

Apriori algorithm is used for market basket analysis. Apriori is a classical algorithm of association rule mining and widely used for generating frequent item sets.

```
In [1]: import sklearn
import pandas as pd
import numpy as np
#ML extensions
from mlxtend.preprocessing import TransactionEncoder #to transform/transactionalize data
from mlxtend.frequent_patterns import apriori #algorithm
from mlxtend.frequent_patterns import association_rules
```

```
In [2]: df = pd.read_csv('teleco_market_basket.csv')
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 15002 entries, 0 to 15001
Data columns (total 20 columns):
 #   Column   Non-Null Count  Dtype  
 ---  -- 
 0   Item01    7501 non-null   object  
 1   Item02    5747 non-null   object  
 2   Item03    4389 non-null   object  
 3   Item04    3345 non-null   object  
 4   Item05    2529 non-null   object  
 5   Item06    1864 non-null   object  
 6   Item07    1369 non-null   object  
 7   Item08    981 non-null    object  
 8   Item09    654 non-null    object  
 9   Item10    395 non-null    object  
 10  Item11    256 non-null    object  
 11  Item12    154 non-null    object  
 12  Item13    87 non-null    object  
 13  Item14    47 non-null    object  
 14  Item15    25 non-null    object  
 15  Item16    8 non-null     object  
 16  Item17    4 non-null     object  
 17  Item18    4 non-null     object  
 18  Item19    3 non-null     object  
 19  Item20    1 non-null     object  
dtypes: object(20)
memory usage: 2.3+ MB
```

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

Out[3]:

| | Item01 | Item02 | Item03 | Item04 | Item05 | Item06 | Item07 | Item08 | Item09 | Item10 | It |
|---|---------------------------------------------------|----------------------------------------------|-----------------|-------------------------------------|------------------------------------|--------------------|---------------------------------------|-------------------------------------------------|-------------------------------------------|-----------------------------------------------------|------------------|
| 0 | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | |
| 1 | Logitech M510 Wireless mouse | HP 63 Ink | HP 65 ink | nonda USB C to USB Adapter | 10ft iPhone Charger Cable | HP 902XL ink | Creative Pebble 2.0 Speakers | Cleaning Gel Universal Dust Cleaner | Micro Center 32GB Memory card | YUNSONG 3pack 6ft Nylon Lightning Cable | TopI La Co |
| 2 | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | |
| 3 | Apple Lightning to Digital AV Adapter | TP-Link AC1750 Smart WiFi Router | Apple Pencil | NaN | NaN | NaN | NaN | NaN | NaN | NaN | |
| 4 | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | NaN | |

In [4]: `df.shape`

Out[4]: `(15002, 20)`

In [5]: `df.dropna(
 axis=0,
 how='all', # Drop rows with all empty cells
 thresh=None,
 subset=None,
 inplace=True
)`

In [6]: `df.shape`

Out[6]: `(7501, 20)`

In [7]: `df.info()`

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 7501 entries, 1 to 15001
Data columns (total 20 columns):
 #   Column  Non-Null Count  Dtype  
---  -- 
 0   Item01   7501 non-null   object 
 1   Item02   5747 non-null   object 
 2   Item03   4389 non-null   object 
 3   Item04   3345 non-null   object 
 4   Item05   2529 non-null   object 
 5   Item06   1864 non-null   object 
 6   Item07   1369 non-null   object 
 7   Item08   981 non-null    object 
 8   Item09   654 non-null    object 
 9   Item10   395 non-null    object 
 10  Item11   256 non-null    object 
 11  Item12   154 non-null    object 
 12  Item13   87 non-null    object 
 13  Item14   47 non-null    object 
 14  Item15   25 non-null    object 
 15  Item16   8 non-null    object 
 16  Item17   4 non-null    object 
 17  Item18   4 non-null    object 
 18  Item19   3 non-null    object 
 19  Item20   1 non-null    object 
dtypes: object(20)
memory usage: 1.2+ MB
```

```
In [8]: pd.DataFrame(df).to_csv("market_analysis_clean.csv")
```

```
In [9]: #create list of lists to prepare for encoding
trans = []
for i in range (0, 7501):
    trans.append([str(df.values[i,j]) for j in range (0,20)])
```

```
In [10]: #Transactionalize dataset to prepare data for Apriori function
TE = TransactionEncoder()
array = TE.fit(trans).transform(trans)
```

```
In [11]: #Convert dataset back to dataframe ###each item is converted to a column
clean_df = pd.DataFrame(array, columns = TE.columns_)
clean_df
```

Out[11]:

| | 10ft iPhone Charger Cable | 10ft iPhone Charger Cable 2 Pack | 3 pack Nylon Braided Lightning Cable | 3A USB Type C Cable 3 pack 6FT | 5pack Nylon Braided USB C cables | ARRIS SURFboard SB8200 Cable Modem | Anker 2-in-1 USB Card Reader | Anker 4-port USB hub | Anker USB C to HDMI Adapter | Apple Lightning to Digital AV Adapter |
|------|---------------------------|----------------------------------|--------------------------------------|--------------------------------|----------------------------------|------------------------------------|------------------------------|----------------------|-----------------------------|---------------------------------------|
| 0 | True | False | False | True | False | False | False | False | False | False |
| 1 | False | False | False | False | False | False | False | False | False | True |
| 2 | False | False | False | False | False | False | False | False | False | False |
| 3 | False | False | False | False | False | False | False | False | False | False |
| 4 | False | False | False | False | False | False | False | False | False | False |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 7496 | False | False | False | False | False | False | False | False | False | False |
| 7497 | False | False | False | False | False | True | False | False | False | True |
| 7498 | False | False | False | False | False | False | False | False | False | False |
| 7499 | False | False | False | False | False | False | False | False | False | False |
| 7500 | False | False | False | False | False | False | False | False | False | False |

7501 rows × 120 columns

In [12]: `for col in clean_df.columns:
 print(col)`

10ft iPHONE Charger Cable
10ft iPHONE Charger Cable 2 Pack
3 pack Nylon Braided Lightning Cable
3A USB Type C Cable 3 pack 6FT
5pack Nylon Braided USB C cables
ARRIS SURFboard SB8200 Cable Modem
Anker 2-in-1 USB Card Reader
Anker 4-port USB hub
Anker USB C to HDMI Adapter
Apple Lightning to Digital AV Adapter
Apple Lightning to USB cable
Apple Magic Mouse 2
Apple Pencil
Apple Pencil 2nd Gen
Apple Power Adapter Extension Cable
Apple USB-C Charger cable
AutoFocus 1080p Webcam
BENGOO G90000 headset
Blue Light Blocking Glasses
Blue Light Blocking Glasses 2pack
Brother Genuine High Yield Toner Cartridge
Cat 6 Ethernet Cable 50ft
Cat8 Ethernet Cable
CicTsing MM057 2.4G Wireless Mouse
Cleaning Gel Universal Dust Cleaner
Creative Pebble 2.0 Speakers
DisplayPort ot HDMI adapter
Dust-Off Compressed Gas
Dust-Off Compressed Gas 2 pack
FEEL2NICE 5 pack 10ft Lighning cable
FEIYOLD Blue light Blocking Glasses
Falcon Dust Off Compressed Gas
HOVAMP Mfi 6pack Lightning Cable
HOVAMP iPhone charger
HP 61 2 pack ink
HP 61 Tri-color ink
HP 61 ink
HP 62XL Tri-Color ink
HP 62XL ink
HP 63 Ink
HP 63 Tri-color ink
HP 63XL Ink
HP 63XL Tri-color ink
HP 64 Tri-Color ink
HP 64 ink
HP 65 ink
HP 902XL ink
HP 952 ink
HP ENVY 5055 printer
HP952XL ink
HooToo USB C Hub
HyperX Cloud Stinger Headset
Jelly Comb 2.4G Slim Wireless mouse
Leader Desk Pad Protector
Logitech M510 Wireless mouse
Logitech MK270 Wireless Keyboard/Mouse
Logitech MK345 Wireless combo
Logitech USB H390 headset
M.2 Screw kit
Mfi-Certified Lightning to USB A Cable

Micro Center 32GB Memory card
Microsot Surface Dock 2
Moread HDMI to VGA Adapter
Mpow HC6 USB Headset
NETGEAR CM500 Cable Modem
NETGEAR Nighthawk WiFi Router
NETGEAR Orbi Home Mesh WiFi System
Nylon Braided Lightning to USB cable
PS4 Headset
Premium Nylon USB Cable
RUNMUS Gaming Headset
SAMSUNG 128GB card
SAMSUNG 256 GB card
SAMSUNG EVO 32GB card
SAMSUNG EVO 64GB card
Sabrent 4-port USB 3.0 hub
SanDisk 128GB Ultra microSDXC card
SanDisk 128GB card
SanDisk 128GB microSDXC card
SanDisk 32GB Ultra SDHC card
SanDisk 32GB card
SanDisk Extreme 128GB card
SanDisk Extreme 256GB card
SanDisk Extreme 32GB 2pack card
SanDisk Extreme Pro 128GB card
SanDisk Extreme Pro 64GB card
SanDisk Ultra 128GB card
SanDisk Ultra 256GB card
SanDisk Ultra 400GB card
SanDisk Ultra 64GB card
Screen Mom Screen Cleaner kit
Stylus Pen for iPad
Syntech USB C to USB Adapter
TONOR USB Gaming Microphone
TP-Link AC1750 Smart WiFi Router
TP-Link AC4000 WiFi router
TopMate C5 Laptop Cooler pad
UNEN Mfi Certified 5-pack Lightning Cable
USB 2.0 Printer cable
USB C to USB Male Adapter
USB Type C Cable
USB Type C to USB-A Charger cable
VIVO Dual LCD Monitor Desk mount
VicTsing Mouse Pad
VicTsing Wireless mouse
Vsco 70 pack stickers
Webcam with Microphone
XPOWER A-2 Air Pump blower
YUNSONG 3pack 6ft Nylon Lightning Cable
hP 65 Tri-color ink
iFixit Pro Tech Toolkit
iPhone 11 case
iPhone 12 Charger cable
iPhone 12 Pro case
iPhone 12 case
iPhone Charger Cable Anker 6ft
iPhone SE case
nan
nonda USB C to USB Adapter
seenda Wireless mouse

```
In [13]: #search for blank columns and drop
df_clean = clean_df.drop(['nan'], axis = 1)
```

```
In [14]: for col in df_clean.columns:
    print(col)
```

10ft iPHONE Charger Cable
10ft iPHONE Charger Cable 2 Pack
3 pack Nylon Braided Lightning Cable
3A USB Type C Cable 3 pack 6FT
5pack Nylon Braided USB C cables
ARRIS SURFboard SB8200 Cable Modem
Anker 2-in-1 USB Card Reader
Anker 4-port USB hub
Anker USB C to HDMI Adapter
Apple Lightning to Digital AV Adapter
Apple Lightning to USB cable
Apple Magic Mouse 2
Apple Pencil
Apple Pencil 2nd Gen
Apple Power Adapter Extension Cable
Apple USB-C Charger cable
AutoFocus 1080p Webcam
BENGOO G90000 headset
Blue Light Blocking Glasses
Blue Light Blocking Glasses 2pack
Brother Genuine High Yield Toner Cartridge
Cat 6 Ethernet Cable 50ft
Cat8 Ethernet Cable
CicTsing MM057 2.4G Wireless Mouse
Cleaning Gel Universal Dust Cleaner
Creative Pebble 2.0 Speakers
DisplayPort ot HDMI adapter
Dust-Off Compressed Gas
Dust-Off Compressed Gas 2 pack
FEEL2NICE 5 pack 10ft Lighning cable
FEIYOLD Blue light Blocking Glasses
Falcon Dust Off Compressed Gas
HOVAMP Mfi 6pack Lightning Cable
HOVAMP iPhone charger
HP 61 2 pack ink
HP 61 Tri-color ink
HP 61 ink
HP 62XL Tri-Color ink
HP 62XL ink
HP 63 Ink
HP 63 Tri-color ink
HP 63XL Ink
HP 63XL Tri-color ink
HP 64 Tri-Color ink
HP 64 ink
HP 65 ink
HP 902XL ink
HP 952 ink
HP ENVY 5055 printer
HP952XL ink
HooToo USB C Hub
HyperX Cloud Stinger Headset
Jelly Comb 2.4G Slim Wireless mouse
Leader Desk Pad Protector
Logitech M510 Wireless mouse
Logitech MK270 Wireless Keyboard/Mouse
Logitech MK345 Wireless combo
Logitech USB H390 headset
M.2 Screw kit
Mfi-Certified Lightning to USB A Cable

Micro Center 32GB Memory card
Microsot Surface Dock 2
Moread HDMI to VGA Adapter
Mpow HC6 USB Headset
NETGEAR CM500 Cable Modem
NETGEAR Nighthawk WiFi Router
NETGEAR Orbi Home Mesh WiFi System
Nylon Braided Lightning to USB cable
PS4 Headset
Premium Nylon USB Cable
RUNMUS Gaming Headset
SAMSUNG 128GB card
SAMSUNG 256 GB card
SAMSUNG EVO 32GB card
SAMSUNG EVO 64GB card
Sabrent 4-port USB 3.0 hub
SanDisk 128GB Ultra microSDXC card
SanDisk 128GB card
SanDisk 128GB microSDXC card
SanDisk 32GB Ultra SDHC card
SanDisk 32GB card
SanDisk Extreme 128GB card
SanDisk Extreme 256GB card
SanDisk Extreme 32GB 2pack card
SanDisk Extreme Pro 128GB card
SanDisk Extreme Pro 64GB card
SanDisk Ultra 128GB card
SanDisk Ultra 256GB card
SanDisk Ultra 400GB card
SanDisk Ultra 64GB card
Screen Mom Screen Cleaner kit
Stylus Pen for iPad
Syntech USB C to USB Adapter
TONOR USB Gaming Microphone
TP-Link AC1750 Smart WiFi Router
TP-Link AC4000 WiFi router
TopMate C5 Laptop Cooler pad
UNEN Mfi Certified 5-pack Lightning Cable
USB 2.0 Printer cable
USB C to USB Male Adapter
USB Type C Cable
USB Type C to USB-A Charger cable
VIVO Dual LCD Monitor Desk mount
VicTsing Mouse Pad
VicTsing Wireless mouse
Vsco 70 pack stickers
Webcam with Microphone
XPOWER A-2 Air Pump blower
YUNSONG 3pack 6ft Nylon Lightning Cable
hP 65 Tri-color ink
iFixit Pro Tech Toolkit
iPhone 11 case
iPhone 12 Charger cable
iPhone 12 Pro case
iPhone 12 case
iPhone Charger Cable Anker 6ft
iPhone SE case
nonda USB C to USB Adapter
seenda Wireless mouse

```
In [15]: df_clean.shape
```

```
Out[15]: (7501, 119)
```

```
In [23]: pd.DataFrame(clean_df).to_csv("market_basket_analysis_clean.csv")
```

```
In [17]: #Apriori function to mine rules  
a_rules = apriori(df_clean, min_support = .05, use_colnames = True)  
a_rules.head(3)
```

```
Out[17]:
```

| | support | itemsets |
|---|----------|-----------------------------------------|
| 0 | 0.050527 | (10ft iPhOne Charger Cable 2 Pack) |
| 1 | 0.068391 | (Anker USB C to HDMI Adapter) |
| 2 | 0.087188 | (Apple Lightning to Digital AV Adapter) |

```
In [18]: #Set metrics and mine rules  
assoc_r = association_rules(a_rules, metric = 'lift', min_threshold = 1)  
assoc_r.head(3)
```

```
Out[18]:
```

| | antecedents | consequents | antecedent support | consequent support | support | confidence | lift | leverage | conv |
|---|----------------------------------|----------------------------------|--------------------|--------------------|----------|------------|----------|----------|------|
| 0 | (Apple Pencil) | (Dust-Off Compressed Gas 2 pack) | 0.179709 | 0.238368 | 0.050927 | 0.283383 | 1.188845 | 0.008090 | 1.0 |
| 1 | (Dust-Off Compressed Gas 2 pack) | (Apple Pencil) | 0.238368 | 0.179709 | 0.050927 | 0.213647 | 1.188845 | 0.008090 | 1.0 |
| 2 | (HP 61 ink) | (Dust-Off Compressed Gas 2 pack) | 0.163845 | 0.238368 | 0.052660 | 0.321400 | 1.348332 | 0.013604 | 1.1 |

```
In [19]: #Set metrics and mine rules  
assoc_r = association_rules(a_rules, metric = 'confidence', min_threshold = .2)  
assoc_r
```

Out[19]:

| | antecedents | consequents | antecedent support | consequent support | support | confidence | lift | leverage | conv |
|---|------------------------------------|------------------------------------|--------------------|--------------------|----------|------------|----------|----------|------|
| 0 | (Apple Pencil) | (Dust-Off Compressed Gas 2 pack) | 0.179709 | 0.238368 | 0.050927 | 0.283383 | 1.188845 | 0.008090 | 1.0 |
| 1 | (Dust-Off Compressed Gas 2 pack) | (Apple Pencil) | 0.238368 | 0.179709 | 0.050927 | 0.213647 | 1.188845 | 0.008090 | 1.0 |
| 2 | (HP 61 ink) | (Dust-Off Compressed Gas 2 pack) | 0.163845 | 0.238368 | 0.052660 | 0.321400 | 1.348332 | 0.013604 | 1.1 |
| 3 | (Dust-Off Compressed Gas 2 pack) | (HP 61 ink) | 0.238368 | 0.163845 | 0.052660 | 0.220917 | 1.348332 | 0.013604 | 1.0 |
| 4 | (VIVO Dual LCD Monitor Desk mount) | (Dust-Off Compressed Gas 2 pack) | 0.174110 | 0.238368 | 0.059725 | 0.343032 | 1.439085 | 0.018223 | 1.1 |
| 5 | (Dust-Off Compressed Gas 2 pack) | (VIVO Dual LCD Monitor Desk mount) | 0.238368 | 0.174110 | 0.059725 | 0.250559 | 1.439085 | 0.018223 | 1.1 |

In [25]: `sorted_rules = assoc_r.sort_values(by=['lift'], ascending=False)`In [27]: `top_k_rules = sorted_rules.head(3)`
`print(top_k_rules)`

| | antecedents | consequents | \ |
|---|------------------------------------|------------------------------------|----------|
| 4 | (VIVO Dual LCD Monitor Desk mount) | (Dust-Off Compressed Gas 2 pack) | |
| 5 | (Dust-Off Compressed Gas 2 pack) | (VIVO Dual LCD Monitor Desk mount) | |
| 2 | (HP 61 ink) | (Dust-Off Compressed Gas 2 pack) | |
| | antecedent support | consequent support | support |
| 4 | 0.174110 | 0.238368 | 0.059725 |
| 5 | 0.238368 | 0.174110 | 0.059725 |
| 2 | 0.163845 | 0.238368 | 0.052660 |
| | confidence | lift | \ |
| 4 | 0.343032 | 1.439085 | |
| 5 | 0.250559 | 1.439085 | |
| 2 | 0.321400 | 1.348332 | |
| | leverage | conviction | |
| 4 | 0.018223 | 1.159314 | |
| 5 | 0.018223 | 1.102008 | |
| 2 | 0.013604 | 1.122357 | |

In [20]: `df_clean['Apple Pencil'].sum()`

Out[20]: 1348

In [21]: `df_clean['Dust-Off Compressed Gas 2 pack'].sum()`

Out[21]: 1788

In [22]: `#Determine rules based on set conditions`
`assoc_r[(assoc_r['lift'] >= 1.40) &`

```
(assoc_r['confidence'] >= .10) ]
```

Out[22]:

| | antecedents | consequents | antecedent support | consequent support | support | confidence | lift | leverage | conv |
|---|------------------------------------|------------------------------------|--------------------|--------------------|----------|------------|----------|----------|------|
| 4 | (VIVO Dual LCD Monitor Desk mount) | (Dust-Off Compressed Gas 2 pack) | 0.174110 | 0.238368 | 0.059725 | 0.343032 | 1.439085 | 0.018223 | 1.1 |
| 5 | (Dust-Off Compressed Gas 2 pack) | (VIVO Dual LCD Monitor Desk mount) | 0.238368 | 0.174110 | 0.059725 | 0.250559 | 1.439085 | 0.018223 | 1.1 |

