Q-1 Select a dataset or datasets of your choice.

- Apply Cross-validation for parameter tuning, model selection, & feature selection like “cross_validation.ipynb”.

source: http://archive.ics.uci.edu/ml/datasets/ISTANBUL+STOCK+EXCHANGE (http://archive.ics.uci.edu/ml/datasets/ISTANBUL+STOCK+EXCHANGE)

In [1]:
```
from IPython.core.interactiveshell import InteractiveShell
InteractiveShell.ast_node_interactivity = "all"
```

In [2]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.neighbors import KNeighborsClassifier
from sklearn import metrics

% matplotlib inline

from IPython.core.display import display, HTML
display(HTML("<style>.container { width:90% !important; }</style>"))
pd.set_option('display.max_columns', 100)
```

In [3]:
```
df3 = pd.read_csv('Payment_and_value_of_care_-_Hospital.csv', index_col=0)
df3 = df3[df3.Payment != "Not Available"]
df3['Value of care category'] = df3['Value of care category'].str.split(' and ').str[0]
df3 = df3[df3['Value of care category'] != "Not Available"].reset_index()

# only doing mortality
df3 = df3[df3['Value of care category'].str.contains('mortality')]
df3['Payment measure name'] = df3['Payment measure name'].str.split(' ').str[2:-1].str.join(' ')

order_care = ['Worse mortality','Average mortality','Better mortality']
```

In [4]:
```
df3.sample()
```

Out[4]:

	Payment measure name	Payment	Value of care category
1166	heart attack	$22,345	Average mortality

In [5]:
```
#df3['Payment category'] = pd.Categorical(df4['Payment categor
y'],ordered=True,categories=order_payment)
df3['Payment catcode'] = (df3['Payment'].replace( '[\$,)]','', r
egex=True )).astype(float)/10000
df3['Value of care category'] = pd.Categorical(df3['Value of car
e category'],ordered=True,categories=order_care)
df3['Value of care catcode'] = df3['Value of care category'].cat
.codes
```

In [6]:
```
df3.sample()
```

Out[6]:

	Payment measure name	Payment	Value of care category	Payment catcode	Value of care catcode
357	pneumonia	$16,632	Worse mortality	1.6632	0

In [7]:
```
feature_cols = ['Payment catcode','Value of care catcode']
X = df3[feature_cols]
y = df3['Payment measure name']
X_train, X_test, y_train, y_test = train_test_split(X, y, random
_state=1)
knn = KNeighborsClassifier(n_neighbors=5)
knn.fit(X_train, y_train)
y_pred = knn.predict(X_test)
print(metrics.accuracy_score(y_test, y_pred))
```

Out[7]:
```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
inkowski',
           metric_params=None, n_jobs=1, n_neighbors=5, p=2,
           weights='uniform')

0.615789473684
```

In [8]:
```
from sklearn.cross_validation import KFold
df3.shape
```

```
/Users/dee/anaconda3/lib/python3.6/site-packages/sklearn/cross
_validation.py:41: DeprecationWarning: This module was depreca
ted in version 0.18 in favor of the model_selection module int
o which all the refactored classes and functions are moved. Al
so note that the interface of the new CV iterators are differe
nt from that of this module. This module will be removed in 0.
20.
  "This module will be removed in 0.20.", DeprecationWarning)
```

Out[8]:
```
(9879, 5)
```

In [9]:
```
kf = KFold(9879, n_folds=10)
```

In [10]:
```
n=0
knn = KNeighborsClassifier(n_neighbors=5)
for train_index, test_index in kf:
    knn.fit(df3.iloc[train_index,-2:], df3.iloc[train_index,0])
    y_pred = knn.predict(df3.iloc[test_index,-2:])
    print(metrics.accuracy_score(df3.iloc[test_index,0], y_pred
))
    n=n+(metrics.accuracy_score(df3.iloc[test_index,0], y_pred))
print('mean: ', n/10)
```

```
Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.622469635628

Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.637651821862

Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.647773279352

Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.623481781377

Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.622469635628

Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.654858299595

Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.57995951417

Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.631578947368

Out[10]: KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
         inkowski',
                    metric_params=None, n_jobs=1, n_neighbors=5, p=2,
                    weights='uniform')

         0.612348178138
```

Out[10]:
```
KNeighborsClassifier(algorithm='auto', leaf_size=30, metric='m
inkowski',
           metric_params=None, n_jobs=1, n_neighbors=5, p=2,
           weights='uniform')
```

```
0.623100303951
mean:  0.625569139707
```

In [11]:
```
from sklearn.model_selection import cross_val_score

scores = cross_val_score(knn, X, y, cv=10, scoring='accuracy').m
ean()
print(scores)
```

```
0.623239973912
```

parameter tuning

In [12]:
```
k_range = list(range(1, 31))
k_scores = []
for k in k_range:
    knn = KNeighborsClassifier(n_neighbors=k)
    scores = cross_val_score(knn, X, y, cv=10, scoring='accurac
y').mean()
    k_scores.append(scores)
print(k_scores)
```

```
[0.60957364770354694, 0.60775434904774217, 0.6200014151581900
7, 0.62070960953939669, 0.62323997391186636, 0.625466284368859
98, 0.63589282125116386, 0.63963724778394437, 0.64621660534314
507, 0.64652168473557059, 0.64793807349798382, 0.6490513312741
7569, 0.65026631636374066, 0.65097553622189674, 0.647230802046
03156, 0.6507739274536587, 0.65087432164699799, 0.651988399804
74921, 0.6550242217655432, 0.65502432431323809, 0.656947913974
78958, 0.65654315822288956, 0.65735266972668982, 0.65856796245
93398, 0.65897251311585014, 0.66271888805483437, 0.66190947909
872877, 0.66494540360721766, 0.6633264831473118, 0.66656463171
020841]
```

In [13]:
```
# best score
max(k_scores)
```

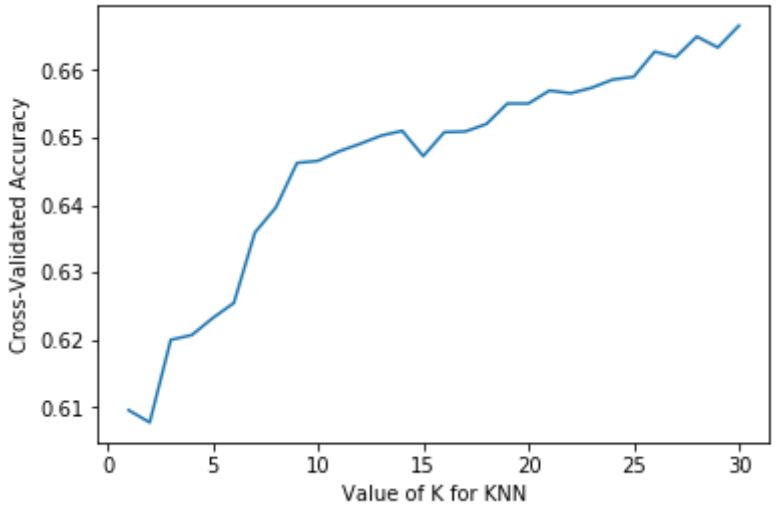
Out[13]:
```
0.66656463171020841
```

In [14]:
```
plt.plot(k_range, k_scores)
plt.xlabel('Value of K for KNN')
plt.ylabel('Cross-Validated Accuracy')
```

Out[14]: [<matplotlib.lines.Line2D at 0x118766320>]

Out[14]: Text(0.5,0,'Value of K for KNN')

Out[14]: Text(0,0.5,'Cross-Validated Accuracy')



model selection

In [15]:
```
knn = KNeighborsClassifier(n_neighbors=20)
print(cross_val_score(knn, X, y, cv=10, scoring='accuracy').mean
())
```

```
0.655024324313
```

In [16]:
```
from sklearn.linear_model import LogisticRegression
logreg = LogisticRegression()
print(cross_val_score(logreg, X, y, cv=10, scoring='accuracy').m
ean())
```

```
0.660694596557
```

feature selection

In [17]:
```
from sklearn.linear_model import LinearRegression
df2 = pd.read_csv('data_akbilgic.csv', index_col=0)
X = df2.loc[:,'SP':]
y = df2.ISE

lm = LinearRegression()
scores = cross_val_score(lm, X, y, cv=10, scoring='neg_mean_squa
red_error')
print(scores)
```

```
[ -2.37069212e-04  -2.09674217e-04  -1.69596589e-04  -1.566719
04e-04
  -1.47380741e-04  -1.45749724e-04  -9.31754211e-05  -4.971986
07e-05
  -1.21922214e-04  -1.10903263e-04]
```

In [18]:
```
df2.columns
```

Out[18]:
```
Index(['ISE', 'ISE.1', 'SP', 'DAX', 'FTSE', 'NIKKEI', 'BOVESP
A', 'EU', 'EM'], dtype='object')
```

In [19]:
```
mse_scores = -scores
print(mse_scores)
```

```
[  2.37069212e-04   2.09674217e-04   1.69596589e-04   1.566719
04e-04
   1.47380741e-04   1.45749724e-04   9.31754211e-05   4.971986
07e-05
   1.21922214e-04   1.10903263e-04]
```

In [20]:
```
rmse_scores = np.sqrt(mse_scores)
print(rmse_scores)
```

```
[ 0.01539705  0.01448013  0.01302293  0.01251686  0.01214005
0.01207269
  0.00965274  0.00705123  0.01104184  0.01053106]
```

In [21]:
```
print(rmse_scores.mean())
```

```
0.0117906580039
```

In [22]:
```
# omitting SP column
X1 = df2.loc[:,'DAX':]
```

In [23]:
```
print(np.sqrt(-cross_val_score(lm, X1, y, cv=10, scoring='neg_me
an_squared_error')).mean())
```

```
0.0117683647862
```