Assignment – 3

1)

Transaction ID	Item bought
1	{a, c, e}
2	{b, e}
3	{b, c, d, e}
4	{c, d}
5	{a, b, c, e}
6	{b, d}
7	{b, c, d, e}
8	{b, c, e}
9	{a, b, c d, e}

Minimum support threshold

$= \frac{36}{100} \times 12 = 3.6$

$\approx$ round int(3.6)

$= 4$

Identifying frequent Itemsets :

a=5 , b=7 , c=8 , d=7 , e=9 , ~~ab=2~~ , ~~ac=1~~

~~ad=2~~ , ~~ae=4~~ ~~bc=5~~ , from this we can safely

athat all a items are frequent Itemsets .

Now lets take combination of 2 .

ab	ac	ad	ae	bc	bd	be	cd	ce	de
2	4	2	4	5	4	6	6	7	4

from this we can eliminate combinations with ab , ad .

Now let's take a combination of 3

acd = 2   ace = 3   bcd = 3   bce = 5   bde = 3 &

cde = 4   ~~acda~~.

from this we can see that

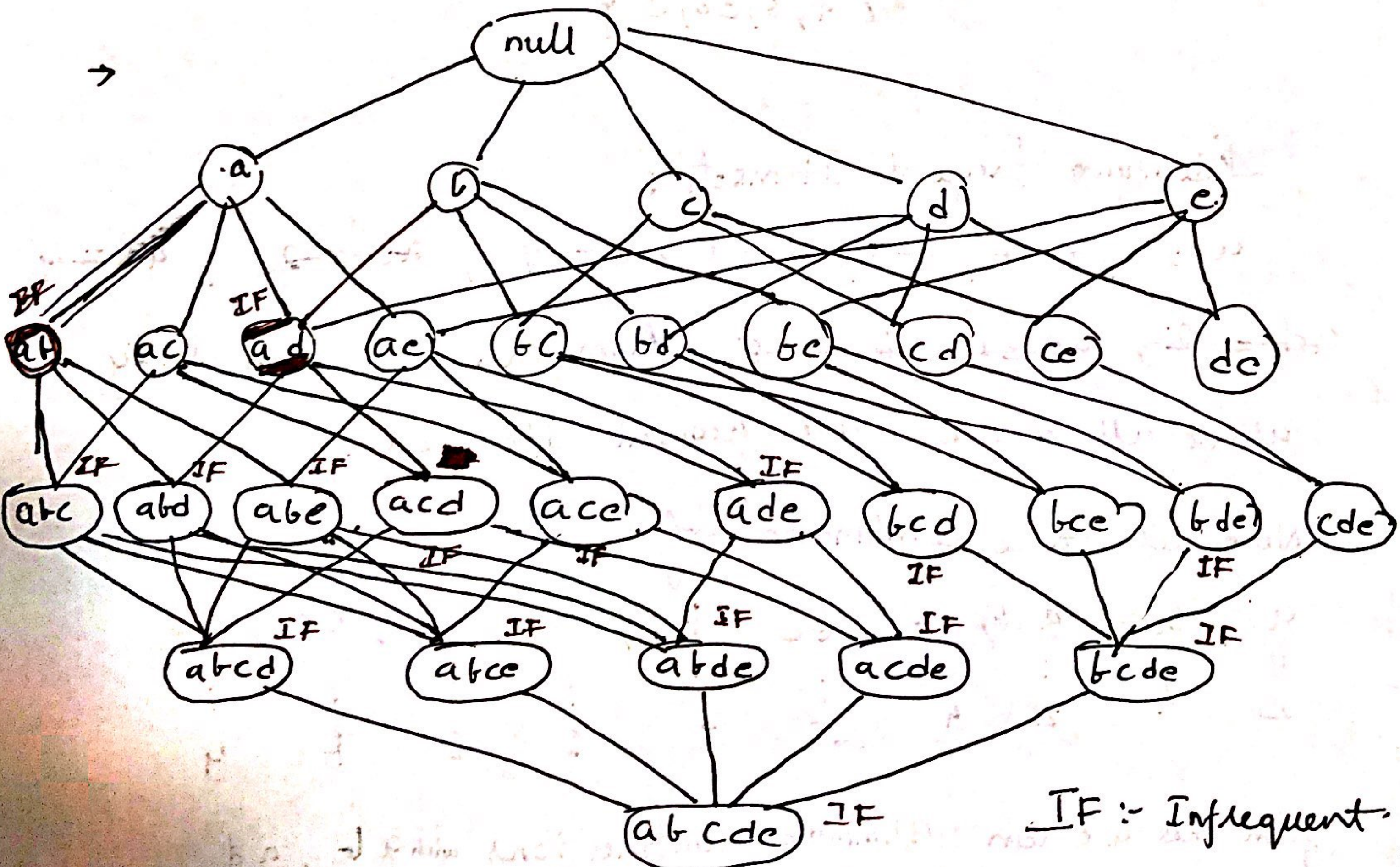
acd ace bcd bde are below the

Support levels.

Now let's take combination of 4

bcde, abde, abcd, abce → Connot be included as values within the respective subsets are below the value.

→



IF :- Infrequent.

Problem 2:
2.1. Download the dataset file HW3_data.csv from the class website
Downloaded.

2.2 Download Chapter 6 “Frequent Itemsets” of the second edition of the book Mining of Massive Datasets by Jure Leskovec, Anand Rajaraman, and Jeff Ullman from the class website, and read the Simple Random Algorithm for frequent itemset generation in Section 6.4.1.
Downloaded and studied.

2.3 Write a function to implement the Apriori algorithm described on page 368 of the class' textbook for frequent itemset generation

```
def support1(df_lol, out, count, dic,support_per):
    if count ==1:
        flat_list = [int(item) for sublist in df_lol for item in sublist]
        #print(len(set(flat_list)))
        def counting(listy):
            d= {}
            for i in listy:
                if i in d:
                    d[(i)] = d[i]+1
                else:
                    d[(i)] = 1
            return(d)
        global d
        d = counting(flat_list)
        out = ([k for (k,v) in d.items() if v >= len(df_lol)*support_per])
        dic[count] = out
        count = count+1
        return support1(df_lol,out,count,dic,support_per)
    else:
        temp = list(combinations(out,count))
        test1 = list(map(lambda x: list(x),temp))
        listy1 = []
        for i in test1:
            counting1 = 0
            for j in df_lol:
                result =  all(elem in j  for elem in i)
                if result == True:
                    counting1 = counting1 +1
                else:
                    pass
            if counting1 >= int(len(df_lol)*support_per):
                all_count[tuple(i)] = counting1
                listy1.append(i)
        if len(listy1) == 0:
            return(dic)
        else:
            dic[count] = listy1
            flat_list = [int(item) for sublist in listy1 for item in sublist]
            out = list(set(flat_list))
            count = count+1
            return(support1(df_lol,out,count,dic,support_per))
```

```python
def generate_rules(z,confidence_level,dic):
    for i in range(2,len(k.keys())+1):
        for j in range(len(k[i])):
            temp = k[i][j]
            #print(temp)
            for l in range(1,len(temp)):
                templ = (combinations(temp,l))
                for m in list(templ):
                    copy = temp.copy()
                    copy =set(copy)
                    #print(copy)
                    remain = list(copy-set(m))
                    #print(remain)
                    ls = []
                    numerator= z[tuple(temp)]
                    #print(temp)
                    x1 = int(str(m[0]).rstrip(','))
                    denominator = z[x1]
                    confidence = numerator/denominator
                    lift = confidence/z[remain[0]]
                    if confidence > confidence_level:
                        ls.append(m)
                        ls.append(remain)
                        ls.append(confidence)
                        ls.append(numerator)
                        ls.append(lift)
                        resultant_rules.append(ls)
      return(resultant_rules)
```

2.4 Write a function to implement the Simple Randomized algorithm described in Section 6.4.1 of Ullman's book to generate frequent item sets (see the reference list at the end of this homework assignment). On the samples that the Simple Randomized algorithm draws you must use the Apriori algorithm to find their frequent item sets.

```python
def remove_emptystrings(x_p):
    for i in range(len(x_p)):
        while("" in x_p[i]):
            x_p[i].remove("")
    return(x_p)
```

```python
df_lol = df.values.tolist()
df_lol = remove_emptystrings(df_lol)
all_count = {}
```

```python
def randome(listoflists, per):
    lists = random.sample(listoflists, int(len(listoflists)*(per/100)))
    return(lists)
print(randome(df_lol,10))
```

2.5. Write a function to implement an algorithm to generate the association rules from the discovered frequent itemsets.

```
resultant_rules = []
initial_list = [left_side, right_side, confidence, numerator, lift]
resultant_rules.append(initial_list)
z = {**d, **all_count}
def generate_rules(z,confidence_level,k):
    for i in range(2,len(k.keys())+1):
        for j in range(len(k[i])):
            temp = k[i][j]
            #print(temp)
            for l in range(1,len(temp)):
                templ = (combinations(temp,l))
                for m in list(templ):
                    copy = temp.copy()
                    copy =set(copy)
                    #print(copy)
                    remain = list(copy-set(m))
                    #print(remain)
                    ls = []
                    numerator= z[tuple(temp)]
                    #print(temp)
                    x1 = int(str(m[0]).rstrip(','))
                    denominator = z[x1]
                    confidence = numerator/denominator
                    lift = confidence/z[remain[0]]
                    if confidence > confidence_level:
                        ls.append(m)
                        ls.append(remain)
                        ls.append(confidence)
                        ls.append(numerator)
                        ls.append(lift)
                        resultant_rules.append(ls)
      return(resultant_rules)
                #print(lift)
```

2.6. Run a program that calls the functions implemented for Tasks 2.3, 2.4, and 2.5 on the given dataset to generate the frequent itemsets and association rules. Use the minimum support thresholds of 1%, 2%, and 5% and the minimum confidence threshold of 5%. For the Simple Randomized algorithm, choose the samples of sizes p=10%, 20%, and 30%. Measure the total execution time of the generation of frequent itemsets for each of the two algorithms, Apriori and Simple Randomized, and count the number of frequent itemsets

Results from Apriori Algorithm

support	Sample size	Number of frequent Items sets	Run Time
1%	100%	159	--- 677.0795619487762 seconds ---
2%	100%	55	--- 50.869351863861084 seconds ---
5%	100%	16	--- 2.8086047172546387 seconds ---

1%	10%	170	157.8045938014984 seconds
2%	10%	57	--- 8.492768049240112 seconds ---
5%	10%	15	0.41901111602783203 seconds
1%	20%	163	251.92460298538208 seconds
2%	20%	53	13.746870040893555 seconds
5%	20%	16	1.0189719200134277 seconds
1%	30%	156	361.52341294288635 seconds
2%	30%	57	30.884540796279907 seconds
5%	30%	16	1.5163190364837646 seconds

2.7 a)

General apriori of support 1%:
Representation () => []
left_side right_side confidence numerator lift
(33,) [39] 0.18678710358014108 2833 1.1976603204676909e-05
(39,) [33] 0.1816491408053347 2833 1.197660320467691e-05
(33,) [40] 0.5574602755983386 8455 1.1000696114422073e-05
(40,) [33] 0.16684755796743955 8455 1.1000696114422071e-05
(33,) [42] 0.2107206435023406 3196 1.4099741953987327e-05
(42,) [33] 0.2138507862161258 3196 1.4099741953987327e-05
(33,) [49] 0.5297026438979363 8034 1.2571559128941172e-05
(49,) [33] 0.19067283730865076 8034 1.2571559128941172e-05
(37,) [39] 0.9502724795640327 2790 6.093052574788617e-05
(39,) [37] 0.1788920235957938 2790 6.0930525747886166e-05
(37,) [40] 0.6938010899182562 2037 1.369119072359657e-05

(37,) [49] 0.4822888283378747 1416 1.1446275740782595e-05
(38,) [39] 0.9739292364990689 1046 6.244737346108418e-05
(39,) [38] 0.06706847909720441 1046 6.244737346108418e-05
(39,) [40] 0.6633111054116441 10345 1.3089513673638758e-05
(40,) [39] 0.20414405525407006 10345 1.3089513673638758e-05
(39,) [42] 0.2498717619902539 3897 1.6719422013399392e-05
(42,) [39] 0.2607561057209769 3897 1.6719422013399392e-05
(39,) [49] 0.5093613747114645 7944 1.2088794937972338e-05
(49,) [39] 0.1885368458526166 7944 1.208879493797234e-05
(39,) [111] 0.1747242882790459 2725 6.253553624876375e-05
(111,) [39] 0.9753042233357194 2725 6.253553624876375e-05
(39,) [171] 0.1943447037701975 3031 6.271206962574944e-05
(171,) [39] 0.9780574378831881 3031 6.271206962574943e-05
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(40,) [49] 0.5750764676862358 29142 1.3648426906045705e-05
(49,) [40] 0.6916340334638661 29142 1.3648426906045705e-05
(61,) [40] 0.6601746138347885 983 1.3027619414598688e-05
(40,) [66] 0.054997533300444004 2787 1.2298196176306799e-05
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(102,) [40] 0.6258381761287438 1400 1.2350038009447337e-05
(111,) [40] 0.629563350035791 1759 1.242354908802745e-05
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(256,) [40] 0.7170963364993216 1057 1.4150889718782862e-05
(271,) [40] 0.6885813148788927 1194 1.3588185789420675e-05
(272,) [40] 0.6848137535816619 1434 1.3513838255188196e-05
(311,) [40] 0.7139552814186585 1852 1.4088905405400267e-05
(414,) [40] 0.601063829787234 1130 1.1861151056482171e-05
(439,) [40] 0.6763285024154589 1260 1.3346393732914828e-05
(476,) [40] 0.6922011998154131 1500 1.3659619137945991e-05
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(171, 49) [40] 0.38915779283639884 1206 7.67948283840945e-06
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left_side right_side confidence numerator lift
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SRM (simple Randomized algorithm)
p = 20% and min support =1%

left_side right_side confidence numerator lift
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(39, 40) [49, 171] 0.07856480049489638 254 9.257075585589299e-06
(39, 171) [40, 49] 0.07856480049489638 254 7.772536653630428e-06
(39, 49) [40, 171] 0.07856480049489638 254 7.772536653630428e-06
(171, 49) [40, 39] 0.38778625954198476 254 3.8364291604865926e-05
(39, 40, 171) [49] 0.07856480049489638 254 9.257075585589299e-06
(39, 40, 49) [171] 0.07856480049489638 254 0.00011994626029755172
(39, 171, 49) [40] 0.07856480049489638 254 7.772536653630428e-06
(39,) [40, 49, 111] 0.06248066811011444 202 6.181308677296641e-06
(111,) [40, 49, 39] 0.3686131386861314 202 3.646746524397817e-05
(39, 40) [49, 111] 0.06248066811011444 202 7.36192625310645e-06
(39, 111) [40, 49] 0.06248066811011444 202 6.181308677296641e-06
(39, 49) [40, 111] 0.06248066811011444 202 6.181308677296641e-06
(111, 49) [40, 39] 0.3686131386861314 202 3.646746524397817e-05
(39, 40, 111) [49] 0.06248066811011444 202 7.36192625310645e-06
(39, 40, 49) [111] 0.06248066811011444 202 0.00011401581771918693
(39, 111, 49) [40] 0.06248066811011444 202 6.181308677296641e-06

SRM (simple Randomized algorithm)
p = 30% and min support =1%

(1147,) [40] 0.6682692307692307 278 4.3996920848589814e-05
(33,) [39] 0.1896322552060257 856 4.079867797031534e-05
(39,) [33] 0.18416523235800344 856 4.079867797031534e-05
(33,) [42] 0.21178555604785113 956 4.657698615523447e-05
(42,) [33] 0.2102485155047284 956 4.657698615523447e-05
(33,) [49] 0.5283562250775365 2385 4.209003625249235e-05
(49,) [33] 0.1899944236437505 2385 4.209003625249235e-05
(33,) [40] 0.5607000443066017 2531 3.6914875522193806e-05
(40,) [33] 0.16663374810718282 2531 3.69148755221938e-05
(39,) [42] 0.25839070567986233 1201 5.6826634193943774e-05
(42,) [39] 0.26413019573345065 1201 5.682663419394377e-05
(39,) [49] 0.5086058519793459 2364 4.051667744597673e-05
(49,) [39] 0.18832151676889985 2364 4.051667744597673e-05
(39,) [40] 0.6746987951807228 3136 4.4420224845659545e-05
(40,) [39] 0.20646520508262559 3136 4.442022484565955e-05
(39,) [171] 0.19535283993115318 908 0.00021073661265496568
(171,) [39] 0.9795037756202805 908 0.00021073661265496568
(39,) [111] 0.1703958691910499 792 0.00020958901499514132
(111,) [39] 0.974169741697417 792 0.00020958901499514135

(39,) [287] 0.07422547332185886 345 0.0002006093873563753
(287,) [39] 0.9324324324324325 345 0.0002006093873563753
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(38,) [39] 0.9715189873417721 307 0.00020901871500468 42
(39,) [37] 0.1703958691910499 792 0.000204556865775701
(37,) [39] 0.9507803121248499 792 0.00020455686577557013
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(40,) [42] 0.22825729146092566 3467 5.0199536279068765e-05
(42,) [66] 0.0633384649219265 5 288 4.780261503541626e-05
(66,) [42] 0.21735849056603773 288 4.780261503541626e-05
(42,) [226] 0.060919287442269626 277 6.260975071147958e-05
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(40,) [49] 0.5685693594048324 8636 4.529350429417927e-05
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(66,) [49] 0.5449056603773584 722 4.340840120906225e-05
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(102,) [49] 0.5864197530864198 380 4.6715506499356314e-05
(171,) [49] 0.4962243797195254 460 3.953034172863263e-05
(311,) [49] 0.6611039794608472 515 5.2665018677674436e-05
(414,) [49] 0.5963963963963964 331 4.751026817465119e-05
(226,) [49] 0.5231243576567317 509 4.1673254015512765e-05
(534,) [49] 0.5846153846153846 266 4.6571766479358294e-05
(238,) [49] 0.5490628445424476 498 4.373957177905262e-05
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(2239,) [49] 0.5538461538461539 288 4.412062087518154e-05
(148,) [49] 0.5872093023255814 303 4.6778403754129006e-05
(256,) [49] 0.6971830985915493 297 5.55391618411176e-05
(80,) [49] 0.5647773279352226 279 4.499142260298117e-05
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(90,) [49] 0.7275862068965517 844 5.7961141312558886e-05
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(1328,) [49] 0.5216535433070866 265 4.155608566136275e-05
(271,) [49] 0.570902394106814 310 4.5479359046189274e-05
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(66,) [40] 0.6181132075471698 819 4.069479278077357e-05
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(102,) [40] 0.6311728395061729 409 4.1554601323732495e-05
(171,) [40] 0.6752966558791802 626 4.445958627158998e-05
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(414,) [40] 0.5963963963963964 331 3.92650205014416e-05
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(534,) [40] 0.6241758241758242 284 4.109393799300969e-05
(238,) [40] 0.6416758544652701 582 4.224608956911384e-05
(476,) [40] 0.6893819334389857 435 4.53869203659876e-05
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(439,) [40] 0.6739130434782609 403 4.4368493217345505e-05
(2239,) [40] 0.7269230769230769 378 4.785852109573223e-05
(148,) [40] 0.6492248062015504 335 4.274309080265656e-05
(12926,) [40] 0.6542056074766355 280 4.3071012408758674e-05
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(271,) [40] 0.6777163904235728 368 4.4618894622659345e-05
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(39, 49) [33] 0.1043459552495697 485 2.3116073382713714e-05
(33,) [40, 42] 0.15485157288435977 699 1.0194981426319032e-05
(42,) [40, 33] 0.1537277325709259 699 1.0120991017902818e-05
(33, 40) [42] 0.15485157288435977 699 3.4055767073754076e-05
(33, 42) [40] 0.15485157288435977 699 1.0194981426319032e-05
(33,) [40, 49] 0.35799734160389896 1616 2.3569513569286914e-05
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(33, 40) [49] 0.35799734160389896 1616 2.85188673308292e-05
(33, 49) [40] 0.35799734160389896 1616 2.3569513569286914e-05
(40, 49) [33] 0.10639278425176114 1616 2.3569513569286918e-05
(33,) [49, 42] 0.13690739920248116 618 1.0906349016369088e-05
(42,) [33, 49] 0.13591378931163403 618 3.0109390631731066e-05
(33, 42) [49] 0.13690739920248116 618 1.0906349016369088e-05
(33, 49) [42] 0.13690739920248116 618 3.0109390631731066e-05
(42, 49) [33] 0.13591378931163403 618 3.0109390631731066e-05
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(39,) [40, 37] 0.1157487091222031 538 7.620561532833176e-06
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(39, 40) [37] 0.1157487091222031 538 0.00013895403255966758

(37,) [49, 39] 0.45738295318127253 381 3.643614699125887e-05
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(37, 40) [49] 0.3709483793517407 309 2.955057590629656e-05
(37, 49) [40] 0.3709483793517407 309 2.4422172582246407e-05
(39,) [40, 42] 0.20718588640275387 963 1.3640521851521092e-05
(40,) [42, 39] 0.06340114556587004 963 1.394351123067298e-05
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(39,) [40, 171] 0.13231497418244406 615 8.71123669645428e-06
(171,) [40, 39] 0.6634304207119741 615 4.3678347535188234e-05
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(39, 171) [40] 0.13231497418244406 615 8.71123669645428e-06
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(40,) [49, 39] 0.12114029890052011 1840 9.6503066120067e-06
(49,) [40, 39] 0.14657850712976978 1840 9.650306612006701e-06
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(39, 49) [40] 0.3958691910499139 1840 2.606288702679004e-05
(40, 49) [39] 0.12114029890052011 1840 2.606288702679004e-05
(39,) [40, 111] 0.10864888123924268 505 7.153129319852702e-06
(111,) [40, 39] 0.6211562115621156 505 4.089513539812467e-05
(39, 40) [111] 0.10864888123924268 505 0.00013363946031887168
(39, 111) [40] 0.10864888123924268 505 7.153129319852702e-06
(39,) [49, 42] 0.15899311531841653 739 1.2665746460480884e-05
(42,) [49, 39] 0.16252474158786012 739 1.2947083692173991e-05
(49,) [42, 39] 0.05887038954831514 5 739 1.2947083692173993e-05
(39, 42) [49] 0.15899311531841653 739 1.2665746460480884e-05
(39, 49) [42] 0.15899311531841653 739 3.49665967271644e-05
(42, 49) [39] 0.16252474158786012 739 3.4966596727164396e-05
(39,) [49, 171] 0.09789156626506024 455 7.798260675938838e-06
(171,) [49, 39] 0.49083063646170444 455 3.910066410114749e-05
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(171, 49) [39] 0.49083063646170444 455 0.00010560039510793985
(39,) [49, 111] 0.08777969018932874 408 6.992726056666035e-06
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(39, 111) [49] 0.08777969018932874 408 6.992726056666035e-06
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(42,) [40, 49] 0.48119639322630303 2188 3.168058418765574e-05
(49,) [40, 42] 0.17430096391300884 2188 1.147547329732101e-05

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(171,) [40, 49] 0.3861920172599784 358 2.5425769784711202e-05
(171, 49) [40] 0.3861920172599784 358 2.5425769784711202e-05
(311,) [40, 49] 0.5340179717586649 416 3.5158204737551183e-05
(66,) [40, 49] 0.38716981132075473 513 2.5490144928616415e-05
(90,) [40, 49] 0.5275862068965518 612 3.473475586915214e-05
(476,) [40, 49] 0.508716323296355 321 3.349241709765982e-05
(226,) [40, 49] 0.4224049331963001 411 2.7809923839377188e-05
(102,) [40, 49] 0.42592592592592593 276 2.8041735856601877e-05
(238,) [40, 49] 0.40683572216097025 369 2.6784891840211354e-05
(111,) [40, 49] 0.3874538745387454 315 2.5508846832493608e-05
(33,) [40, 49, 39] 0.08351794417368189 377 5.4985808264982475e-06
(39,) [40, 33, 49] 0.08111015490533563 377 5.340058917989046e-06
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(39, 49) [40, 33] 0.08111015490533563 377 5.340058917989046e-06
(33, 39, 40) [49] 0.08351794417368189 377 6.653225856263991e-06
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(33,) [40, 49, 42] 0.10700044306601683 483 7.044600899731176e-06
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(42, 49) [40, 33] 0.10622388387948098 483 6.993474480181775e-06
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(33, 42, 49) [40] 0.10700044306601683 483 7.044600899731176e-06
(37,) [40, 49, 39] 0.35414165666266506 295 2.3315666381109032e-05
(39,) [40, 49, 37] 0.06346815834767643 295 4.178560691795143e-06
(37, 39) [40, 49] 0.35414165666266506 295 2.3315666381109032e-05
(37, 40) [49, 39] 0.35414165666266506 295 2.8211714861998333e-05
(37, 49) [40, 39] 0.35414165666266506 295 2.3315666381109032e-05
(39, 40) [49, 37] 0.06346815834767643 295 5.056015163520786e-06
(39, 49) [40, 37] 0.06346815834767643 295 4.178560691795143e-06
(37, 39, 40) [49] 0.35414165666266506 295 2.8211714861998333e-05
(37, 39, 49) [40] 0.35414165666266506 295 2.3315666381109032e-05
(37, 40, 49) [39] 0.35414165666266506 295 7.61922669239813e-05
(39, 40, 49) [37] 0.06346815834767643 295 7.619226692398131e-05
(39,) [40, 49, 42] 0.1346815834767642 626 8.867047434114438e-06
(42,) [40, 49, 39] 0.13767319111502088 626 9.064006262098946e-06

(39, 40) [49, 42] 0.1346815834767642 626 1.0729035567335633e-05
(39, 42) [40, 49] 0.1346815834767642 626 8.867047434114438e-06
(39, 49) [40, 42] 0.1346815834767642 626 8.867047434114438e-06
(42, 49) [40, 39] 0.13767319111502088 626 9.064006262098946e-06
(39, 40, 42) [49] 0.1346815834767642 626 1.0729035567335633e-05
(39, 40, 49) [42] 0.1346815834767642 626 2.9619877606501914e-05
(39, 42, 49) [40] 0.1346815834767642 626 8.867047434114438e-06
(39,) [40, 49, 171] 0.0761617900172117 354 5.0142728301541705e-06
(171,) [40, 49, 39] 0.3818770226537217 354 2.5141682971474204e-05
(39, 40) [49, 171] 0.0761617900172117 354 6.067218196224942e-06
(39, 171) [40, 49] 0.0761617900172117 354 5.0142728301541705e-06
(39, 49) [40, 171] 0.0761617900172117 354 5.0142728301541705e-06
(171, 49) [40, 39] 0.3818770226537217 354 2.5141682971474204e-05
(39, 40, 171) [49] 0.0761617900172117 354 6.067218196224942e-06
(39, 40, 49) [171] 0.0761617900172117 354 8.215942828178177e-05
(39, 171, 49) [40] 0.0761617900172117 354 5.0142728301541705e-06
(39,) [40, 49, 111] 0.0673407917383821 313 4.433523717057219e-06
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(39, 40) [49, 111] 0.0673407917383821 313 5.364517783667817e-06
(39, 111) [40, 49] 0.0673407917383821 313 4.433523717057219e-06
(39, 49) [40, 111] 0.0673407917383821 313 4.433523717057219e-06
(111, 49) [40, 39] 0.3849938499384994 313 2.5346885900223806e-05
(39, 40, 111) [49] 0.0673407917383821 313 5.364517783667817e-06
(39, 40, 49) [111] 0.0673407917383821 313 8.283000213823137e-05
(39, 111, 49) [40] 0.0673407917383821 313 4.433523717057219e-06

b)

Algorithm	Number of candidate frequent itemset	Number of association rules	Execution time
1 % Support			
SR (p = 10%)	170	245	157.8045938014984 seconds
SR (p = 20%)	163	231	254.29010725021362 seconds
SR (p = 30%)	161	229	341.30471420288086 seconds
2 % support			
SR (p = 10%)	168	239	8.84989595413208 seconds ---

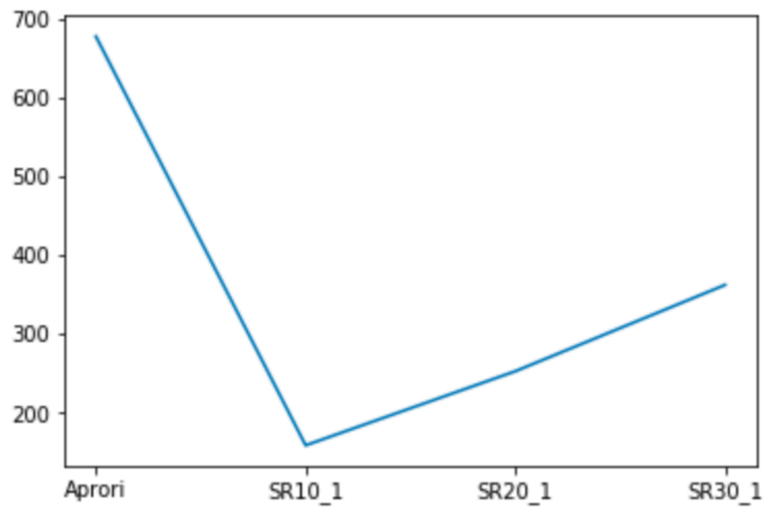
SR (p = 20%)	101	169	16.815354824066162 seconds
SR (p = 30%)	57	103	23.606297969818115 seconds
5 % support			
SR (p = 10%)	15	33	0.4861466884613037 seconds
SR (p = 20%)	16	30	0.9693319797515869 seconds
SR (p = 30%)	16	33	1.5163190364837646 seconds

c)

Algorithm	Flase Positive	Flase Negative
1 % Support		
SR (p = 10%)	7	5
SR (p = 20%)	9	2
SR (p = 30%)	3	6
2 % support		
SR (p = 10%)	5	2
SR (p = 20%)	3	3
SR (p = 30%)	5	2
5 % support		
SR (p = 10%)	2	3
SR (p = 20%)	1	3
SR (p = 30%)	0	1

d) Comparsion analysis of the SRM and default apriori algorithm

The graph represents the execution time vs the algorithm.



From the graph, it is observed that execution time for Apriori algorithm which is implemented on entire data is very large when compared to simple random algorithms which is applied on sample of data. The reason behind large execution time of Apriori algorithm is that in this algorithm, it traverse through entire data to find each frequent item. To find 'n' frequent itemsets of size k , then it makes passes through entire data for np times if p is the number of whole transactions. Thus the execution time is large for Apriori algorithm as p is large. Whereas in simple random algorithm , only sample of data is considered(10%,20% or 30%), thus execution time is small when compared to Apriori algorithm applied on entire data. One more observation from the graph is, execution time for simple random algorithm increases as the sample size increases and this is because the number of transactions increases as the sample size increase.

e)

From the above the results we can go with following assumptions:

1) with the increase in support the sample size doesn't matter in the generating in number of rules.
2) The False positive and False negative tend to become zero with the increase in the support. Support is more like confidence intervals.
3) Lower the sample size and lower the support more the False positive and False negatives.
4) We can see that execution increases with increase in the sample size.
5) With minimum we are able to generate maximum number of rules irrespective of the sample size.

I would recommend using random sample Apriori algorithm because of two reasons,

1) The results tend to more accurate with accurate higher frequency items than lower frequency one's.
2) Candidate generation generates large numbers of subsets (the algorithm attempts to load up the candidate set with as many as possible before each scan).
3) Scanning the whole database to decrease the efficiency of the algorithm.
4) Since we have infinite space in present era, we can say time time complexity is more important. Apriori algorithm tend to be less efficient with both time and space complexity.
5) In present big data era, the algorithm is computational expensive.