Encoding Numerical Features

There are two main methods to encode numerical features 1) Discritization 2) Binarization

Discretization

Discretization is the process of transforming the continous variables into discrete variables by creating a set of contiguous intervals that span teh range of the vriable's value. Discretization is also called binning, where bin is an alternative name of a interval.

Why use bin? 1) To handel Outliers 2) To improve the value spread

In [1]:
```
import numpy as np
import pandas as pd
```

In [2]:
```
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier

from sklearn.model_selection import cross_val_score
from sklearn.metrics import accuracy_score

from sklearn.preprocessing import KBinsDiscretizer
from sklearn.compose import ColumnTransformer
```

In [3]:
```
df=pd.read_csv('train.csv',usecols=['Age','Fare','Survived'])
```

In [4]:
```
df.dropna(inplace=True)
```

In [5]:
```
df.shape
```

Out[5]:
```
(714, 3)
```

In [6]:
```
df.head()
```

Out[6]:

	Survived	Age	Fare
0	0	22.0	7.2500
1	1	38.0	71.2833
2	1	26.0	7.9250
3	1	35.0	53.1000
4	0	35.0	8.0500

Without using binning

In [9]:
```
X=df.iloc[:,1:]
y=df.iloc[:,0]
```

In [14]:
```
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2,random_state=42)
```

In [15]:
```
X_train.head()
```

Out[15]:

	Age	Fare
328	31.0	20.5250
73	26.0	14.4542
253	30.0	16.1000
719	33.0	7.7750
666	25.0	13.0000

In [16]:
```
clf=DecisionTreeClassifier()
```

In [17]:
```
clf.fit(X_train,y_train)
```

Out[17]:
```
DecisionTreeClassifier()
```

In [18]:
```
y_pred=clf.predict(X_test)
```

In [19]:
```
accuracy_score(y_pred,y_test)
```

Out[19]:
```
0.6363636363636364
```

In [21]:
```
np.mean(cross_val_score(DecisionTreeClassifier(),X,y,cv=10,scoring='accuracy'))
```

Out[21]:
```
0.6401017214397496
```

Applaying binning

In [33]:
```
Kbin_age=KBinsDiscretizer(n_bins=10,encode='ordinal',strategy='quantile')
Kbin_fare=KBinsDiscretizer(n_bins=10,encode='ordinal',strategy='quantile')
```

In [34]:
```
trf=ColumnTransformer([
    ('first',Kbin_age,[0]),
    ('second',Kbin_fare,[1])
])
```

In [35]:
```
X_train_trf=trf.fit_transform(X_train)
X_test_trf=trf.fit_transform(X_test)
```

In [36]:
```
trf.named_transformers_
```

Out[36]:
```
{'first': KBinsDiscretizer(encode='ordinal', n_bins=10),
 'second': KBinsDiscretizer(encode='ordinal', n_bins=10)}
```

In [37]:
```
trf.named_transformers_['first'].n_bins_
```

Out[37]:
```
array([10])
```

In [38]:
```
trf.named_transformers_['first'].bin_edges_
```

Out[38]:
```
array([array([ 1. , 11. , 17. , 20.6, 24. , 28. , 30.1, 34.4, 38.6, 47.8, 62. ])],
      dtype=object)
```

In [39]:
```
trf.named_transformers_['second'].bin_edges_
```

Out[39]:
```
array([array([  0.     ,   7.74336,   7.925  ,   8.6625 ,  10.5    ,  14.4542 ,
              22.62   ,  28.39   ,  38.1    ,  57.78336, 512.3292 ])          ],
      dtype=object)
```

In [41]:
```
output=pd.DataFrame({
    'age':X_train['Age'],
    'age_trf':X_train_trf[:,0],
    'fare':X_train['Fare'],
    'fare_trf':X_train_trf[:,1],

})
```

In [44]:
```
output['age_label']=pd.cut(x=X_train['Age'],bins=trf.named_transformers_['first'].bin_edges_[0].tolist())
output['fare_label']=pd.cut(x=X_train['Fare'],bins=trf.named_transformers_['second'].bin_edges_[0].tolist())
```

In [46]:
```
output.sample(5)
```

Out[46]:

	age	age_trf	fare	fare_trf	age_label	fare_label
209	40.0	7.0	31.0000	7.0	(38.6, 47.8]	(28.39, 38.1]
127	24.0	3.0	7.1417	0.0	(20.6, 24.0]	(0.0, 7.743]
120	21.0	2.0	73.5000	8.0	(20.6, 24.0]	(57.783, 512.329]
594	37.0	7.0	26.0000	6.0	(34.4, 38.6]	(22.62, 28.39]
343	25.0	4.0	13.0000	4.0	(24.0, 28.0]	(10.5, 14.454]

Applaying DecisionTree after the Binning

In [47]:
```
clf=DecisionTreeClassifier()
clf.fit(X_train_trf,y_train)
```

Out[47]:
```
DecisionTreeClassifier()
```

In [48]:
```
y_pred2=clf.predict(X_test_trf)
```

In [49]:
```
accuracy_score(y_test,y_pred2)
```

Out[49]:
```
0.6853146853146853
```

Function for Discretization

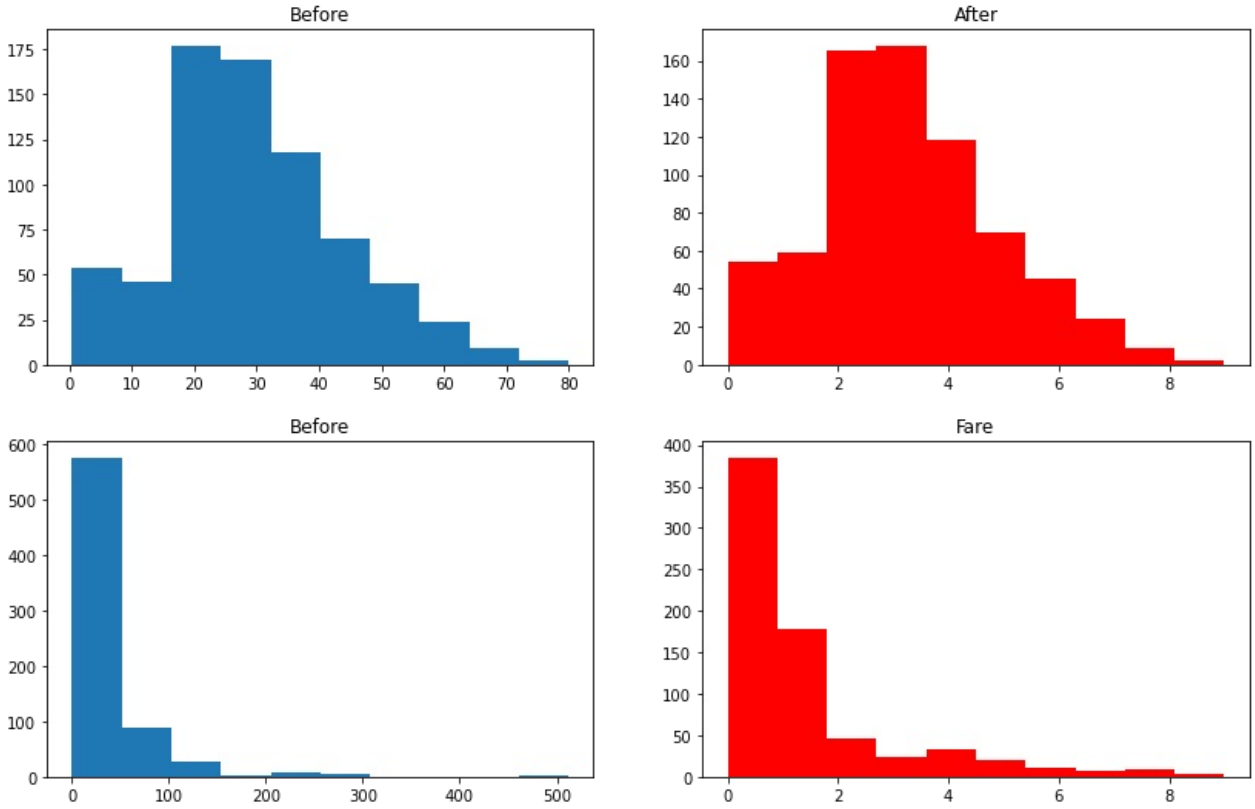
In [50]:
```
def discretize(bins,strategy):
    kbin_age = KBinsDiscretizer(n_bins=bins,encode='ordinal',strategy=strategy)
    kbin_fare = KBinsDiscretizer(n_bins=bins,encode='ordinal',strategy=strategy)

    trf = ColumnTransformer([
        ('first',kbin_age,[0]),
        ('second',kbin_fare,[1])
    ])

    X_trf = trf.fit_transform(X)
    print(np.mean(cross_val_score(DecisionTreeClassifier(),X,y,cv=10,scoring='accuracy')))

    plt.figure(figsize=(14,4))
    plt.subplot(121)
    plt.hist(X['Age'])
    plt.title("Before")

    plt.subplot(122)
    plt.hist(X_trf[:,0],color='red')
    plt.title("After")

    plt.show()

    plt.figure(figsize=(14,4))
```

```
    plt.subplot(121)
    plt.hist(X['Fare'])
    plt.title("Before")

    plt.subplot(122)
    plt.hist(X_trf[:,1],color='red')
    plt.title("Fare")

    plt.show()
```

In [51]:

```
discretize(10,'kmeans')
```

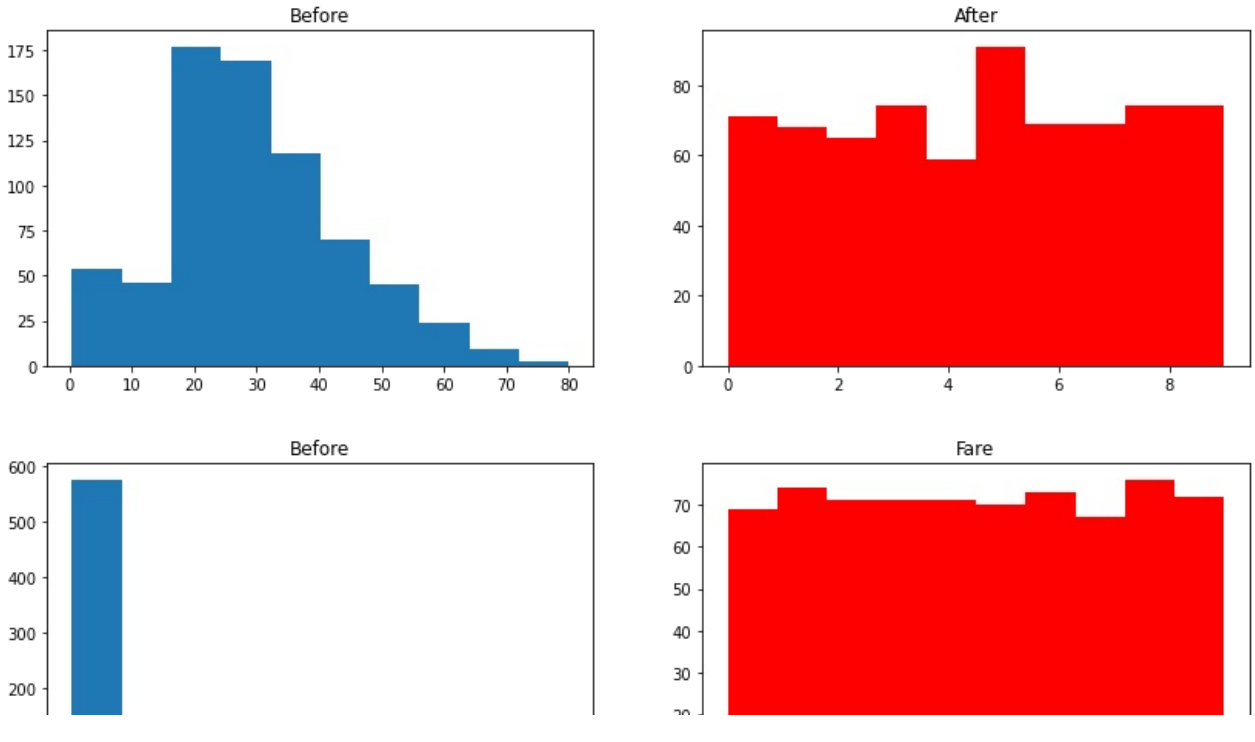
```
0.6288732394366197
```

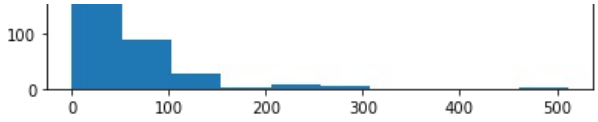
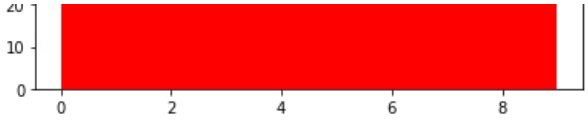


In [52]:

```
discretize(10,'quantile')
```

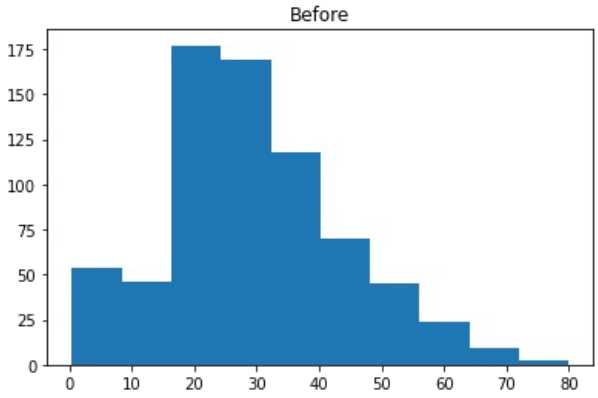
```
0.6359154929577464
```

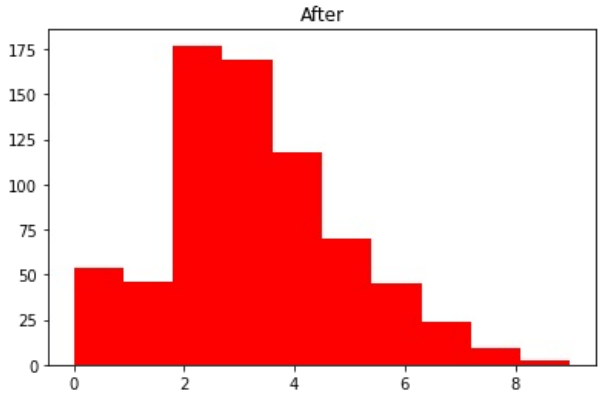


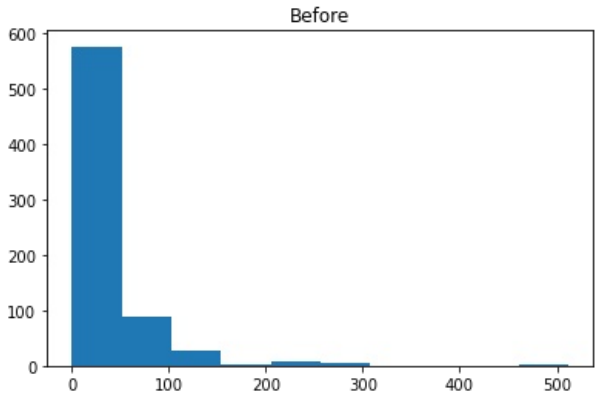



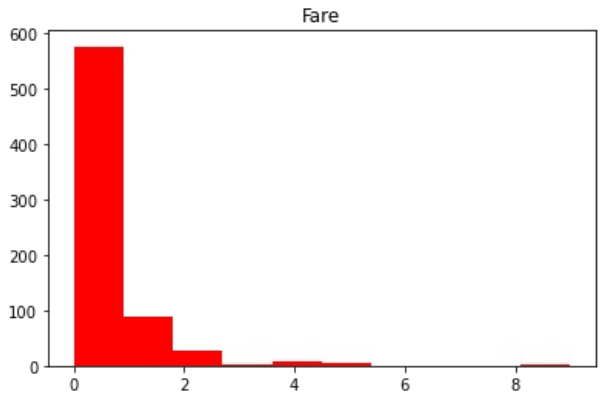
In [53]:
```
discretize(10,'uniform')
```

```
0.6317097026604068
```









Binarization

inarization is the process of transforming data features of any entity into vectors of binary numbers to make classifier algorithms more efficient. In a simple example, transforming an image's gray-scale from the 0-255 spectrum to a 0-1 spectrum is binarization.

In [54]:
```
df = pd.read_csv('train.csv')[['Age','Fare','SibSp','Parch','Survived']]
```

In [55]:
```
df.dropna(inplace=True)
```

In [56]:
```
df.head()
```

Out[56]:

	Age	Fare	SibSp	Parch	Survived
0	22.0	7.2500	1	0	0
1	38.0	71.2833	1	0	1
2	26.0	7.9250	0	0	1
3	35.0	53.1000	1	0	1
4	35.0	8.0500	0	0	0

In [57]:
```
df['family'] = df['SibSp'] + df['Parch']
```

In [58]:
```
df.head()
```

Out[58]:

	Age	Fare	SibSp	Parch	Survived	family
0	22.0	7.2500	1	0	0	1
1	38.0	71.2833	1	0	1	1
2	26.0	7.9250	0	0	1	0
3	35.0	53.1000	1	0	1	1
4	35.0	8.0500	0	0	0	0

In [59]:
```
df.drop(columns=['SibSp','Parch'],inplace=True)
```

In [60]:
```
df.head()
```

Out[60]:

	Age	Fare	Survived	family
0	22.0	7.2500	0	1
1	38.0	71.2833	1	1
2	26.0	7.9250	1	0
3	35.0	53.1000	1	1
4	35.0	8.0500	0	0

In [61]:
```
X = df.drop(columns=['Survived'])
y = df['Survived']
```

In [62]:
```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2,random_state=42)
```

In [63]:
```
# Without binarization

clf = DecisionTreeClassifier()

clf.fit(X_train,y_train)

y_pred = clf.predict(X_test)

accuracy_score(y_test,y_pred)
```

Out[63]:
```
0.6293706293706294
```

In [66]:
```
np.mean(cross_val_score(DecisionTreeClassifier(),X,y,cv=10,scoring='accuracy'))
```

Out[66]:
```
0.6527582159624413
```

In [67]:
```
# Applying Binarization

from sklearn.preprocessing import Binarizer
```

In [68]:
```
trf = ColumnTransformer([
    ('bin',Binarizer(copy=False),['family'])
],remainder='passthrough')
```

In [74]:
```
X_train_trf = trf.fit_transform(X_train)
X_test_trf = trf.transform(X_test)
```

In [75]:
```
pd.DataFrame(X_train_trf,columns=['family','Age','Fare'])
```

Out[75]:

	family	Age	Fare
0	1.0	31.0	20.5250
1	1.0	26.0	14.4542
2	1.0	30.0	16.1000
3	0.0	33.0	7.7750

4	0.0	25.0	13.0000
...	...	...	...
566	1.0	46.0	61.1750
567	0.0	25.0	13.0000
568	0.0	41.0	134.5000
569	1.0	33.0	20.5250
570	0.0	33.0	7.8958

571 rows × 3 columns

In [71]:
```
clf = DecisionTreeClassifier()
clf.fit(X_train_trf,y_train)
y_pred2 = clf.predict(X_test_trf)

accuracy_score(y_test,y_pred2)
```

Out[71]:
```
0.6153846153846154
```

In [73]:
```
X_trf = trf.fit_transform(X)
np.mean(cross_val_score(DecisionTreeClassifier(),X_trf,y,cv=10,scoring='accuracy'))
```

Out[73]:
```
0.6317879499217527
```

Thank you

Author

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