互评作业二 频繁模式与关联规则挖掘

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具体流程为将两个数据集进行合并 对price 和 points进行离散化处理

并挖掘其中的关联关系 并进行数据可视化

```
import matplotlib.pyplot as plt
import matplotlib
from collections import Counter
import warnings
import seaborn as sns
warnings.filterwarnings('ignore')
```

```
import numpy as np
import pandas as pd
```

```
train = pd.read_csv('C:/Users/15192/Desktop/数据挖掘/winemag-data-130k-v2.csv')
```

```
train.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 129971 entries, 0 to 129970
Data columns (total 14 columns):
 #   Column                 Non-Null Count   Dtype  
---  ------                 --------------   -----  
 0   Unnamed: 0             129971 non-null  int64  
 1   country                129908 non-null  object 
 2   description            129971 non-null  object 
 3   designation            92506 non-null   object 
 4   points                 129971 non-null  int64  
 5   price                  120975 non-null  float64
 6   province               129908 non-null  object 
 7   region_1               108724 non-null  object 
 8   region_2               50511 non-null   object 
 9   taster_name            103727 non-null  object 
 10  taster_twitter_handle  98758 non-null   object 
 11  title                  129971 non-null  object 
 12  variety                129970 non-null  object 
 13  winery                 129971 non-null  object 
dtypes: float64(1), int64(2), object(11)
memory usage: 13.9+ MB
```

```
train1 = pd.read_csv('C:/Users/15192/Desktop/数据挖掘/winemag-data_first150k.csv')
```

```
train1.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150930 entries, 0 to 150929
Data columns (total 11 columns):
 #   Column       Non-Null Count   Dtype  
---  ------       --------------   -----  
 0   Unnamed: 0   150930 non-null  int64  
 1   country      150925 non-null  object 
 2   description  150930 non-null  object 
 3   designation  105195 non-null  object 
 4   points       150930 non-null  int64  
 5   price        137235 non-null  float64
 6   province     150925 non-null  object 
 7   region_1     125870 non-null  object 
 8   region_2     60953 non-null   object 
 9   variety      150930 non-null  object 
 10  winery       150930 non-null  object 
dtypes: float64(1), int64(2), object(8)
memory usage: 12.7+ MB
```

```
data = pd.concat([train, train1], axis=0)
```

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
```

```
Int64Index: 280901 entries, 0 to 150929
Data columns (total 14 columns):
 #   Column                 Non-Null Count   Dtype  
---  ------                 --------------   -----  
 0   Unnamed: 0             280901 non-null  int64  
 1   country                280833 non-null  object 
 2   description            280901 non-null  object 
 3   designation            197701 non-null  object 
 4   points                 280901 non-null  int64  
 5   price                  258210 non-null  float64
 6   province               280833 non-null  object 
 7   region_1               234594 non-null  object 
 8   region_2               111464 non-null  object 
 9   taster_name            103727 non-null  object 
 10  taster_twitter_handle  98758 non-null   object 
 11  title                  129971 non-null  object 
 12  variety                280900 non-null  object 
 13  winery                 280901 non-null  object 
dtypes: float64(1), int64(2), object(11)
memory usage: 32.1+ MB
```

```
data.head()
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	taster_name	t
0	0	Italy	Aromas include tropical fruit, broom, brimston...	Vulkà Bianco	87	NaN	Sicily & Sardinia	Etna	NaN	Kerin O’Keefe	@
1	1	Portugal	This is ripe and fruity, a wine that is smooth...	Avidagos	87	15.0	Douro	NaN	NaN	Roger Voss	@
2	2	US	Tart and snappy, the flavors of lime flesh and...	NaN	87	14.0	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@
3	3	US	Pineapple rind, lemon pith and orange blossom ...	Reserve Late Harvest	87	13.0	Michigan	Lake Michigan Shore	NaN	Alexander Peartree	N
4	4	US	Much like the regular bottling from 2012, this...	Vintner's Reserve Wild Child Block	87	65.0	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@

```
print(data.isnull().sum)
```

```
<bound method DataFrame.sum of         Unnamed: 0  country  description  designation  points  price  \
0            False    False        False        False   False   True
1            False    False        False        False   False  False
2            False    False        False         True   False  False
3            False    False        False        False   False  False
4            False    False        False        False   False  False
...            ...      ...          ...          ...     ...    ...
150925       False    False        False         True   False  False
150926       False    False        False        False   False  False
150927       False    False        False        False   False  False
150928       False    False        False        False   False  False
150929       False    False        False         True   False  False

        province  region_1  region_2  taster_name  taster_twitter_handle  \
0          False     False      True        False                  False
1          False      True      True        False                  False
2          False     False     False        False                  False
3          False     False      True        False                   True
4          False     False     False        False                  False
...          ...       ...       ...          ...                    ...
150925     False     False      True         True                   True
150926     False     False      True         True                   True
150927     False     False      True         True                   True
150928     False     False      True         True                   True
150929     False     False      True         True                   True

        title  variety  winery
0       False    False   False
1       False    False   False
2       False    False   False
3       False    False   False
4       False    False   False
...       ...      ...     ...
150925   True    False   False
150926   True    False   False
150927   True    False   False
150928   True    False   False
150929   True    False   False

[280901 rows x 14 columns]>
```

```
data1=data.dropna(axis=0)
```

```
data1.head()
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	taster_name	taster_twitter_
4	4	US	Much like the regular bottling from 2012, this...	Vintner's Reserve Wild Child Block	87	65.0	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@paulgwine
10	10	US	Soft, supple plum envelopes an oaky structure ...	Mountain Cuvée	87	19.0	California	Napa Valley	Napa	Virginie Boone	@vboone
23	23	US	This wine from the Geneseo district offers aro...	Signature Selection	87	22.0	California	Paso Robles	Central Coast	Matt Kettmann	@mattkettmanr
25	25	US	Oak and earth intermingle around robust aromas...	King Ridge Vineyard	87	69.0	California	Sonoma Coast	Sonoma	Virginie Boone	@vboone
35	35	US	As with many of the Erath 2010 vineyard design...	Hyland	86	50.0	Oregon	McMinnville	Willamette Valley	Paul Gregutt	@paulgwine

```
从中可以看到points和price为数值属性，将其离散化
```

```
number_data = ['points','price']
data1[number_data].describe()
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	points	price
count	22387.000000	22387.000000
mean	89.537812	41.465404
std	2.809306	29.379374
min	80.000000	4.000000
25%	88.000000	25.000000
50%	90.000000	36.000000
75%	92.000000	50.000000
max	100.000000	2013.000000

```
将points和price分成4个等级，points为低度，中低度，中度，高度，pirce为低价，中低价，中价，高价

points 0-88 88-90 90-92 92-100

price 0-25 25-36 36-50 50-2013

经过处理后的结果如下所示
```

```
bin = [0,88,90,92,100]
data1['points'] = pd.cut(data1['points'],bin)
data1['points'] = data1['points'].astype('str')
data1.head()
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	taster_name	taster_twitter_
4	4	US	Much like the regular bottling from 2012, this...	Vintner's Reserve Wild Child Block	(0, 88]	65.0	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@paulgwine
10	10	US	Soft, supple plum envelopes an oaky structure ...	Mountain Cuvée	(0, 88]	19.0	California	Napa Valley	Napa	Virginie Boone	@vboone
23	23	US	This wine from the Geneseo district offers aro...	Signature Selection	(0, 88]	22.0	California	Paso Robles	Central Coast	Matt Kettmann	@mattkettmanr
25	25	US	Oak and earth intermingle around robust aromas...	King Ridge Vineyard	(0, 88]	69.0	California	Sonoma Coast	Sonoma	Virginie Boone	@vboone
35	35	US	As with many of the Erath 2010 vineyard design...	Hyland	(0, 88]	50.0	Oregon	McMinnville	Willamette Valley	Paul Gregutt	@paulgwine

```
bin = [0,25,36,50,2013]
data1['price'] = pd.cut(data1['price'],bin)
data1['price'] = data1['price'].astype('str')
data1.head()
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	Unnamed: 0	country	description	designation	points	price	province	region_1	region_2	taster_name	taster_twitter_
4	4	US	Much like the regular bottling from 2012, this...	Vintner's Reserve Wild Child Block	(0, 88]	(50, 2013]	Oregon	Willamette Valley	Willamette Valley	Paul Gregutt	@paulgwine
10	10	US	Soft, supple plum envelopes an oaky structure ...	Mountain Cuvée	(0, 88]	(0, 25]	California	Napa Valley	Napa	Virginie Boone	@vboone
23	23	US	This wine from the Geneseo district offers aro...	Signature Selection	(0, 88]	(0, 25]	California	Paso Robles	Central Coast	Matt Kettmann	@mattkettman
25	25	US	Oak and earth intermingle around robust aromas...	King Ridge Vineyard	(0, 88]	(50, 2013]	California	Sonoma Coast	Sonoma	Virginie Boone	@vboone
35	35	US	As with many of the Erath 2010 vineyard design...	Hyland	(0, 88]	(36, 50]	Oregon	McMinnville	Willamette Valley	Paul Gregutt	@paulgwine

```
data1 = data1[['points','price','country','winery']]
data1.head(5)
```

```
.dataframe tbody tr th {
    vertical-align: top;
}

.dataframe thead th {
    text-align: right;
}
```

	points	price	country	winery
4	(0, 88]	(50, 2013]	US	Sweet Cheeks
10	(0, 88]	(0, 25]	US	Kirkland Signature
23	(0, 88]	(0, 25]	US	Bianchi
25	(0, 88]	(50, 2013]	US	Castello di Amorosa
35	(0, 88]	(36, 50]	US	Erath

```
选取points,price,country以及winery进行挖掘
利用Apriori算法找出所有的频繁项集
```

```
---------------------------------------------------------------------------

NameError                                 Traceback (most recent call last)

<ipython-input-51-40d90427dd0a> in <module>
----> 1 选取points,price,country以及winery进行挖掘
      2 利用Apriori算法找出所有的频繁项集
```

```
NameError: name '选取points' is not defined
```

```
from efficient_apriori import apriori
```

```
data2 = list(zip(*[data1[c].values.tolist() for c in data1]))
```

```
itemsets, rules = apriori(data2, min_support=0.5, min_confidence=0.9)
```

```
print(rules)
```

```
[]
```

```
itemsets, rules = apriori(data2, min_support=0.25, min_confidence=0.9)
print(rules)
```

```
[{(0, 88]} -> {US}, {(0, 25]} -> {US}, {(36, 50]} -> {US}]
```

```
print(itemsets)
```

```
{1: {('(0, 88]',): 8282, ('US',): 22387, ('(0, 25]',): 6367, ('(36, 50]',): 5668}, 2: {('(0, 88]', 'US'): 8282, ('(0, 25]', 'US'): 6367,
('(36, 50]', 'US'): 5668}}
```

可以看出points度数品级和酒的产地之间的关系也较为紧密

```
def createC1( dataSet ):
    C1 = []
    for transaction in np.array(dataSet):
        for item in transaction:
            if [item] not in C1:
                C1.append( [item] )
    C1.sort()
    return list(map( frozenset, C1 ))

def scanD( D, Ck, minSupport ):
    ssCnt = {}
    for tid in D:
        if Ck is not None:
            for can in Ck:
                if can.issubset( tid ):
                    ssCnt[ can ] = ssCnt.get( can, 0) + 1
    numItems = float( len( D ) )
    retList = []
    supportData = {}
    for key in ssCnt:
        support = ssCnt[ key ] / numItems
        if support >= minSupport:
            retList.insert( 0, key )
            supportData[ key ] = support
    return retList, supportData
```

```
def aprioriGen( Lk, k ):
    retList = []
    lenLk = len( Lk )
    for i in range( lenLk ):
        for j in range( i + 1, lenLk ):
            L1 = list( Lk[ i ] )[ : k - 2 ];
            L2 = list( Lk[ j ] )[ : k - 2 ];
            L1.sort();L2.sort()
            if L1==L2:
                retList.append( Lk[ i ] | Lk[ j ] )
    return retList

def apriori( dataSet, minSupport = 0.5 ):
    C1 = createC1( dataSet )
    D =list( map( set, dataSet ))
    L1, suppData = scanD( D, C1, minSupport )
    L = [ L1 ]
    k = 2

    while ( len( L[ k - 2 ] ) > 0 ):
        Ck = aprioriGen( L[ k - 2 ], k )
        Lk, supK = scanD( D, Ck, minSupport )
        suppData.update( supK )
        L.append( Lk )
        k += 1
    return L, suppData
```

```
newData = list(map(set,np.array(data1)))
L, suppData = apriori(newData, 0.05)
L
```

```
[[frozenset({'(92, 100]'}),
  frozenset({'(88, 90]'}),
  frozenset({'(90, 92]'}),
  frozenset({'(25, 36]'}),
  frozenset({'(36, 50]'}),
  frozenset({'(0, 25]'}),
  frozenset({'US'}),
  frozenset({'(50, 2013]'}),
  frozenset({'(0, 88]'})],
 [frozenset({'(50, 2013]', '(92, 100]'}),
  frozenset({'(92, 100]', 'US'}),
  frozenset({'(36, 50]', '(88, 90]'}),
  frozenset({'(0, 25]', '(88, 90]'}),
  frozenset({'(25, 36]', '(88, 90]'}),
  frozenset({'(88, 90]', 'US'}),
  frozenset({'(36, 50]', '(90, 92]'}),
  frozenset({'(25, 36]', '(90, 92]'}),
  frozenset({'(50, 2013]', '(90, 92]'}),
  frozenset({'(90, 92]', 'US'}),
  frozenset({'(0, 88]', '(25, 36]'}),
  frozenset({'(25, 36]', 'US'}),
  frozenset({'(0, 88]', '(36, 50]'}),
  frozenset({'(36, 50]', 'US'}),
  frozenset({'(0, 25]', '(0, 88]'}),
  frozenset({'(0, 25]', 'US'}),
  frozenset({'(0, 88]', 'US'}),
  frozenset({'(50, 2013]', 'US'})],
 [frozenset({'(50, 2013]', '(92, 100]', 'US'}),
  frozenset({'(36, 50]', '(88, 90]', 'US'}),
  frozenset({'(0, 25]', '(88, 90]', 'US'}),
  frozenset({'(25, 36]', '(88, 90]', 'US'}),
  frozenset({'(36, 50]', '(90, 92]', 'US'}),
  frozenset({'(25, 36]', '(90, 92]', 'US'}),
  frozenset({'(50, 2013]', '(90, 92]', 'US'}),
  frozenset({'(0, 88]', '(25, 36]', 'US'}),
  frozenset({'(0, 88]', '(36, 50]', 'US'}),
  frozenset({'(0, 25]', '(0, 88]', 'US'})],
 []]
```

```
for tmp, num in suppData.items():
    print(tmp, ':', num)
```

```
frozenset({'(0, 88]'}) : 0.3699468441506231
frozenset({'(50, 2013]'}) : 0.23187564211372672
frozenset({'US'}) : 1.0
frozenset({'(0, 25]'}) : 0.2844061285567517
frozenset({'(36, 50]'}) : 0.25318265064546386
frozenset({'(25, 36]'}) : 0.23053557868405772
frozenset({'(90, 92]'}) : 0.24514227006744985
frozenset({'(88, 90]'}) : 0.23719122705141377
frozenset({'(92, 100]'}) : 0.14771965873051324
frozenset({'(50, 2013]', 'US'}) : 0.23187564211372672
frozenset({'(0, 88]', 'US'}) : 0.3699468441506231
frozenset({'(0, 25]', 'US'}) : 0.2844061285567517
frozenset({'(0, 88]', '(0, 25]'}) : 0.18064055031938178
frozenset({'(36, 50]', 'US'}) : 0.25318265064546386
frozenset({'(0, 88]', '(36, 50]'}) : 0.06222361191763077
frozenset({'(25, 36]', 'US'}) : 0.23053557868405772
frozenset({'(0, 88]', '(25, 36]'}) : 0.09501049716353241
frozenset({'(90, 92]', 'US'}) : 0.24514227006744985
frozenset({'(90, 92]', '(50, 2013]'}) : 0.07450752668959663
frozenset({'(90, 92]', '(25, 36]'}) : 0.055165944521374015
frozenset({'(90, 92]', '(36, 50]'}) : 0.08433465850716934
frozenset({'(88, 90]', 'US'}) : 0.23719122705141377
frozenset({'(88, 90]', '(25, 36]'}) : 0.06508241390092465
frozenset({'(88, 90]', '(0, 25]'}) : 0.06771787197927369
frozenset({'(88, 90]', '(36, 50]'}) : 0.0621789431366418
frozenset({'US', '(92, 100]'}) : 0.14771965873051324
frozenset({'(50, 2013]', '(92, 100]'}) : 0.08308393263947828
frozenset({'(0, 88]', '(0, 25]', 'US'}) : 0.18064055031938178
frozenset({'(0, 88]', '(36, 50]', 'US'}) : 0.06222361191763077
frozenset({'(0, 88]', '(25, 36]', 'US'}) : 0.09501049716353241
frozenset({'(90, 92]', 'US', '(50, 2013]'}) : 0.07450752668959663
frozenset({'(90, 92]', '(25, 36]', 'US'}) : 0.055165944521374015
frozenset({'(90, 92]', '(36, 50]', 'US'}) : 0.08433465850716934
frozenset({'(88, 90]', '(25, 36]', 'US'}) : 0.06508241390092465
frozenset({'(88, 90]', '(0, 25]', 'US'}) : 0.06771787197927369
frozenset({'(88, 90]', '(36, 50]', 'US'}) : 0.0621789431366418
frozenset({'US', '(50, 2013]', '(92, 100]'}) : 0.08308393263947828
```

导出关联规则，计算其支持度和置信度，并对规则进行评价

```
#输入频繁项集列表、频繁项集的支持度字典、最小置信度
#输出包含置信度的规则列表
def generateRules(L, supportData, minConf=0.5):
    bigRuleList = []
    for i in range(1, len(L)):
        for freqSet in L[i]:
            H1 = [frozenset([item]) for item in freqSet]   #规则后件集合
            if (i > 1):
                rulesFromConseq(freqSet, H1, supportData, bigRuleList, minConf)
            else:
                calcConf(freqSet, H1, supportData, bigRuleList, minConf)
    return bigRuleList

#生成候选规则集合
def calcConf(freqSet, H, supportData, brl, minConf=0.5):
    prunedH = []
    for conseq in H:
        conf = supportData[freqSet]/supportData[freqSet-conseq]   #集合相减
        if conf >= minConf:
            print(f'{freqSet-conseq} --> {conseq} conf:{conf}'+ "  support: "+ str(supportData[freqSet]))
            brl.append((freqSet-conseq, conseq, conf, supportData[freqSet]))
            prunedH.append(conseq)
    return prunedH

#对规则进行评估
def rulesFromConseq(freqSet, H, supportData, brl, minConf=0.5):
    m = len(H[0])
    if (len(freqSet) > (m + 1)):
        Hmp1 = aprioriGen(H, m+1)
        Hmp1 = calcConf(freqSet, Hmp1, supportData, brl, minConf)
        if (len(Hmp1) > 1):
            rulesFromConseq(freqSet, Hmp1, supportData, brl, minConf)
```

```
rules = generateRules(L, suppData, minConf=0.05)
```

```
frozenset({'(92, 100]'}) --> frozenset({'(50, 2013]'}) conf:0.5624433020864833  support: 0.08308393263947828
frozenset({'(50, 2013]'}) --> frozenset({'(92, 100]'}) conf:0.358312463879792  support: 0.08308393263947828
frozenset({'(92, 100]'}) --> frozenset({'US'}) conf:1.0  support: 0.14771965873051324
frozenset({'US'}) --> frozenset({'(92, 100]'}) conf:0.14771965873051324  support: 0.14771965873051324
frozenset({'(36, 50]'}) --> frozenset({'(88, 90]'}) conf:0.24558927311220893  support: 0.0621789431366418
frozenset({'(88, 90]'}) --> frozenset({'(36, 50]'}) conf:0.2621468926553672  support: 0.0621789431366418
frozenset({'(0, 25]'}) --> frozenset({'(88, 90]'}) conf:0.23810271713522854  support: 0.06771787197927369
frozenset({'(88, 90]'}) --> frozenset({'(0, 25]'}) conf:0.28549905838041434  support: 0.06771787197927369
frozenset({'(25, 36]'}) --> frozenset({'(88, 90]'}) conf:0.2823096299166828  support: 0.06508241390092465
frozenset({'(88, 90]'}) --> frozenset({'(25, 36]'}) conf:0.2743879472693032  support: 0.06508241390092465
frozenset({'US'}) --> frozenset({'(88, 90]'}) conf:0.23719122705141377  support: 0.23719122705141377
frozenset({'(88, 90]'}) --> frozenset({'US'}) conf:1.0  support: 0.23719122705141377
frozenset({'(36, 50]'}) --> frozenset({'(90, 92]'}) conf:0.3330980945659845  support: 0.08433465850716934
frozenset({'(90, 92]'}) --> frozenset({'(36, 50]'}) conf:0.34402332361516036  support: 0.08433465850716934
frozenset({'(25, 36]'}) --> frozenset({'(90, 92]'}) conf:0.23929471032745592  support: 0.05516594452137401
frozenset({'(90, 92]'}) --> frozenset({'(25, 36]'}) conf:0.22503644314868806  support: 0.05516594452137401
frozenset({'(50, 2013]'}) --> frozenset({'(90, 92]'}) conf:0.321325370834136  support: 0.07450752668959663
frozenset({'(90, 92]'}) --> frozenset({'(50, 2013]'}) conf:0.303935860058309  support: 0.07450752668959663
frozenset({'US'}) --> frozenset({'(90, 92]'}) conf:0.24514227006744985  support: 0.24514227006744985
frozenset({'(90, 92]'}) --> frozenset({'US'}) conf:1.0  support: 0.24514227006744985
frozenset({'(25, 36]'}) --> frozenset({'(0, 88]'}) conf:0.41212943228056576  support: 0.09501049716353241
frozenset({'(0, 88]'}) --> frozenset({'(25, 36]'}) conf:0.2568220236657812  support: 0.09501049716353241
frozenset({'US'}) --> frozenset({'(25, 36]'}) conf:0.23053557868405772  support: 0.23053557868405772
frozenset({'(25, 36]'}) --> frozenset({'US'}) conf:1.0  support: 0.23053557868405772
frozenset({'(36, 50]'}) --> frozenset({'(0, 88]'}) conf:0.24576570218772056  support: 0.06222361191763077
frozenset({'(0, 88]'}) --> frozenset({'(36, 50]'}) conf:0.16819608790147308  support: 0.06222361191763077
frozenset({'US'}) --> frozenset({'(36, 50]'}) conf:0.25318265064546386  support: 0.25318265064546386
frozenset({'(36, 50]'}) --> frozenset({'US'}) conf:1.0  support: 0.25318265064546386
frozenset({'(0, 25]'}) --> frozenset({'(0, 88]'}) conf:0.6351499921470081  support: 0.18064055031938178
frozenset({'(0, 88]'}) --> frozenset({'(0, 25]'}) conf:0.48828785317556145  support: 0.18064055031938178
frozenset({'US'}) --> frozenset({'(0, 25]'}) conf:0.2844061285567517  support: 0.2844061285567517
frozenset({'(0, 25]'}) --> frozenset({'US'}) conf:1.0  support: 0.2844061285567517
frozenset({'US'}) --> frozenset({'(0, 88]'}) conf:0.3699468441506231  support: 0.3699468441506231
frozenset({'(0, 88]'}) --> frozenset({'US'}) conf:1.0  support: 0.3699468441506231
frozenset({'US'}) --> frozenset({'(50, 2013]'}) conf:0.23187564211372672  support: 0.23187564211372672
frozenset({'(50, 2013]'}) --> frozenset({'US'}) conf:1.0  support: 0.23187564211372672
frozenset({'(92, 100]'}) --> frozenset({'(50, 2013]', 'US'}) conf:0.5624433020864833  support: 0.08308393263947828
frozenset({'(50, 2013]'}) --> frozenset({'(92, 100]', 'US'}) conf:0.358312463879792  support: 0.08308393263947828
frozenset({'US'}) --> frozenset({'(92, 100]', '(50, 2013]'}) conf:0.08308393263947828  support: 0.08308393263947828
frozenset({'US'}) --> frozenset({'(88, 90]', '(36, 50]'}) conf:0.0621789431366418  support: 0.0621789431366418
frozenset({'(36, 50]'}) --> frozenset({'(88, 90]', 'US'}) conf:0.24558927311220893  support: 0.0621789431366418
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frozenset({'US'}) --> frozenset({'(88, 90]', '(0, 25]'}) conf:0.06771787197927369  support: 0.06771787197927369
frozenset({'(0, 25]'}) --> frozenset({'(88, 90]', 'US'}) conf:0.23810271713522854  support: 0.06771787197927369
frozenset({'(88, 90]'}) --> frozenset({'(0, 25]', 'US'}) conf:0.28549905838041434  support: 0.06771787197927369
frozenset({'US'}) --> frozenset({'(88, 90]', '(25, 36]'}) conf:0.06508241390092465  support: 0.06508241390092465
frozenset({'(25, 36]'}) --> frozenset({'(88, 90]', 'US'}) conf:0.2823096299166828  support: 0.06508241390092465
frozenset({'(88, 90]'}) --> frozenset({'(25, 36]', 'US'}) conf:0.2743879472693032  support: 0.06508241390092465
frozenset({'US'}) --> frozenset({'(90, 92]', '(36, 50]'}) conf:0.08433465850716934  support: 0.08433465850716934
frozenset({'(36, 50]'}) --> frozenset({'(90, 92]', 'US'}) conf:0.3330980945659845  support: 0.08433465850716934
frozenset({'(90, 92]'}) --> frozenset({'(36, 50]', 'US'}) conf:0.34402332361516036  support: 0.08433465850716934
frozenset({'US'}) --> frozenset({'(90, 92]', '(25, 36]'}) conf:0.055165944521374015  support: 0.055165944521374015
frozenset({'(25, 36]'}) --> frozenset({'(90, 92]', 'US'}) conf:0.23929471032745592  support: 0.055165944521374015
frozenset({'(90, 92]'}) --> frozenset({'(25, 36]', 'US'}) conf:0.22503644314868806  support: 0.055165944521374015
frozenset({'(50, 2013]'}) --> frozenset({'(90, 92]', 'US'}) conf:0.321325370834136  support: 0.07450752668959663
frozenset({'US'}) --> frozenset({'(90, 92]', '(50, 2013]'}) conf:0.07450752668959663  support: 0.07450752668959663
frozenset({'(90, 92]'}) --> frozenset({'(50, 2013]', 'US'}) conf:0.303935860058309  support: 0.07450752668959663
frozenset({'US'}) --> frozenset({'(0, 88]', '(25, 36]'}) conf:0.09501049716353241  support: 0.09501049716353241
frozenset({'(25, 36]'}) --> frozenset({'(0, 88]', 'US'}) conf:0.41212943228056576  support: 0.09501049716353241
frozenset({'(0, 88]'}) --> frozenset({'(25, 36]', 'US'}) conf:0.2568220236657812  support: 0.09501049716353241
frozenset({'US'}) --> frozenset({'(0, 88]', '(36, 50]'}) conf:0.06222361191763077  support: 0.06222361191763077
frozenset({'(36, 50]'}) --> frozenset({'(0, 88]', 'US'}) conf:0.24576570218772056  support: 0.06222361191763077
frozenset({'(0, 88]'}) --> frozenset({'(36, 50]', 'US'}) conf:0.16819608790147308  support: 0.06222361191763077
frozenset({'US'}) --> frozenset({'(0, 88]', '(0, 25]'}) conf:0.18064055031938178  support: 0.18064055031938178
frozenset({'(0, 25]'}) --> frozenset({'(0, 88]', 'US'}) conf:0.6351499921470081  support: 0.18064055031938178
frozenset({'(0, 88]'}) --> frozenset({'(0, 25]', 'US'}) conf:0.48828785317556145  support: 0.18064055031938178
```

```
def getlift(rules, suppData):
    lift = []
    for rule in rules:
        freqSet_conseq = rule[0]
        conseq = rule[1]
        lift_val = float(rule[3]) / float(suppData[rule[1]])
        lift.append([freqSet_conseq, conseq, lift_val])
    return lift
```

```
lift = getlift(rules, suppData)
lift
```

```
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```
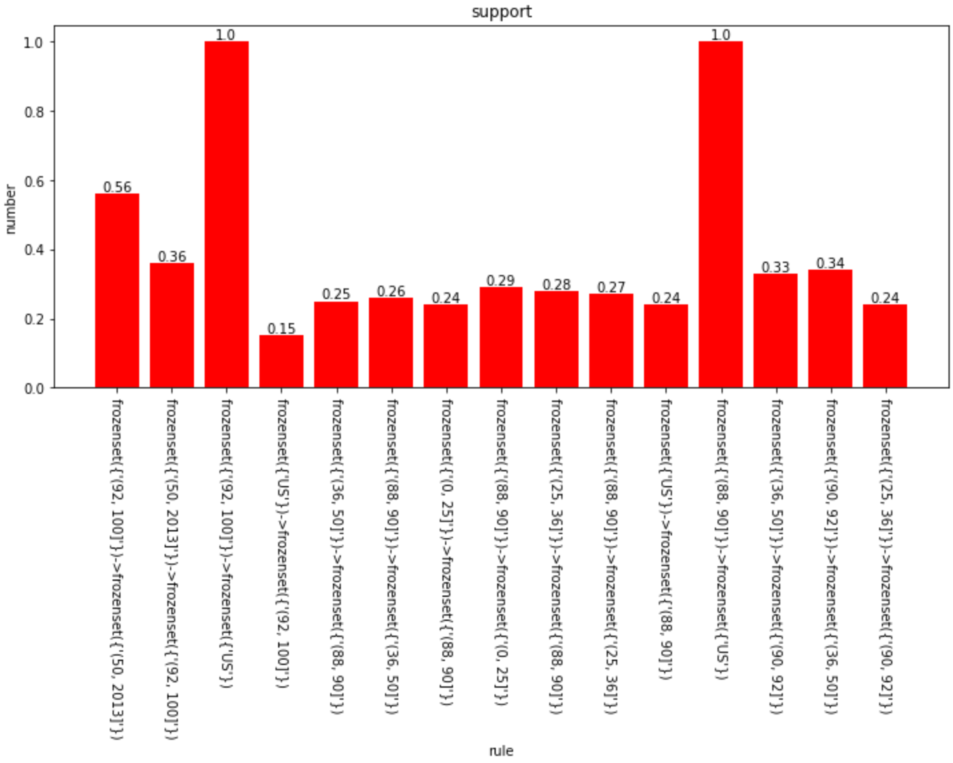

利用Lift进行评价

对挖掘结果进行可视化分析

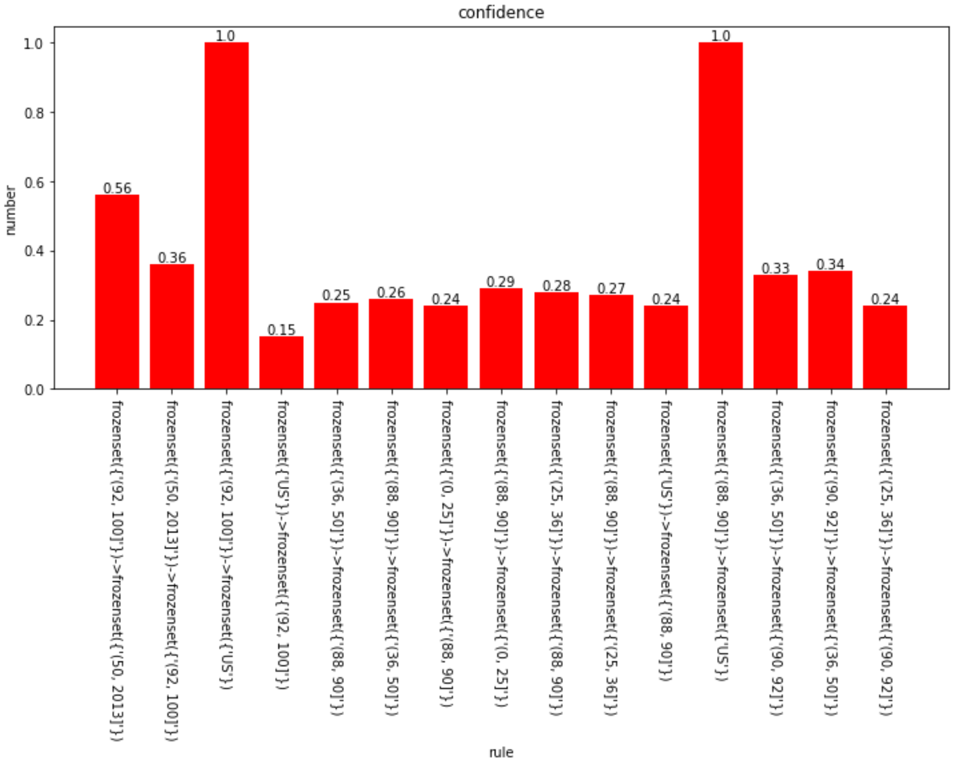
```python
import matplotlib.pyplot as plt

def show(x,y,title,K):
    plt.figure(figsize=(12,5))
    plt.xticks(rotation=270)
    plt.bar(x=x, height=y, label='d', color='r', alpha=1)
    for xx, yy in zip(x, y):
        plt.text(xx, yy, str(yy), ha='center', va='bottom', fontsize=10, rotation=0)
    plt.title(title)
    plt.xlabel("rule")
    plt.ylabel(K)
    plt.show()
```

```python
rule = []
sup = []
conf = []
for tmp in rules[:15]:
    rule.append(str(tmp[0])+"->"+str(tmp[1]))
    conf.append(round(tmp[2], 2))
    sup.append(round(tmp[3], 2))
```

```python
show(rule,conf,"support","number")
```



```
show(rule,conf,"confidence","number")
```



92，100]->'US' 和（88，90]->'US'有较高的置信度，说明高价酒为美国的产地比较高