TBC E-commerce Dataset of Period: June-2016 to Jan-2021

Methods used are: EDA - Exploratory Data Analysis Time Series Analysis using Pandas Market Basket Analysis using Apriori Algorithm

Loading Necessary Libraries

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

Importing the Datasets

In [2]:
```
df =pd.read_csv('Ecommerce Dataset.csv')
df_new=pd.read_csv('TBC_Ecommerce.csv')
```

In [3]:
```
df_new.head()
```

Out[3]:

	SKU	Product	Order number	Date placed	Quantity	Unit price	Total price	Order status	Categories	Customer email	Customer phone
0	2030301005022	The Wolf of Wall Street	20018	16/06/2016 20:43	1	350.0	332.5	Delivered	Books > Novels: Books > Biographies	oscar.nganga@gmail.com	2.547213e+11
1	2030301003312	Decision Points	20018	16/06/2016 20:43	1	1390.0	1320.5	Delivered	Books > Biographies	oscar.nganga@gmail.com	2.547213e+11
2	2030301004296	Ghana must go	20018	16/06/2016 20:43	1	950.0	902.5	Delivered	Books > Novels	oscar.nganga@gmail.com	2.547213e+11
3	2030301001226	Why He's So Last Minute And She's Got It All W...	20027	17/06/2016 01:38	1	350.0	350.0	Cancelled	Books > Motivation & Self Help	aligulaaa@gmail.com	2.547057e+11
4	2030301002838	What the Dog Saw (Penguin)	20027	17/06/2016 01:38	1	1200.0	1200.0	Cancelled	Books > Novels > Fiction: Books > Motivation &...	aligulaaa@gmail.com	2.547057e+11

In [4]:
```
df =df.rename(columns={'Order number': 'Order_number'}, inplace = False)
```

i) Exploration of Data

Shape of the Dataset by Row xColumns

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

Out[5]: (116171, 3)

In [6]:
```
df_new.shape
```

Out[6]: (116171, 12)

Value Count on Popularity on the Entire Dataset

Popular Categories by Value

In [7]:
```
df_new['Categories'].value_counts()
```

Out[7]:
```
Books > Children's Books
                                          7345
Stationery > School Stationery
                                          5255
Stationery > Pens, Pencils & Pouches
                                          5117
Art Supplies > Paints & Mediums
                                          4866
Books > Novels > Fiction
                                          4385

                                          ...
Books > Novels: Books > Biographies: Books > Sports & Hobbies
                                             1
Digital Books > Afrikaans
                                             1
Text Books > Higher Education > Current Affairs & Politics: Text Books > Higher Education > Social Sc
ience                                        1
Books > Novels > Romance: Books > Novels > Fiction: Books > Africana
                                             1
Text Books > Primary School > Standard 7: Text Books > Primary School > Standard 8: Text Books > Prim
ary School > KCPE Revision                   1
Name: Categories, Length: 475, dtype: int64
```

Popular Customer by Orders

In [8]:
```
df_new['Customer name'].value_counts()
```

Out[8]:
```
Victoria Kritzell           1180
Julie Wilson                 845
HASSAN SUMBA                 586
Mr Wilson - Head Teacher     531
Anita                        523
                            ...
CHRISTINA BULIBA               1
NOEL OJAKOL                    1
Olivia Pendergast              1
Antony Mumia                   1
Timothy Kabui                  1
Name: Customer name, Length: 19605, dtype: int64
```

#Recognizing these customers may enhance more loyalty.

In [9]:
```
#Extract Popular Customers by Orders as a list into Excel for Comparison.

popular_items = df_new['Customer name'].value_counts()
popular_items.to_csv(r'popular_customer.csv', index=True, header=True)
```

Popular Products by Customer Orders

In [10]:
```
df_new['Product'].value_counts()
```

Out[10]:
```
Photocopy Paper A4 AONE                          614
A Promised Land (Barack Obama)                   338
Hp ink Cartridge 123 Black                       322
Born a crime                                     312
Pelikan Eraser BR40                              296
                                                ...
Panya na Chura                                     1
KS3 Chemistry Study & Question Book - Higher       1
Improve your English Std 7 Workbook                1
Julius Caesar (EAEP)                               1
Champ Ball pen Red 25s                             1
Name: Product, Length: 16523, dtype: int64
```

Recognizing these products may enhance inventory management and knowing products to consider for offers by Marketing

In [11]:
```
#Extract Popular Products as a list into Excel for Comparison.

popular_items = df_new['Product'].value_counts()
popular_items.to_csv(r'popular_items.csv', index=True, header=True)
```

In [12]:
```
df_new.columns
```

Out[12]:
```
Index(['SKU', 'Product', 'Order number', 'Date placed', 'Quantity',
       'Unit price', 'Total price', 'Order status', 'Categories',
       'Customer email', 'Customer phone', 'Customer name'],
      dtype='object')
```

Plotting the Order Status by Value

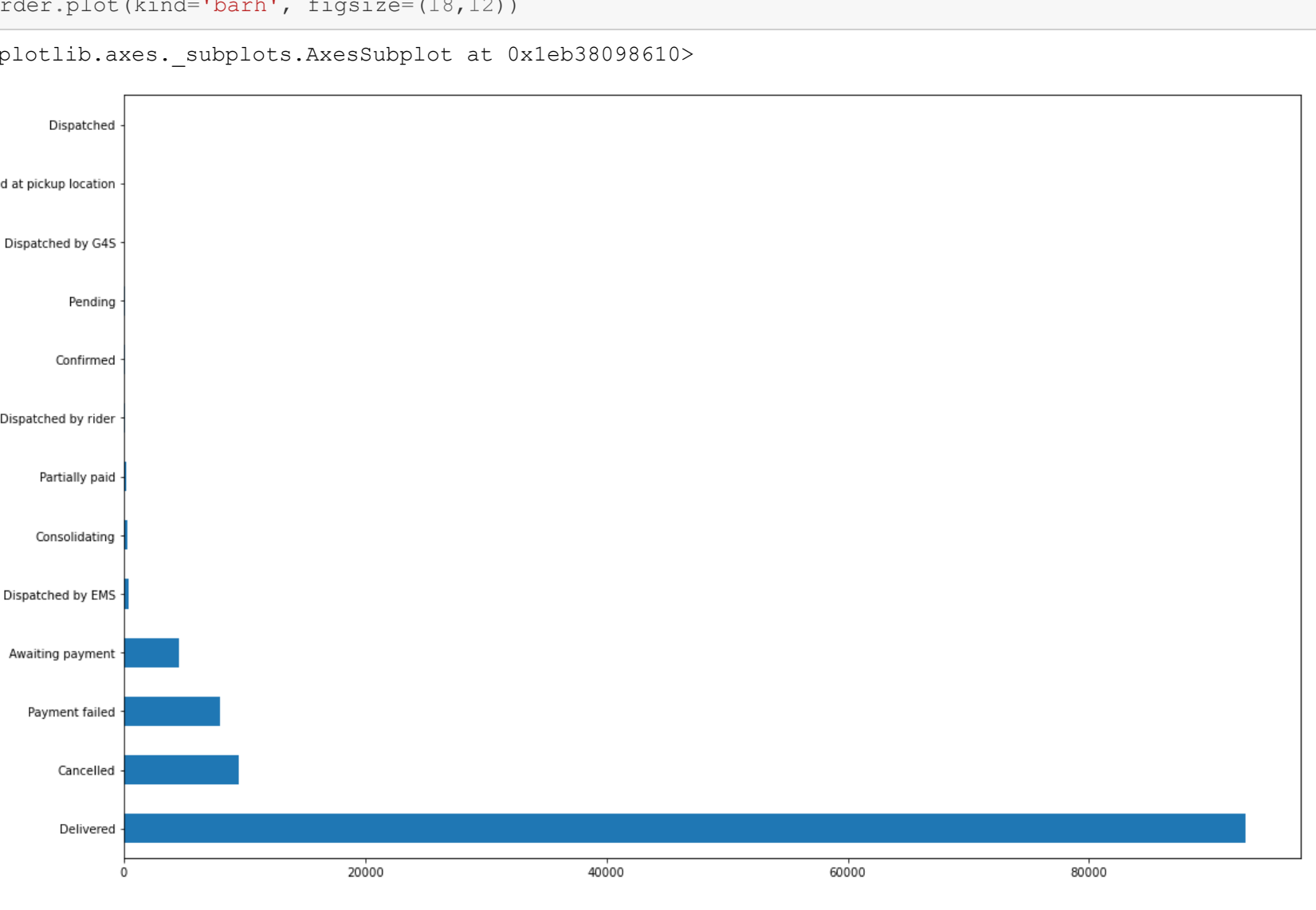
In [13]:
```
df_new['Order status'].value_counts()
```

Out[13]:
```
Delivered                        92935
Cancelled                         9505
Payment failed                    8012
Awaiting payment                  4571
Dispatched by EMS                  375
Consolidating                      265
Partially paid                     182
Dispatched by rider                121
Confirmed                           56
Pending                             54
Dispatched by G4S                   40
Delivered at pickup location        33
Dispatched                          22
Name: Order status, dtype: int64
```

Visualizing the Order Status using Bar-Graph

In [14]:
```
df_order = df_new['Order status'].value_counts()
df_order.plot(kind='barh', figsize=(18,12))
```

Out[14]: <matplotlib.axes._subplots.AxesSubplot at 0x1eb38098610>



In [15]:
```
df1 =df.groupby(['Order_number','SKU'])[['SKU']].count().T
df1
```

Out[15]:

Order_number	20018			20019			20027	
SKU	2030301003312	2030301004296	2030301005022	2010141001975	2030301001213	2030301001588	2030301001226	2030301002
SKU	1	1	1	1	1	1	1	

1 rows × 116171 columns

In [16]:
```
#Grouping of Order Number by SKU
```

In [17]:
```
df1 =df.groupby(['Order_number','SKU']).count()[['Date placed']]
df1
```

Out[17]:

Order_number	SKU	Date placed
20018	2030301003312	1
	2030301004296	1
	2030301005022	1
20019	2010141001975	1
	2030301001213	1
...	...	...
378022	2010101001101	1
	2010101001782	1
	2010117000646	1
378026	9781118805800	1
378034	2070701000090	1

116171 rows × 1 columns

In [18]:
```
df2 =df.groupby(['Order_number','SKU']).count()
df2
```

Out[18]:

Order_number	SKU	Date placed
20018	2030301003312	1
	2030301004296	1
	2030301005022	1
20019	2010141001975	1
	2030301001213	1
...	...	...
378022	2010101001101	1
	2010101001782	1
	2010117000646	1
378026	9781118805800	1
378034	2070701000090	1

116171 rows × 1 columns

In [19]:
```
#Time Series Analysis
```

In [20]:
```
df_new.head()
```

Out[20]:

	SKU	Product	Order number	Date placed	Quantity	Unit price	Total price	Order status	Categories	Customer email	Customer phone
0	2030301005022	The Wolf of Wall Street	20018	16/06/2016 20:43	1	350.0	332.5	Delivered	Books > Novels: Books > Biographies	oscar.nganga@gmail.com	2.547213e+11
1	2030301003312	Decision Points	20018	16/06/2016 20:43	1	1390.0	1320.5	Delivered	Books > Biographies	oscar.nganga@gmail.com	2.547213e+11
2	2030301004296	Ghana must go	20018	16/06/2016 20:43	1	950.0	902.5	Delivered	Books > Novels	oscar.nganga@gmail.com	2.547213e+11
3	2030301001226	Why He's So Last Minute And She's Got It All W...	20027	17/06/2016 01:38	1	350.0	350.0	Cancelled	Books > Motivation & Self Help	aligulaaa@gmail.com	2.547057e+11
4	2030301002838	What the Dog Saw (Penguin)	20027	17/06/2016 01:38	1	1200.0	1200.0	Cancelled	Books > Novels > Fiction: Books > Motivation &...	aligulaaa@gmail.com	2.547057e+11

In [21]:
```
EcommerceData = df_new
```

In [22]:
```
EcommerceData.head()
```

Out[22]:

	SKU	Product	Order number	Date placed	Quantity	Unit price	Total price	Order status	Categories	Customer email	Customer phone
0	2030301005022	The Wolf of Wall Street	20018	16/06/2016 20:43	1	350.0	332.5	Delivered	Books > Novels: Books > Biographies	oscar.nganga@gmail.com	2.547213e+11
1	2030301003312	Decision Points	20018	16/06/2016 20:43	1	1390.0	1320.5	Delivered	Books > Biographies	oscar.nganga@gmail.com	2.547213e+11
2	2030301004296	Ghana must go	20018	16/06/2016 20:43	1	950.0	902.5	Delivered	Books > Novels	oscar.nganga@gmail.com	2.547213e+11
3	2030301001226	Why He's So Last Minute And She's Got It All W...	20027	17/06/2016 01:38	1	350.0	350.0	Cancelled	Books > Motivation & Self Help	aligulaaa@gmail.com	2.547057e+11
4	2030301002838	What the Dog Saw (Penguin)	20027	17/06/2016 01:38	1	1200.0	1200.0	Cancelled	Books > Novels > Fiction: Books > Motivation &...	aligulaaa@gmail.com	2.547057e+11

In [23]:
```
#Renaming the Columns of the Dataset

EcommerceData.rename(columns={'SKU':'SKU', 'Product':'Product', 'Order number':'OrderNumber', 'Date pla
ced':'OrderDate',
                              'Quantity':'Quantity','Unit price':'UnitPrice', 'Total price':'TotalPric
e',
                              'Order status':'OrderStatus','Categories':'Categories','Customer email':
'CustomerEmail',
                              'Customer phone':'CustomerPhone','Customer name':'CustomerName'}, inplace
=True)
```

In [24]:
```
EcommerceData.head()
```

Out[24]:

	SKU	Product	OrderNumber	OrderDate	Quantity	UnitPrice	TotalPrice	OrderStatus	Categories	CustomerEmail
0	2030301005022	The Wolf of Wall Street	20018	16/06/2016 20:43	1	350.0	332.5	Delivered	Books > Novels: Books > Biographies	oscar.nganga@gmail.com
1	2030301003312	Decision Points	20018	16/06/2016 20:43	1	1390.0	1320.5	Delivered	Books > Biographies	oscar.nganga@gmail.com
2	2030301004296	Ghana must go	20018	16/06/2016 20:43	1	950.0	902.5	Delivered	Books > Novels	oscar.nganga@gmail.com
3	2030301001226	Why He's So Last Minute And She's Got It All W...	20027	17/06/2016 01:38	1	350.0	350.0	Cancelled	Books > Motivation & Self Help	aligulaaa@gmail.com
4	2030301002838	What the Dog Saw (Penguin)	20027	17/06/2016 01:38	1	1200.0	1200.0	Cancelled	Books > Novels > Fiction: Books > Motivation &...	aligulaaa@gmail.com

In [25]:
```
#Convert OrderDate to Datetime

EcommerceData['OrderDate'] = pd.to_datetime(EcommerceData['OrderDate'])
```

In [26]:
```
EcommerceData.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 116171 entries, 0 to 116170
Data columns (total 12 columns):
 #   Column         Non-Null Count   Dtype
---  ------         --------------   -----
 0   SKU            116171 non-null  object
 1   Product        115373 non-null  object
 2   OrderNumber    116171 non-null  int64
 3   OrderDate      116171 non-null  datetime64[ns]
 4   Quantity       116171 non-null  int64
 5   UnitPrice      116171 non-null  float64
 6   TotalPrice     116171 non-null  float64
 7   OrderStatus    116171 non-null  object
 8   Categories     115108 non-null  object
 9   CustomerEmail  116048 non-null  object
 10  CustomerPhone  114455 non-null  float64
 11  CustomerName   114786 non-null  object
dtypes: datetime64[ns](1), float64(3), int64(2), object(6)
memory usage: 10.6+ MB
```

In [27]:
```
EcommerceData = EcommerceData.set_index('OrderDate')
```

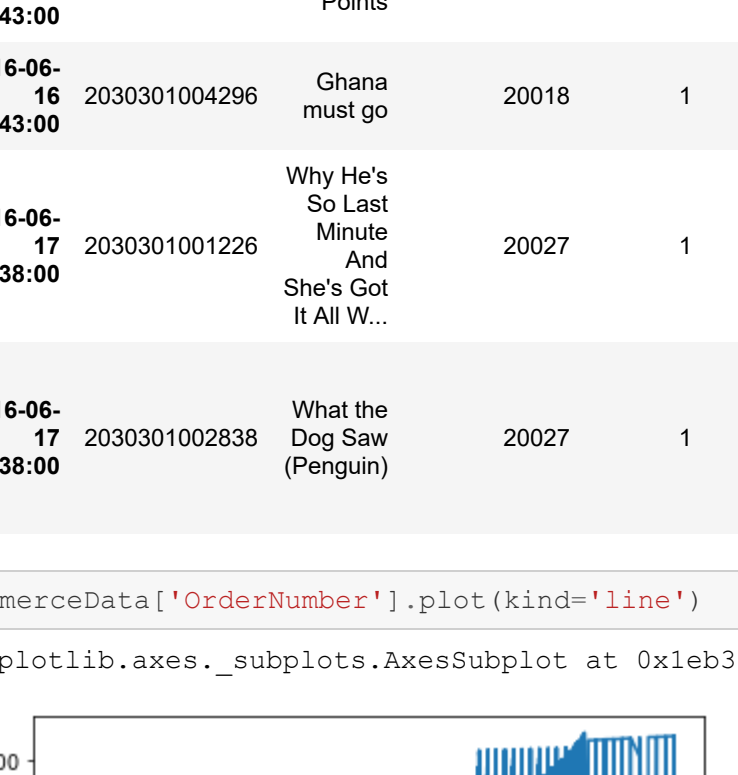
In [28]:
```
EcommerceData.head()
```

Out[28]:

OrderDate	SKU	Product	OrderNumber	Quantity	UnitPrice	TotalPrice	OrderStatus	Categories	CustomerEmail	Cus
2016-06-16 20:43:00	2030301005022	The Wolf of Wall Street	20018	1	350.0	332.5	Delivered	Books > Novels: Books > Biographies	oscar.nganga@gmail.com	2
2016-06-16 20:43:00	2030301003312	Decision Points	20018	1	1390.0	1320.5	Delivered	Books > Biographies	oscar.nganga@gmail.com	2
2016-06-16 20:43:00	2030301004296	Ghana must go	20018	1	950.0	902.5	Delivered	Books > Novels	oscar.nganga@gmail.com	2
2016-06-17 01:38:00	2030301001226	Why He's So Last Minute And She's Got It All W...	20027	1	350.0	350.0	Cancelled	Books > Motivation & Self Help	aligulaaa@gmail.com	2
2016-06-17 01:38:00	2030301002838	What the Dog Saw (Penguin)	20027	1	1200.0	1200.0	Cancelled	Books > Novels > Fiction: Books > Motivation &...	aligulaaa@gmail.com	2

In [29]:
```
EcommerceData['OrderNumber'].plot(kind='line')
```

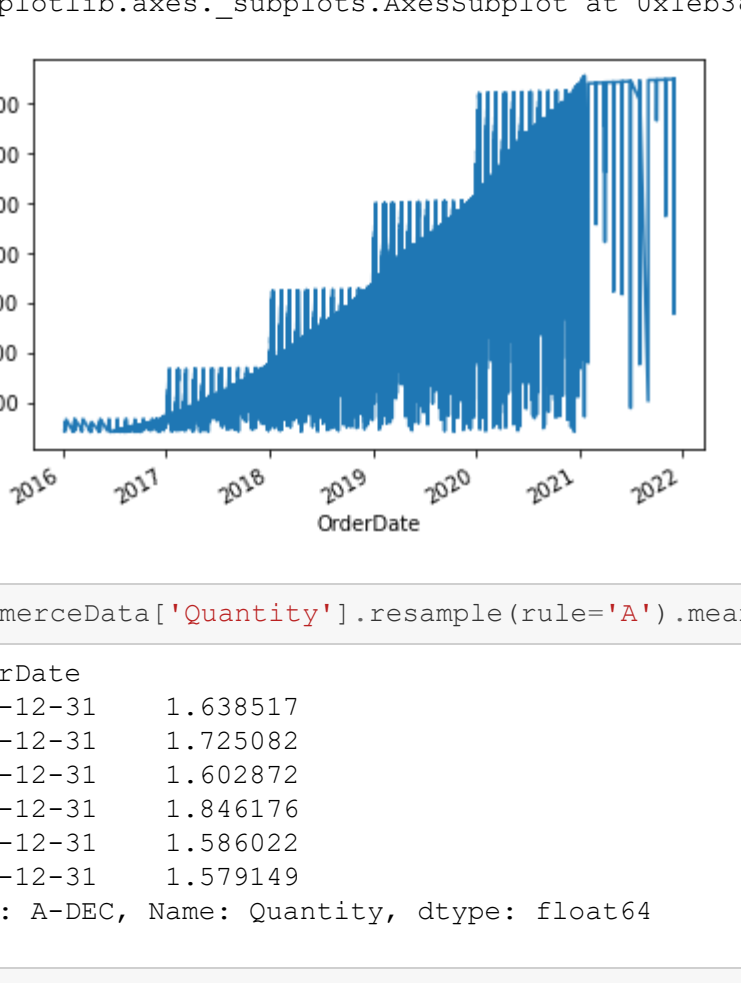
Out[29]: <matplotlib.axes._subplots.AxesSubplot at 0x1eb38029100>



In [30]:
```
EcommerceData['Quantity'].resample(rule='A').mean()
```

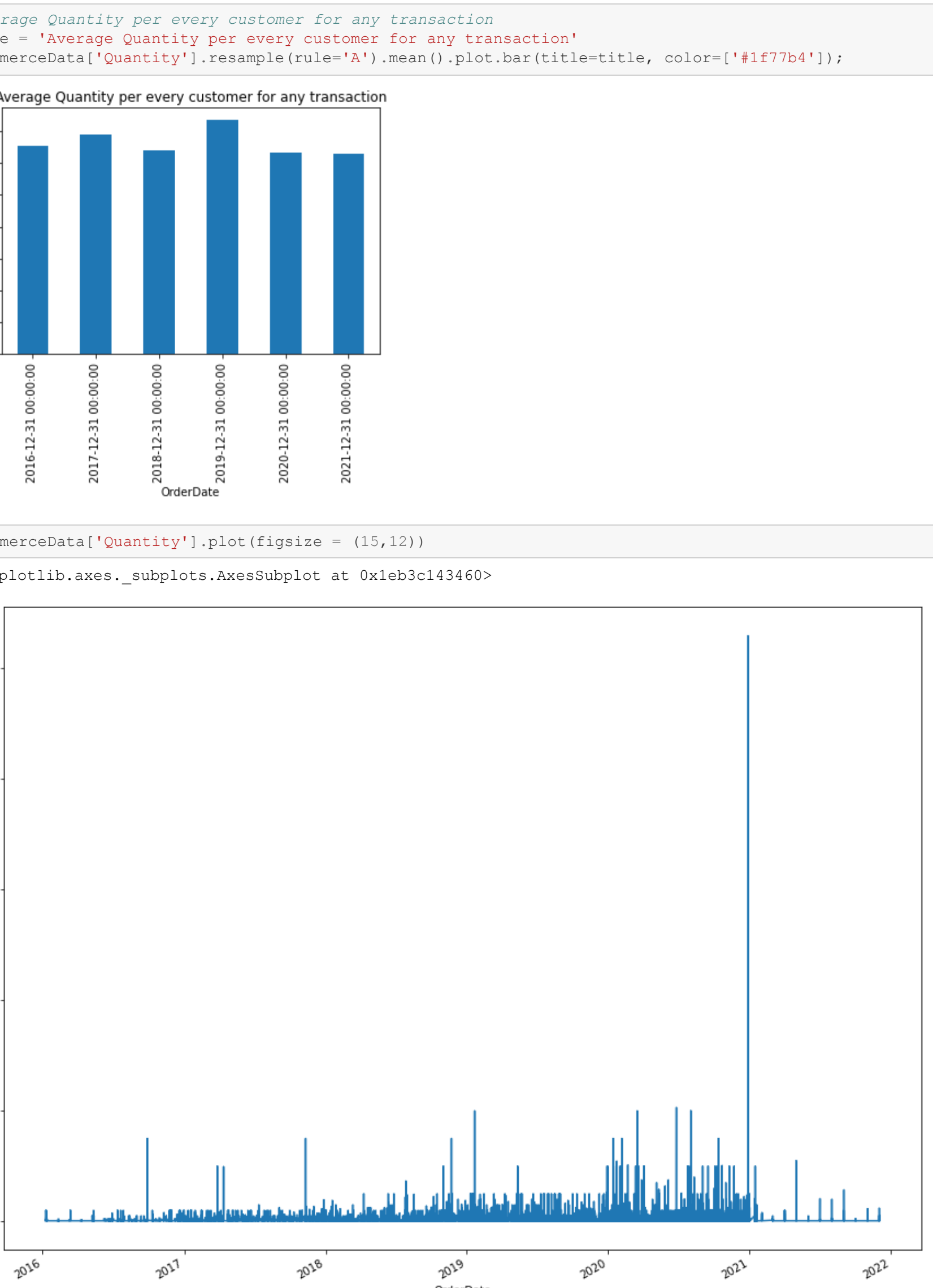
Out[30]:
```
OrderDate
2016-12-31    1.638517
2017-12-31    1.725082
2018-12-31    1.602872
2019-12-31    1.846176
2020-12-31    1.586022
2021-12-31    1.579149
Freq: A-DEC, Name: Quantity, dtype: float64
```

In [31]:
```
#Average Quantity per every customer for any transaction
title = 'Average Quantity per every customer for any transaction'
EcommerceData['Quantity'].resample(rule='A').mean().plot.bar(title=title, color=['#1f77b4']);
```



In [32]:
```
EcommerceData['Quantity'].plot(figsize = (15,12))
```

Out[32]: <matplotlib.axes._subplots.AxesSubplot at 0x1eb3c143460>



In [ ]:

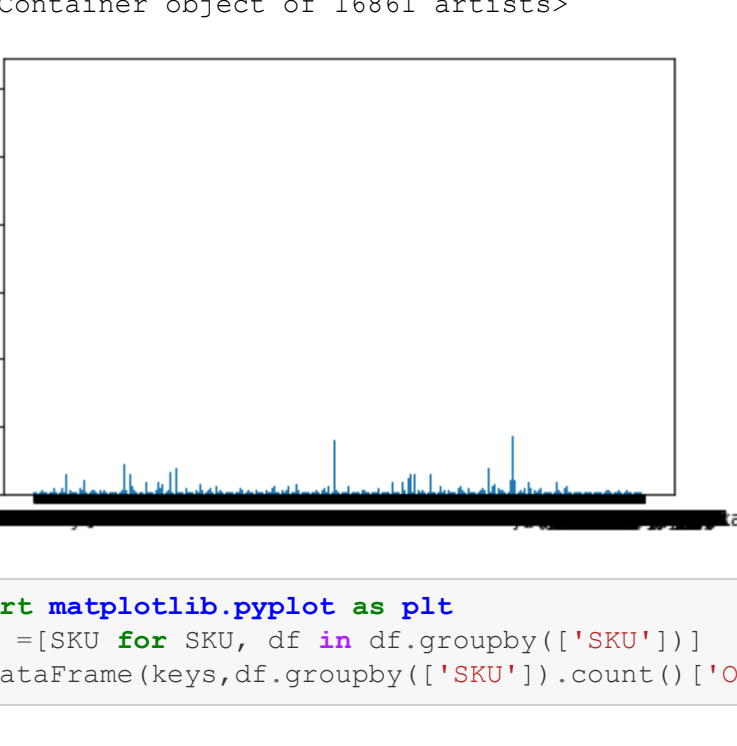
In [ ]:

In [ ]:

In [ ]:

In [33]:
```
import matplotlib.pyplot as plt
keys =[SKU for SKU, df in df.groupby(['SKU'])]
plt.bar(keys,df.groupby(['SKU']).count()['Order_number'])
```

Out[33]: <BarContainer object of 16861 artists>



In [34]:
```
import matplotlib.pyplot as plt
keys =[SKU for SKU, df in df.groupby(['SKU'])]
pd.DataFrame(keys,df.groupby(['SKU']).count()['Order_number']).T
```

Out[34]:

Order_number	1	1	2	1	2	6	1	7
0	0GEQNMB7UJQM1	0WPZX9VT5PQPN	1K9KCYM8LC6LM	1UXI2W02NG5ZY	2	2000000000	2010101000004	2010101000012

1 rows × 16861 columns

In [35]:
```
#SKU_group = pd.DataFrame(keys,df.groupby(['SKU']).count()['Order_number']).T
#SKU_group.count()['Order_number']
```

In [36]:
```
'''
load apriori and association package from mlxtend.
Used different dataset because mlxtend need data in below format.

             itemname  apple banana grapes
transaction  1            0     1      1
             2            1     0      1
             3            1     0      0
             4            0     1      0

 we could have used above data as well but need to perform operation to bring in this format instead /
 of that used seperate data only.
'''


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

df1 = pd.read_csv('TBC_Ecommerce.csv', encoding="ISO-8859-1")
df1.head()
```

Out[36]:

	SKU	Product	Order number	Date placed	Quantity	Unit price	Total price	Order status	Categories	Customer email	Customer phone
0	2030301005022	The Wolf of Wall Street	20018	16/06/2016 20:43	1	350.0	332.5	Delivered	Books > Novels: Books > Biographies	oscar.nganga@gmail.com	2.547213e+11
1	2030301003312	Decision Points	20018	16/06/2016 20:43	1	1390.0	1320.5	Delivered	Books > Biographies	oscar.nganga@gmail.com	2.547213e+11
2	2030301004296	Ghana must go	20018	16/06/2016 20:43	1	950.0	902.5	Delivered	Books > Novels	oscar.nganga@gmail.com	2.547213e+11
3	2030301001226	Why He's So Last Minute And She's Got It All W...	20027	17/06/2016 01:38	1	350.0	350.0	Cancelled	Books > Motivation & Self Help	aligulaaa@gmail.com	2.547057e+11
4	2030301002838	What the Dog Saw (Penguin)	20027	17/06/2016 01:38	1	1200.0	1200.0	Cancelled	Books > Novels > Fiction: Books > Motivation &...	aligulaaa@gmail.com	2.547057e+11

In [37]:
```
# data has many country choose any one for check..
df1.SKU.value_counts().head(15)
```

Out[37]:
```
2040417000356    614
BK00000000818    338
2060607000851    322
2030310000330    312
2040411000046    296
2030310000383    281
2040405000137    273
2040405000150    248
2040410000016    247
2060607000557    246
2040407000019    232
2010122000062    229
2030301007037    220
2030301006141    212
2040404000159    204
Name: SKU, dtype: int64
```

In [38]:
```
#convert data in format which it require converting using pivot table and Quantity sum as values. fill
 0 if any nan values

basket = pd.pivot_table(data=df1,index='Order number',columns='Product',values='Quantity', aggfunc='su
m',fill_value=0)
```

In [39]:
```
#Convert data in format which it require converting using pivot table and Quantity sum as values. fill
 0 if any nan values

basket = pd.pivot_table(data=df1,index='Order number',columns='Product',values='Quantity', aggfunc='su
m',fill_value=0)
```

In [40]:
```
basket.head()
```

Out[40]:

Product	"A" Finder Biology Practical Answer booklet	"A" Finder Biology Practical Manual	"A" Finder Chemistry Practical Answer booklet	"A" Finder Chemistry Practical Manual	"A" Finder Physics Practical Answer booklet	"A" Finder Physics Practical Manual	"Bantex Clipboard plastic 9859- 01 Blue"	"Bantex Clipboard plastic 9859- 09 Red"	"Bantex PVC folder 3420-04 Green"	"Koko riko nani ameniamsha?"	...	ladybird Tales : The Little Red Hen	little Oxfo Thes
Order number													
20018	0	0	0	0	0	0	0	0	0	0	...	0	
20019	0	0	0	0	0	0	0	0	0	0	...	0	
20027	0	0	0	0	0	0	0	0	0	0	...	0	
20029	0	0	0	0	0	0	0	0	0	0	...	0	
20030	0	0	0	0	0	0	0	0	0	0	...	0	

5 rows × 16523 columns

In [41]:
```
#this to check correctness after binning it to 1 at below code..
basket['What the Dog Saw (Penguin)'].head()
```

Out[41]:
```
Order number
20018    0
20019    0
20027    1
20029    0
20030    0
Name: What the Dog Saw (Penguin), dtype: int64
```

In [42]:
```
# we dont need quantity sum we need either has taken or not so if user has taken that item mark as 1 el
se he has not taken 0.

def convert_into_binary(x):
    if x > 0:
        return 1
    else:
        return 0
```

In [43]:
```
basket_sets = basket.applymap(convert_into_binary)
```

In [44]:
```
# above steps we can same item has quantity now converted to 1 or 0.
basket_sets['The Wolf of Wall Street'].head()
```

Out[44]:
```
Order number
20018    1
20019    0
20027    0
20029    0
20030    0
Name: The Wolf of Wall Street, dtype: int64
```

In [46]:
```
#Call apriori function and pass minimum support here we are passing 7%. means 7 times in total number o
f \`
 #transaction that item was present.
frequent_itemsets = apriori(basket_sets, min_support=0.003, use_colnames=True)
```

In [47]:
```
#it will generate frequent itemsets using two step approch
frequent_itemsets
```

Out[47]:

	support	itemsets
0	0.003223	(5Am Club (The))
1	0.004398	(A Doll's House)
2	0.010181	(A Promised Land (Barack Obama))
3	0.003223	(Americanah)
4	0.008464	(Becoming By Michelle Obama (Hard Cover))
...	...	...
82	0.003313	(When Breath Becomes Air (Small))
83	0.003103	(Why Nations fail:The Origins of Power, Prospe...
84	0.004910	(Hp Ink Cartridge 650 Black, Hp Ink Cartridge 65...
85	0.004127	(Hp Ink Cartridge 652 Black, Hp Ink Cartridge 65...
86	0.004880	(Hp ink Cartridge 123 Colour, Hp ink Cartridge...

87 rows × 2 columns

In [48]:
```
frequent_itemsets.to_csv(r'frequent_tbc_items.csv', index=False, header=True)
```

In [49]:
```
frequent_itemsets.count()
```

Out[49]:
```
support     87
itemsets    87
dtype: int64
```

In [50]:
```
# we have association rules which need to put on frequent itemset. here we are setting based on lift an
d has minimum lift as 1
rules_mlxtend = association_rules(frequent_itemsets, metric="lift", min_threshold=1)
rules_mlxtend.head()
```

Out[50]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	leverage	conviction
0	(Hp Ink Cartridge 650 Black)	(Hp Ink Cartridge 650 Colour)	0.007410	0.005663	0.004910	0.662602	117.005579	0.004868	2.947071
1	(Hp Ink Cartridge 650 Colour)	(Hp Ink Cartridge 650 Black)	0.005663	0.007410	0.004910	0.867021	117.005579	0.004868	7.464276
2	(Hp Ink Cartridge 652 Black)	(Hp Ink Cartridge 652 Colour)	0.005633	0.004850	0.004127	0.732620	151.065400	0.004099	3.721862
3	(Hp Ink Cartridge 652 Colour)	(Hp Ink Cartridge 652 Black)	0.004850	0.005633	0.004127	0.850932	151.065400	0.004099	6.670546
4	(Hp ink Cartridge 123 Colour)	(Hp ink Cartridge 123 Black)	0.005814	0.009699	0.004880	0.839378	86.539375	0.004823	6.165420

In [51]:
```
ruless=rules_mlxtend.head()
```

In [52]:
```
ruless
```

Out[52]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	leverage	conviction
0	(Hp Ink Cartridge 650 Black)	(Hp Ink Cartridge 650 Colour)	0.007410	0.005663	0.004910	0.662602	117.005579	0.004868	2.947071
1	(Hp Ink Cartridge 650 Colour)	(Hp Ink Cartridge 650 Black)	0.005663	0.007410	0.004910	0.867021	117.005579	0.004868	7.464276
2	(Hp Ink Cartridge 652 Black)	(Hp Ink Cartridge 652 Colour)	0.005633	0.004850	0.004127	0.732620	151.065400	0.004099	3.721862
3	(Hp Ink Cartridge 652 Colour)	(Hp Ink Cartridge 652 Black)	0.004850	0.005633	0.004127	0.850932	151.065400	0.004099	6.670546
4	(Hp ink Cartridge 123 Colour)	(Hp ink Cartridge 123 Black)	0.005814	0.009699	0.004880	0.839378	86.539375	0.004823	6.165420

In [53]:
```
ruless.to_csv(r'ruless_tbc_items.csv', index=False, header=True)
```

In [54]:
```
# rules_mlxtend.rename(columns={'antecedents':'lhs','consequents':'rhs'})

# as based business use case we can sort based on confidance and lift.
rules_mlxtend[ (rules_mlxtend['lift'] >= 4) & (rules_mlxtend['confidence'] >= 0.8) ]
```

Out[54]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	leverage	conviction
1	(Hp Ink Cartridge 650 Colour)	(Hp Ink Cartridge 650 Black)	0.005663	0.007410	0.004910	0.867021	117.005579	0.004868	7.464276
3	(Hp Ink Cartridge 652 Colour)	(Hp Ink Cartridge 652 Black)	0.004850	0.005633	0.004127	0.850932	151.065400	0.004099	6.670546
4	(Hp ink Cartridge 123 Colour)	(Hp ink Cartridge 123 Black)	0.005814	0.009699	0.004880	0.839378	86.539375	0.004823	6.165420

In [55]:
```
rules_mlxtend.shape
```

Out[55]: (6, 9)

In [56]:
```
rules_mlxtend.to_csv(r'rmxtend_tbc_items.csv', index=False, header=True)
```

Directed graph below is built for this rule and shown below. it will have always incoming and outcoming edges. Incoming edge(s) will represent antecedants and the stub (arrow) will be next to node.

#plotting output in a graph plot. import networkx as nx import matplotlib.pyplot as plt def draw_graph(rules, rules_to_show): G1 = nx.DiGraph() color_map=[] N = 50 colors = np.random.rand(N) strs=['R0', 'R1', 'R2', 'R3', 'R4', 'R5', 'R6', 'R7', 'R8', 'R9', 'R10', 'R11'] for i in range(rules_to_show): G1.add_nodes_from(["R"+str(i)]) for a in rules.iloc[i]['antecedents']: G1.add_nodes_from([a]) G1.add_edge(a, "R"+str(i), color=colors[i] , weight = 2) for c in rules.iloc[i]['consequents']: G1.add_nodes_from([c]) G1.add_edge("R"+str(i), c, color=colors[i], weight=2) for node in G1: found_a_string = False for item in strs: if node==item: found_a_string = True if found_a_string: color_map.append('yellow') else: color_map.append('green') edges = G1.edges() colors = [G1[u][v]['color'] for u,v in edges] weights = [G1[u][v]['weight'] for u,v in edges] pos = nx.spring_layout(G1, k=16, scale=1) nx.draw(G1, pos, edges=edges, node_color = color_map, edge_color=colors, width=weights, font_size=16, with_labels=False) for p in pos: # raise text positions pos[p][1] += 0.07 nx.draw_networkx_labels(G1, pos) plt.show() draw_graph (rules_mlxtend, 10)

In [58]:

```
# rules_mlxtend.rename(columns={'antecedents':'lhs','consequents':'rhs'})

# as based business use case we can sort based on confidance and lift.
rules_mlxtend[ (rules_mlxtend['lift'] >= 4) & (rules_mlxtend['confidence'] >= 0.5) ]
```

Out[58]:

	antecedents	consequents	antecedent support	consequent support	support	confidence	lift	leverage	conviction
0	(Hp Ink Cartidge 650 Black)	(Hp Ink Cartidge 650 Colour)	0.007410	0.005663	0.004910	0.662602	117.005579	0.004868	2.947071
1	(Hp Ink Cartidge 650 Colour)	(Hp Ink Cartidge 650 Black)	0.005663	0.007410	0.004910	0.867021	117.005579	0.004868	7.464276
2	(Hp Ink Cartidge 652 Black)	(Hp Ink Cartidge 652 Colour)	0.005633	0.004850	0.004127	0.732620	151.065400	0.004099	3.721862
3	(Hp Ink Cartidge 652 Colour)	(Hp Ink Cartidge 652 Black)	0.004850	0.005633	0.004127	0.850932	151.065400	0.004099	6.670546
4	(Hp ink Cartridge 123 Colour)	(Hp ink Cartridge 123 Black)	0.005814	0.009699	0.004880	0.839378	86.539375	0.004823	6.165420
5	(Hp ink Cartridge 123 Black)	(Hp ink Cartridge 123 Colour)	0.009699	0.005814	0.004880	0.503106	86.539375	0.004823	2.000800

In [59]:

```
rules_mlxtend.shape
```

Out[59]: (6, 9)

In [ ]: