

```
In [1]: from apyori import apriori
import numpy as np
import pandas as pd
import matplotlib.pyplot as pl
import time
```

## Combinations function

```
In [2]: def createCk(Lk, k):
    cand_list = []
    len_Lk = len(Lk)

    for i in range(len_Lk):
        for j in range(i + 1, len_Lk):
            L1 = list(Lk[i])[:k - 2]
            L2 = list(Lk[j])[:k - 2]
            L1.sort()
            L2.sort()
            if L1 == L2:
                cand_list.append(Lk[i] | Lk[j])
    return cand_list
```

```
In [3]: def Diff(li1, li2):
    li_dif = [i for i in li1 + li2 if i not in li1 or i not in li2]
    return li_dif
```

## Apyori algorithm

```
In [4]: def apriori(itemsets, percentChunk, min_support):
    C1 = []
    for basket in itemsets:
        for item in basket:
            if not [item] in C1:
                C1.append([item])
    C1 = [set(x) for x in C1]

    count = {}
    freq_itemSingle = []
    L1 = []

    for basket in itemsets:
        for item in C1:
            if item.issubset(basket):
                candidate = frozenset(item)
                if candidate not in count:
                    count[candidate] = 1
                else:
                    count[candidate] += 1

    for key in count:
        support = count[key] / len(itemsets)
        if support >= min_support:
            freq_itemSingle.insert(0, key)
            freq_itemSingle.insert(1, support)
            L1.insert(0, key)

    C2 = createCk(L1, 2)

    count = {}
    freq_itemDouble = []
    L2 = []

    for basket in itemsets:
        for item in C2:
            if item.issubset(basket):
                candidate = frozenset(item)
                if candidate not in count:
                    count[candidate] = 1
                else:
                    count[candidate] += 1

    for key in count:
        support = count[key] / len(itemsets)
        if support >= min_support:
            freq_itemDouble.insert(0, key)
            freq_itemDouble.insert(1, support)
            L2.insert(0, key)

    return L1, L2
```

## Retail DataSet

```
In [5]: retail = pd.read_csv("http://fimi.uantwerpen.be/data/retail.dat", delimiter=" ", c
itemsets = retail.values.tolist()
```

## Remove Nan values

```
In [6]: retail_NN = []
for x in itemsets:
    retail_NN.append([i for i in x if str(i) != 'nan'])
itemsets = retail_NN
```

## SON

```

In [7]: times = []
for x in [.1,.2,.5]:
    start = time.time()
    percentChunk = x
    min_support = 0.01

    # divide item set sample into 2 chunks for SON implementation
    itemsets = itemsets[:int(len(itemsets) * percentChunk)]
    middle = int(len(itemsets) / 2)
    itemsetOne = itemsets[:middle]
    itemsetTwo = itemsets[middle:]
    # change support value for both chunks appropriately
    newMinSupp = min_support / 2
    # get singles, pairs for each chunk
    singlesOne, doublesOne = apriori(itemsetOne, percentChunk, newMinSupp)
    singlesTwo, doublesTwo = apriori(itemsetTwo, percentChunk, newMinSupp)
    # get singles, pairs for whole item set
    singles, doubles = apriori(itemsets, percentChunk, min_support)
    # get the union of both chunks results
    UnionSingle = set(singlesOne + singlesTwo)
    UnionDouble = set(doublesOne + doublesTwo)

    print("Frequent Values with false positives: ", UnionSingle, "\n")
    print("Frequent Pairs with false positives: ", UnionDouble, "\n")
    # get the number of false positives
    numfalsePositivesSingle = len(Diff(list(UnionSingle), singles))
    numfalsePositivesDoubles = len(Diff(list(UnionDouble), doubles))

    falsePositivesSingle = Diff(list(UnionSingle), singles)
    falsePositivesDoubles = Diff(list(UnionDouble), doubles)

    print("Number of False Positives Single: ", numfalsePositivesSingle,
          "\nNumber of False Positives Doubles: ", numfalsePositivesDoubles)
    # output the results without false positives
    print("Frequent Values: ", Diff(list(UnionSingle), falsePositivesSingle), "\n")
    print("Frequent Pairs: ", Diff(list(UnionDouble), falsePositivesDoubles), "\n")
    end = time.time()
    times.append(end - start)

```

```

Frequent Values with false positives: {frozenset({1425.0}), frozenset({396.
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```

```

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```

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0}), frozenset({604.0, 60.0}), frozenset({589.0, 39.0}), frozenset({45.0, 39.
0}), frozenset({48.0, 734.0}), frozenset({979.0, 39.0}), frozenset({438.0, 38.
0}), frozenset({39.0, 3735.0}), frozenset({1004.0, 39.0}), frozenset({39.0, 85
5.0}), frozenset({1121.0, 39.0}), frozenset({48.0, 123.0}), frozenset({476.0, 3

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et({548.0}), frozenset({379.0}), frozenset({23.0}), frozenset({384.0}), froz
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({1034.0}), frozenset({381.0}), frozenset({3462.0}), frozenset({1659.0}), fr
ozenset({260.0}), frozenset({2199.0}), frozenset({60.0}), frozenset({824.
0}), frozenset({592.0}), frozenset({812.0}), frozenset({1598.0}), frozenset
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({156.0}), frozenset({348.0}), frozenset({170.0}), frozenset({76.0}), frozen
set({56.0}), frozenset({43.0}), frozenset({549.0}), frozenset({242.0}), froz
enset({1.0}), frozenset({251.0}), frozenset({1593.0}), frozenset({846.0}), f
rozenset({433.0}), frozenset({150.0}), frozenset({694.0}), frozenset({147.
0}), frozenset({3548.0}), frozenset({536.0}), frozenset({1291.0}), frozenset
({225.0}), frozenset({939.0}), frozenset({3195.0}), frozenset({866.0}), froz
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09.0}), frozenset({200.0}), frozenset({3412.0}), frozenset({2343.0}), frozen
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0}), frozenset({31.0}), frozenset({885.0}), frozenset({101.0}), frozenset({4
1.0}), frozenset({2383.0}), frozenset({2238.0}), frozenset({418.0}), frozens
et({48.0}), frozenset({3276.0}), frozenset({195.0}), frozenset({67.0}), froz
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0}), frozenset({107.0}), frozenset({3735.0}), frozenset({2350.0}), frozenset
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set({622.0}), frozenset({2786.0}), frozenset({2362.0}), frozenset({647.0}),
frozenset({3411.0}), frozenset({201.0}), frozenset({2250.0}), frozenset({15
2.0}), frozenset({511.0}), frozenset({282.0}), frozenset({371.0}), frozenset
({740.0}), frozenset({65.0}), frozenset({420.0}), frozenset({665.0}), frozen
set({793.0}), frozenset({1372.0}), frozenset({232.0}), frozenset({1144.0}),
frozenset({2117.0}), frozenset({272.0}), frozenset({550.0}), frozenset({327
9.0}), frozenset({4026.0}), frozenset({1174.0}), frozenset({1011.0}), frozen
set({237.0}), frozenset({78.0}), frozenset({36.0}), frozenset({117.0}), froz

```

```

frozenset({79.0}), frozenset({30.0}), frozenset({3840.0}), frozenset({341.0}), f
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0}), frozenset({1715.0}), frozenset({1393.0}), frozenset({940.0}), frozenset
({778.0}), frozenset({723.0}), frozenset({3074.0}), frozenset({370.0}), froz
enset({789.0}), frozenset({952.0}), frozenset({910.0}), frozenset({840.0}),
frozenset({2425.0}), frozenset({45.0}), frozenset({1198.0}), frozenset({279.
0}), frozenset({2284.0}), frozenset({178.0}), frozenset({522.0}), frozenset
({794.0}), frozenset({589.0}), frozenset({11.0}), frozenset({2987.0}), froze
nset({9.0}), frozenset({488.0}), frozenset({3664.0}), frozenset({103.0}), fr
ozenset({855.0}), frozenset({1121.0}), frozenset({2958.0}), frozenset({55.
0}), frozenset({606.0}), frozenset({1853.0}), frozenset({95.0}), frozenset
({916.0}), frozenset({535.0}), frozenset({349.0}), frozenset({878.0}), froze
nset({730.0}), frozenset({425.0}), frozenset({249.0}), frozenset({155.0}), f
rozenset({1796.0}), frozenset({1600.0}), frozenset({772.0}), frozenset({345.
0}), frozenset({1135.0}), frozenset({2187.0}), frozenset({616.0}), frozenset
({751.0})}

```

Frequent Pairs with false positives: {frozenset({371.0, 38.0})}, frozenset({334.0, 39.0}), frozenset({48.0, 19.0}), frozenset({740.0, 38.0}), frozenset({48.0, 237.0}), frozenset({664.0, 39.0}), frozenset({49.0, 39.0}), frozenset({41.0, 475.0}), frozenset({48.0, 740.0}), frozenset({237.0, 38.0}), frozenset({48.0, 150.0}), frozenset({1198.0, 39.0}), frozenset({39.0, 751.0}), frozenset({48.0, 2199.0}), frozenset({349.0, 39.0}), frozenset({1481.0, 39.0}), frozenset({89.0, 39.0}), frozenset({1681.0, 39.0}), frozenset({2238.0, 39.0}), frozenset({48.0, 47.0}), frozenset({352.0, 41.0}), frozenset({41.0, 1715.0}), frozenset({956.0, 39.0}), frozenset({278.0, 39.0}), frozenset({48.0, 105.0}), frozenset({150.0, 39.0}), frozenset({48.0, 570.0}), frozenset({338.0, 39.0}), frozenset({208.0, 39.0}), frozenset({438.0, 39.0}), frozenset({694.0, 39.0}), frozenset({48.0, 441.0}), frozenset({48.0, 101.0}), frozenset({824.0, 48.0}), frozenset({48.0, 41.0}), frozenset({48.0, 179.0}), frozenset({48.0, 39.0}), frozenset({41.0, 438.0}), frozenset({441.0, 39.0}), frozenset({48.0, 155.0}), frozenset({48.0, 249.0}), frozenset({48.0, 170.0}), frozenset({152.0, 48.0}), frozenset({976.0, 39.0}), frozenset({37.0, 38.0}), frozenset({48.0, 1578.0}), frozenset({242.0, 39.0}), frozenset({348.0, 39.0}), frozenset({3638.0, 39.0}), frozenset({1715.0, 39.0}), frozenset({48.0, 1859.0}), frozenset({272.0, 39.0}), frozenset({677.0, 39.0}), frozenset({32.0, 225.0}), frozenset({65.0, 38.0}), frozenset({48.0, 1715.0}), frozenset({885.0, 39.0}), frozenset({9.0, 39.0}), frozenset({856.0, 48.0}), frozenset({32.0, 170.0}), frozenset({152.0, 39.0}), frozenset({41.0, 270.0}), frozenset({185.0, 39.0}), frozenset({48.0, 334.0}), frozenset({48.0, 49.0}), frozenset({723.0, 39.0}), frozenset({48.0, 3270.0}), frozenset({812.0, 39.0}), frozenset({264.0, 39.0}), frozenset({32.0, 39.0}), frozenset({32.0, 475.0}), frozenset({48.0, 55.0}), frozenset({32.0, 65.0}), frozenset({48.0, 365.0}), frozenset({370.0, 38.0}), frozenset({48.0, 9.0}), frozenset({48.0, 310.0}), frozenset({408.0, 48.0}), frozenset({38.0, 110.0}), frozenset({352.0, 39.0}), frozenset({48.0, 110.0}), frozenset({976.0, 38.0}), frozenset({48.0, 3638.0}), frozenset({189.0, 39.0}), frozenset({301.0, 39.0}), frozenset({39.0, 271.0}), frozenset({48.0, 11.0}), frozenset({39.0, 535.0}), frozenset({32.0, 271.0}), frozenset({48.0, 681.0}), frozenset({1344.0, 41.0}), frozenset({681.0, 39.0}), frozenset({48.0, 476.0}), frozenset({195.0, 39.0}), frozenset({48.0, 117.0}), frozenset({105.0, 38.0}), frozenset({41.0, 79.0}), frozenset({41.0, 36.0}), frozenset({48.0, 1372.0}), frozenset({94.0, 39.0}), frozenset({41.0, 740.0}), frozenset({1704.0, 39.0}), frozenset({96.0, 39.0}), frozenset({41.0, 310.0}), frozenset({41.0, 286.0}), frozenset({2.0, 39.0}), frozenset({1146.0, 39.0}), frozenset({706.0, 39.0}), frozenset({1249.0, 39.0}), frozenset({225.0, 41.0}), frozenset({41.0, 147.0}), frozenset({952.0, 39.0}), frozenset({785.0, 39.0}), frozenset({286.0, 39.0}), frozenset({269.0, 39.0}), frozenset({

```

nset({365.0, 39.0}), frozenset({41.0, 604.0}), frozenset({1938.0, 39.0}), fr
ozenset({170.0, 39.0}), frozenset({101.0, 38.0}), frozenset({41.0, 38.0}), f
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0}), frozenset({39.0, 79.0}), frozenset({19.0, 39.0}), frozenset({201.0, 39.
0}), frozenset({664.0, 32.0}), frozenset({48.0, 402.0}), frozenset({48.0, 81
2.0}), frozenset({418.0, 39.0}), frozenset({41.0, 37.0}), frozenset({1344.0,
39.0}), frozenset({48.0, 438.0}), frozenset({41.0, 1327.0}), frozenset({259.
0, 39.0}), frozenset({749.0, 39.0}), frozenset({2805.0, 38.0}), frozenset({4
1.0, 170.0}), frozenset({549.0, 39.0}), frozenset({65.0, 39.0}), frozenset
({41.0, 1938.0}), frozenset({281.0, 38.0}), frozenset({533.0, 39.0}), frozen
set({856.0, 39.0}), frozenset({48.0, 89.0}), frozenset({48.0, 246.0}), froze
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ozenset({48.0, 2117.0}), frozenset({48.0, 1249.0}), frozenset({310.0, 39.
0}), frozenset({408.0, 39.0}), frozenset({976.0, 117.0}), frozenset({48.0, 2
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({48.0, 36.0}), frozenset({1425.0, 39.0}), frozenset({32.0, 36.0}), froze
t({402.0, 39.0}), frozenset({384.0, 39.0}), frozenset({475.0, 38.0}), frozen
set({570.0, 39.0}), frozenset({248.0, 48.0}), frozenset({32.0, 371.0}), froz
enset({340.0, 39.0}), frozenset({41.0, 271.0}), frozenset({1344.0, 38.0}), f
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frozenset({48.0, 286.0}), frozenset({3323.0, 39.0}), frozenset({352.0, 48.
0}), frozenset({48.0, 381.0}), frozenset({110.0, 39.0}), frozenset({48.0, 22
5.0}), frozenset({48.0, 95.0}), frozenset({48.0, 242.0}), frozenset({89.0, 3
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et({36.0, 38.0}), frozenset({1435.0, 39.0}), frozenset({270.0, 39.0}), froze
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0}), frozenset({39.0, 47.0}), frozenset({41.0, 255.0}), frozenset({48.0, 139
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enset({41.0, 101.0}), frozenset({39.0, 1327.0}), frozenset({475.0, 39.0}), f
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0}), frozenset({65.0, 41.0}), frozenset({38.0, 47.0}), frozenset({740.0, 39.
0}), frozenset({48.0, 156.0}), frozenset({48.0, 94.0}), frozenset({38.0, 39
0.0}), frozenset({76.0, 39.0}), frozenset({48.0, 418.0}), frozenset({264.0,
48.0}), frozenset({48.0, 32.0}), frozenset({3005.0, 38.0}), frozenset({1938.
0, 38.0}), frozenset({48.0, 1327.0}), frozenset({370.0, 39.0}), frozenset({4
8.0, 338.0}), frozenset({48.0, 79.0}), frozenset({101.0, 39.0}), frozenset
({41.0, 39.0}), frozenset({1233.0, 39.0}), frozenset({38.0, 39.0}), frozense
t({41.0, 379.0}), frozenset({48.0, 1938.0}), frozenset({32.0, 38.0}), frozen
set({48.0, 2118.0}), frozenset({48.0, 255.0}), frozenset({38.0, 271.0}), fro
zenset({39.0, 3279.0}), frozenset({48.0, 789.0}), frozenset({48.0, 189.0}),
frozenset({48.0, 301.0}), frozenset({225.0, 39.0}), frozenset({39.0, 255.
0}), frozenset({789.0, 39.0}), frozenset({48.0, 147.0}), frozenset({246.0, 3
9.0}), frozenset({592.0, 39.0}), frozenset({374.0, 39.0}), frozenset({48.0,
340.0}), frozenset({32.0, 855.0}), frozenset({589.0, 39.0}), frozenset({45.
0, 39.0}), frozenset({38.0, 438.0}), frozenset({39.0, 3735.0}), frozenset({1
004.0, 39.0}), frozenset({1704.0, 41.0}), frozenset({48.0, 259.0}), frozense
t({39.0, 639.0}), frozenset({420.0, 39.0}), frozenset({39.0, 855.0}), frozen
set({1121.0, 39.0}), frozenset({48.0, 123.0}), frozenset({476.0, 39.0}), fro
zenset({39.0, 1135.0}), frozenset({41.0, 390.0}), frozenset({681.0, 41.0})}
```

Number of False Positives Single: 230

Number of False Positives Doubles: 297

Frequent Values: [frozenset({264.0}), frozenset({32.0}), frozenset({49.0}),  
frozenset({677.0}), frozenset({89.0}), frozenset({664.0}), frozenset({570.  
0}), frozenset({548.0}), frozenset({749.0}), frozenset({271.0}), frozenset  
({105.0}), frozenset({340.0}), frozenset({37.0}), frozenset({475.0}), frozen  
set({110.0}), frozenset({301.0}), frozenset({189.0}), frozenset({255.0}), fr  
ozenset({123.0}), frozenset({270.0}), frozenset({161.0}), frozenset({352.  
0}), frozenset({438.0}), frozenset({381.0}), frozenset({1659.0}), frozenset  
({60.0}), frozenset({824.0}), frozenset({592.0}), frozenset({286.0}), frozen  
set({413.0}), frozenset({533.0}), frozenset({604.0}), frozenset({170.0}), fr  
ozenset({147.0}), frozenset({225.0}), frozenset({179.0}), frozenset({1327.  
0}), frozenset({39.0}), frozenset({338.0}), frozenset({441.0}), frozenset({1  
01.0}), frozenset({41.0}), frozenset({48.0}), frozenset({976.0}), frozenset  
({38.0}), frozenset({310.0}), frozenset({201.0}), frozenset({371.0}), frozen  
set({740.0}), frozenset({65.0}), frozenset({237.0}), frozenset({36.0}), froz  
enset({117.0}), frozenset({79.0}), frozenset({1715.0}), frozenset({1393.0}),  
frozenset({1198.0}), frozenset({522.0}), frozenset({589.0}), frozenset({9.  
0}), frozenset({855.0}), frozenset({1121.0}), frozenset({95.0}), frozenset  
({249.0})]

Frequent Pairs: [frozenset({371.0, 38.0}), frozenset({48.0, 237.0}), frozen  
set({664.0, 39.0}), frozenset({89.0, 39.0}), frozenset({438.0, 39.0}), froze  
nset({48.0, 101.0}), frozenset({48.0, 41.0}), frozenset({48.0, 39.0}), froze  
nset({48.0, 170.0}), frozenset({37.0, 38.0}), frozenset({32.0, 39.0}), froze  
nset({48.0, 310.0}), frozenset({38.0, 110.0}), frozenset({48.0, 110.0}), fro  
zenset({39.0, 271.0}), frozenset({41.0, 36.0}), frozenset({170.0, 39.0}), fr  
ozenset({41.0, 38.0}), frozenset({39.0, 79.0}), frozenset({48.0, 438.0}), fr  
ozenset({41.0, 1327.0}), frozenset({41.0, 170.0}), frozenset({65.0, 39.0}),  
frozenset({48.0, 89.0}), frozenset({170.0, 38.0}), frozenset({310.0, 39.0}),

```
frozenset({32.0, 41.0}), frozenset({36.0, 39.0}), frozenset({48.0, 36.0}), f
rozenset({110.0, 39.0}), frozenset({48.0, 475.0}), frozenset({36.0, 38.0}),
frozenset({41.0, 110.0}), frozenset({60.0, 39.0}), frozenset({38.0, 1327.
0}), frozenset({237.0, 39.0}), frozenset({371.0, 39.0}), frozenset({89.0, 4
1.0}), frozenset({48.0, 38.0}), frozenset({39.0, 1327.0}), frozenset({475.0,
39.0}), frozenset({38.0, 286.0}), frozenset({604.0, 39.0}), frozenset({147.
0, 39.0}), frozenset({48.0, 60.0}), frozenset({48.0, 65.0}), frozenset({65.
0, 41.0}), frozenset({740.0, 39.0}), frozenset({48.0, 32.0}), frozenset({48.
0, 1327.0}), frozenset({101.0, 39.0}), frozenset({41.0, 39.0}), frozenset({3
8.0, 39.0}), frozenset({32.0, 38.0}), frozenset({48.0, 255.0}), frozenset({2
25.0, 39.0}), frozenset({39.0, 255.0}), frozenset({48.0, 147.0}), frozenset
({589.0, 39.0})]
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Frequent Values with false positives: {frozenset({677.0}), frozenset({89.0}), frozenset({1343.0}), frozenset({1859.0}), frozenset({926.0}), frozenset({739.0}), frozenset({2058.0}), frozenset({379.0}), frozenset({2225.0}), frozenset({271.0}), frozenset({493.0}), frozenset({1736.0}), frozenset({561.0}), frozenset({185.0}), frozenset({104.0}), frozenset({1313.0}), frozenset({334.0}), frozenset({835.0}), frozenset({1783.0}), frozenset({96.0}), frozenset({1417.0}), frozenset({261.0}), frozenset({1585.0}), frozenset({1814.0}), frozenset({2310.0}), frozenset({1146.0}), frozenset({381.0}), frozenset({276.0}), frozenset({2199.0}), frozenset({592.0}), frozenset({1598.0}), frozenset({281.0}), frozenset({209.0}), frozenset({979.0}), frozenset({1349.0}), frozenset({1899.0}), frozenset({248.0}), frozenset({170.0}), frozenset({973.0}), frozenset({694.0}), frozenset({1327.0}), frozenset({338.0}), frozenset({2521.0}), frozenset({441.0}), frozenset({101.0}), frozenset({41.0}), frozenset({61.0}), frozenset({2064.0}), frozenset({195.0}), frozenset({107.0}), frozenset({38.0}), frozenset({174.0}), frozenset({357.0}), frozenset({272.0}), frozenset({495.0}), frozenset({1956.0}), frozenset({359.0}), frozenset({1655.0}), frozenset({1393.0}), frozenset({789.0}), frozenset({952.0}), frozenset({522.0}), frozenset({589.0}), frozenset({9.0}), frozenset({855.0}), frozenset({55.0}), frozenset({80.0}), frozenset({535.0}), frozenset({730.0}), frozenset({249.0}), frozenset({155.0}), frozenset({345.0}), frozenset({201.0}), frozenset({616.0}), frozenset({2164.0}), frozenset({396.0}), frozenset({1425.0}), frozenset({961.0}), frozenset({264.0}), frozenset({32.0}), frozenset({2602.0}), frozenset({49.0}), frozenset({664.0}), frozenset({220.0}), frozenset({1543.0}), frozenset({570.0}), frozenset({645.0}), frozenset({548.0}), frozenset({1415.0}), frozenset({23.0}), frozenset({2049.0}), frozenset({384.0}), frozenset({749.0}), frozenset({1233.0}), frozenset({1465.0}), frozenset({105.0}), frozenset({1105.0}), frozenset({649.0}), frozenset({703.0}), frozenset({1249.0}), frozenset({1980.0}), frozenset({110.0}), frozenset({301.0}), frozenset({189.0}), frozenset({378.0}), frozenset({1387.0}), frozenset({303.0}), frozenset({278.0}), frozenset({572.0}), frozenset({543.0}), frozenset({344.0}), frozenset({260.0}), frozenset({1062.0}), frozenset({413.0}), frozenset({504.0}), frozenset({581.0}), frozenset({346.0}), frozenset({259.0}), frozenset({604.0}), frozenset({856.0}), frozenset({348.0}), frozenset({242.0}), frozenset({846.0}), frozenset({433.0}), frozenset({290.0}), frozenset({1593.0}), frozenset({147.0}), frozenset({1291.0}), frozenset({586.0}), frozenset({225.0}), frozenset({72.0}), frozenset({200.0}), frozenset({2205.0}), frozenset({312.0}), frozenset({1013.0}), frozenset({597.0}), frozenset({1004.0}), frozenset({2350.0}), frozenset({727.0}), frozenset({408.0}), frozenset({930.0}), frozenset({310.0}), frozenset({622.0}), frozenset({544.0}), frozenset({2378.0}), frozenset({1930.0}), frozenset({740.0}), frozenset({490.0}), frozenset({414.0}), frozenset({332.0}), frozenset({232.0}), frozenset({550.0}), frozenset({1709.0}), frozenset({36.0}), frozenset({79.0}), frozenset({2106.0}), frozenset({1180.0}), frozenset({794.0}), frozenset({11.0}), frozenset({2259.0}), frozenset({488.0}), frozenset({2354.0}), frozenset({1976.0}), frozenset({2187.0}), frozenset({352.0}), frozenset

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zenset({1436.0}), frozenset({491.0}), frozenset({970.0}), frozenset({681.0}), f
rozenset({123.0}), frozenset({2180.0}), frozenset({2043.0}), frozenset({521.
0}), frozenset({2812.0}), frozenset({1435.0}), frozenset({270.0}), frozenset({5
98.0}), frozenset({503.0}), frozenset({2364.0}), frozenset({273.0}), frozenset
({60.0}), frozenset({286.0}), frozenset({2182.0}), frozenset({715.0}), frozense
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et({1991.0}), frozenset({179.0}), frozenset({39.0}), frozenset({571.0}), frozen
set({1344.0}), frozenset({31.0}), frozenset({48.0}), frozenset({151.0}), frozen
set({976.0}), frozenset({978.0}), frozenset({266.0}), frozenset({492.0}), froze
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enset({1144.0}), frozenset({1011.0}), frozenset({1867.0}), frozenset({341.0}),
frozenset({778.0}), frozenset({27.0}), frozenset({910.0}), frozenset({45.0}), f
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frozenset({1590.0}), frozenset({916.0}), frozenset({331.0}), frozenset({1994.
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64.0}), frozenset({525.0}), frozenset({1966.0}), frozenset({258.0}), frozenset
({915.0}), frozenset({587.0}), frozenset({340.0}), frozenset({825.0}), frozense
t({676.0}), frozenset({47.0}), frozenset({68.0}), frozenset({593.0}), frozenset
({479.0}), frozenset({783.0}), frozenset({255.0}), frozenset({1591.0}), frozens
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frozenset({438.0}), frozenset({92.0}), frozenset({208.0}), frozenset({1659.0}),
frozenset({824.0}), frozenset({750.0}), frozenset({1274.0}), frozenset({186.
0}), frozenset({533.0}), frozenset({767.0}), frozenset({766.0}), frozenset({15
6.0}), frozenset({2030.0}), frozenset({56.0}), frozenset({43.0}), frozenset({54
9.0}), frozenset({1916.0}), frozenset({866.0}), frozenset({809.0}), frozenset
({246.0}), frozenset({2290.0}), frozenset({269.0}), frozenset({885.0}), frozens
et({2238.0}), frozenset({423.0}), frozenset({67.0}), frozenset({2463.0}), froze
nset({361.0}), frozenset({152.0}), frozenset({511.0}), frozenset({420.0}), froz
enset({665.0}), frozenset({806.0}), frozenset({237.0}), frozenset({78.0}), froz
enset({117.0}), frozenset({390.0}), frozenset({859.0}), frozenset({723.0}), fro
zenset({993.0}), frozenset({141.0}), frozenset({1198.0}), frozenset({95.0}), fr
ozenset({349.0}), frozenset({878.0}), frozenset({714.0}), frozenset({425.0}), f
rozenset({2329.0})}
```

Frequent Pairs with false positives: {frozenset({371.0, 38.0}), frozenset({334.0, 39.0}), frozenset({740.0, 38.0}), frozenset({48.0, 237.0}), frozenset({664.0, 39.0}), frozenset({152.0, 151.0}), frozenset({49.0, 39.0}), frozenset({41.0, 475.0}), frozenset({67.0, 68.0}), frozenset({48.0, 740.0}), frozenset({809.0, 38.0}), frozenset({237.0, 38.0}), frozenset({48.0, 150.0}), frozenset({1198.0, 39.0}), frozenset({48.0, 2225.0}), frozenset({170.0, 117.0}), frozenset({676.0, 39.0}), frozenset({48.0, 739.0}), frozenset({587.0, 39.0}), frozenset({952.0, 48.0}), frozenset({48.0, 67.0}), frozenset({2310.0, 39.0}), frozenset({349.0, 39.0}), frozenset({89.0, 39.0}), frozenset({48.0, 47.0}), frozenset({276.0, 39.0}), frozenset({48.0, 593.0}), frozenset({2269.0, 39.0}), frozenset({956.0, 39.0}), frozenset({1899.0, 39.0}), frozenset({1433.0, 39.0}), frozenset({278.0, 39.0}), frozenset({41.0, 978.0}), frozenset({384.0, 48.0}), frozenset({150.0, 39.0}), frozenset({976.0, 41.0}), frozenset({48.0, 570.0}), frozenset({284.0, 39.0}), frozenset({338.0, 39.0}), frozenset({824.0, 101.0}), frozenset({208.0, 39.0}), frozenset({438.0, 39.0}), frozenset({694.0, 39.0}), frozenset({48.0, 441.0}), frozenset({48.0, 41.0}), frozenset({824.0, 48.0}), frozenset({48.0, 101.0}), frozenset({48.0, 39.0}), frozenset({48.0, 179.0}), frozenset({48.0, 57

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0}), frozenset({1966.0, 39.0}), frozenset({723.0, 39.0}), frozenset({664.0, 132
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0}), frozenset({1233.0, 39.0}), frozenset({38.0, 39.0}), frozenset({32.0, 548.
0}), frozenset({41.0, 379.0}), frozenset({41.0, 739.0}), frozenset({32.0, 38.
0}), frozenset({48.0, 255.0}), frozenset({38.0, 271.0}), frozenset({48.0, 798.
0}), frozenset({48.0, 789.0}), frozenset({48.0, 189.0}), frozenset({225.0, 39.
0}), frozenset({39.0, 255.0}), frozenset({39.0, 303.0}), frozenset({789.0, 39.
0}), frozenset({39.0, 359.0}), frozenset({48.0, 147.0}), frozenset({246.0, 39.
0}), frozenset({592.0, 39.0}), frozenset({493.0, 39.0}), frozenset({32.0, 855.

```



```
0})), frozenset({589.0, 39.0})), frozenset({45.0, 39.0})), frozenset({961.0, 549.0})), frozenset({38.0, 438.0})), frozenset({1004.0, 39.0})), frozenset({48.0, 259.0})), frozenset({39.0, 639.0})), frozenset({39.0, 855.0})), frozenset({48.0, 123.0})), frozenset({36.0, 1327.0})), frozenset({39.0, 1135.0})), frozenset({41.0, 390.0})), frozenset({39.0, 1991.0}))}
```

Number of False Positives Single: 250

Number of False Positives Doubles: 341

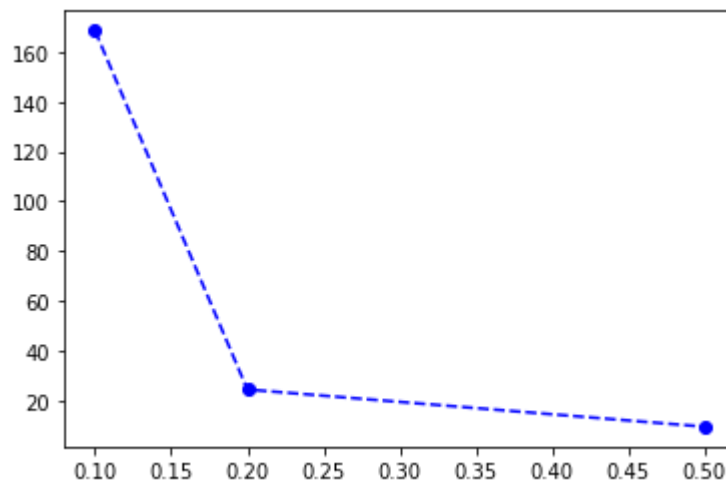
Frequent Values: [frozenset({677.0}), frozenset({89.0}), frozenset({271.0}), frozenset({334.0}), frozenset({381.0}), frozenset({592.0}), frozenset({170.0}), frozenset({1327.0}), frozenset({338.0}), frozenset({441.0}), frozenset({101.0}), frozenset({41.0}), frozenset({38.0}), frozenset({359.0}), frozenset({522.0}), frozenset({589.0}), frozenset({9.0}), frozenset({855.0}), frozenset({535.0}), frozenset({249.0}), frozenset({155.0}), frozenset({201.0}), frozenset({264.0}), frozenset({32.0}), frozenset({49.0}), frozenset({664.0}), frozenset({570.0}), frozenset({548.0}), frozenset({105.0}), frozenset({110.0}), frozenset({413.0}), frozenset({259.0}), frozenset({604.0}), frozenset({242.0}), frozenset({225.0}), frozenset({310.0}), frozenset({740.0}), frozenset({550.0}), frozenset({36.0}), frozenset({79.0}), frozenset({37.0}), frozenset({475.0}), frozenset({123.0}), frozenset({60.0}), frozenset({286.0}), frozenset({179.0}), frozenset({39.0}), frozenset({48.0}), frozenset({976.0}), frozenset({65.0}), frozenset({371.0}), frozenset({45.0}), frozenset({340.0}), frozenset({68.0}), frozenset({255.0}), frozenset({161.0}), frozenset({438.0}), frozenset({1659.0}), frozenset({824.0}), frozenset({533.0}), frozenset({809.0}), frozenset({511.0}), frozenset({237.0}), frozenset({117.0}), frozenset({1198.0})]

Frequent Pairs: [frozenset({371.0, 38.0}), frozenset({740.0, 38.0}), frozenset({48.0, 237.0}), frozenset({49.0, 39.0}), frozenset({1198.0, 39.0}), frozenset({89.0, 39.0}), frozenset({48.0, 41.0}), frozenset({824.0, 48.0}), frozenset({48.0, 101.0}), frozenset({48.0, 39.0}), frozenset({48.0, 170.0}), frozenset({37.0, 38.0}), frozenset({677.0, 39.0}), frozenset({48.0, 49.0}), frozenset({32.0, 39.0}), frozenset({48.0, 310.0}), frozenset({38.0, 110.0}), frozenset({48.0, 110.0}), frozenset({39.0, 271.0}), frozenset({41.0, 36.0}), frozenset({170.0, 39.0}), frozenset({41.0, 38.0}), frozenset({41.0, 1327.0}), frozenset({41.0, 170.0}), frozenset({65.0, 39.0}), frozenset({48.0, 89.0}), frozenset({170.0, 38.0}), frozenset({310.0, 39.0}), frozenset({32.0, 41.0}), frozenset({36.0, 39.0}), frozenset({48.0, 36.0}), frozenset({809.0, 39.0}), frozenset({110.0, 39.0}), frozenset({89.0, 38.0}), frozenset({249.0, 39.0}), frozenset({123.0, 39.0}), frozenset({48.0, 475.0}), frozenset({36.0, 38.0}), frozenset({41.0, 110.0}), frozenset({48.0, 809.0}), frozenset({38.0, 1327.0}), frozenset({237.0, 39.0}), frozenset({824.0, 39.0}), frozenset({89.0, 41.0}), frozenset({48.0, 38.0}), frozenset({475.0, 39.0}), frozenset({39.0, 1327.0}), frozenset({37.0, 39.0}), frozenset({48.0, 37.0}), frozenset({38.0, 286.0}), frozenset({48.0, 65.0}), frozenset({65.0, 41.0}), frozenset({740.0, 39.0}), frozenset({48.0, 32.0}), frozenset({48.0, 1327.0}), frozenset({101.0, 39.0}), frozenset({41.0, 39.0}), frozenset({38.0, 39.0}), frozenset({32.0, 38.0}), frozenset({48.0, 255.0}), frozenset({39.0, 255.0}), frozenset({589.0, 39.0}), frozenset({45.0, 39.0}), frozenset({48.0, 123.0})]

## Graph

```
In [8]: pl.plot([.1,.2,.5], times,'bo--')
```

```
Out[8]: [<matplotlib.lines.Line2D at 0x7ff8f6b355e0>]
```



## Random sampling

```
In [9]: sections = [2,5,10,15]
sections2 = [5,10,15, 20]
associationR = []
for i, x in enumerate(sections):
    new_list = retail_NN[int(len(retail_NN)*(sections[i]/100)):int(len(netflix_NN)
    associationR.append(new_list)
```

```
In [ ]: minsup = 0.01
newSup = minsup*.5
times = []
pairslen = []
actualpairs = []
for x in range(5):
    results = apyori(associationN[x],0.01)
    times.append(results[0])
    pairslen.append(len(results[1]))
    actualpairs.append(results[1])
# singles, doubles = apriori(subset, percentChunk, newSup)
```

## Netflix Dataset

```
In [ ]: netflix = pd.read_csv('netflix.data', delimiter=" ",engine='python', on_bad_lines
netflix_L = netflix.values.tolist()
```

## remove Nan

```
In [ ]: netflix_NN = []
        for x in netflix_L:
            netflix_NN.append([i for i in x if str(i) != 'nan'])
```

## son for netflix

```
In [ ]: times = []
        for x in [.1,.2,.5]:
            start = time.time()
            percentChunk = x
            min_support = 0.01

            # divide item set sample into 2 chunks for SON implementation
            itemsets = itemsets[:int(len(itemsets) * percentChunk)]
            middle = int(len(itemsets) / 2)
            itemsetOne = itemsets[:middle]
            itemsetTwo = itemsets[middle:]
            # change support value for both chunks appropriately
            newMinSupp = min_support / 2
            # get singles, pairs for each chunk
            singlesOne, doublesOne = apriori(itemsetOne, percentChunk, newMinSupp)
            singlesTwo, doublesTwo = apriori(itemsetTwo, percentChunk, newMinSupp)
            # get singles, pairs for whole item set
            singles, doubles = apriori(itemsets, percentChunk, min_support)
            # get the union of both chunks results
            UnionSingle = set(singlesOne + singlesTwo)
            UnionDouble = set(doublesOne + doublesTwo)

            print("Frequent Values with false positives: ", UnionSingle, "\n")
            print("Frequent Pairs with false positives: ", UnionDouble, "\n")
            # get the number of false positives
            numfalsePositivesSingle = len(Diff(list(UnionSingle), singles))
            numfalsePositivesDoubles = len(Diff(list(UnionDouble), doubles))

            falsePositivesSingle = Diff(list(UnionSingle), singles)
            falsePositivesDoubles = Diff(list(UnionDouble), doubles)

            print("Number of False Positives Single: ", numfalsePositivesSingle,
                  "\nNumber of False Positives Doubles: ", numfalsePositivesDoubles)
            # output the results without false positives
            print("Frequent Values: ", Diff(list(UnionSingle), falsePositivesSingle), "\r")
            print("Frequent Pairs: ", Diff(list(UnionDouble), falsePositivesDoubles), "\r")
            end = time.time()
            times.append(end - start)
```

## Graph

```
In [ ]: pl.plot([.1,.2,.5], times,'bo--')
```

## Random Sampling

```
In [ ]: sections = [2,5,10,15]
sections2 = [5,10,15, 20]
associationR = []
for i, x in enumerate(sections):
    new_list = retail_NN[int(len(retail_NN)*(sections[i]/100)):int(len(netflix_NN)
    associationR.append(new_list)
```

```
In [ ]: minsup = 0.01
newSup = minsup*.5
times = []
pairslen = []
actualpairs = []
for x in range(5):
    results = apyori(associationN[x],0.01)
    times.append(results[0])
    pairslen.append(len(results[1]))
    actualpairs.append(results[1])
# singles, doubles = apriori(subset, percentChunk, newSup)
```

## Conclusion

When running this dataset with the various algorithms, the most effective way to get the results is to use the built in Apriori algorithm in python as it returns the results within the shortest amount of time. As per usual I was not able to run the netflix data set as it was crashing my kernel. :)