bank-loan-risk

March 4, 2022

0.1 Bank loan risk classification

[ ]:
```
import pandas as pd
import numpy as np
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split, cross_val_score,␣
 ↪validation_curve
from sklearn.svm import SVC
%matplotlib inline
import matplotlib.pyplot as plt
import seaborn; seaborn.set()
```

[ ]:
```
df = pd.read_excel('https://github.com/aphilas/loan-risk/blob/main/Risk%20data.
 ↪xlsx?raw=true')
df = df.loc[:, ~df.columns.str.contains('^Unnamed')] # Drop "#Unnamed" colums
# df.head()
df
```

[ ]:

	ID	AGE	INCOME	GENDER	MARITAL	NUMKIDS	NUMCARDS	HOWPAID	MORTGAGE	STORECAR	LOANS	RISK
0	100756	44	59944	m	married	1	2	monthly	y	2	0	good risk
1	100668	35	59692	m	married	1	1	monthly	y	1	0	bad loss
2	100418	34	59508	m	married	1	1	monthly	y	2	1	good risk
3	100416	34	59463	m	married	0	2	monthly				
4	100590	39	59393	f	married	0	2	monthly				
…	…	…	…	…	…	…	…	…				
4112	101121	20	15035	m	married	2	2	weekly				
4113	101602	23	15032	f	married	1	1	monthly				
4114	101983	25	15020	f	married	2	0	weekly				
4115	101819	24	15018	m	married	1	2	monthly				
4116	103676	50	15005	f	divsepwid	2	6	weekly				

```
3           y         1      1    bad loss
4           y         1      0   good risk
…       …       …    …          …
4112        y         1      2  bad profit
4113        y         2      2  bad profit
4114        y         1      1  bad profit
4115        y         1      2  bad profit
4116        y         5      3  bad profit

[4117 rows x 12 columns]
```

[ ]:
```
df.describe()
```

[ ]:
```
                ID          AGE        INCOME      NUMKIDS     NUMCARDS  \
count    4117.000000  4117.000000   4117.000000  4117.000000  4117.000000
mean   102059.000000    31.819529  25580.211805     1.452514     2.429439
std      1188.619858     9.876729   8766.867219     1.170579     1.880721
min    100001.000000    18.000000  15005.000000     0.000000     0.000000
25%    101030.000000    23.000000  20497.000000     1.000000     1.000000
50%    102059.000000    31.000000  23490.000000     1.000000     2.000000
75%    103088.000000    41.000000  27566.000000     2.000000     4.000000
max    104117.000000    50.000000  59944.000000     4.000000     6.000000

          STORECAR        LOANS
count  4117.000000  4117.000000
mean      2.515910     1.375759
std       1.352768     0.838183
min       0.000000     0.000000
25%       1.000000     1.000000
50%       2.000000     1.000000
75%       3.000000     2.000000
max       5.000000     3.000000
```

[ ]:
```

```

0.2 Data prep

[ ]:
```
target = df.RISK.astype('category').cat.codes

input = df.drop(['ID', 'RISK'], axis='columns')
input.INCOME = pd.cut(input.INCOME, bins=[15000, 20000, 24000, 30000, 42000,␣
 ↪60000], labels=False)
input.AGE = pd.cut(input.AGE, bins=[17, 21, 31, 41, 51], labels=False)
input.NUMKIDS = pd.cut(input.NUMKIDS, bins=[-1,0,1,5 ], labels=False)
input.NUMCARDS = pd.cut(input.NUMCARDS, bins=[-1,1,2,7 ], labels=False)
input.STORECAR = pd.cut(input.STORECAR, bins=[-1,1,2,3,6 ], labels=False)
```

```
input.LOANS = pd.cut(input.LOANS, bins=[-1,0,1,6 ], labels=False)
input = pd.get_dummies(input, columns=['GENDER', 'MARITAL', 'HOWPAID',␣
↪'MORTGAGE'], drop_first=True)
input
```

[ ]:

	AGE	INCOME	NUMKIDS	NUMCARDS	STORECAR	LOANS	GENDER_m	\
0	3	4	1	1	1	0	1	
1	2	4	1	0	0	0	1	
2	2	4	1	0	1	1	1	
3	2	4	0	1	0	1	1	
4	2	4	0	1	0	0	0	
…	…	…	…	…	…	…	…	
4112	0	0	2	1	0	2	1	
4113	1	0	1	0	1	2	0	
4114	1	0	2	0	0	1	0	
4115	1	0	1	1	0	2	1	
4116	3	0	2	2	3	2	0	

	MARITAL_married	MARITAL_single	HOWPAID_weekly	MORTGAGE_y
0	1	0	0	1
1	1	0	0	1
2	1	0	0	1
3	1	0	0	1
4	1	0	0	1
…	…	…	…	…
4112	1	0	1	1
4113	1	0	0	1
4114	1	0	1	1
4115	1	0	0	1
4116	0	0	1	1

[4117 rows x 11 columns]

0.2.1 Feature selection test

[ ]:
```
score_sums = dict()

for i in range(20):
    for column in list(input):
        X_train, X_test, y_train, y_test = train_test_split(input.drop(column,␣
↪axis='columns'), target, test_size=0.2)
        knn = KNeighborsClassifier(n_neighbors=3)
        knn.fit(X_train,y_train)
        score = knn.score(X_test,y_test)

        try:
```

```
            score_sums[column] += score
        except KeyError:
            score_sums[column] = score

scores = sorted([ (score_sums[column] / 20, column) for column in list(input)␣
↪], key=lambda v:v[0], reverse=True)

# score of model with respective columns dropped
# appears to be random!?
scores

# STORECAR, GENDER_m, AGE, HOWPAID_weekly
```

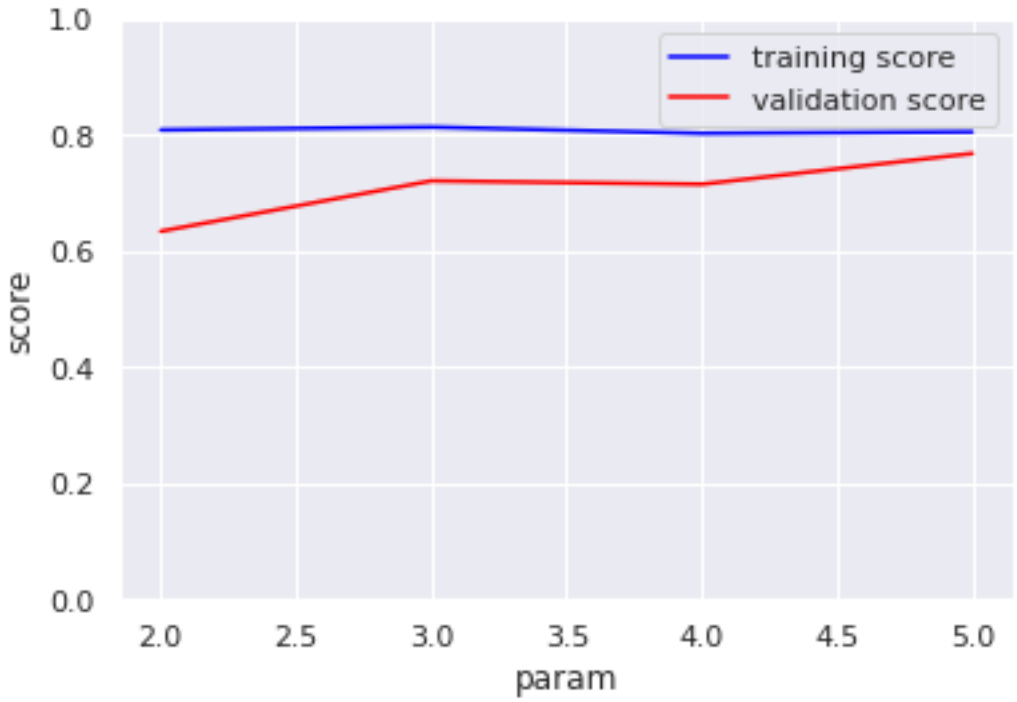
[ ]:
```
[(0.7023665048543688, 'GENDER_m'),
 (0.7001213592233012, 'LOANS'),
 (0.7000000000000001, 'MORTGAGE_y'),
 (0.6994538834951456, 'HOWPAID_weekly'),
 (0.6987864077669903, 'AGE'),
 (0.6985436893203884, 'STORECAR'),
 (0.6958131067961166, 'MARITAL_single'),
 (0.6950242718446601, 'NUMCARDS'),
 (0.6945995145631069, 'NUMKIDS'),
 (0.6913228155339806, 'INCOME'),
 (0.6910194174757281, 'MARITAL_married')]
```

0.2.2 With a validation set

[ ]:
```
# 60-20-20
train_ratio = 0.6
validation_ratio = 0.2
test_ratio = 0.2

X_train, X_test, y_train, y_test = train_test_split(input, target, test_size=1␣
↪- train_ratio)
X_val, X_test, y_val, y_test = train_test_split(X_test, y_test,␣
↪test_size=test_ratio/(test_ratio + validation_ratio))

### testing n_neighbors param, as an example

# use validation or training set!?
param_range = (2, 3, 4, 5)
train_score, val_score = validation_curve(KNeighborsClassifier(), X_val, y_val,␣
↪cv=10, param_name='n_neighbors', param_range=param_range)

plt.plot(param_range, np.median(train_score, 1), color='blue', label='training␣
↪score')
```

```
plt.plot(param_range, np.median(val_score, 1), color='red', label='validation␣
↪score')
plt.legend(loc='best')
plt.ylim(0, 1)
plt.xlabel('param')
plt.ylabel('score')

###

knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(X_train,y_train)
knn.score(X_test, y_test)
```

[ ]: 0.6929611650485437



0.2.3 With cross-validation

[ ]:
```
knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(input,target)
# score = knn.score(X_test,y_test)
scores = cross_val_score(knn, input, target, cv=10)
scores.mean()
```

[ ]: 0.6468316679658895

0.3 DT

[ ]:
```
X_train, X_test, y_train, y_test = train_test_split(input, target, test_size=0.
↪2)
dtree = DecisionTreeClassifier( max_depth=8)

dtree.fit(X_train, y_train)
dtree.score(X_test, y_test)
```

[ ]: 0.7548543689320388

0.4 KNN

[ ]:
```
knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(X_train,y_train)
knn.score(X_test,y_test)
```

[ ]: 0.7196601941747572

0.5 SVM

[ ]:
```
svc = SVC()
svc.fit(X_train, y_train)
svc.score(X_test, y_test)
```

[ ]: 0.7609223300970874

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