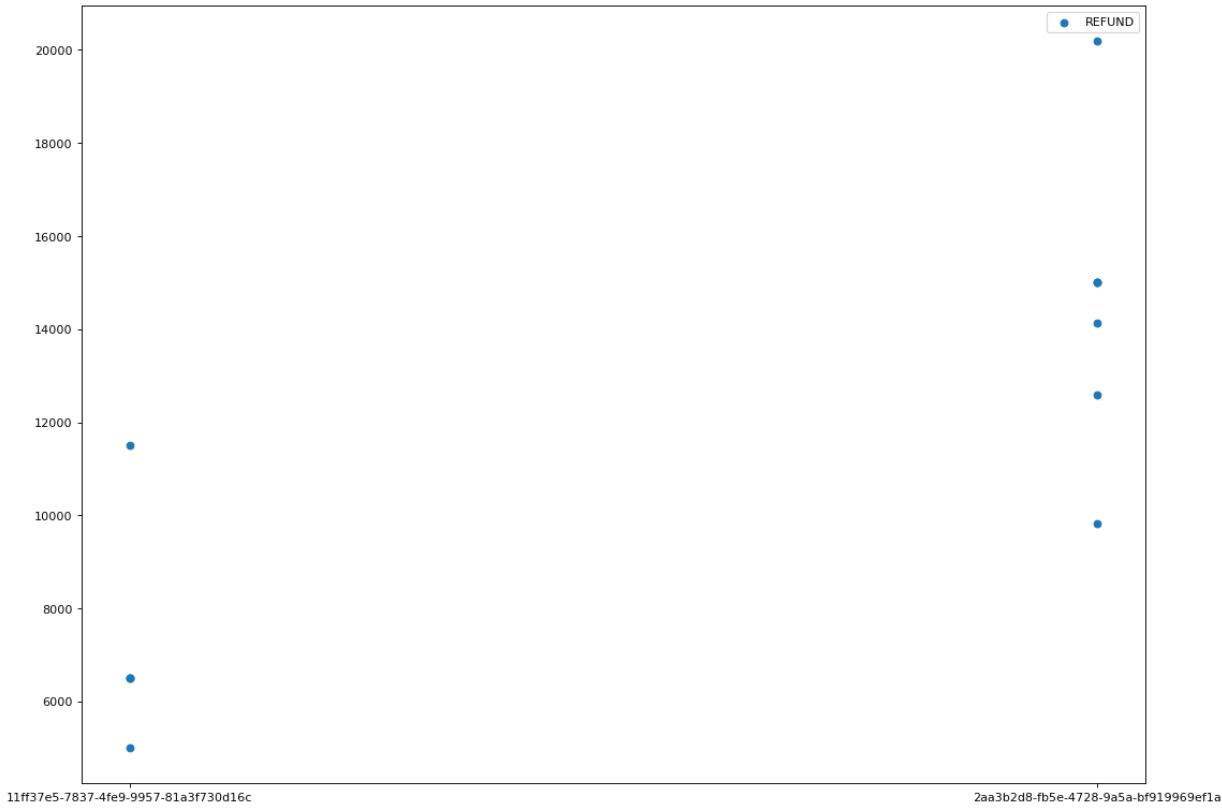
OTHER 67

Name: externalParty.transactionCategory, dtype: int64

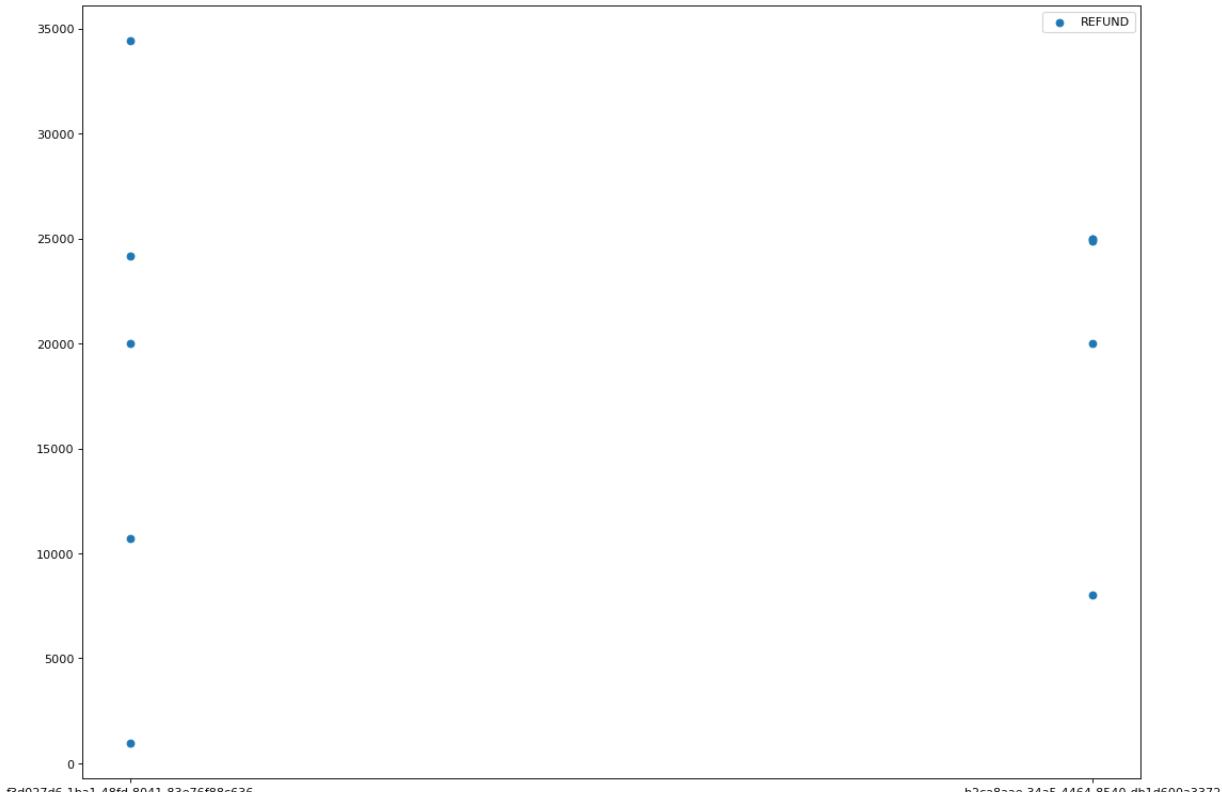


OTHER 9

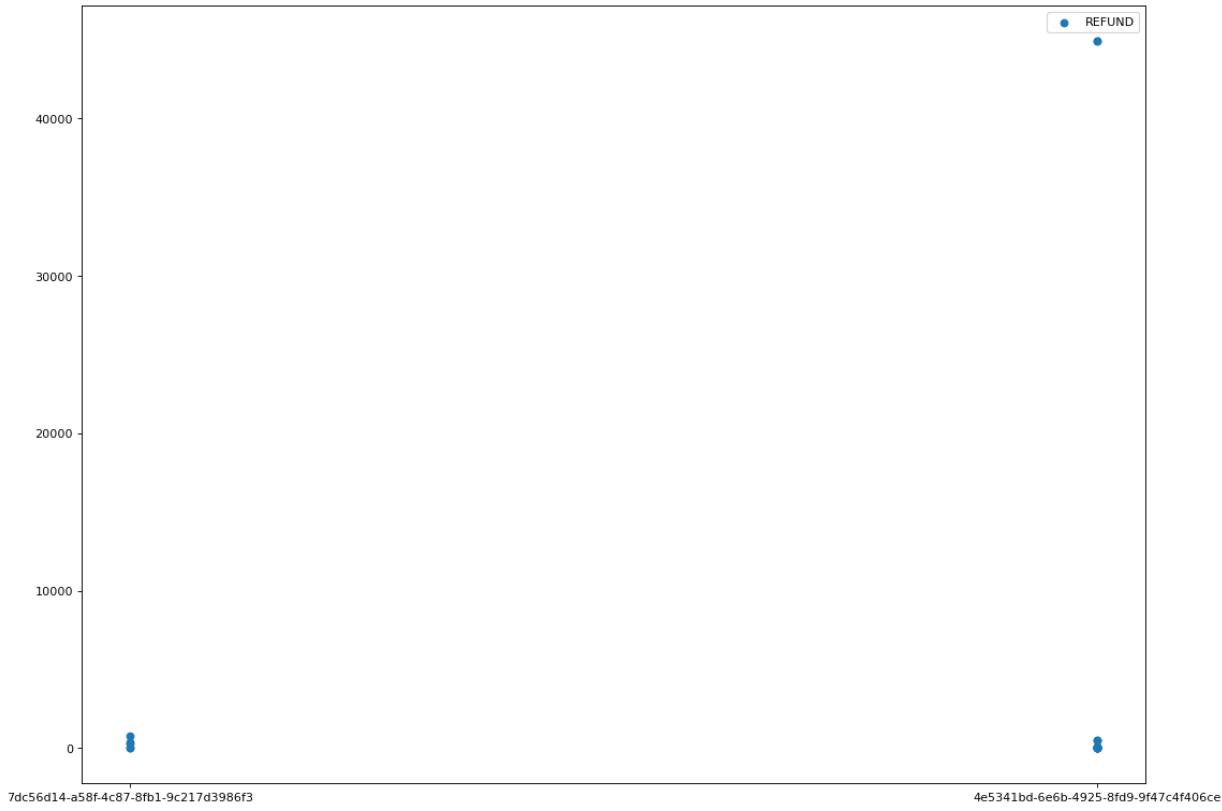
Name: externalParty.transactionCategory, dtype: int64



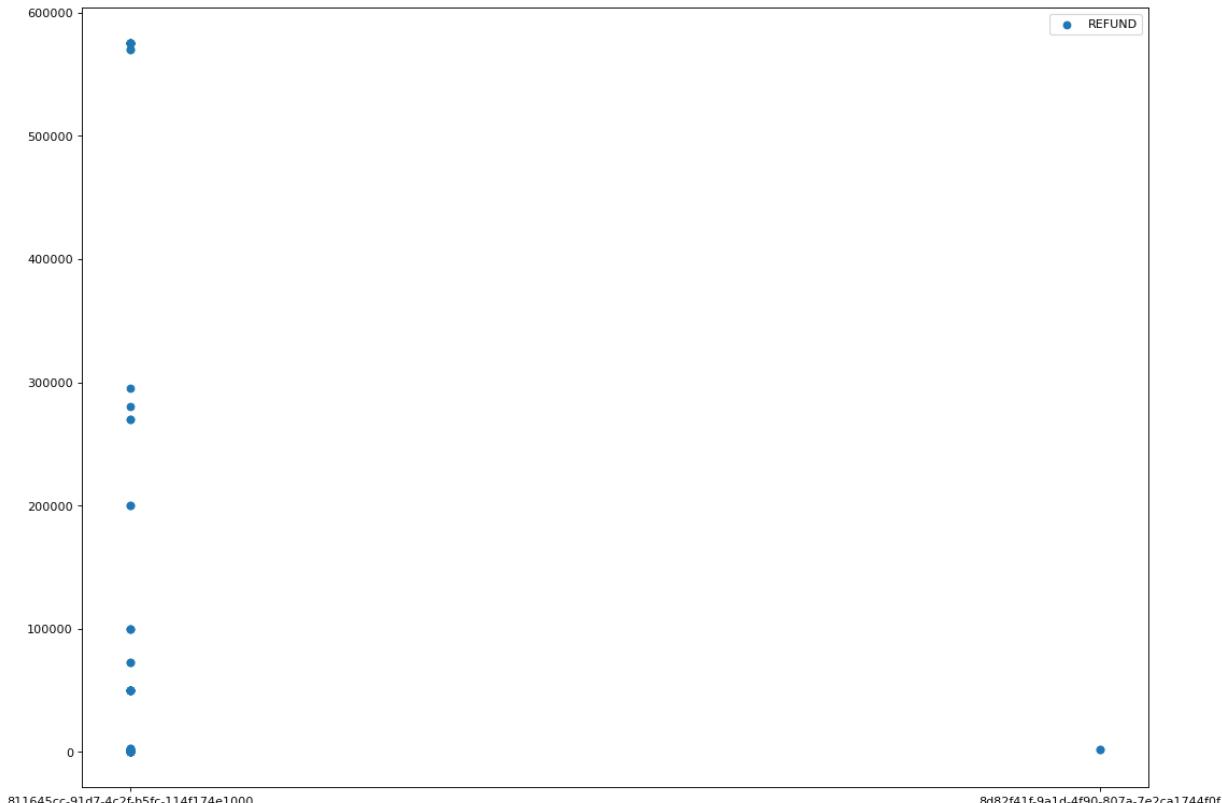
OTHER 12
Name: externalParty.transactionCategory, dtype: int64



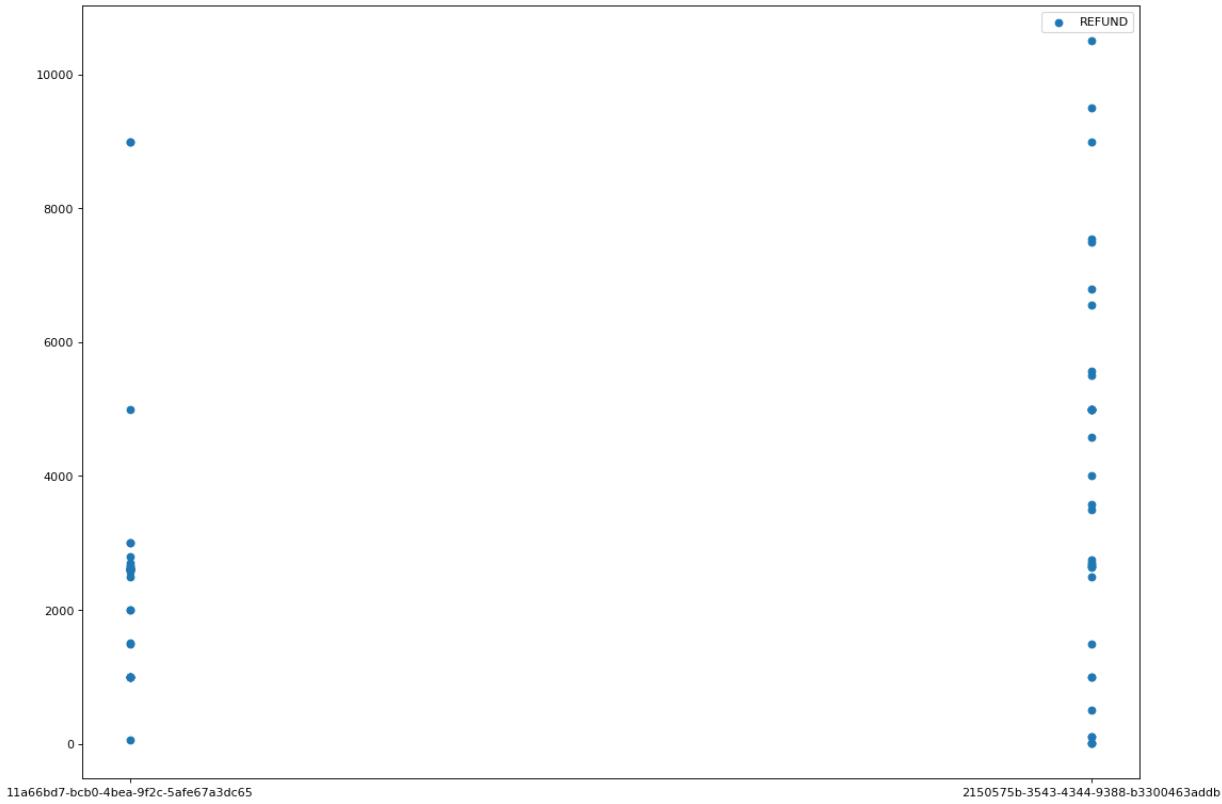
OTHER 10
Name: externalParty.transactionCategory, dtype: int64



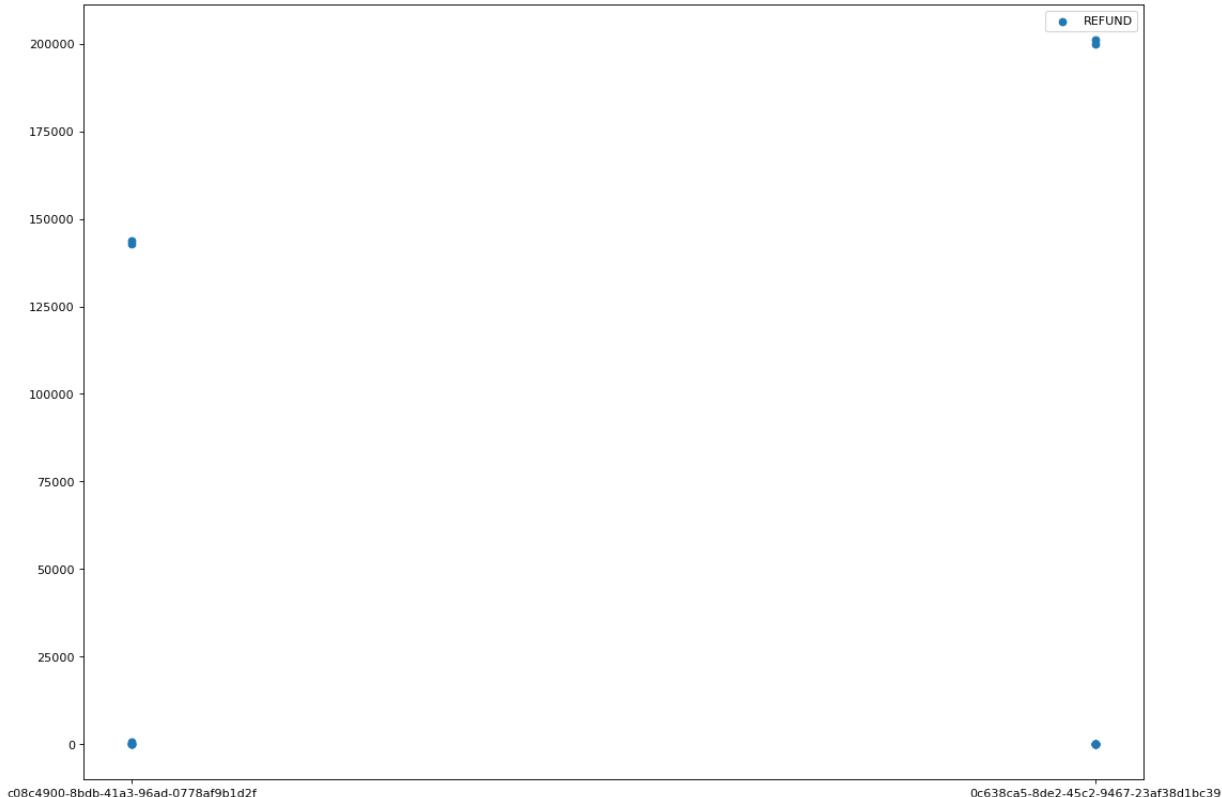
OTHER 20
Name: externalParty.transactionCategory, dtype: int64



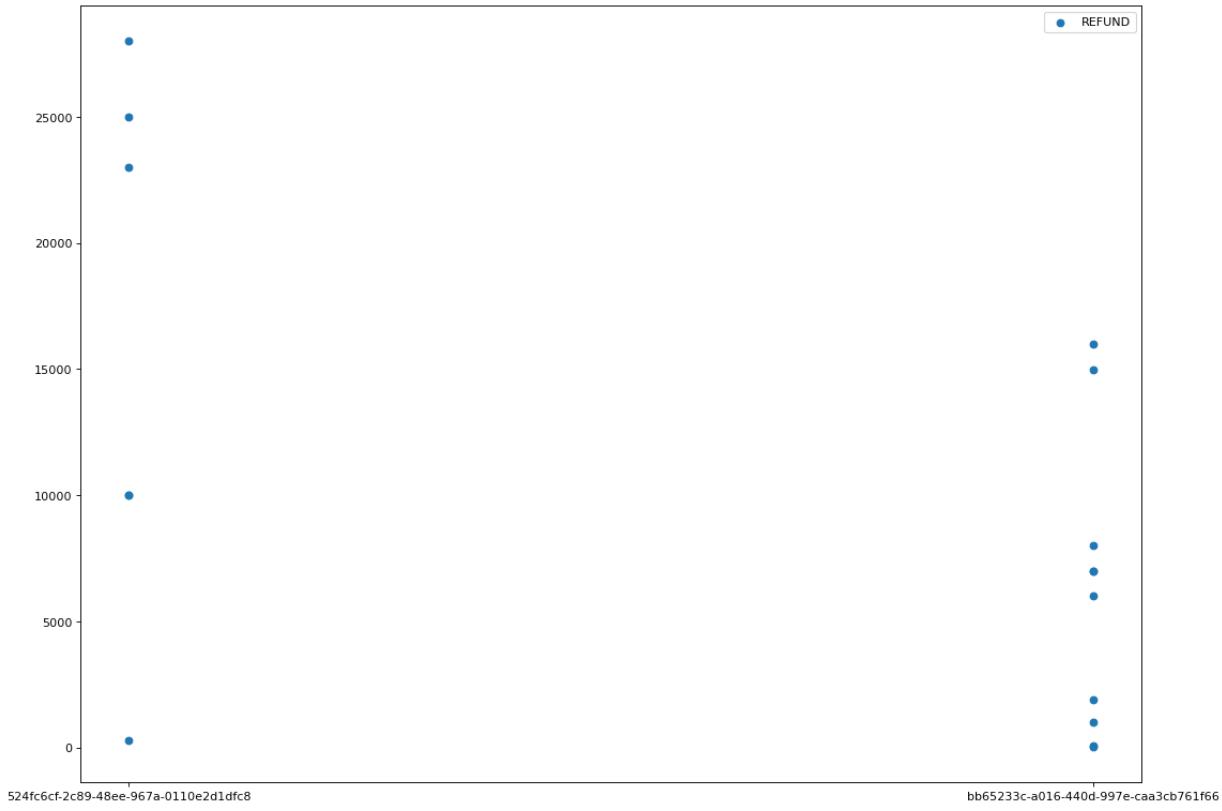
OTHER 55
SHOPPING 2
GROCERIES 2
Name: externalParty.transactionCategory, dtype: int64



OTHER 67
Name: externalParty.transactionCategory, dtype: int64

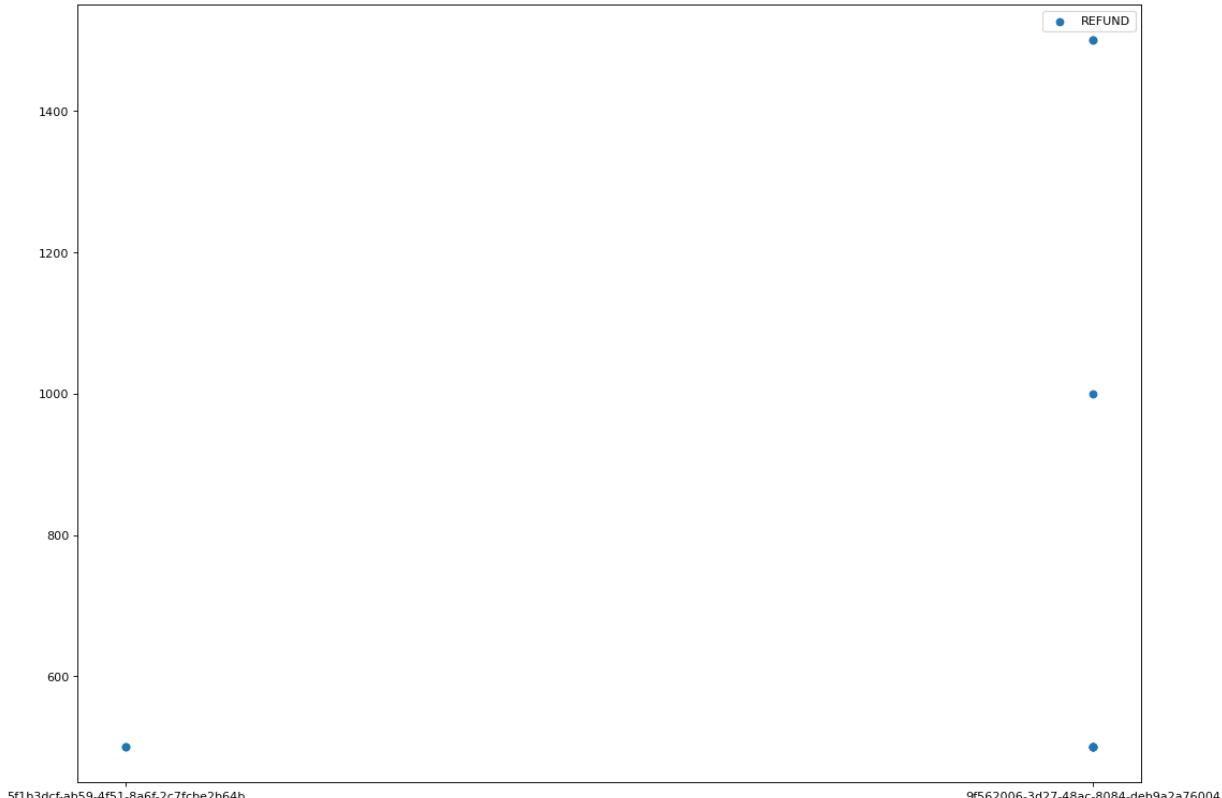


OTHER 16
Name: externalParty.transactionCategory, dtype: int64



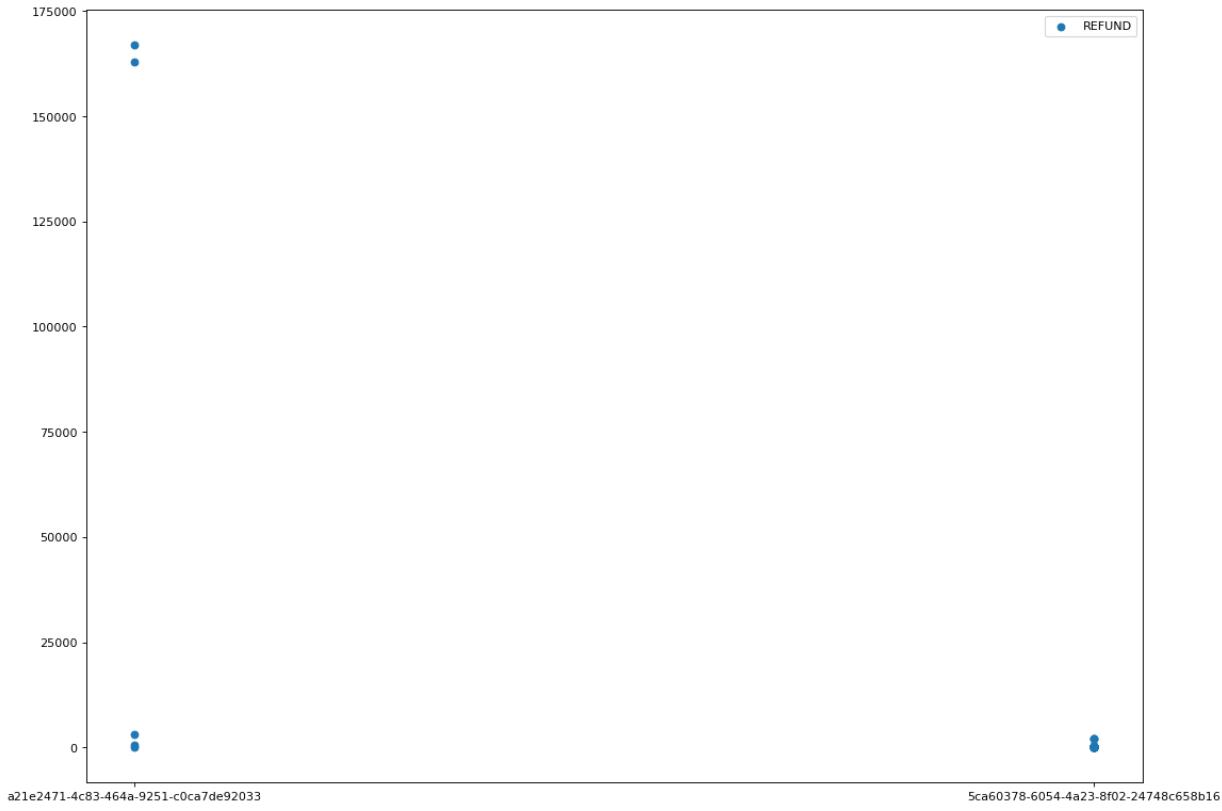
OTHER 16

Name: externalParty.transactionCategory, dtype: int64

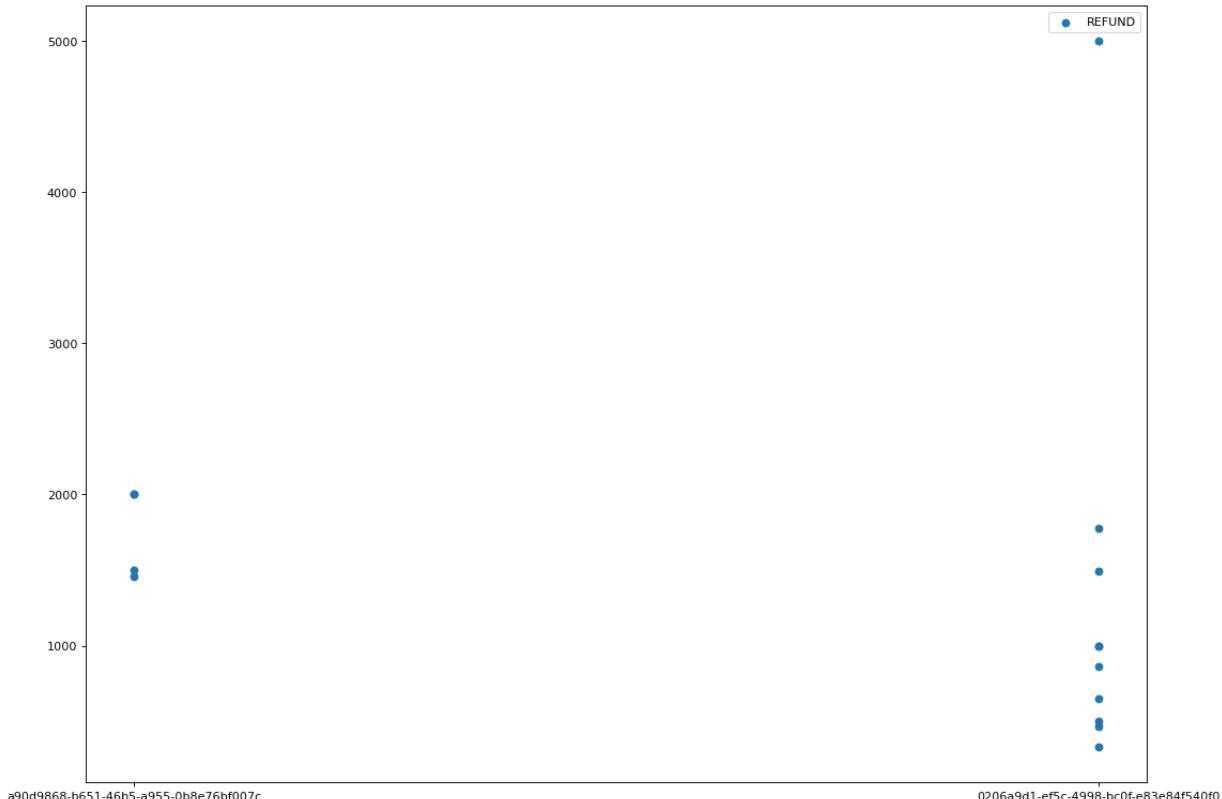


OTHER 10

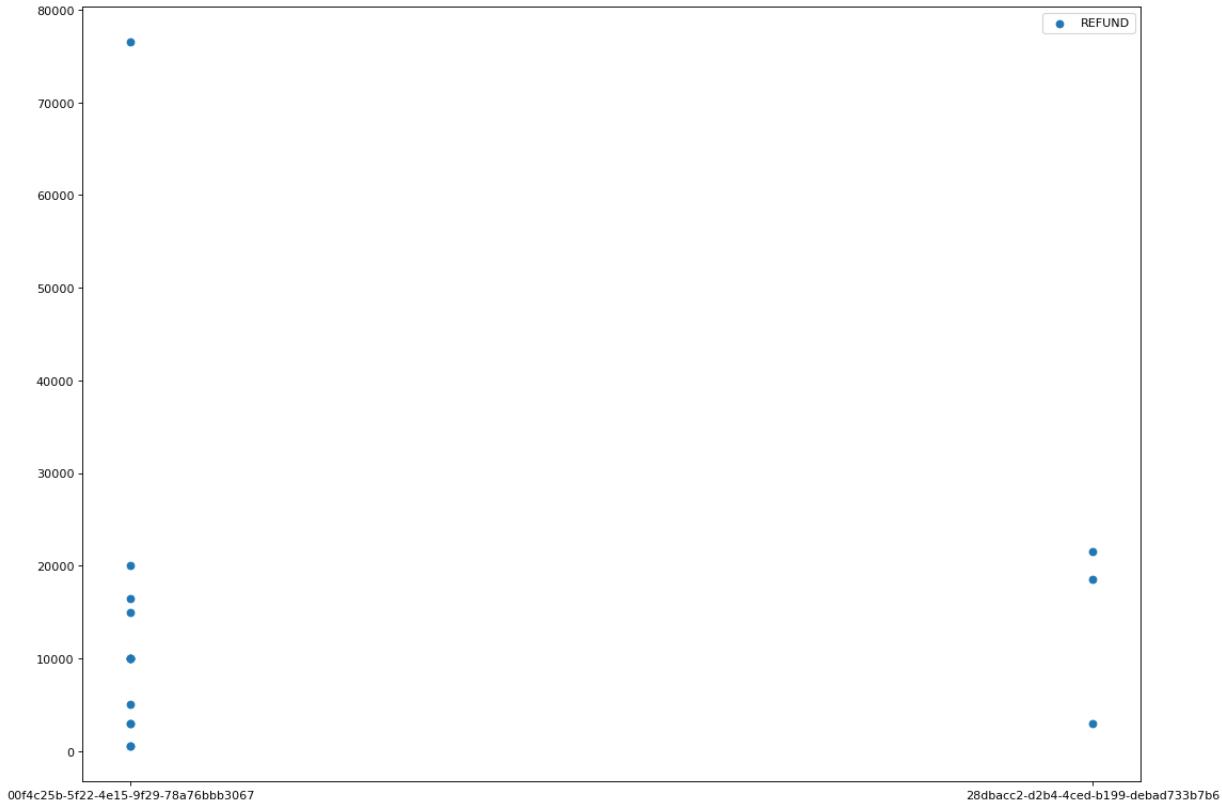
Name: externalParty.transactionCategory, dtype: int64



OTHER 70
Name: externalParty.transactionCategory, dtype: int64

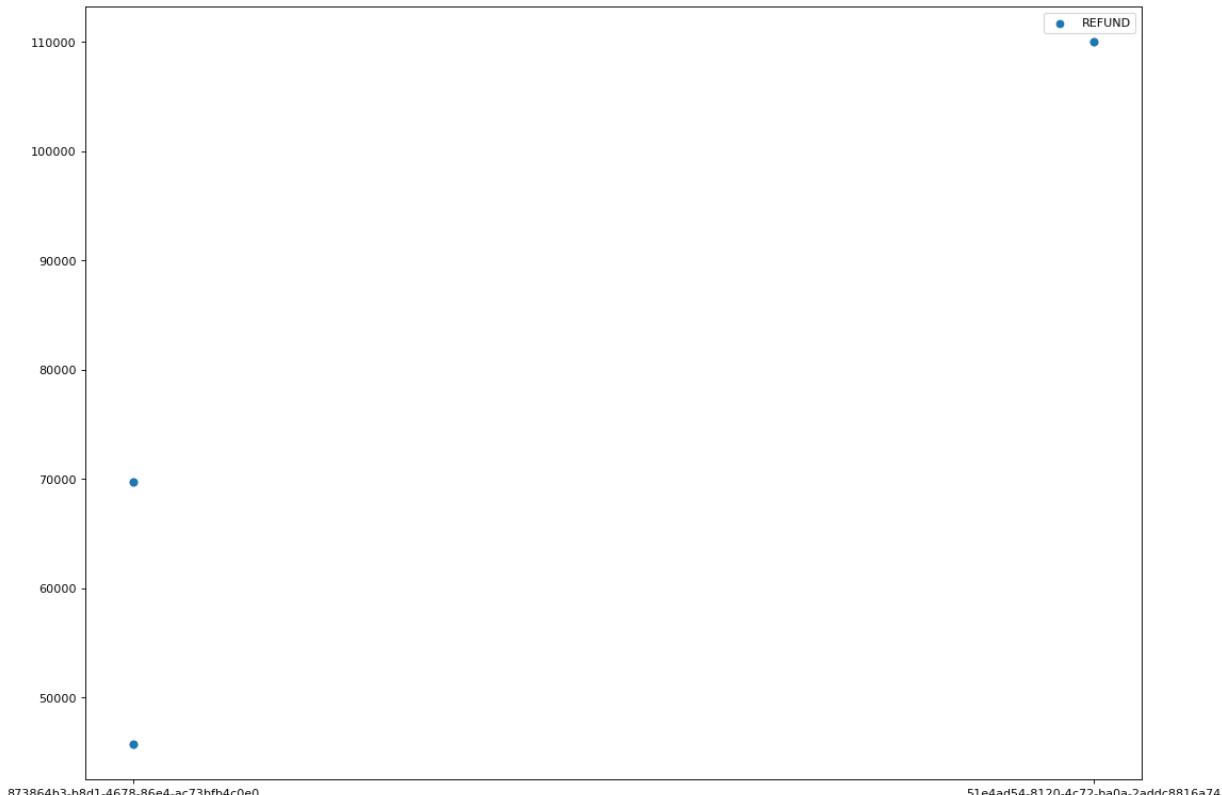


OTHER 11
SHOPPING 3
Name: externalParty.transactionCategory, dtype: int64



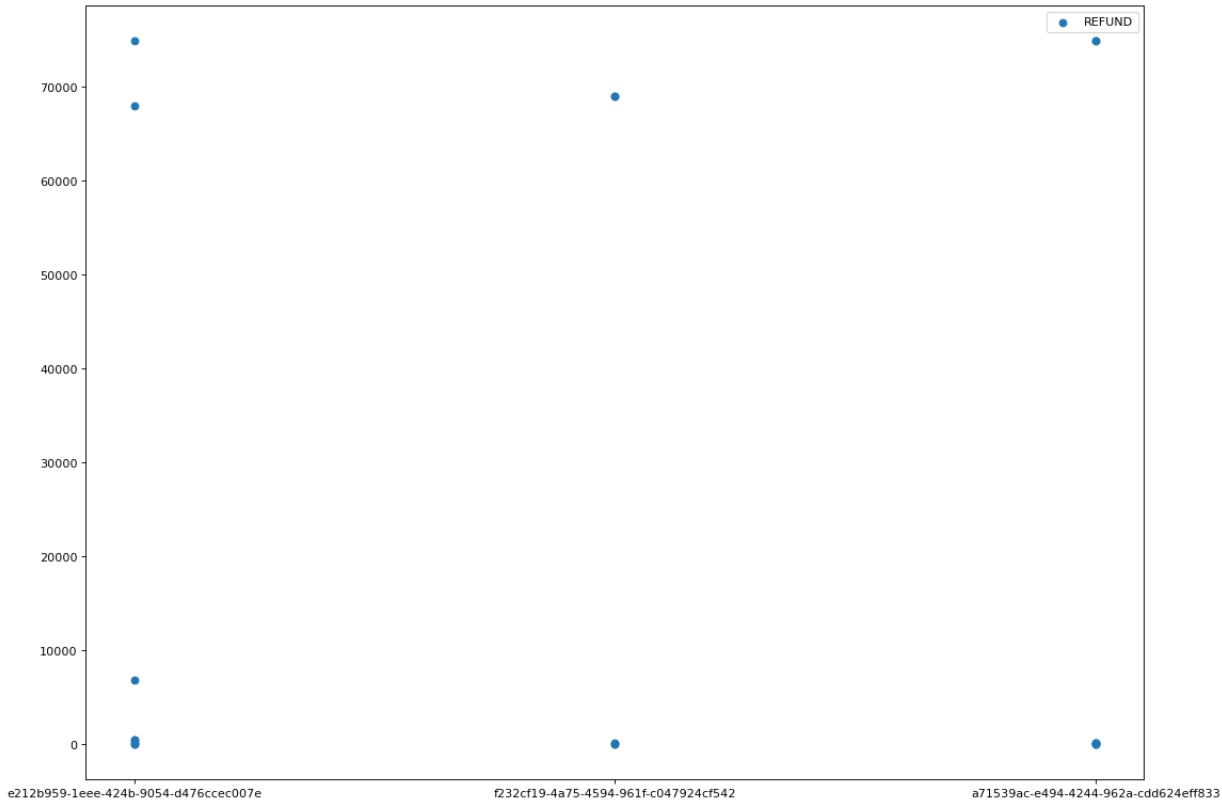
OTHER 16

Name: externalParty.transactionCategory, dtype: int64



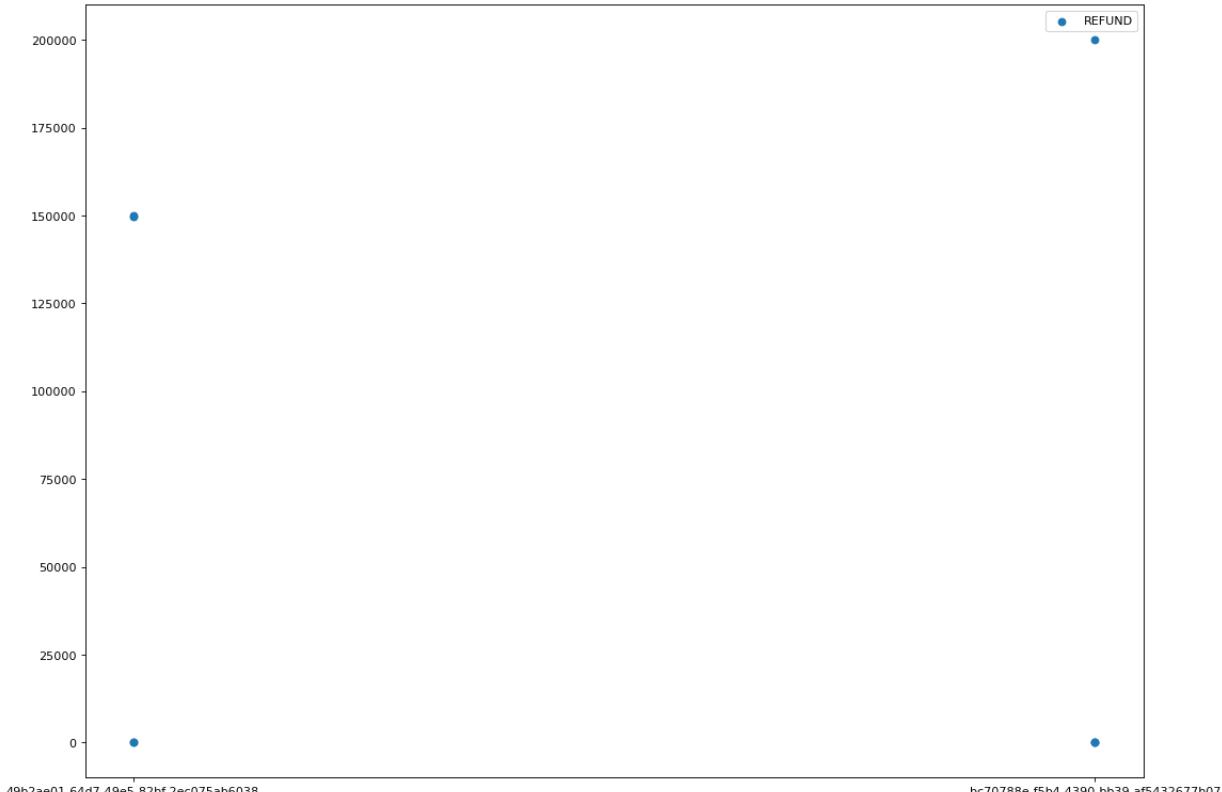
OTHER 6

Name: externalParty.transactionCategory, dtype: int64



OTHER 21

Name: externalParty.transactionCategory, dtype: int64



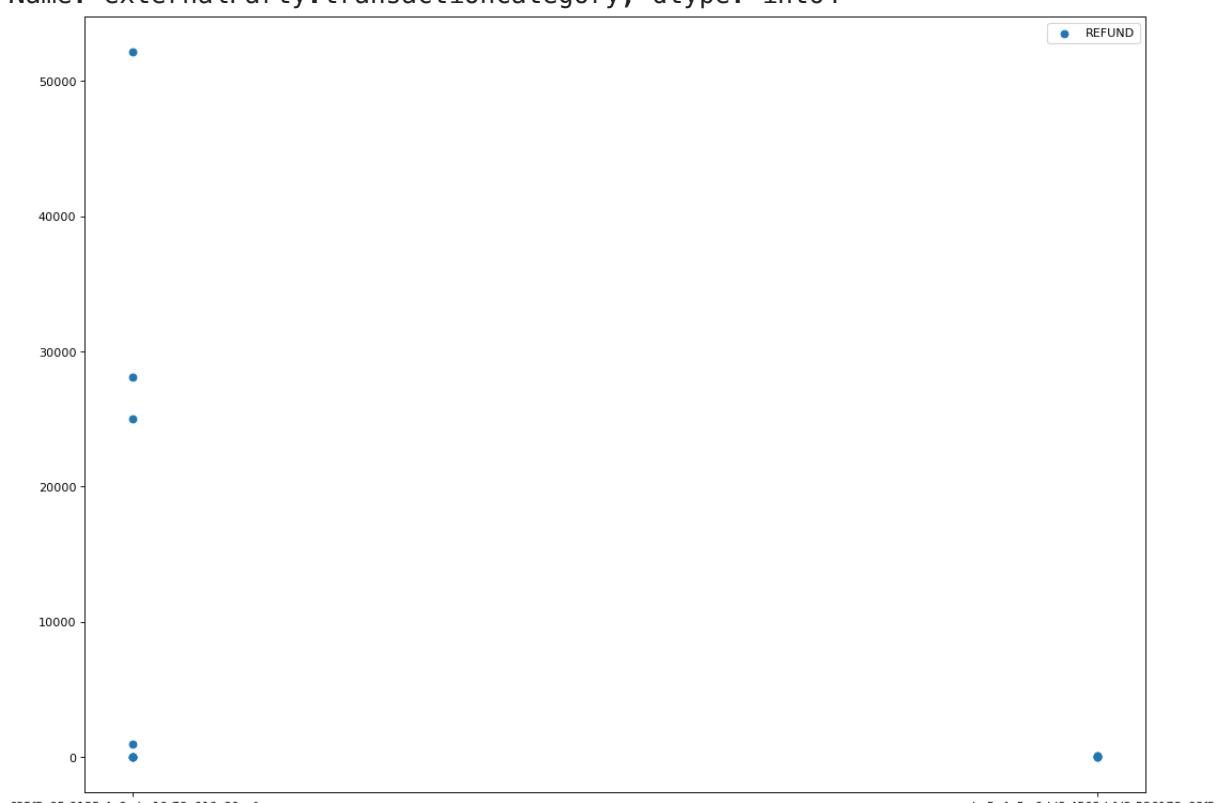
OTHER 8

Name: externalParty.transactionCategory, dtype: int64



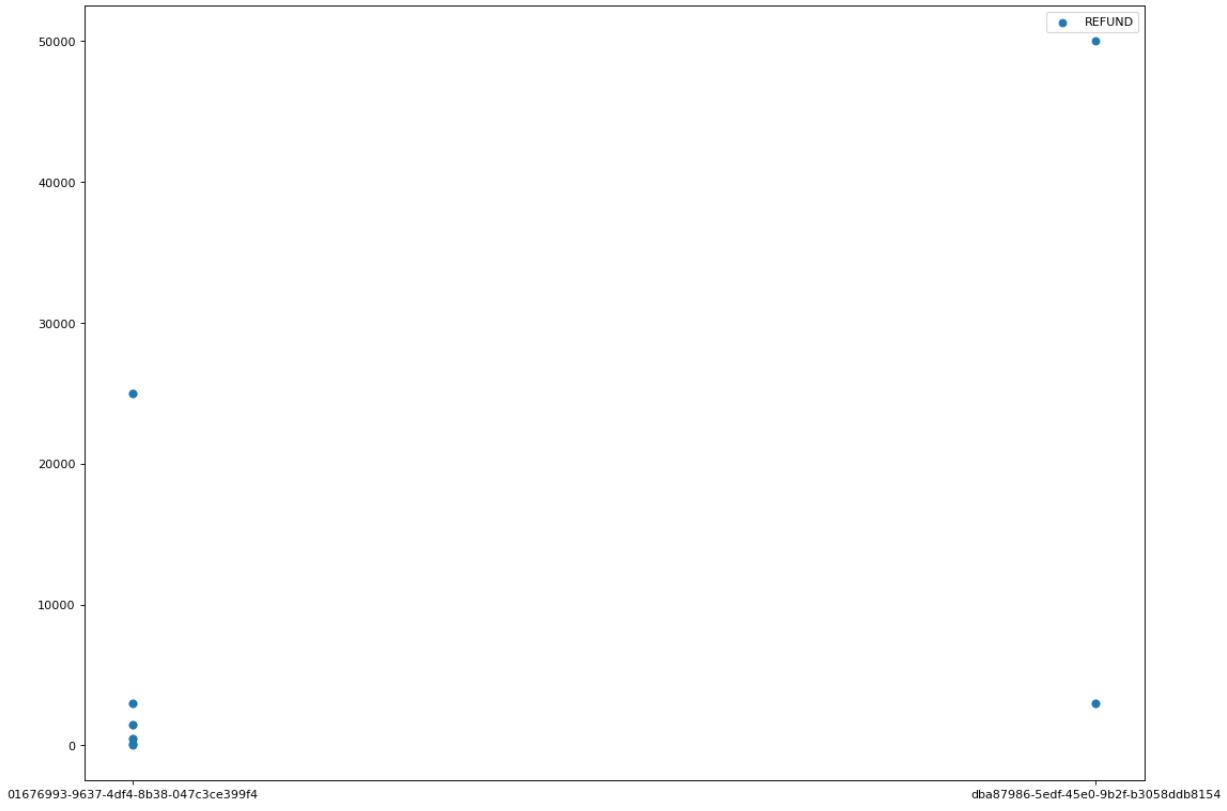
OTHER 7

Name: externalParty.transactionCategory, dtype: int64

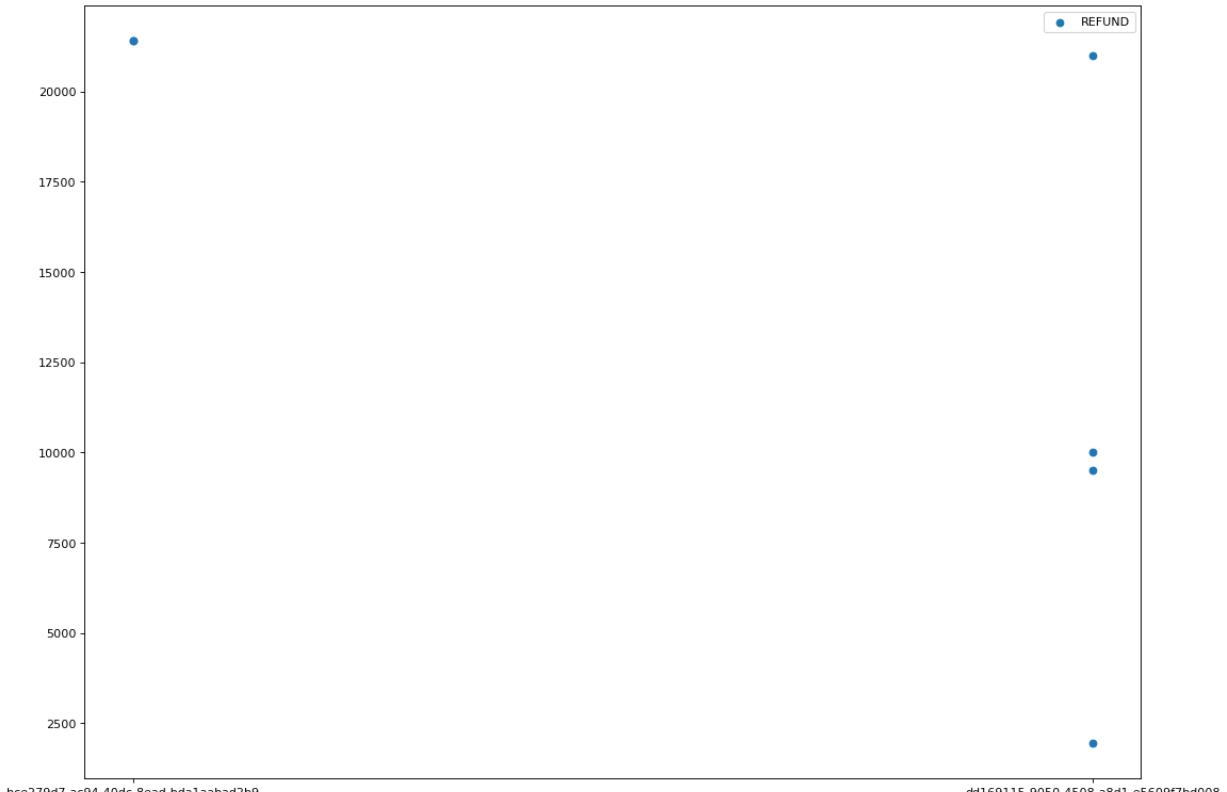


OTHER 13

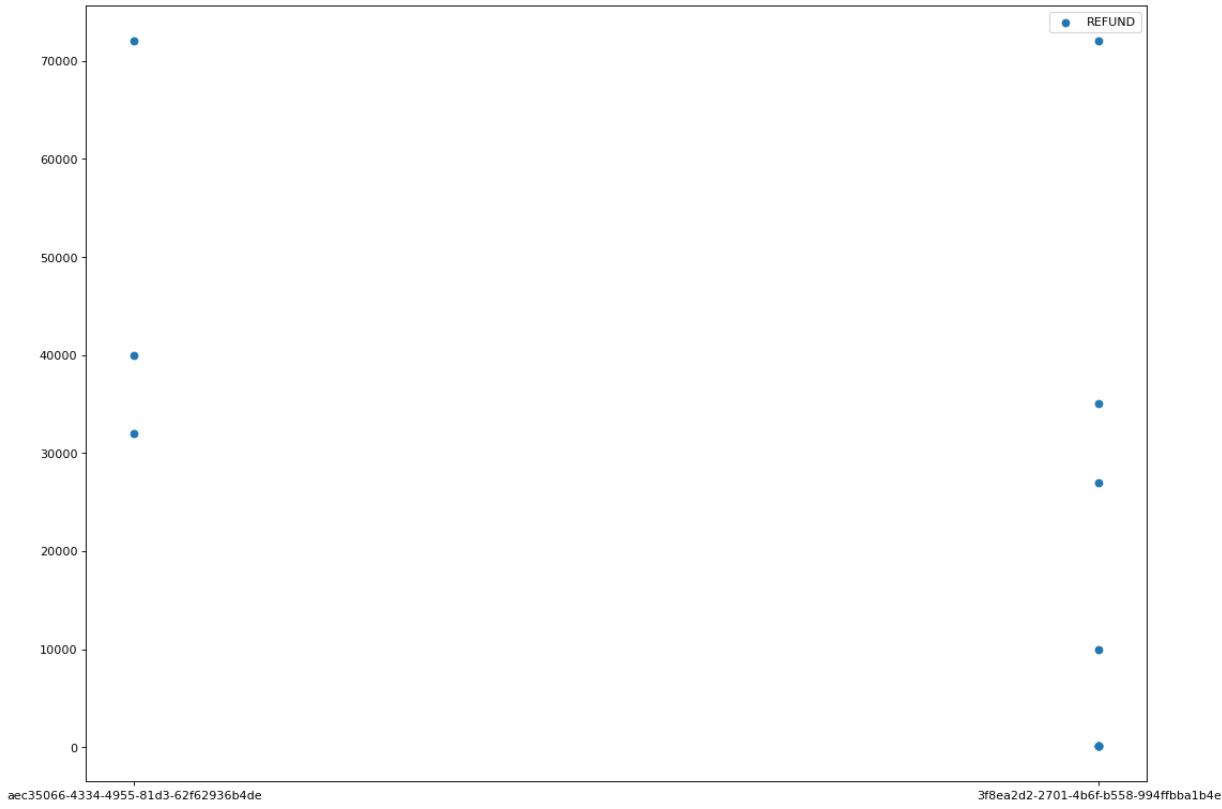
Name: externalParty.transactionCategory, dtype: int64



OTHER 14
Name: externalParty.transactionCategory, dtype: int64

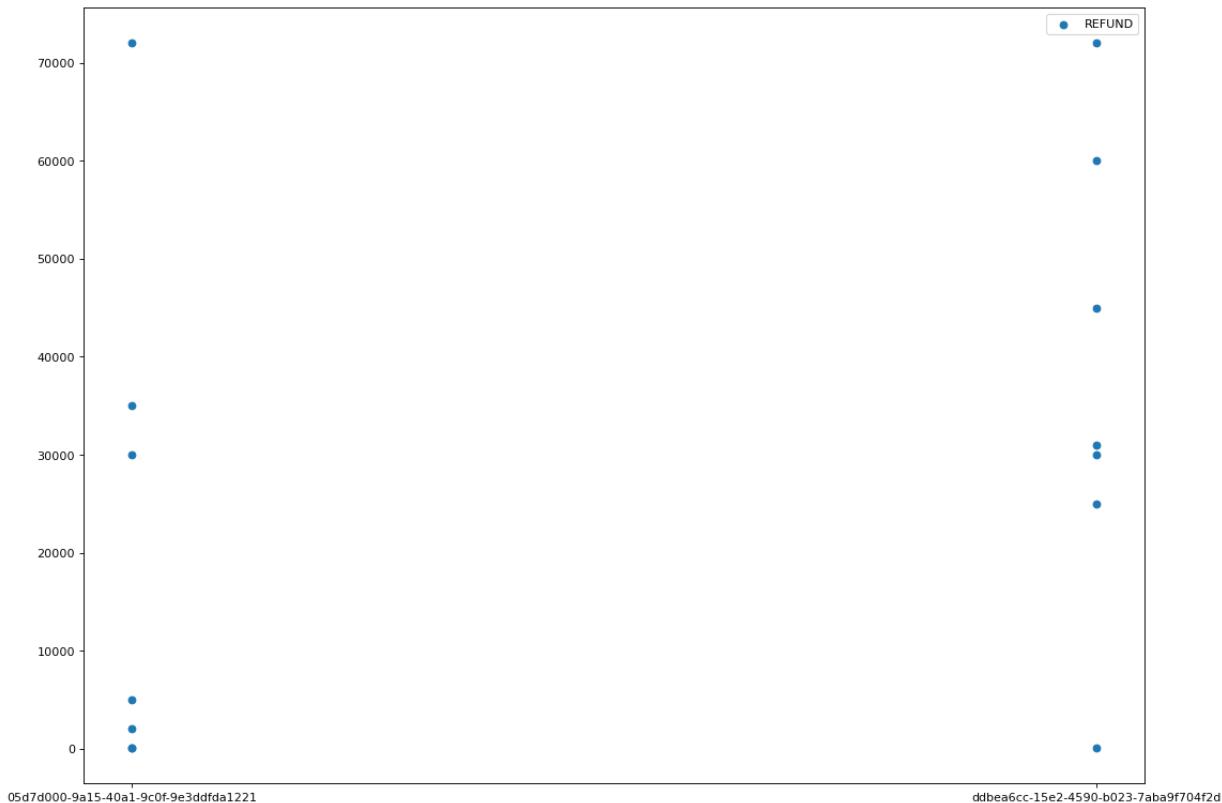


OTHER 6
Name: externalParty.transactionCategory, dtype: int64



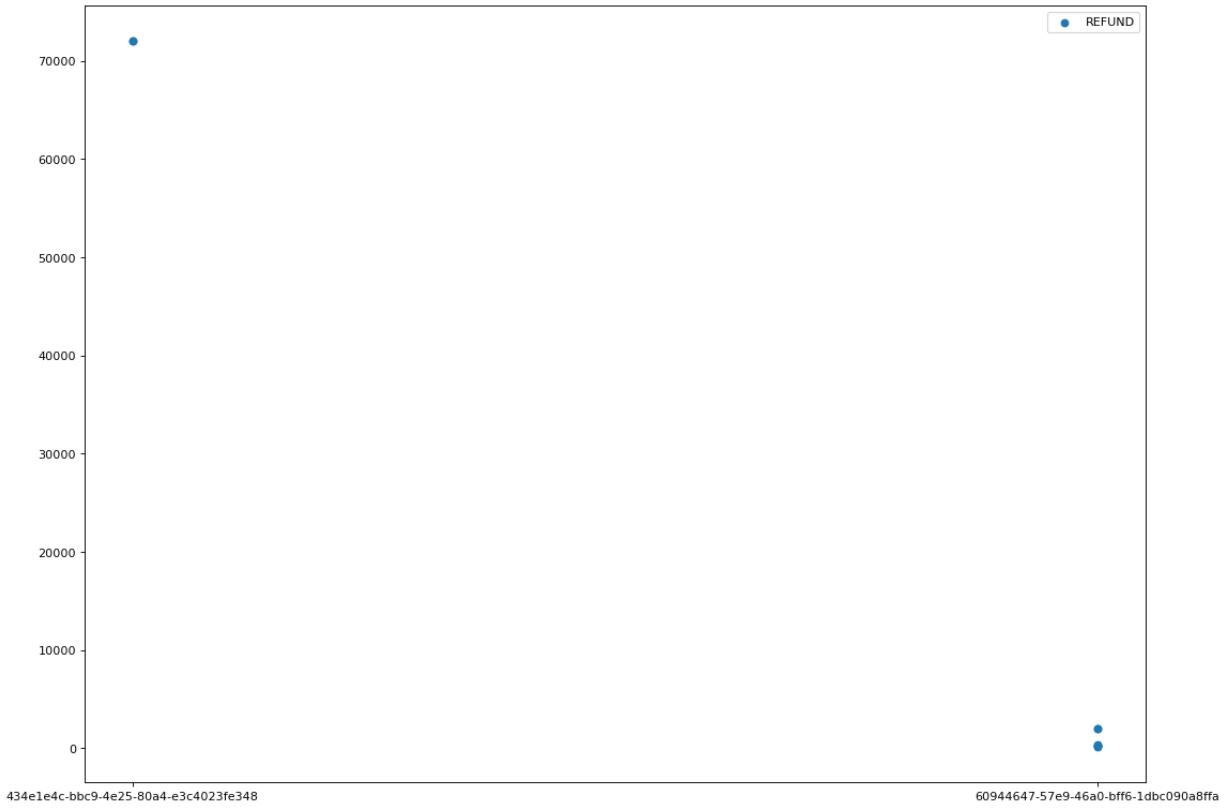
OTHER 11

Name: externalParty.transactionCategory, dtype: int64



OTHER 14

Name: externalParty.transactionCategory, dtype: int64



OTHER 9

Name: externalParty.transactionCategory, dtype: int64
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In [295...]

```
M2 = nx.Graph()
node_color = []
for month in df_p:
    M = nx.from_pandas_edgelist(month, 'Sender customerId', 'accaccount_full',
                                 create_using=nx.DiGraph())
    d = dict(M.in_degree())
    received_trans = [x for x in d if d[x] > 0]

    #community_list = {}

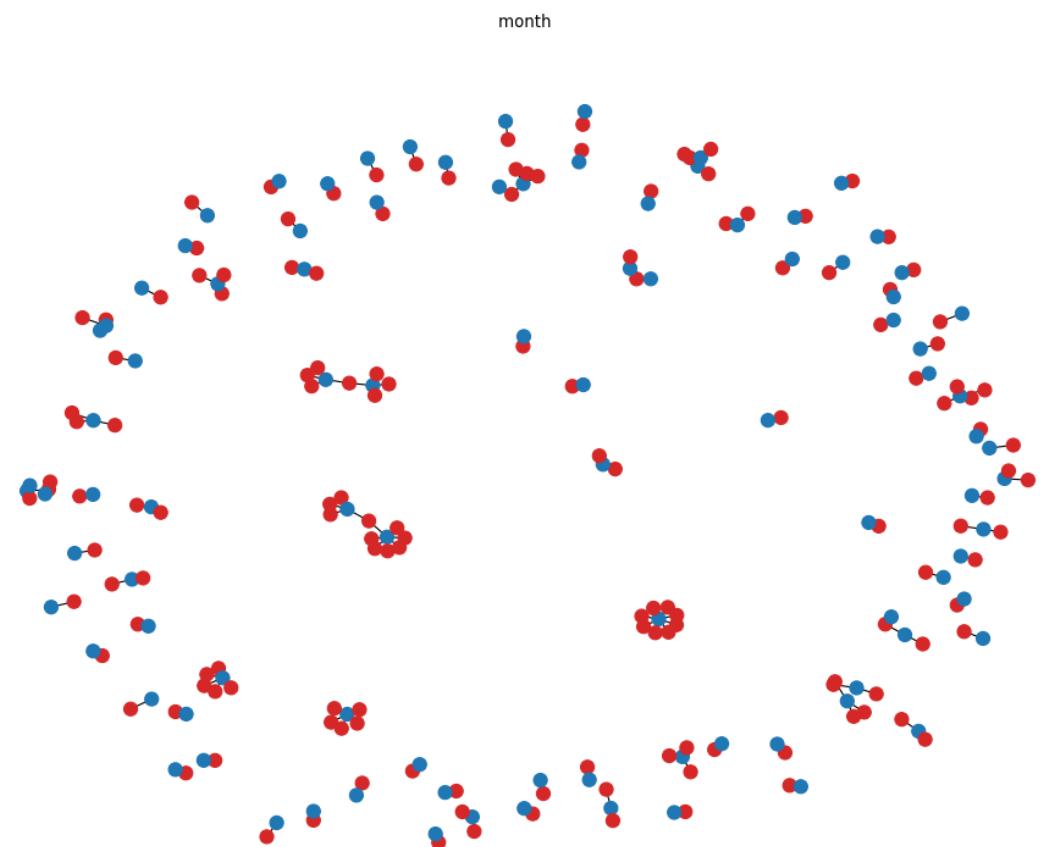
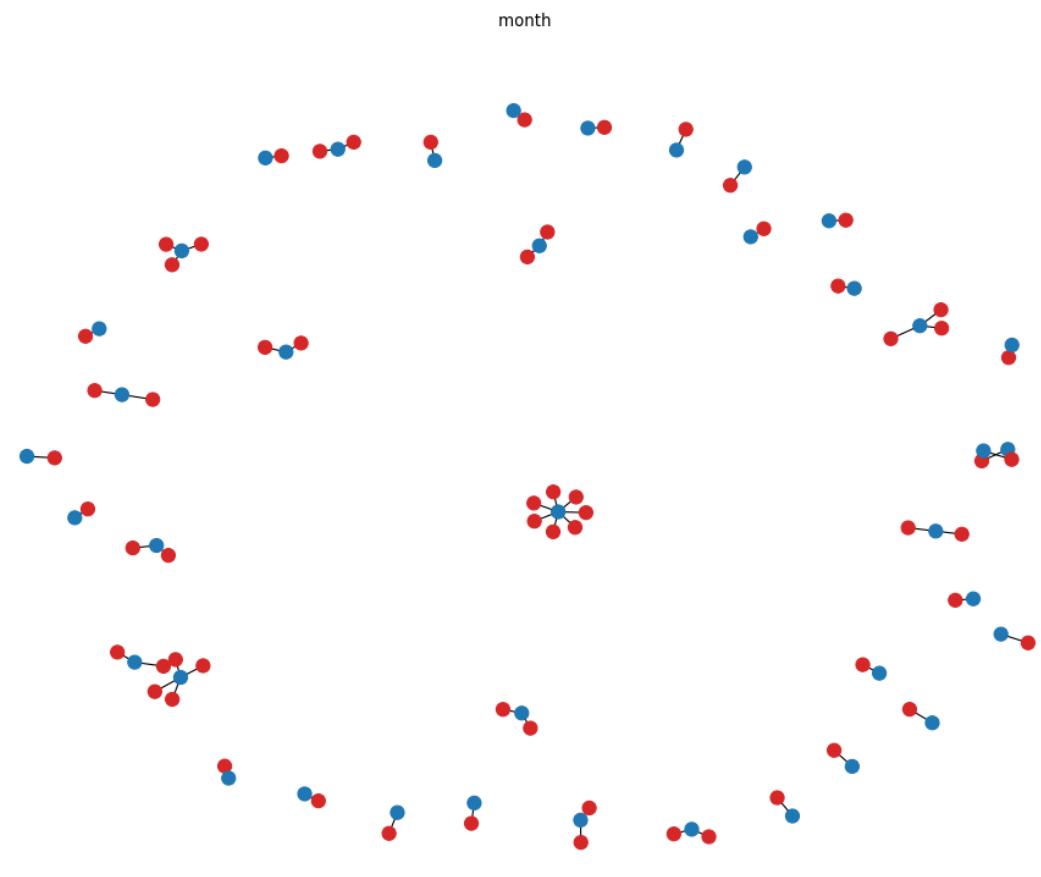
    for acc in received_trans:
        payees = nx.ancestors(M, acc)
        #community_list[acc] = payees

        num = M2.number_of_nodes()
        M2.add_node(acc)
        num = M2.number_of_nodes() - num
        node_color.extend(['tab:red']*num)

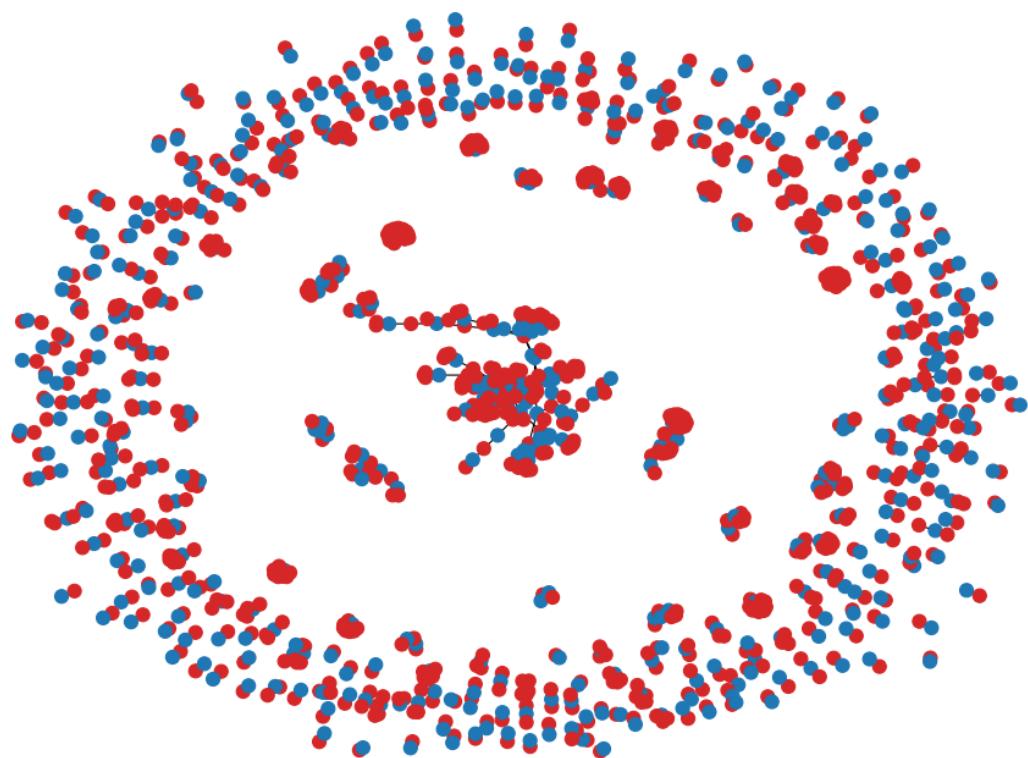
        num = M2.number_of_nodes()
        M2.add_nodes_from(payees)
        num = M2.number_of_nodes() - num
        node_color.extend(['tab:blue']*num)

    M2.add_edges_from(map(lambda e: (e, acc), payees))
if received_trans:
    figure(figsize=(16, 12), dpi=80)
    plt.title('month ')
    nx.draw(M2, node_size=100, node_color=node_color)
    plt.show()
```

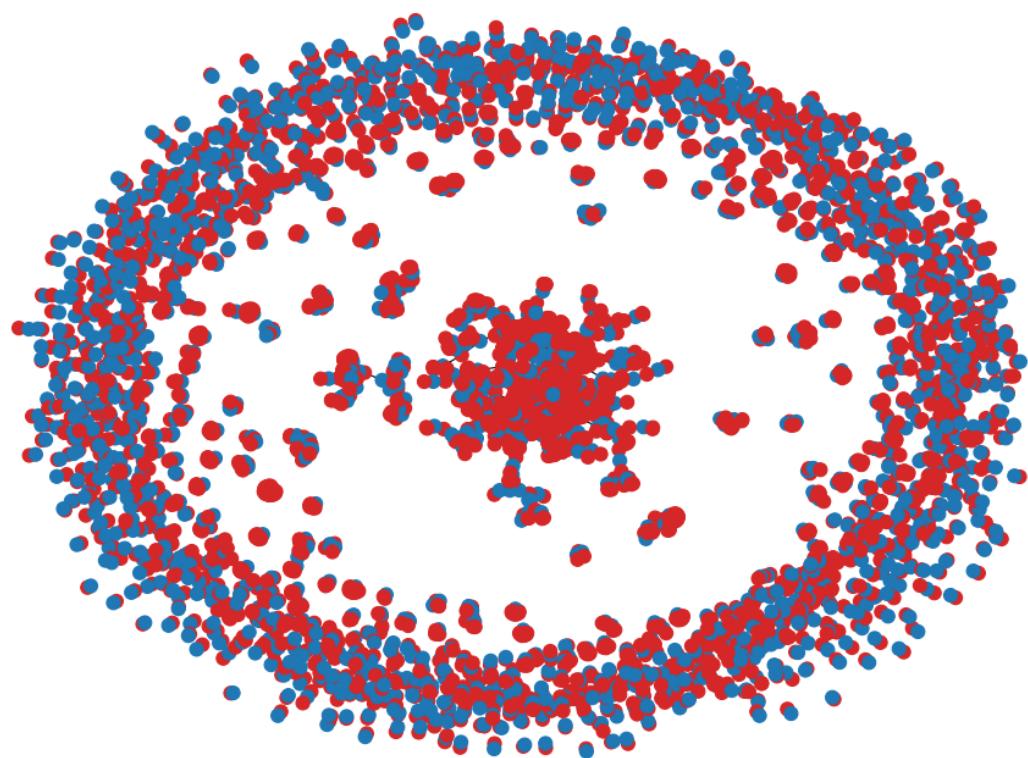
```
101
101
244
244
1261
1261
4646
4646
8188
8188
8882
8882
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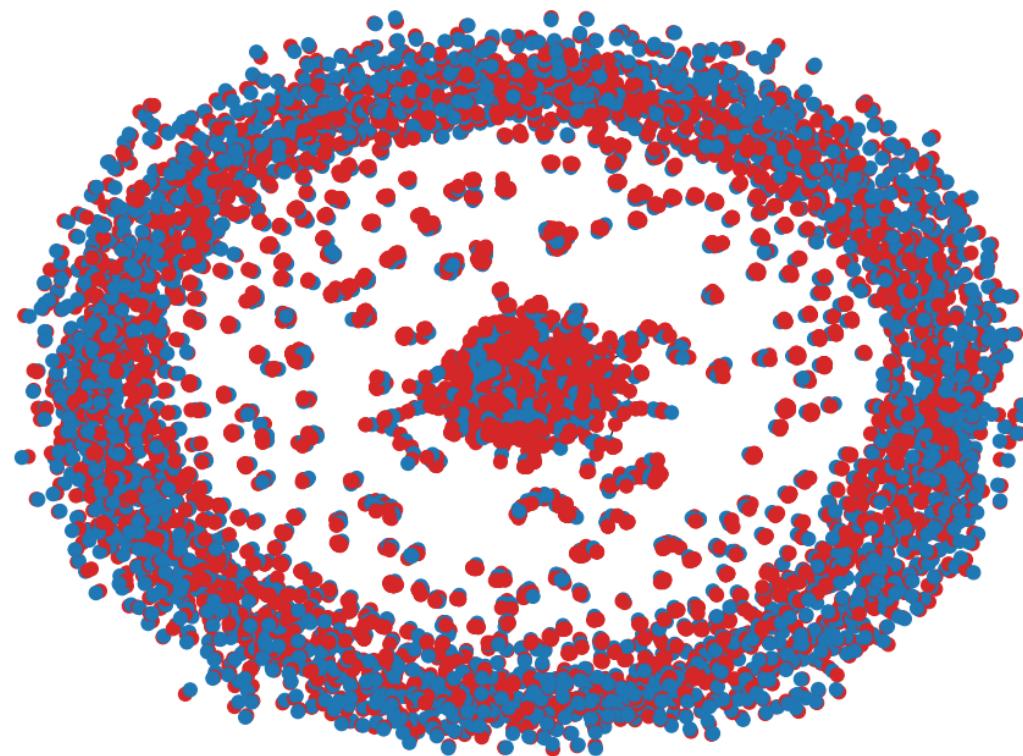
month



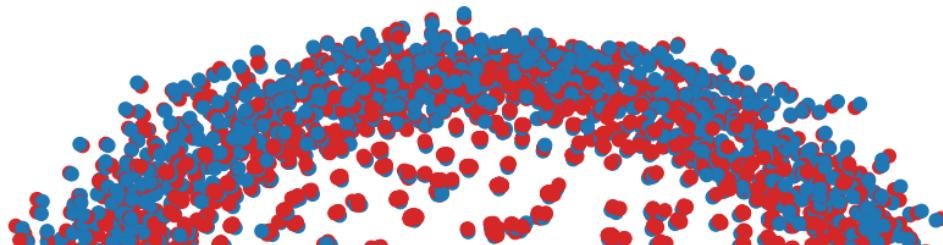
month



month



month



In [296...]

community_list

Out [296...]

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```
In [276...]: itertools.repeat(0, 10)
```

```
Out[276... repeat(0, 10)
```

```
In [226]: #G = nx.from_pandas_edgelist(df_trans, 'accountId', 'customerId')
```

```
In [228]: G.number_of_edges() # 3763 #5598  
G.number_of_nodes() # 7526 #6466  
# so every unique account linked with a unique customer, there is no customer
```

Out[228... 7526

```
In [21]: print(df_trans.shape)
print(df_users.shape)
print(df_payees.shape)
# so we have 62167 transactions, 12988 user informations and 6721 transfers i
```

(62167, 12)
 (12988, 7)
 (6721, 10)

```
In [231]: d = dict(G.in_degree())
received_trans = [x for x in d if d[x] >= 2]
print(type(received_trans))
print(received_trans)
#len(pd.Series(df_payees['accconut_full']).unique()) # customer 3284 , accoun
```

```
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```

In [232...]

```
nx.ancestors(G, '47715207_40357')  
community_list = []  
  
for acc in received_trans:  
    payees = nx.ancestors(G, acc)  
    community_list.append(payees) if payees not in community_list else None  
community_list
```

Out [232...]

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 '.....'}
```

In [104]:

```
print(len(community_list)) #384 community, 401 accounts
#community_list = list(community_list)
upper_community = []
active_acc = set()
for i, com in enumerate(community_list):
    for j in range(i+1, len(community_list)):
        if not com.isdisjoint(list(community_list[j])):
            upper_community.append(sorted((i,j)))
            s = com.intersection(community_list[j])
            active_acc.update(s)
print(upper_community)
```

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```
[[0, 16], [0, 18], [0, 42], [0, 43], [0, 49], [0, 54], [0, 55], [0, 83], [0, 108], [0, 145], [0, 193], [0, 195], [0, 199], [0, 305], [1, 6], [4, 165], [6, 7], [6, 125], [6, 276], [7, 125], [7, 276], [11, 13], [12, 26], [14, 37], [11, 42], [14, 48], [14, 55], [14, 71], [14, 76], [14, 86], [14, 113], [14, 13], [14, 133], [15, 21], [15, 29], [15, 167], [15, 246], [16, 38], [16, 43], [16, 48], [16, 49], [16, 54], [16, 59], [16, 69], [16, 74], [16, 75], [16, 82], [16, 92], [16, 95], [16, 139], [16, 140], [16, 145], [16, 185], [16, 200], [16, 201], [16, 259], [16, 273], [16, 328], [16, 348], [18, 39], [18, 41], [18, 43], [18, 44], [18, 49], [18, 53], [18, 65], [18, 79], [18, 109], [18, 113], [18, 115], [18, 121], [18, 128], [18, 130], [18, 144], [18, 151], [18, 155], [18, 156], [18, 157], [18, 164], [18, 177], [18, 178], [18, 179], [18, 186], [18, 191], [18, 197], [18, 217], [18, 220], [18, 241], [18, 243], [18, 283], [18, 316], [18, 339], [18, 357], [21, 29], [21, 167], [22, 46], [22, 167], [22, 269], [23, 36], [27, 28], [27, 34], [28, 34], [29, 246], [31, 106], [31, 123], [37, 172], [38, 40], [38, 41], [39, 40], [39, 41], [39, 128], [40, 41], [41, 128], [41, 148], [41, 161], [41, 170], [41, 238], [41, 267], [41, 331], [41, 361], [42, 43], [42, 50], [42, 53], [42, 54], [42, 55], [42, 60], [42, 63], [42, 64], [42, 65], [42, 71], [42, 72], [42, 73], [42, 75], [42, 77], [42, 78], [42, 79], [42, 83], [42, 86], [42, 87], [42, 93], [42, 113], [42, 121], [42, 133], [42, 148], [42, 150], [42, 154], [42, 160], [42, 161], [42, 182], [42, 237], [43, 49], [43, 50], [43, 54], [43, 61], [43, 64], [43, 70], [43, 71], [43, 73], [43, 77], [43, 81], [43, 93], [43, 108], [43, 112], [43, 113], [43, 115], [43, 117], [43, 121], [43, 129], [43, 150], [43, 159], [43, 163], [43, 232], [43, 289], [43, 300], [43, 305], [43, 333], [43, 339], [44, 102], [44, 103], [46, 167], [46, 269], [48, 74], [48, 76], [48, 95], [48, 187], [49, 54], [49, 104], [49, 119], [49, 120], [49, 127], [49, 282], [49, 283], [49, 296], [50, 55], [50, 58], [50, 63], [50, 64], [50, 71], [50, 93], [52, 57], [53, 55], [53, 60], [53, 63], [53, 65], [53, 79], [54, 55], [54, 81], [54, 96], [54, 108], [54, 136], [54, 138], [55, 58], [55, 60], [55, 63], [55, 65], [55, 71], [55, 72], [55, 73], [55, 78], [55, 83], [55, 86], [55, 87], [55, 96], [55, 107], [55, 113], [55, 133], [58, 63], [60, 65], [61, 67], [63, 65], [63, 73], [64, 71], [64, 93], [64, 154], [64, 160], [65, 71], [65, 72], [65, 78], [65, 79], [65, 83], [66, 153], [71, 72], [71, 75], [71, 78], [71, 83], [71, 86], [71, 87], [71, 93], [71, 113], [71, 133], [72, 78], [72, 83], [73, 77], [74, 76], [74, 95], [75, 253], [77, 79], [78, 83], [78, 87], [79, 170], [81, 108], [81, 137], [81, 159], [82, 139], [83, 87], [83, 108], [86, 113], [86, 121], [86, 133], [87, 272], [92, 140], [92, 328], [92, 348], [96, 136], [96, 138], [96, 161], [96, 170], [96, 181], [96, 225], [97, 110], [97, 119], [99, 110], [99, 120], [100, 202], [101, 194], [101, 311], [102, 103], [102, 105], [102, 109], [103, 130], [105, 109], [107, 113], [107, 170], [107, 198], [109, 156], [109, 241], [110, 119], [110, 120], [111, 117], [111, 147], [111, 270], [111, 339], [111, 377], [112, 150], [112, 159], [113, 115], [113, 133], [113, 148], [113, 149], [113, 150], [113, 154], [113, 160], [113, 161], [114, 135], [115, 117], [116, 295], [116, 328], [116, 338], [116,
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```

In [146...]

```
from collections import Counter  
import operator  
test = [item for sublist in upper_community for item in sublist]  
test1 = Counter(test)  
  
test = sorted(test1.items(), key=operator.itemgetter(1), reverse=True) #268  
#test = sorted((t for t in test1.items() if t[1] >= 2), key=operator.itemgett  
len(test)
```

Out[146...]

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In [147...]

```
#print(community_list[18])  
print(len(upper_community))  
print(len(active_acc))  
test = [item for sublist in community_list for item in sublist]  
test1 = Counter(test)  
  
test = sorted(test1.items(), key=operator.itemgetter(1), reverse=True) #1077  
#test = sorted((t for t in test1.items() if t[1] >= 2), key=operator.itemgett  
test
```

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261

Out[147...]

```
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