In [1]:

```
pip install mlxtend
```

```
Requirement already satisfied: mlxtend in /opt/anaconda3/lib/pytho
n3.9/site-packages (0.21.0)
Requirement already satisfied: matplotlib>=3.0.0 in /opt/anaconda3
/lib/python3.9/site-packages (from mlxtend) (3.4.3)
Requirement already satisfied: scikit-learn>=1.0.2 in /opt/anacond
a3/lib/python3.9/site-packages (from mlxtend) (1.2.0)
Requirement already satisfied: pandas>=0.24.2 in /opt/anaconda3/li
b/python3.9/site-packages (from mlxtend) (1.3.4)
Requirement already satisfied: joblib>=0.13.2 in /opt/anaconda3/li
b/python3.9/site-packages (from mlxtend) (1.2.0)
Requirement already satisfied: scipy>=1.2.1 in /opt/anaconda3/lib/
python3.9/site-packages (from mlxtend) (1.7.1)
Requirement already satisfied: numpy>=1.16.2 in /opt/anaconda3/lib
/python3.9/site-packages (from mlxtend) (1.20.3)
Requirement already satisfied: setuptools in /opt/anaconda3/lib/py
thon3.9/site-packages (from mlxtend) (58.0.4)
Requirement already satisfied: kiwisolver>=1.0.1 in /opt/anaconda3
/lib/python3.9/site-packages (from matplotlib>=3.0.0->mlxtend) (1.
3.1)
Requirement already satisfied: python-dateutil>=2.7 in /opt/anacon
da3/lib/python3.9/site-packages (from matplotlib>=3.0.0->mlxtend)
(2.8.2)
Requirement already satisfied: pyparsing>=2.2.1 in /opt/anaconda3/
lib/python3.9/site-packages (from matplotlib>=3.0.0->mlxtend) (3.0
.4)
Requirement already satisfied: cycler>=0.10 in /opt/anaconda3/lib/
python3.9/site-packages (from matplotlib>=3.0.0->mlxtend) (0.10.0)
Requirement already satisfied: pillow>=6.2.0 in /opt/anaconda3/lib
/python3.9/site-packages (from matplotlib>=3.0.0->mlxtend) (8.4.0)
Requirement already satisfied: six in /opt/anaconda3/lib/python3.9
/site-packages (from cycler>=0.10->matplotlib>=3.0.0->mlxtend) (1.
16.0)
Requirement already satisfied: pytz>=2017.3 in /opt/anaconda3/lib/
python3.9/site-packages (from pandas>=0.24.2->mlxtend) (2021.3)
Requirement already satisfied: threadpoolctl>=2.0.0 in /opt/anacon
da3/lib/python3.9/site-packages (from scikit-learn>=1.0.2->mlxtend
) (2.2.0)
Note: you may need to restart the kernel to use updated packages.
```

In [2]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from mlxtend.frequent_patterns import apriori,association_rules
from mlxtend.preprocessing import TransactionEncoder
```

In [3]:
```
data = pd.read_csv("book.csv")
data.head()
```

Out[3]:

	ChildBks	YouthBks	CookBks	DoItYBks	RefBks	ArtBks	GeogBks	ItalCook	ItalAtlas
0	0	1	0	1	0	0	1	0	0
1	1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
3	1	1	1	0	1	0	1	0	0
4	0	0	1	0	0	0	1	0	0

In [4]:
```
data.dtypes
```

Out[4]:
```
ChildBks     int64
YouthBks     int64
CookBks      int64
DoItYBks     int64
RefBks       int64
ArtBks       int64
GeogBks      int64
ItalCook     int64
ItalAtlas    int64
ItalArt      int64
Florence     int64
dtype: object
```

In [5]:
```
data.isnull().sum()
```

Out[5]:
```
ChildBks     0
YouthBks     0
CookBks      0
DoItYBks     0
RefBks       0
ArtBks       0
GeogBks      0
ItalCook     0
ItalAtlas    0
ItalArt      0
Florence     0
dtype: int64
```

In [6]:
```
data.corr()
```

Out[6]:

	ChildBks	YouthBks	CookBks	DoItYBks	RefBks	ArtBks	GeogBks	ItalCool
ChildBks	1.000000	0.282861	0.301188	0.291107	0.299654	0.286600	0.354335	0.23603
YouthBks	0.282861	1.000000	0.258884	0.235362	0.245061	0.224043	0.270534	0.22578
CookBks	0.301188	0.258884	1.000000	0.295996	0.295417	0.298061	0.332222	0.41112
DoItYBks	0.291107	0.235362	0.295996	1.000000	0.243694	0.288585	0.271783	0.18561
RefBks	0.299654	0.245061	0.295417	0.243694	1.000000	0.215347	0.279570	0.17015
ArtBks	0.286600	0.224043	0.298061	0.288585	0.215347	1.000000	0.318979	0.21484
GeogBks	0.354335	0.270534	0.332222	0.271783	0.279570	0.318979	1.000000	0.23043
ItalCook	0.236039	0.225789	0.411127	0.185612	0.170150	0.214842	0.230431	1.00000
ItalAtlas	0.137784	0.102410	0.134288	0.100850	0.375100	0.112509	0.121925	0.31399
ItalArt	0.145903	0.118612	0.188908	0.168864	0.108833	0.400663	0.167805	0.46954
Florence	0.016951	-0.010086	0.004782	0.006452	0.060525	0.168036	0.090299	0.05256

In [7]:
```
frequent_itemsets = apriori(data,min_support=0.1,use_colnames=True)
frequent_itemsets
```

```
/opt/anaconda3/lib/python3.9/site-packages/mlxtend/frequent_patter
ns/fpcommon.py:111: DeprecationWarning: DataFrames with non-bool t
ypes result in worse computationalperformance and their support mi
ght be discontinued in the future.Please use a DataFrame with bool
type
  warnings.warn(
```

Out[7]:

	support	itemsets
0	0.4230	(ChildBks)
1	0.2475	(YouthBks)
2	0.4310	(CookBks)
3	0.2820	(DoItYBks)
4	0.2145	(RefBks)
5	0.2410	(ArtBks)
6	0.2760	(GeogBks)
7	0.1135	(ItalCook)
8	0.1085	(Florence)
9	0.1650	(YouthBks, ChildBks)
10	0.2560	(CookBks, ChildBks)
11	0.1840	(ChildBks, DoItYBks)

11	0.1640	(ChildBks, DoItYBks)
12	0.1515	(ChildBks, RefBks)
13	0.1625	(ArtBks, ChildBks)
14	0.1950	(GeogBks, ChildBks)
15	0.1620	(CookBks, YouthBks)
16	0.1155	(YouthBks, DoItYBks)
17	0.1010	(ArtBks, YouthBks)
18	0.1205	(YouthBks, GeogBks)
19	0.1875	(CookBks, DoItYBks)
20	0.1525	(CookBks, RefBks)
21	0.1670	(ArtBks, CookBks)
22	0.1925	(CookBks, GeogBks)
23	0.1135	(CookBks, ItalCook)
24	0.1055	(DoItYBks, RefBks)
25	0.1235	(ArtBks, DoItYBks)
26	0.1325	(GeogBks, DoItYBks)
27	0.1105	(GeogBks, RefBks)
28	0.1275	(ArtBks, GeogBks)
29	0.1290	(CookBks, YouthBks, ChildBks)
30	0.1460	(CookBks, ChildBks, DoItYBks)
31	0.1225	(CookBks, ChildBks, RefBks)
32	0.1265	(ArtBks, CookBks, ChildBks)
33	0.1495	(GeogBks, CookBks, ChildBks)
34	0.1045	(GeogBks, ChildBks, DoItYBks)
35	0.1020	(GeogBks, ArtBks, ChildBks)
36	0.1015	(ArtBks, CookBks, DoItYBks)
37	0.1085	(CookBks, GeogBks, DoItYBks)
38	0.1035	(ArtBks, CookBks, GeogBks)

In [8]:
```
rules = association_rules(frequent_itemsets,metric='lift',min_thres
rules
```

Out[8]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	lev
0	(YouthBks)	(ChildBks)	0.2475	0.4230	0.1650	0.666667	1.576044	0.0
1	(ChildBks)	(YouthBks)	0.4230	0.2475	0.1650	0.390071	1.576044	0.0
2	(CookBks)	(ChildBks)	0.4310	0.4230	0.2560	0.593968	1.404179	0.0
3	(ChildBks)	(CookBks)	0.4230	0.4310	0.2560	0.605201	1.404179	0.0
4	(ChildBks)	(DoItYBks)	0.4230	0.2820	0.1840	0.434988	1.542511	0.0
...	...	...	...	...	...	...	...	
95	(ArtBks, GeogBks)	(CookBks)	0.1275	0.4310	0.1035	0.811765	1.883445	0.0
96	(CookBks, GeogBks)	(ArtBks)	0.1925	0.2410	0.1035	0.537662	2.230964	0.0
97	(ArtBks)	(CookBks, GeogBks)	0.2410	0.1925	0.1035	0.429461	2.230964	0.0
98	(CookBks)	(ArtBks, GeogBks)	0.4310	0.1275	0.1035	0.240139	1.883445	0.0
99	(GeogBks)	(ArtBks, CookBks)	0.2760	0.1670	0.1035	0.375000	2.245509	0.0

100 rows × 9 columns

In [9]:
```
rules.sort_values('lift',ascending=False)[0:20]
```

Out[9]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	lev
28	(CookBks)	(ItalCook)	0.4310	0.1135	0.1135	0.263341	2.320186	0.0
29	(ItalCook)	(CookBks)	0.1135	0.4310	0.1135	1.000000	2.320186	0.0
78	(ArtBks, ChildBks)	(GeogBks)	0.1625	0.2760	0.1020	0.627692	2.274247	0.0
79	(GeogBks)	(ArtBks, ChildBks)	0.2760	0.1625	0.1020	0.369565	2.274247	0.0
85	(ArtBks)	(CookBks, DoItYBks)	0.2410	0.1875	0.1015	0.421162	2.246196	0.0
84	(CookBks, DoItYBks)	(ArtBks)	0.1875	0.2410	0.1015	0.541333	2.246196	0.0
99	(GeogBks)	(ArtBks, CookBks)	0.2760	0.1670	0.1035	0.375000	2.245509	0.0
94	(ArtBks, CookBks)	(GeogBks)	0.1670	0.2760	0.1035	0.619760	2.245509	0.0
97	(ArtBks)	(CookBks, GeogBks)	0.2410	0.1925	0.1035	0.429461	2.230964	0.0
96	(CookBks, GeogBks)	(ArtBks)	0.1925	0.2410	0.1035	0.537662	2.230964	0.0
52	(CookBks, ChildBks)	(RefBks)	0.2560	0.2145	0.1225	0.478516	2.230842	0.0
57	(RefBks)	(CookBks, ChildBks)	0.2145	0.2560	0.1225	0.571096	2.230842	0.0
77	(ChildBks, GeogBks)	(ArtBks)	0.1950	0.2410	0.1020	0.523077	2.170444	0.0
80	(ArtBks)	(ChildBks, GeogBks)	0.2410	0.1950	0.1020	0.423237	2.170444	0.0
87	(DoItYBks)	(ArtBks, CookBks)	0.2820	0.1670	0.1015	0.359929	2.155264	0.0
82	(ArtBks, CookBks)	(DoItYBks)	0.1670	0.2820	0.1015	0.607784	2.155264	0.0
67	(GeogBks)	(CookBks, ChildBks)	0.2760	0.2560	0.1495	0.541667	2.115885	0.0
66	(CookBks, ChildBks)	(GeogBks)	0.2560	0.2760	0.1495	0.583984	2.115885	0.0
89	(CookBks, DoItYBks)	(GeogBks)	0.1875	0.2760	0.1085	0.578667	2.096618	0.0
92	(GeogBks)	(CookBks, DoItYBks)	0.2760	0.1875	0.1085	0.393116	2.096618	0.0

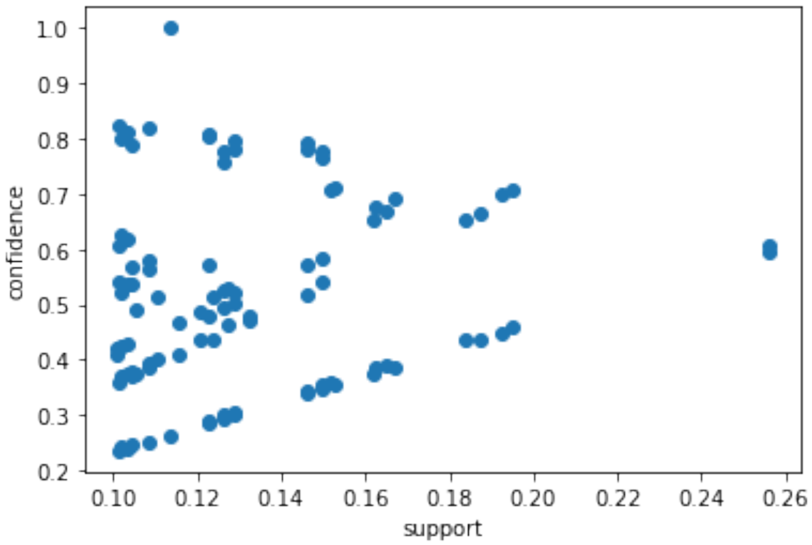
In [10]:
```
rules[rules.lift>1]
```

Out[10]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	lev
0	(YouthBks)	(ChildBks)	0.2475	0.4230	0.1650	0.666667	1.576044	0.0
1	(ChildBks)	(YouthBks)	0.4230	0.2475	0.1650	0.390071	1.576044	0.0
2	(CookBks)	(ChildBks)	0.4310	0.4230	0.2560	0.593968	1.404179	0.0
3	(ChildBks)	(CookBks)	0.4230	0.4310	0.2560	0.605201	1.404179	0.0
4	(ChildBks)	(DoItYBks)	0.4230	0.2820	0.1840	0.434988	1.542511	0.0
...	...	...	...	...	...	...	...	
95	(ArtBks, GeogBks)	(CookBks)	0.1275	0.4310	0.1035	0.811765	1.883445	0.0
96	(CookBks, GeogBks)	(ArtBks)	0.1925	0.2410	0.1035	0.537662	2.230964	0.0
97	(ArtBks)	(CookBks, GeogBks)	0.2410	0.1925	0.1035	0.429461	2.230964	0.0
98	(CookBks)	(ArtBks, GeogBks)	0.4310	0.1275	0.1035	0.240139	1.883445	0.0
99	(GeogBks)	(ArtBks, CookBks)	0.2760	0.1670	0.1035	0.375000	2.245509	0.0

100 rows × 9 columns

In [11]:
```
plt.scatter(rules['support'],rules['confidence'])
plt.xlabel('support')
plt.ylabel('confidence')
plt.show()
```



In [12]:

```
frequent_book2 = apriori(data,min_support = 0.05,use_colnames = Tru
frequent_book2
```

```
/opt/anaconda3/lib/python3.9/site-packages/mlxtend/frequent_patter
ns/fpcommon.py:111: DeprecationWarning: DataFrames with non-bool t
ypes result in worse computationalperformance and their support mi
ght be discontinued in the future.Please use a DataFrame with bool
type
  warnings.warn(
```

Out[12]:

	support	itemsets
0	0.4230	(ChildBks)
1	0.2475	(YouthBks)
2	0.4310	(CookBks)
3	0.2820	(DoItYBks)
4	0.2145	(RefBks)
...	...	...
95	0.0600	(CookBks, YouthBks, GeogBks, DoItYBks)
96	0.0560	(CookBks, ArtBks, YouthBks, GeogBks)
97	0.0650	(ArtBks, CookBks, GeogBks, DoItYBks)
98	0.0510	(GeogBks, DoItYBks, CookBks, ChildBks, YouthBks)
99	0.0535	(GeogBks, DoItYBks, CookBks, ArtBks, ChildBks)

100 rows × 2 columns

In [13]:
```
rules2 = association_rules(frequent_book2,metric = "confidence",min
rules2
```

Out[13]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	lev
0	(RefBks)	(ChildBks)	0.2145	0.423	0.1515	0.706294	1.669725	0.0
1	(GeogBks)	(ChildBks)	0.2760	0.423	0.1950	0.706522	1.670264	0.0
2	(ItalCook)	(ChildBks)	0.1135	0.423	0.0850	0.748899	1.770446	0.0
3	(RefBks)	(CookBks)	0.2145	0.431	0.1525	0.710956	1.649549	0.0
4	(ItalCook)	(CookBks)	0.1135	0.431	0.1135	1.000000	2.320186	0.0
...	...	...	...	...	...	...	...	
82	(ChildBks, YouthBks, GeogBks, DoItYBks)	(CookBks)	0.0565	0.431	0.0510	0.902655	2.094327	0.0
83	(YouthBks, GeogBks, DoItYBks)	(CookBks, ChildBks)	0.0680	0.256	0.0510	0.750000	2.929687	0.0
84	(ArtBks, CookBks, GeogBks, DoItYBks)	(ChildBks)	0.0650	0.423	0.0535	0.823077	1.945808	0.0
85	(ChildBks, ArtBks, GeogBks, DoItYBks)	(CookBks)	0.0595	0.431	0.0535	0.899160	2.086217	0.0
86	(ArtBks, GeogBks, DoItYBks)	(CookBks, ChildBks)	0.0730	0.256	0.0535	0.732877	2.862800	0.0

87 rows × 9 columns

In [14]:

```
rules2[rules2.lift>1]
```

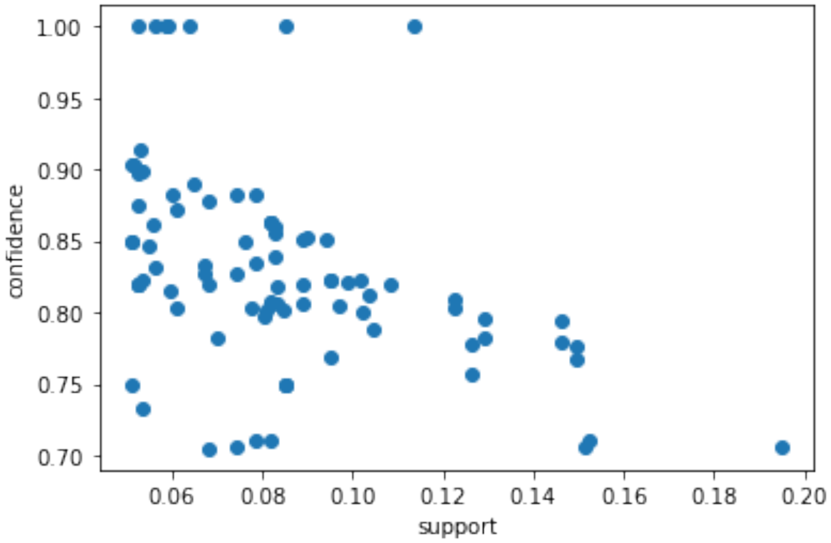
Out[14]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	lev
0	(RefBks)	(ChildBks)	0.2145	0.423	0.1515	0.706294	1.669725	0.0
1	(GeogBks)	(ChildBks)	0.2760	0.423	0.1950	0.706522	1.670264	0.0
2	(ItalCook)	(ChildBks)	0.1135	0.423	0.0850	0.748899	1.770446	0.0
3	(RefBks)	(CookBks)	0.2145	0.431	0.1525	0.710956	1.649549	0.0
4	(ItalCook)	(CookBks)	0.1135	0.431	0.1135	1.000000	2.320186	0.0
...	...	...	...	...	...	...	...	
82	(ChildBks, YouthBks, GeogBks, DoItYBks)	(CookBks)	0.0565	0.431	0.0510	0.902655	2.094327	0.0
83	(YouthBks, GeogBks, DoItYBks)	(CookBks, ChildBks)	0.0680	0.256	0.0510	0.750000	2.929687	0.0
84	(ArtBks, CookBks, GeogBks, DoItYBks)	(ChildBks)	0.0650	0.423	0.0535	0.823077	1.945808	0.0
85	(ChildBks, ArtBks, GeogBks, DoItYBks)	(CookBks)	0.0595	0.431	0.0535	0.899160	2.086217	0.0
86	(ArtBks, GeogBks, DoItYBks)	(CookBks, ChildBks)	0.0730	0.256	0.0535	0.732877	2.862800	0.0

87 rows × 9 columns

In [15]:

```
plt.scatter(rules2['support'],rules2['confidence'])
plt.xlabel('support')
plt.ylabel('confidence')
plt.show()
```



In [ ]: