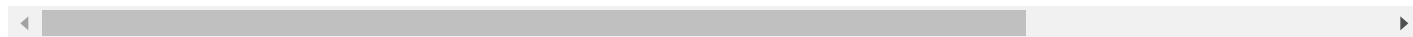


▼ Prepare rules for the all the data sets

- 1) Try different values of support and confidence. Observe the change in number of rules for different
- 2) Change the minimum length in apriori algorithm
- 3) Visualize the obtained rules using different plots



```
import pandas as pd
```

```
book = pd.read_csv('Book.csv')
book
```



	ChildBks	YouthBks	CookBks	DoItYBks	RefBks	ArtBks	GeogBks	ItalCook	ItalAtl:
0	0	1	0	1	0	0	1	0	
1	1	0	0	0	0	0	0	0	
2	0	0	0	0	0	0	0	0	
3	1	1	1	0	1	0	1	0	
4	0	0	1	0	0	0	1	0	
...	
1995	0	0	1	0	0	1	1	1	
1996	0	0	0	0	0	0	0	0	
1997	0	0	0	0	0	0	0	0	
1998	0	0	1	0	0	0	0	0	
1999	0	0	0	0	0	0	0	0	

2000 rows × 11 columns

```
from mlxtend.frequent_patterns import apriori, association_rules
```

▼ With 10% support and 50% confidence

```
frequent_itemset = apriori(book, min_support=0.1, use_colnames=True,)
frequent_itemset
```

	support	itemsets
0	0.4230	(ChildBks)
1	0.2475	(YouthBks)
2	0.4310	(CookBks)
3	0.2820	(DoltYBks)
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	(ChildBks, CookBks)
11	0.1840	(ChildBks, DoltYBks)
12	0.1515	(RefBks, ChildBks)
13	0.1625	(ArtBks, ChildBks)
14	0.1950	(GeogBks, ChildBks)
15	0.1620	(YouthBks, CookBks)
16	0.1155	(YouthBks, DoltYBks)
17	0.1010	(YouthBks, ArtBks)
18	0.1205	(YouthBks, GeogBks)
19	0.1875	(CookBks, DoltYBks)
20	0.1525	(RefBks, CookBks)
21	0.1670	(ArtBks, CookBks)
22	0.1925	(GeogBks, CookBks)
23	0.1135	(CookBks, ItalCook)
24	0.1055	(RefBks, DoltYBks)
25	0.1235	(ArtBks, DoltYBks)
26	0.1325	(GeogBks, DoltYBks)
27	0.1105	(RefBks, GeogBks)
28	0.1275	(GeogBks, ArtBks)
29	0.1290	(YouthBks, ChildBks, CookBks)

30 0.1460 (ChildBks, CookBks, DoltYBks)

```
rule = association_rules(frequent_iteam_set, metric='confidence', min_threshold=0.5)
rule
```

	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)	(CookBks)	0.4230	0.4310	0.2560	0.605201	1.404179	0.0
2	(CookBks)	(ChildBks)	0.4310	0.4230	0.2560	0.593968	1.404179	0.0
3	(DoltYBks)	(ChildBks)	0.2820	0.4230	0.1840	0.652482	1.542511	0.0
4	(RefBks)	(ChildBks)	0.2145	0.4230	0.1515	0.706294	1.669725	0.0
5	(ArtBks)	(ChildBks)	0.2410	0.4230	0.1625	0.674274	1.594028	0.0
6	(GeogBks)	(ChildBks)	0.2760	0.4230	0.1950	0.706522	1.670264	0.0
7	(YouthBks)	(CookBks)	0.2475	0.4310	0.1620	0.654545	1.518667	0.0
8	(DoltYBks)	(CookBks)	0.2820	0.4310	0.1875	0.664894	1.542677	0.0
9	(RefBks)	(CookBks)	0.2145	0.4310	0.1525	0.710956	1.649549	0.0
10	(ArtBks)	(CookBks)	0.2410	0.4310	0.1670	0.692946	1.607763	0.0
11	(GeogBks)	(CookBks)	0.2760	0.4310	0.1925	0.697464	1.618245	0.0
12	(ItalCook)	(CookBks)	0.1135	0.4310	0.1135	1.000000	2.320186	0.0
13	(ArtBks)	(DoltYBks)	0.2410	0.2820	0.1235	0.512448	1.817192	0.0
14	(RefBks)	(GeogBks)	0.2145	0.2760	0.1105	0.515152	1.866491	0.0
15	(ArtBks)	(GeogBks)	0.2410	0.2760	0.1275	0.529046	1.916832	0.0
16	(YouthBks, ChildBks)	(CookBks)	0.1650	0.4310	0.1290	0.781818	1.813963	0.0
17	(YouthBks, CookBks)	(ChildBks)	0.1620	0.4230	0.1290	0.796296	1.882497	0.0
18	(ChildBks, CookBks)	(YouthBks)	0.2560	0.2475	0.1290	0.503906	2.035985	0.0
19	(YouthBks)	(ChildBks, CookBks)	0.2475	0.2560	0.1290	0.521212	2.035985	0.0
20	(ChildBks, CookBks)	(DoltYBks)	0.2560	0.2820	0.1460	0.570312	2.022385	0.0
21	(ChildBks, DoltYBks)	(CookBks)	0.1840	0.4310	0.1460	0.793478	1.841017	0.0
22	(CookBks, DoltYBks)	(ChildBks)	0.1875	0.4230	0.1460	0.778667	1.840820	0.0
23	(DoltYBks)	(ChildBks, CookBks)	0.2820	0.2560	0.1460	0.517730	2.022385	0.0

```
rule.sort_values('lift', ascending=False)
```


	antecedents	consequents	antecedent support	consequent support	support	confidence	lift
12	(ItalCook)	(CookBks)	0.1135	0.4310	0.1135	1.000000	2.320180
38	(ChildBks, ArtBks)	(GeogBks)	0.1625	0.2760	0.1020	0.627692	2.274247
42	(CookBks, DoltYBks)	(ArtBks)	0.1875	0.2410	0.1015	0.541333	2.246190
48	(ArtBks, CookBks)	(GeogBks)	0.1670	0.2760	0.1035	0.619760	2.245509
47	(GeogBks, CookBks)	(ArtBks)	0.1925	0.2410	0.1035	0.537662	2.230964
26	(RefBks)	(ChildBks, CookBks)	0.2145	0.2560	0.1225	0.571096	2.230847
39	(GeogBks, ChildBks)	(ArtBks)	0.1950	0.2410	0.1020	0.523077	2.170444
40	(ArtBks, CookBks)	(DoltYBks)	0.1670	0.2820	0.1015	0.607784	2.155264
32	(ChildBks, CookBks)	(GeogBks)	0.2560	0.2760	0.1495	0.583984	2.115889
33	(GeogBks)	(ChildBks, CookBks)	0.2760	0.2560	0.1495	0.541667	2.115889
45	(CookBks, DoltYBks)	(GeogBks)	0.1875	0.2760	0.1085	0.578667	2.096611
36	(ChildBks, DoltYBks)	(GeogBks)	0.1840	0.2760	0.1045	0.567935	2.057731

```
rule.sort_values('confidence',ascending=False)
```

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	lev
12	(ItalCook)	(CookBks)	0.1135	0.4310	0.1135	1.000000	2.320186	0.0
41	(ArtBks, DoltYBks)	(CookBks)	0.1235	0.4310	0.1015	0.821862	1.906873	0.0
44	(GeogBks, DoltYBks)	(CookBks)	0.1325	0.4310	0.1085	0.818868	1.899926	0.0
46	(GeogBks, ArtBks)	(CookBks)	0.1275	0.4310	0.1035	0.811765	1.883445	0.0
24	(RefBks, ChildBks)	(CookBks)	0.1515	0.4310	0.1225	0.808581	1.876058	0.0
25	(RefBks, CookBks)	(ChildBks)	0.1525	0.4230	0.1225	0.803279	1.899004	0.0
37	(GeogBks, ArtBks)	(ChildBks)	0.1275	0.4230	0.1020	0.800000	1.891253	0.0
17	(YouthBks, CookBks)	(ChildBks)	0.1620	0.4230	0.1290	0.796296	1.882497	0.0
21	(ChildBks, DoltYBks)	(CookBks)	0.1840	0.4310	0.1460	0.793478	1.841017	0.0
35	(GeogBks, DoltYBks)	(ChildBks)	0.1325	0.4230	0.1045	0.788679	1.864490	0.0
16	(YouthBks, ChildBks)	(CookBks)	0.1650	0.4310	0.1290	0.781818	1.813963	0.0
22	(CookBks, DoltYBks)	(ChildBks)	0.1875	0.4230	0.1460	0.778667	1.840820	0.0
27	(ChildBks, ArtBks)	(CookBks)	0.1625	0.4310	0.1265	0.778462	1.806175	0.0
31	(GeogBks, CookBks)	(ChildBks)	0.1925	0.4230	0.1495	0.776623	1.835989	0.0
30	(GeogBks, ChildBks)	(CookBks)	0.1950	0.4310	0.1495	0.766667	1.778809	0.0
28	(ArtBks, CookBks)	(ChildBks)	0.1670	0.4230	0.1265	0.757485	1.790745	0.0
9	(RefBks)	(CookBks)	0.2145	0.4310	0.1525	0.710956	1.649549	0.0
6	(GeogBks)	(ChildBks)	0.2760	0.4230	0.1950	0.706522	1.670264	0.0
4	(RefBks)	(ChildBks)	0.2145	0.4230	0.1515	0.706294	1.669725	0.0
11	(GeogBks)	(CookBks)	0.2760	0.4310	0.1925	0.697464	1.618245	0.0
10	(ArtBks)	(CookBks)	0.2410	0.4310	0.1670	0.692946	1.607763	0.0

5	(ArtBks)	(ChildBks)	0.2410	0.4230	0.1625	0.674274	1.594028	0.0
---	----------	------------	--------	--------	--------	----------	----------	-----

```
# if lift>1 - best Association  
rule[rule.lift>1]
```


	antecedents	consequents	antecedent support	consequent support	support	confidence	lift
0	(YouthBks)	(ChildBks)	0.2475	0.4230	0.1650	0.666667	1.57604
1	(ChildBks)	(CookBks)	0.4230	0.4310	0.2560	0.605201	1.40417
2	(CookBks)	(ChildBks)	0.4310	0.4230	0.2560	0.593968	1.40417
3	(DoltYBks)	(ChildBks)	0.2820	0.4230	0.1840	0.652482	1.54251
4	(RefBks)	(ChildBks)	0.2145	0.4230	0.1515	0.706294	1.66972
5	(ArtBks)	(ChildBks)	0.2410	0.4230	0.1625	0.674274	1.59402
6	(GeogBks)	(ChildBks)	0.2760	0.4230	0.1950	0.706522	1.67026
7	(YouthBks)	(CookBks)	0.2475	0.4310	0.1620	0.654545	1.51866
8	(DoltYBks)	(CookBks)	0.2820	0.4310	0.1875	0.664894	1.54267
9	(RefBks)	(CookBks)	0.2145	0.4310	0.1525	0.710956	1.64954
10	(ArtBks)	(CookBks)	0.2410	0.4310	0.1670	0.692946	1.60776
11	(GeogBks)	(CookBks)	0.2760	0.4310	0.1925	0.697464	1.61824
12	(ItalCook)	(CookBks)	0.1135	0.4310	0.1135	1.000000	2.32018
13	(ArtBks)	(DoltYBks)	0.2410	0.2820	0.1235	0.512448	1.81719
14	(RefBks)	(GeogBks)	0.2145	0.2760	0.1105	0.515152	1.86649
15	(ArtBks)	(GeogBks)	0.2410	0.2760	0.1275	0.529046	1.91683
16	(YouthBks, ChildBks)	(CookBks)	0.1650	0.4310	0.1290	0.781818	1.81396
17	(YouthBks, CookBks)	(ChildBks)	0.1620	0.4230	0.1290	0.796296	1.88249
18	(ChildBks, CookBks)	(YouthBks)	0.2560	0.2475	0.1290	0.503906	2.03598
19	(YouthBks)	(ChildBks, CookBks)	0.2475	0.2560	0.1290	0.521212	2.03598
20	(ChildBks, CookBks)	(DoltYBks)	0.2560	0.2820	0.1460	0.570312	2.02238
21	(ChildBks, DoltYBks)	(CookBks)	0.1840	0.4310	0.1460	0.793478	1.84101
22	(CookBks, DoltYBks)	(ChildBks)	0.1875	0.4230	0.1460	0.778667	1.84082
23	(DoltYBks)	(ChildBks, CookBks)	0.2820	0.2560	0.1460	0.517730	2.02238
24	(RefBks, ChildBks)	(CookBks)	0.1515	0.4310	0.1225	0.808581	1.87605

▼ With 20% support and 70% confidence

```
frequent_item_set = apriori(book, min_support=0.2, use_colnames=True,)
frequent_item_set
```

	support	itemsets
0	0.4230	(ChildBks)
1	0.2475	(YouthBks)
2	0.4310	(CookBks)
3	0.2820	(DoltYBks)
4	0.2145	(RefBks)
5	0.2410	(ArtBks)
6	0.2760	(GeogBks)
7	0.2560	(ChildBks, CookBks)

```
rule_1 = association_rules(frequent_iteam_set, metric='confidence', min_threshold=0.7)
rule_1
```

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift
0	(RefBks)	(ChildBks)	0.2145	0.423	0.1515	0.706294	1.669729
1	(GeogBks)	(ChildBks)	0.2760	0.423	0.1950	0.706522	1.670264
2	(RefBks)	(CookBks)	0.2145	0.431	0.1525	0.710956	1.649549
3	(ItalCook)	(CookBks)	0.1135	0.431	0.1135	1.000000	2.320180

```
rule_1.sort_values('lift', ascending=False,)
```

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift
3	(ItalCook)	(CookBks)	0.1135	0.431	0.1135	1.000000	2.320180
16	(ArtBks, DoltYBks)	(CookBks)	0.1235	0.431	0.1015	0.821862	1.906879
17	(GeogBks, DoltYBks)	(CookBks)	0.1325	0.431	0.1085	0.818868	1.899920
9	(RefBks, CookBks)	(ChildBks)	0.1525	0.423	0.1225	0.803279	1.899004
15	(GeogBks, ArtBks)	(ChildBks)	0.1275	0.423	0.1020	0.800000	1.891259
18	(GeogBks, ArtBks)	(CookBks)	0.1275	0.431	0.1035	0.811765	1.883449
5	(YouthBks, CookBks)	(ChildBks)	0.1620	0.423	0.1290	0.796296	1.882499
8	(RefBks, ChildBks)	(CookBks)	0.1515	0.431	0.1225	0.808581	1.876059
14	(GeogBks, DoltYBks)	(ChildBks)	0.1325	0.423	0.1045	0.788679	1.864490
6	(ChildBks, DoltYBks)	(CookBks)	0.1840	0.431	0.1460	0.793478	1.841019
7	(CookBks, DoltYBks)	(ChildBks)	0.1875	0.423	0.1460	0.778667	1.840820
13	(GeogBks, CookBks)	(ChildBks)	0.1925	0.423	0.1495	0.776623	1.835989
	(YouthBks						

```
rule_1.sort_values('confidence', ascending=False,)
```

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	lev
3	(ItalCook)	(CookBks)	0.1135	0.431	0.1135	1.000000	2.320186	0.0
16	(ArtBks, DoltYBks)	(CookBks)	0.1235	0.431	0.1015	0.821862	1.906873	0.0
17	(GeogBks, DoltYBks)	(CookBks)	0.1325	0.431	0.1085	0.818868	1.899926	0.0
18	(GeogBks, ArtBks)	(CookBks)	0.1275	0.431	0.1035	0.811765	1.883445	0.0
8	(RefBks, ChildBks)	(CookBks)	0.1515	0.431	0.1225	0.808581	1.876058	0.0
9	(RefBks, CookBks)	(ChildBks)	0.1525	0.423	0.1225	0.803279	1.899004	0.0
15	(GeogBks, ArtBks)	(ChildBks)	0.1275	0.423	0.1020	0.800000	1.891253	0.0
5	(YouthBks, CookBks)	(ChildBks)	0.1620	0.423	0.1290	0.796296	1.882497	0.0
6	(ChildBks, DoltYBks)	(CookBks)	0.1840	0.431	0.1460	0.793478	1.841017	0.0
14	(GeogBks, DoltYBks)	(ChildBks)	0.1325	0.423	0.1045	0.788679	1.864490	0.0
4	(YouthBks, ChildBks)	(CookBks)	0.1650	0.431	0.1290	0.781818	1.813963	0.0
7	(CookBks, ChildBks)	(DoltYBks)	0.1075	0.400	0.1100	0.770000	1.810000	0.0
rule_1[rule_1.lift>1] # Best Association								

	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	(RefBks)	(CookBks)	0.2145	0.431	0.1525	0.710956	1.649549	0.0
3	(ItalCook)	(CookBks)	0.1135	0.431	0.1135	1.000000	2.320186	0.0
4	(YouthBks, ChildBks)	(CookBks)	0.1650	0.431	0.1290	0.781818	1.813963	0.0
5	(YouthBks, CookBks)	(ChildBks)	0.1620	0.423	0.1290	0.796296	1.882497	0.0
6	(ChildBks, DoltYBks)	(CookBks)	0.1840	0.431	0.1460	0.793478	1.841017	0.0

▼ With 50% support and 50% confidence

```

frequent_item_set = apriori(book, min_support=0.5, use_colnames=True,)
frequent_item_set

support itemsets
0 (ArtBks) (CookBks) 0.1620 0.431 0.1290 0.770492 1.888170 0.0
rule_2 = association_rules(frequent_iteam_set, metric='confidence', min_threshold=0.5)
rule_2
```

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift
0	(YouthBks)	(ChildBks)	0.2475	0.4230	0.1650	0.666667	1.57604
1	(ChildBks)	(CookBks)	0.4230	0.4310	0.2560	0.605201	1.40417
2	(CookBks)	(ChildBks)	0.4310	0.4230	0.2560	0.593968	1.40417
3	(DoltYBks)	(ChildBks)	0.2820	0.4230	0.1840	0.652482	1.54251
4	(RefBks)	(ChildBks)	0.2145	0.4230	0.1515	0.706294	1.66972
5	(ArtBks)	(ChildBks)	0.2410	0.4230	0.1625	0.674274	1.59402
6	(GeogBks)	(ChildBks)	0.2760	0.4230	0.1950	0.706522	1.67026
7	(YouthBks)	(CookBks)	0.2475	0.4310	0.1620	0.654545	1.51866
8	(DoltYBks)	(CookBks)	0.2820	0.4310	0.1875	0.664894	1.54267
9	(RefBks)	(CookBks)	0.2145	0.4310	0.1525	0.710956	1.64954
10	(ArtBks)	(CookBks)	0.2410	0.4310	0.1670	0.692946	1.60776
11	(GeogBks)	(CookBks)	0.2760	0.4310	0.1925	0.697464	1.61824
12	(ItalCook)	(CookBks)	0.1135	0.4310	0.1135	1.000000	2.32018
13	(ArtBks)	(DoltYBks)	0.2410	0.2820	0.1235	0.512448	1.81719
14	(RefBks)	(GeogBks)	0.2145	0.2760	0.1105	0.515152	1.86649
15	(ArtBks)	(GeogBks)	0.2410	0.2760	0.1275	0.529046	1.91683
16	(YouthBks, ChildBks)	(CookBks)	0.1650	0.4310	0.1290	0.781818	1.81396
17	(YouthBks, CookBks)	(ChildBks)	0.1620	0.4230	0.1290	0.796296	1.88249
18	(ChildBks, CookBks)	(YouthBks)	0.2560	0.2475	0.1290	0.503906	2.03598
19	(YouthBks)	(ChildBks, CookBks)	0.2475	0.2560	0.1290	0.521212	2.03598
20	(ChildBks, CookBks)	(DoltYBks)	0.2560	0.2820	0.1460	0.570312	2.02238
21	(ChildBks, DoltYBks)	(CookBks)	0.1840	0.4310	0.1460	0.793478	1.84101
22	(CookBks, DoltYBks)	(ChildBks)	0.1875	0.4230	0.1460	0.778667	1.84082
23	(DoltYBks)	(ChildBks, CookBks)	0.2820	0.2560	0.1460	0.517730	2.02238
24	(RefBks, ChildBks)	(CookBks)	0.1515	0.4310	0.1225	0.808581	1.87605



```
rule_2.sort_values('lift',ascending=True,)
```

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift
1	(ChildBks)	(CookBks)	0.4230	0.4310	0.2560	0.605201	1.404179
2	(CookBks)	(ChildBks)	0.4310	0.4230	0.2560	0.593968	1.404179
7	(YouthBks)	(CookBks)	0.2475	0.4310	0.1620	0.654545	1.518667
3	(DoltYBks)	(ChildBks)	0.2820	0.4230	0.1840	0.652482	1.542517
8	(DoltYBks)	(CookBks)	0.2820	0.4310	0.1875	0.664894	1.542677
0	(YouthBks)	(ChildBks)	0.2475	0.4230	0.1650	0.666667	1.576044
5	(ArtBks)	(ChildBks)	0.2410	0.4230	0.1625	0.674274	1.594028
10	(ArtBks)	(CookBks)	0.2410	0.4310	0.1670	0.692946	1.607765
11	(GeogBks)	(CookBks)	0.2760	0.4310	0.1925	0.697464	1.618249
9	(RefBks)	(CookBks)	0.2145	0.4310	0.1525	0.710956	1.649549
4	(RefBks)	(ChildBks)	0.2145	0.4230	0.1515	0.706294	1.669729
6	(GeogBks)	(ChildBks)	0.2760	0.4230	0.1950	0.706522	1.670264
30	(GeogBks, ChildBks)	(CookBks)	0.1950	0.4310	0.1495	0.766667	1.778809
28	(ArtBks, CookBks)	(ChildBks)	0.1670	0.4230	0.1265	0.757485	1.790749
27	(ChildBks, ArtBks)	(CookBks)	0.1625	0.4310	0.1265	0.778462	1.806179
16	(YouthBks, ChildBks)	(CookBks)	0.1650	0.4310	0.1290	0.781818	1.813965
13	(ArtBks)	(DoltYBks)	0.2410	0.2820	0.1235	0.512448	1.817195
31	(GeogBks, CookBks)	(ChildBks)	0.1925	0.4230	0.1495	0.776623	1.835989
22	(CookBks, DoltYBks)	(ChildBks)	0.1875	0.4230	0.1460	0.778667	1.840820
21	(ChildBks, DoltYBks)	(CookBks)	0.1840	0.4310	0.1460	0.793478	1.841017
35	(GeogBks, DoltYBks)	(ChildBks)	0.1325	0.4230	0.1045	0.788679	1.864490
14	(RefBks)	(GeogBks)	0.2145	0.2760	0.1105	0.515152	1.866107

```
rule_2.sort_values('confidence',ascending=True,)
```