

```
In [1]: import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
%matplotlib inline

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

```
In [2]: df = pd.read_excel('Online Retail.xlsx')
```

```
In [3]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 541909 entries, 0 to 541908
Data columns (total 8 columns):
#   Column          Non-Null Count  Dtype  
---  -
0   InvoiceNo        541909 non-null object  
1   StockCode       541909 non-null object  
2   Description     540455 non-null object  
3   Quantity        541909 non-null int64   
4   InvoiceDate     541909 non-null datetime64[ns]
5   UnitPrice       541909 non-null float64  
6   CustomerID     406829 non-null float64  
7   Country         541909 non-null object  
dtypes: datetime64[ns](1), float64(2), int64(1), object(4)
memory usage: 33.1+ MB
```

```
In [4]: df.head(10)
```

Out[4]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Cou
0	536365	85123A	WHITE HANGING HEART T- LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17850.0	Un Kingc
1	536365	71053	WHITE METAL LANTERN	6	2010-12-01 08:26:00	3.39	17850.0	Un Kingc
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00	2.75	17850.0	Un Kingc
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	2010-12-01 08:26:00	3.39	17850.0	Un Kingc
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	2010-12-01 08:26:00	3.39	17850.0	Un Kingc
5	536365	22752	SET 7 BABUSHKA NESTING BOXES	2	2010-12-01 08:26:00	7.65	17850.0	Un Kingc
6	536365	21730	GLASS STAR FROSTED T- LIGHT HOLDER	6	2010-12-01 08:26:00	4.25	17850.0	Un Kingc
7	536366	22633	HAND WARMER UNION JACK	6	2010-12-01 08:28:00	1.85	17850.0	Un Kingc
8	536366	22632	HAND WARMER RED POLKA DOT	6	2010-12-01 08:28:00	1.85	17850.0	Un Kingc
9	536367	84879	ASSORTED COLOUR BIRD ORNAMENT	32	2010-12-01 08:34:00	1.69	13047.0	Un Kingc

In [5]: `df['Description']=df['Description'].str.strip()`

```
df.dropna(axis=0, subset=['InvoiceNo'], inplace=True)  
df['InvoiceNo'] = df['InvoiceNo'].astype('str')
```

```
In [6]: df.head(10)
```

Out[6]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Cou
0	536365	85123A	WHITE HANGING HEART T- LIGHT HOLDER	6	2010-12-01 08:26:00	2.55	17850.0	Un Kingc
1	536365	71053	WHITE METAL LANTERN	6	2010-12-01 08:26:00	3.39	17850.0	Un Kingc
2	536365	84406B	CREAM CUPID HEARTS COAT HANGER	8	2010-12-01 08:26:00	2.75	17850.0	Un Kingc
3	536365	84029G	KNITTED UNION FLAG HOT WATER BOTTLE	6	2010-12-01 08:26:00	3.39	17850.0	Un Kingc
4	536365	84029E	RED WOOLLY HOTTIE WHITE HEART.	6	2010-12-01 08:26:00	3.39	17850.0	Un Kingc
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7	536366	22633	HAND WARMER UNION JACK	6	2010-12-01 08:28:00	1.85	17850.0	Un Kingc
8	536366	22632	HAND WARMER RED POLKA DOT	6	2010-12-01 08:28:00	1.85	17850.0	Un Kingc
9	536367	84879	ASSORTED COLOUR BIRD ORNAMENT	32	2010-12-01 08:34:00	1.69	13047.0	Un Kingc

In [7]: `df[df.InvoiceNo.str.contains('C', na=False)].head()`

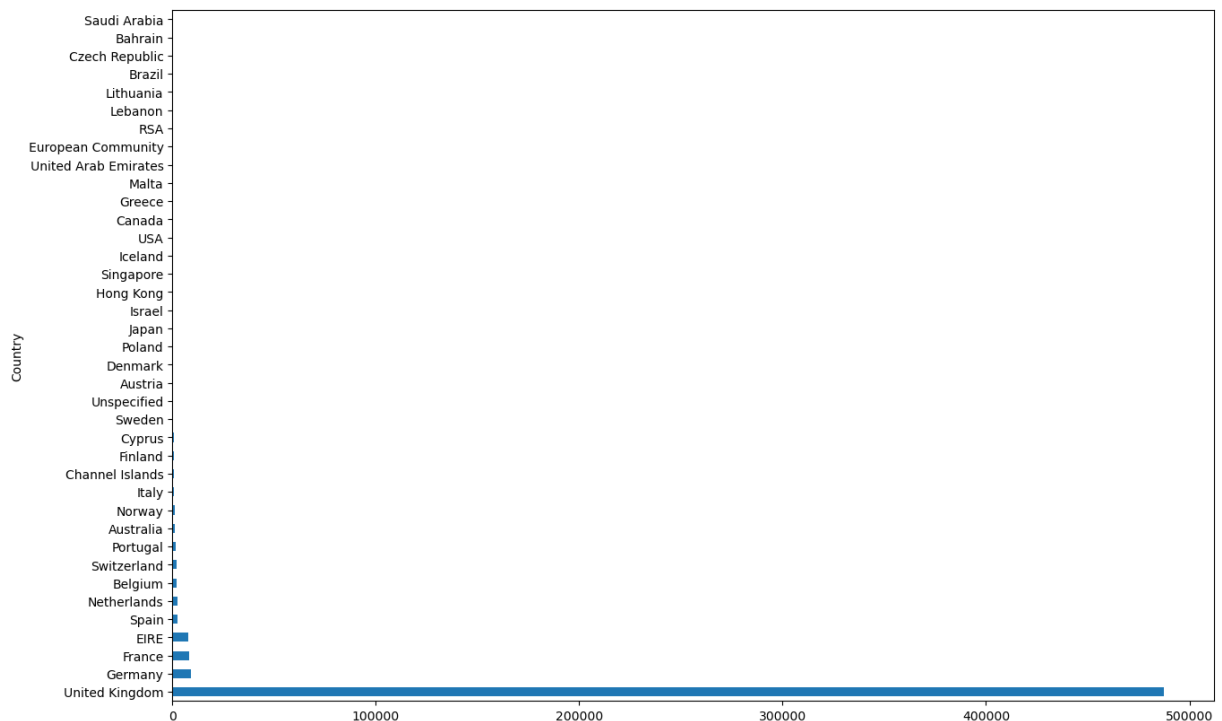
Out[7]:

	InvoiceNo	StockCode	Description	Quantity	InvoiceDate	UnitPrice	CustomerID	Cc
141	C536379	D	Discount	-1	2010-12-01 09:41:00	27.50	14527.0	Kir
154	C536383	35004C	SET OF 3 COLOURED FLYING DUCKS	-1	2010-12-01 09:49:00	4.65	15311.0	Kir
235	C536391	22556	PLASTERS IN TIN CIRCUS PARADE	-12	2010-12-01 10:24:00	1.65	17548.0	Kir
236	C536391	21984	PACK OF 12 PINK PAISLEY TISSUES	-24	2010-12-01 10:24:00	0.29	17548.0	Kir
237	C536391	21983	PACK OF 12 BLUE PAISLEY TISSUES	-24	2010-12-01 10:24:00	0.29	17548.0	Kir

In [8]: `df=df[~df['InvoiceNo'].str.contains('C')]`

In [9]: `df['Country'].value_counts().plot(kind='barh', figsize=(15,10))`

Out[9]: <Axes: ylabel='Country'>



In [10]: `basket = df[df['Country']=="United Kingdom"].groupby(['InvoiceNo', 'Description'])['`

```
In [11]: basket = basket.sum().unstack().reset_index().fillna(0).set_index('InvoiceNo')
```

```
In [12]: basket.head(10)
```

Out[12]:

Description	*Boombox Ipod Classic	*USB Office Mirror Ball	10 COLOUR SPACEBOY PEN	12 COLOURED PARTY BALLOONS	12 DAISY PEGS IN WOOD BOX	12 EGG HOUSE PAINTED WOOD	12 HANGING EGGS HAND PAINTED	12 RO! SET
InvoiceNo								
536365	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536366	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536367	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536368	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536369	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536371	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536372	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536373	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536374	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
536375	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

10 rows × 4175 columns

```
In [13]: def encode_data(datapoint):
          if datapoint <= 0:
              return 0
          if datapoint >= 1:
              return 1
```

```
In [14]: basket = basket.applymap(encode_data)
```

C:\Users\GIA KIET\AppData\Local\Temp\ipykernel_16960\1901855995.py:1: FutureWarning:
DataFrame.applymap has been deprecated. Use DataFrame.map instead.
basket = basket.applymap(encode_data)

```
In [15]: basket.drop('POSTAGE', inplace=True, axis=1)
```

```
In [31]: itemsets = apriori(basket.astype('bool'), min_support=0.03, use_colnames=True)
```

```
In [32]: itemsets.head(10)
```

```
Out[32]:
```

	support	itemsets
0	0.045803	(6 RIBBONS RUSTIC CHARM)
1	0.031124	(60 CAKE CASES VINTAGE CHRISTMAS)
2	0.040339	(60 TEATIME FAIRY CAKE CASES)
3	0.046928	(ALARM CLOCK BAKELIKE GREEN)
4	0.035142	(ALARM CLOCK BAKELIKE PINK)
5	0.049821	(ALARM CLOCK BAKELIKE RED)
6	0.036214	(ANTIQUA SILVER T-LIGHT GLASS)
7	0.073445	(ASSORTED COLOUR BIRD ORNAMENT)
8	0.042267	(BAKING SET 9 PIECE RETROSPOT)
9	0.035089	(BATHROOM METAL SIGN)

```
In [33]: rules = association_rules(itemsets, metric="confidence", min_threshold=0.5)
```

```
In [34]: rules.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 10 columns):
#   Column                Non-Null Count  Dtype
---  -
0   antecedents            10 non-null    object
1   consequents            10 non-null    object
2   antecedent support     10 non-null    float64
3   consequent support     10 non-null    float64
4   support                10 non-null    float64
5   confidence              10 non-null    float64
6   lift                   10 non-null    float64
7   leverage               10 non-null    float64
8   conviction              10 non-null    float64
9   zhangs_metric          10 non-null    float64
dtypes: float64(8), object(2)
memory usage: 932.0+ bytes
```

```
In [35]: rules["antecedents"]=rules["antecedents"].apply(lambda x:list(x)[0]).astype("unicod
rules["consequents"]=rules["consequents"].apply(lambda x:list(x)[0]).astype("unicod
```

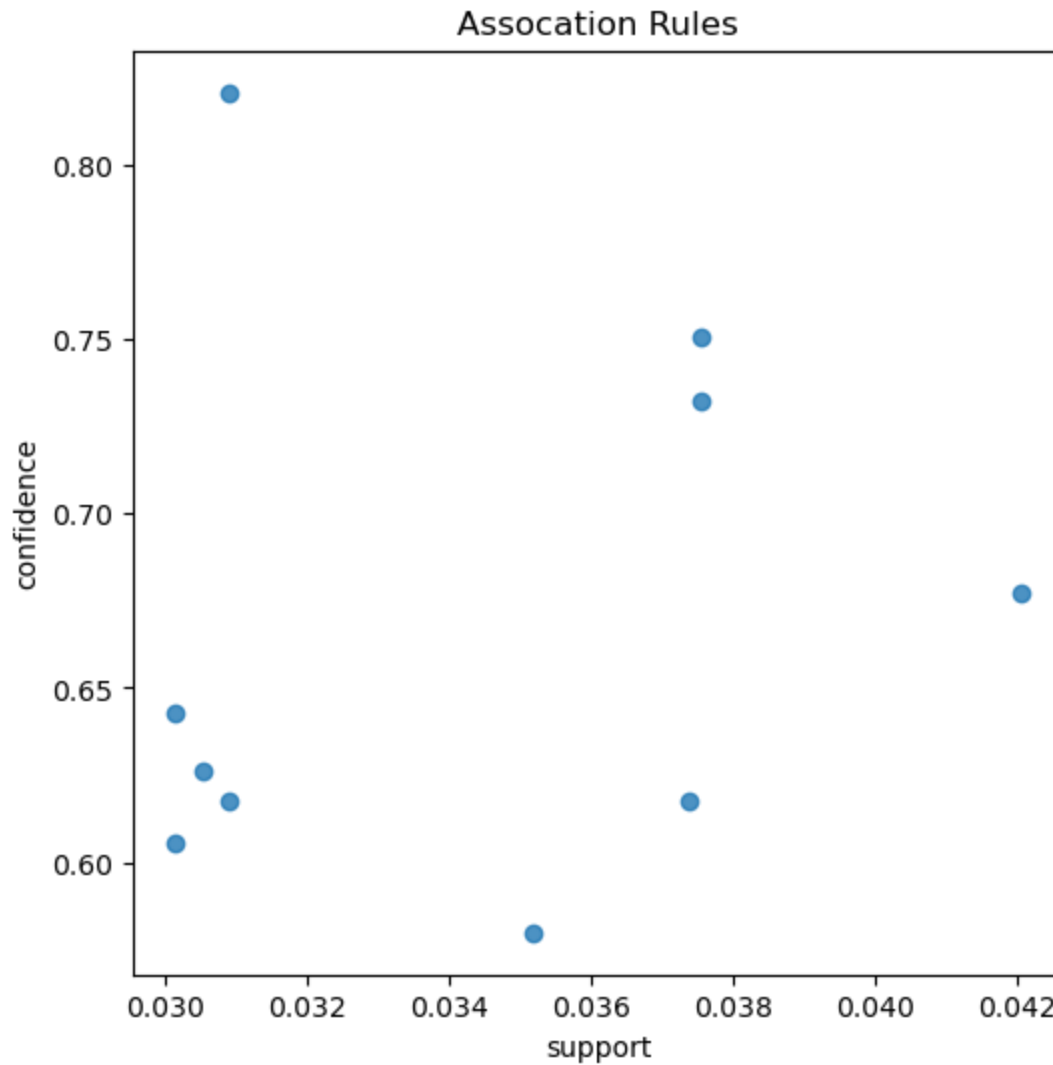
```
In [36]: for i in range(len(rules)):
          print(rules.loc[i, 'antecedents'], ' ==> ', rules.loc[i, 'consequents'],
                ' [', rules.loc[i, 'support'], ', ', rules.loc[i, 'confidence'], ' ]')
```

```
ALARM CLOCK BAKELIKE RED ==> ALARM CLOCK BAKELIKE GREEN [ 0.030160175711148016 ,  
0.6053763440860216 ]  
ALARM CLOCK BAKELIKE GREEN ==> ALARM CLOCK BAKELIKE RED [ 0.030160175711148016 ,  
0.6426940639269406 ]  
GREEN REGENCY TEACUP AND SAUCER ==> PINK REGENCY TEACUP AND SAUCER [ 0.0309101623  
18530027 , 0.6177730192719486 ]  
PINK REGENCY TEACUP AND SAUCER ==> GREEN REGENCY TEACUP AND SAUCER [ 0.0309101623  
18530027 , 0.8207681365576103 ]  
GREEN REGENCY TEACUP AND SAUCER ==> ROSES REGENCY TEACUP AND SAUCER [ 0.037552900  
84105641 , 0.7505353319057816 ]  
ROSES REGENCY TEACUP AND SAUCER ==> GREEN REGENCY TEACUP AND SAUCER [ 0.037552900  
84105641 , 0.7324973876698014 ]  
JUMBO BAG BAROQUE BLACK WHITE ==> JUMBO BAG RED RETROSPOT [ 0.03053516901483902  
, 0.6263736263736264 ]  
JUMBO BAG PINK POLKADOT ==> JUMBO BAG RED RETROSPOT [ 0.042052820485348474 , 0.6  
773080241587576 ]  
JUMBO SHOPPER VINTAGE RED PAISLEY ==> JUMBO BAG RED RETROSPOT [ 0.035195800074998  
66 , 0.5798764342453663 ]  
JUMBO STORAGE BAG SUKI ==> JUMBO BAG RED RETROSPOT [ 0.037392189425188835 , 0.61  
76991150442478 ]
```

```
In [37]: support = rules['support'].values  
confidence = rules['confidence'].values
```

```
In [38]: plt.figure(figsize=(6,6))  
plt.title('Association Rules')  
plt.xlabel('support')  
plt.ylabel('confidence')  
sns.regplot(x=support,y=confidence, fit_reg=False)
```

```
Out[38]: <Axes: title={'center': 'Association Rules'}, xlabel='support', ylabel='confidenc  
e'>
```

```
In [39]: from mlxtend.frequent_patterns import fpgrowth  
itemsets = fpgrowth(basket.astype('bool'), min_support=0.03, use_colnames=True)
```

```
In [40]: rules = association_rules(itemsets, metric="confidence", min_threshold=0.5)
```

```
In [41]: rules.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 10 entries, 0 to 9
Data columns (total 10 columns):
#   Column                Non-Null Count  Dtype
---  -
0   antecedents            10 non-null    object
1   consequents            10 non-null    object
2   antecedent support     10 non-null    float64
3   consequent support     10 non-null    float64
4   support                10 non-null    float64
5   confidence             10 non-null    float64
6   lift                   10 non-null    float64
7   leverage               10 non-null    float64
8   conviction              10 non-null    float64
9   zhangs_metric          10 non-null    float64
dtypes: float64(8), object(2)
memory usage: 932.0+ bytes
```

```
In [42]: rules["antecedents"]=rules["antecedents"].apply(lambda x:list(x)[0]).astype("unicod
rules["consequents"]=rules["consequents"].apply(lambda x:list(x)[0]).astype("unicod
```

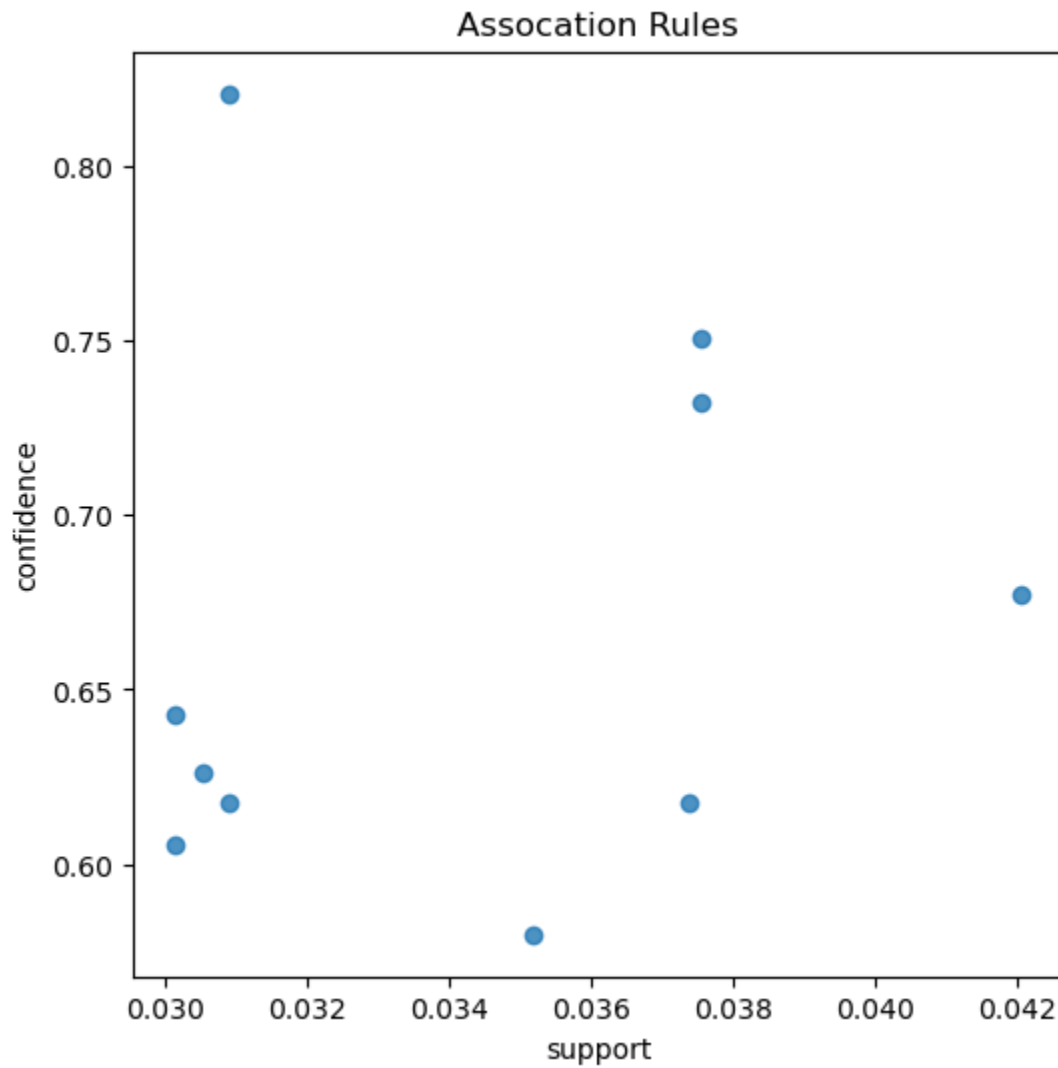
```
In [43]: for i in range(len(rules)):
          print(rules.loc[i, 'antecedents'], ' ==> ', rules.loc[i, 'consequents'],
                ' [', rules.loc[i, 'support'], ', ', rules.loc[i, 'confidence'], ']' )

JUMBO BAG PINK POLKADOT ==> JUMBO BAG RED RETROSPOT [ 0.042052820485348474 , 0.6
773080241587576 ]
JUMBO STORAGE BAG SUKI ==> JUMBO BAG RED RETROSPOT [ 0.037392189425188835 , 0.61
76991150442478 ]
JUMBO BAG BAROQUE BLACK WHITE ==> JUMBO BAG RED RETROSPOT [ 0.03053516901483902
, 0.6263736263736264 ]
JUMBO SHOPPER VINTAGE RED PAISLEY ==> JUMBO BAG RED RETROSPOT [ 0.035195800074998
66 , 0.5798764342453663 ]
ALARM CLOCK BAKELIKE RED ==> ALARM CLOCK BAKELIKE GREEN [ 0.030160175711148016 ,
0.6053763440860216 ]
ALARM CLOCK BAKELIKE GREEN ==> ALARM CLOCK BAKELIKE RED [ 0.030160175711148016 ,
0.6426940639269406 ]
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84105641 , 0.7505353319057816 ]
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84105641 , 0.7324973876698014 ]
GREEN REGENCY TEACUP AND SAUCER ==> PINK REGENCY TEACUP AND SAUCER [ 0.0309101623
18530027 , 0.6177730192719486 ]
PINK REGENCY TEACUP AND SAUCER ==> GREEN REGENCY TEACUP AND SAUCER [ 0.0309101623
18530027 , 0.8207681365576103 ]
```

```
In [44]: support = rules['support'].values
          confidence = rules['confidence'].values
```

```
In [45]: plt.figure(figsize=(6,6))
          plt.title('Association Rules')
          plt.xlabel('support')
          plt.ylabel('confidence')
          sns.regplot(x=support,y=confidence, fit_reg=False)
```

```
Out[45]: <Axes: title={'center': 'Association Rules'}, xlabel='support', ylabel='confidence'>
```



```
In [46]: #Kết Luận: Hai thuật toán cho ra kết quả giống nhau.
```