Filterbasedpredictors

March 17, 2023

[1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
from sklearn.model_selection import train_test_split
from sklearn.feature_selection import mutual_info_regression,␣
 ↪mutual_info_classif
```

[103]:
```
#read dataset
data = pd.read_csv("/content/drive/MyDrive/CIND 820 Capstone Project/
 ↪merged_completedata.csv")
data.shape
```

[103]:
```
(78032, 28)
```

[104]:
```
# filter dataframe to 2019 records
data = data[data['Year'] >= 2019]
```

[105]:
```
data.head()
```

[105]:

	RecordID	X	Y	FID	BusinessID	\
46689	46690	-79.665386	43.684736	1	7	
46690	46691	-79.642760	43.593515	2	4246	
46691	46692	-79.667311	43.682752	3	10	
46692	46693	-79.629235	43.698932	4	4247	
46693	46694	-79.629235	43.698932	5	4250	

	Name	Address	StreetNo	\
46689	Peel Car & Truck Rentals	7050 Bramalea Rd	7050	
46690	Real Fruit Bubble Tea	100 City Centre Dr	100	
46691	Unifor 2002	7015 Tranmere Dr	7015	
46692	Laura with Plus and Petites	100 City Centre Dr	100	
46693	Footlocker	100 City Centre Dr	100	

	StreetName	BldgNo	…	Fax	TollFree	EMail	WebAddress	EmplRange	\
46689	Bramalea Rd	Yes	…	Yes	Yes	Yes	Yes	1	

```
46690  City Centre Dr     No  …   No       No    No         Yes          2
46691     Tranmere Dr     No  …  Yes      Yes   Yes         Yes          3
46692  City Centre Dr     No  …   No       No    No         Yes          2
46693  City Centre Dr     No  …   No       No    No          No          4

            CENT_X        CENT_Y  Year isnew Closed
46689  607567.2334  4.837723e+06  2019    No     No
46690  609556.5032  4.827621e+06  2019   Yes     No
46691  607415.6044  4.837500e+06  2019    No     No
46692  610454.8654  4.839347e+06  2019   Yes     No
46693  610454.8654  4.839347e+06  2019   Yes     No

[5 rows x 28 columns]
```

[106]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 31343 entries, 46689 to 78031
Data columns (total 28 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   RecordID    31343 non-null  int64
 1   X           31343 non-null  float64
 2   Y           31343 non-null  float64
 3   FID         31343 non-null  int64
 4   BusinessID  31343 non-null  int64
 5   Name        31343 non-null  object
 6   Address     31343 non-null  object
 7   StreetNo    31343 non-null  int64
 8   StreetName  31343 non-null  object
 9   BldgNo      31343 non-null  object
 10  UnitNo      31343 non-null  object
 11  PostalCode  31343 non-null  object
 12  Location    31343 non-null  object
 13  Ward        31343 non-null  int64
 14  NAICSCode   31343 non-null  int64
 15  NAICSCat    31343 non-null  object
 16  NAICSDescr  31343 non-null  object
 17  Phone       31343 non-null  object
 18  Fax         31343 non-null  object
 19  TollFree    31343 non-null  object
 20  EMail       31343 non-null  object
 21  WebAddress  31343 non-null  object
 22  EmplRange   31343 non-null  int64
 23  CENT_X      31343 non-null  float64
 24  CENT_Y      31343 non-null  float64
 25  Year        31343 non-null  int64
```

```
 26  isnew       31343 non-null  object
 27  Closed      31343 non-null  object
dtypes: float64(4), int64(8), object(16)
memory usage: 6.9+ MB
```

[107]:
```
#NAICSCode back to object as it is nominal not ordinal
data['NAICSCode'] = data['NAICSCode'].astype(str)
```

[108]:
```
#drop unique fields
data.drop(['RecordID','FID','BusinessID','Name','Address',␣
 ↪'StreetNo','StreetName','NAICSDescr','Year'], axis=1, inplace=True)
```

[109]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 31343 entries, 46689 to 78031
Data columns (total 19 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   X           31343 non-null  float64
 1   Y           31343 non-null  float64
 2   BldgNo      31343 non-null  object
 3   UnitNo      31343 non-null  object
 4   PostalCode  31343 non-null  object
 5   Location    31343 non-null  object
 6   Ward        31343 non-null  int64
 7   NAICSCode   31343 non-null  object
 8   NAICSCat    31343 non-null  object
 9   Phone       31343 non-null  object
 10  Fax         31343 non-null  object
 11  TollFree    31343 non-null  object
 12  EMail       31343 non-null  object
 13  WebAddress  31343 non-null  object
 14  EmplRange   31343 non-null  int64
 15  CENT_X      31343 non-null  float64
 16  CENT_Y      31343 non-null  float64
 17  isnew       31343 non-null  object
 18  Closed      31343 non-null  object
dtypes: float64(4), int64(2), object(13)
memory usage: 4.8+ MB
```

[110]:
```
#decribe categorical data
data.describe(include='O')
#There is none if I get an error
```

[110]:

	BldgNo	UnitNo	PostalCode	Location	NAICSCode	NAICSCat	\
count	31343	31343	31343	31343	31343	31343	

```
unique      2      2         37                    56        24            19
top        No    Yes       L4W  Northeast EA (West)        81  Retail Trade
freq    29769  20869       5084                  8325      3576          4377

         Phone    Fax TollFree  EMail WebAddress  isnew Closed
count    31343  31343    31343  31343      31343  31343  31343
unique       2      2        2      2          2      2      2
top        Yes    Yes       No    Yes        Yes     No     No
freq     30965  19310    26636  19963      23174  28576  28629
```

[111]:
```
#if there is categorical data then factorize it
data['WebAddress'] = pd.factorize(data['WebAddress'])[0]
data['BldgNo'] = pd.factorize(data['BldgNo'])[0]
data['Fax'] = pd.factorize(data['Fax'])[0]
data['TollFree'] = pd.factorize(data['TollFree'])[0]
data['UnitNo'] = pd.factorize(data['UnitNo'])[0]
data['isnew'] = pd.factorize(data['isnew'])[0]
data['Closed'] = pd.factorize(data['Closed'])[0]
data['NAICSCode'] = pd.factorize(data['NAICSCode'])[0]
data['NAICSCat'] = pd.factorize(data['NAICSCat'])[0]
data['Location'] = pd.factorize(data['Location'])[0]
data['Phone'] = pd.factorize(data['Phone'])[0]
data['EMail'] = pd.factorize(data['EMail'])[0]
data['PostalCode'] = pd.factorize(data['PostalCode'])[0]
```

[112]:
```
#decribe categorical data
data.describe(include='O')
#There is none if I get an error
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-112-0c5d7d2ffda0> in <module>
      1 #decribe categorical data
----> 2 data.describe(include='O')
      3 #There is none if I get an error

/usr/local/lib/python3.9/dist-packages/pandas/core/generic.py in describe(self,
 ↪percentiles, include, exclude, datetime_is_numeric)
  10230         max            NaN      3.0
  10231         """
> 10232         return describe_ndframe(
  10233             obj=self,
  10234             include=include,

/usr/local/lib/python3.9/dist-packages/pandas/core/describe.py in␣
 ↪describe_ndframe(obj, include, exclude, datetime_is_numeric, percentiles)
```

```
     92         )
     93
---> 94     result = describer.describe(percentiles=percentiles)
     95     return cast(NDFrameT, result)
     96

/usr/local/lib/python3.9/dist-packages/pandas/core/describe.py in describe(self
 ↪percentiles)
    175
    176         col_names = reorder_columns(ldesc)
--> 177         d = concat(
    178             [x.reindex(col_names, copy=False) for x in ldesc],
    179             axis=1,

/usr/local/lib/python3.9/dist-packages/pandas/util/_decorators.py in
 ↪wrapper(*args, **kwargs)
    309                     stacklevel=stacklevel,
    310                 )
--> 311             return func(*args, **kwargs)
    312
    313         return wrapper

/usr/local/lib/python3.9/dist-packages/pandas/core/reshape/concat.py in
 ↪concat(objs, axis, join, ignore_index, keys, levels, names, verify_integrity,
 ↪sort, copy)
    345     ValueError: Indexes have overlapping values: ['a']
    346     """
--> 347     op = _Concatenator(
    348         objs,
    349         axis=axis,

/usr/local/lib/python3.9/dist-packages/pandas/core/reshape/concat.py in
 ↪__init__(self, objs, axis, join, keys, levels, names, ignore_index,
 ↪verify_integrity, copy, sort)
    402
    403         if len(objs) == 0:
--> 404             raise ValueError("No objects to concatenate")
    405
    406         if keys is None:

ValueError: No objects to concatenate
```

[113]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 31343 entries, 46689 to 78031
Data columns (total 19 columns):
```

```
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   X            31343 non-null  float64
 1   Y            31343 non-null  float64
 2   BldgNo       31343 non-null  int64
 3   UnitNo       31343 non-null  int64
 4   PostalCode   31343 non-null  int64
 5   Location     31343 non-null  int64
 6   Ward         31343 non-null  int64
 7   NAICSCode    31343 non-null  int64
 8   NAICSCat     31343 non-null  int64
 9   Phone        31343 non-null  int64
 10  Fax          31343 non-null  int64
 11  TollFree     31343 non-null  int64
 12  EMail        31343 non-null  int64
 13  WebAddress   31343 non-null  int64
 14  EmplRange    31343 non-null  int64
 15  CENT_X       31343 non-null  float64
 16  CENT_Y       31343 non-null  float64
 17  isnew        31343 non-null  int64
 18  Closed       31343 non-null  int64
dtypes: float64(4), int64(15)
memory usage: 4.8 MB
```

[114]:
```
data.head()
```

[114]:

	X	Y	BldgNo	UnitNo	PostalCode	Location	Ward
46689	-79.665386	43.684736	0	0	0	0	5
46690	-79.642760	43.593515	1	0	1	1	4
46691	-79.667311	43.682752	1	0	0	0	5
46692	-79.629235	43.698932	1	0	1	2	4
46693	-79.629235	43.698932	1	0	1	2	4

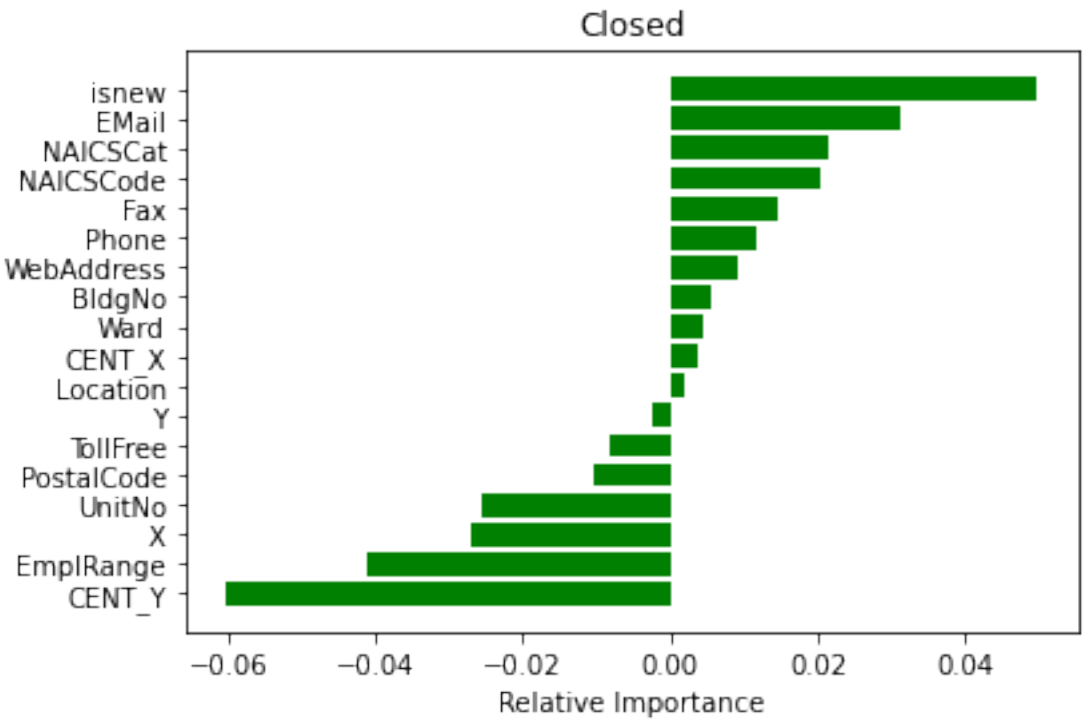
	NAICSCode	NAICSCat	Phone	Fax	TollFree	EMail	WebAddress
46689	0	0	0	0	0	0	0
46690	1	1	1	1	1	1	0
46691	2	2	0	0	0	0	0
46692	0	0	0	1	1	1	0
46693	0	0	0	1	1	1	1

	EmplRange	CENT_X	CENT_Y	isnew	Closed
46689	1	607567.2334	4.837723e+06	0	0
46690	2	609556.5032	4.827621e+06	1	0
46691	3	607415.6044	4.837500e+06	0	0
46692	2	610454.8654	4.839347e+06	1	0
46693	4	610454.8654	4.839347e+06	1	0

[115]:
```
importances = data.drop('Closed', axis=1).apply(lambda x: x.corr(data.Closed))
indices = np.argsort(importances)
print(importances[indices])
```

```
CENT_Y       -0.060260
EmplRange    -0.041116
X            -0.026877
UnitNo       -0.025721
PostalCode   -0.010325
TollFree     -0.008072
Y            -0.002403
Location      0.001719
CENT_X        0.003526
Ward          0.004591
BldgNo        0.005347
WebAddress    0.009212
Phone         0.011712
Fax           0.014476
NAICSCode     0.020264
NAICSCat      0.021286
EMail         0.031282
isnew         0.049747
dtype: float64
```

[116]:
```
names=['X','Y','BldgNo','UnitNo','PostalCode','Location','Ward','NAICSCode','NAICSCat','Phone'
plt.title('Closed')
plt.barh(range(len(indices)), importances[indices], color='g', align='center')
plt.yticks(range(len(indices)), [names[i] for i in indices])
plt.xlabel('Relative Importance')
plt.show()
```



[136]:
```
for i in range(0, len(indices)):
    if np.abs(importances[i])>0.04:
        print(names[i])
    #nothing is greater than .4  only 0.04! So nothing is correlated to Closed.
 ↪So all the code after this will yield nothing of significance.
```

```
EmplRange
CENT_Y
isnew
```

[118]:
```
X= data[ ['EmplRange','CENT_Y','isnew']]
```

[119]:
```
for i in range(0,len(X.columns)):
    for j in  range(0,len(X.columns)):
        if i!=j:
            corr_1=np.abs(X[X.columns[i]].corr(X[X.columns[j]]))
            if corr_1 <0.3:
                print( X.columns[i] , " is not correlated  with ", X.columns[j])
            elif corr_1>0.75:
                print( X.columns[i] , " is highly  correlated  with ", X.
 ↪columns[j])
```

```
EmplRange  is not correlated  with  CENT_Y
EmplRange  is not correlated  with  isnew
```

```
CENT_Y  is not correlated  with  EmplRange
CENT_Y  is not correlated  with  isnew
isnew  is not correlated  with  EmplRange
isnew  is not correlated  with  CENT_Y
```

[132]:
```
X = data[ ['EmplRange']]
```

[133]:
```
y = data['Closed']
```

[134]:
```
mi = mutual_info_regression(X, y)
```

[135]:
```
mi = pd.Series(mi)
mi.index = X.columns
mi.sort_values(ascending=False)
mi.sort_values(ascending=False).plot.bar(figsize=(10, 4))
```

[135]: <Axes: >