Q8 Association Rules

2023-08-14

```
library(tidyverse)
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.2     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v ggplot2   3.4.2     v tibble    3.2.1
## v lubridate 1.9.2     v tidyr     1.3.0
## v purrr     1.0.1
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```
library(igraph)
```

```
##
## Attaching package: 'igraph'
##
## The following objects are masked from 'package:lubridate':
##
##     %--%, union
##
## The following objects are masked from 'package:dplyr':
##
##     as_data_frame, groups, union
##
## The following objects are masked from 'package:purrr':
##
##     compose, simplify
##
## The following object is masked from 'package:tidyr':
##
##     crossing
##
## The following object is masked from 'package:tibble':
##
##     as_data_frame
##
## The following objects are masked from 'package:stats':
##
##     decompose, spectrum
##
## The following object is masked from 'package:base':
##
```

```
##     union
```

```
library(arules)  # has a big ecosystem of packages built around it
```

```
## Loading required package: Matrix
##
## Attaching package: 'Matrix'
##
## The following objects are masked from 'package:tidyr':
##
##     expand, pack, unpack
##
##
## Attaching package: 'arules'
##
## The following object is masked from 'package:dplyr':
##
##     recode
##
## The following objects are masked from 'package:base':
##
##     abbreviate, write
```

```
library(arulesViz)
```

```
#read the .txt file
data <- readLines("groceries.txt")
```

```
# Split items and create a transaction dataset
transactions <- strsplit(data, ",")
```

```
# Remove duplicate items within transactions
transactions_list_clean <- lapply(transactions, function(transaction) unique(transaction))
```

```
# Cast this variable as a special arules "transactions" class.
transactions_clean <- as(transactions_list_clean, "transactions")
```

```
# Lets look at our baskets
inspect(head(transactions_clean) )
```

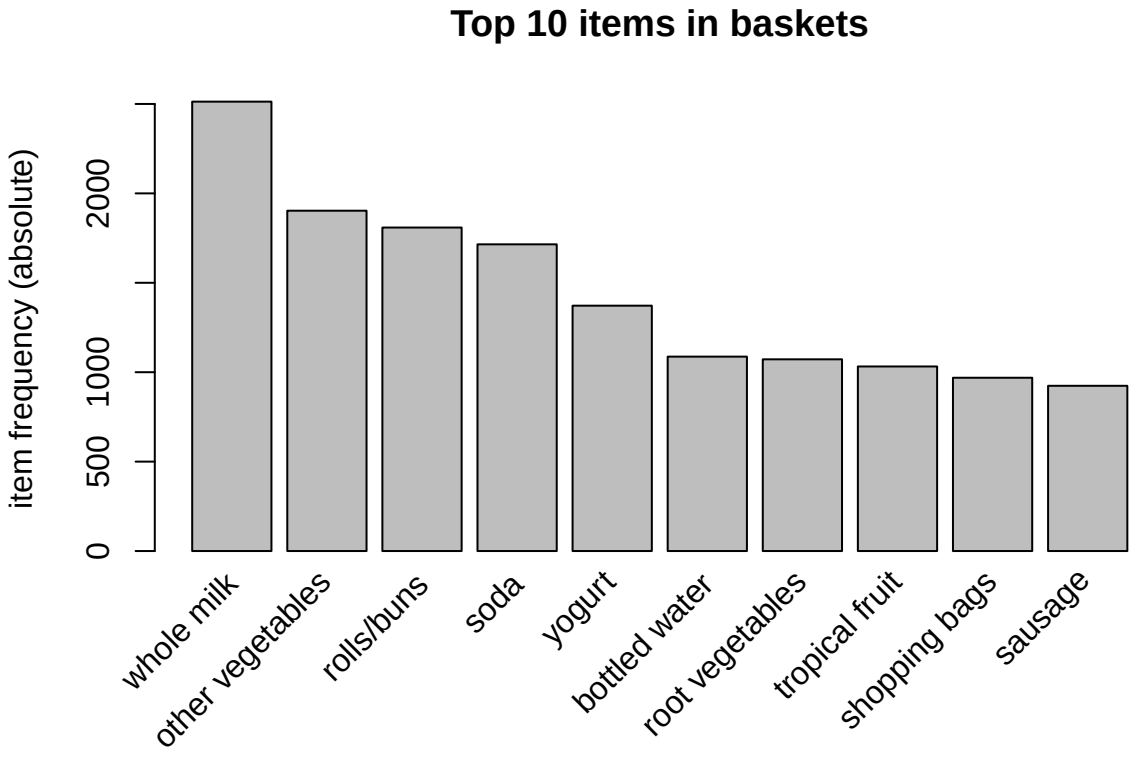
```
##     items
## [1] {citrus fruit,
##      margarine,
##      ready soups,
##      semi-finished bread}
## [2] {coffee,
##      tropical fruit,
##      yogurt}
## [3] {whole milk}
## [4] {cream cheese ,
##      meat spreads,
##      pip fruit,
##      yogurt}
## [5] {condensed milk,
##      long life bakery product,
##      other vegetables,
##      whole milk}
```

```
## [6] {abrasive cleaner,
##      butter,
##      rice,
##      whole milk,
##      yogurt}
```

```
#Number of baskets
dim(transactions_clean)[1]
```

```
## [1] 9835
```

```
#Top 10 most selling items
itemFrequencyPlot(transactions_clean,topN=10,type='absolute',main = "Top 10 items in baskets")
```



The data set has 9835 rows/baskets.

Most commonly bought products are:

1) Whole milk
2) other vegetables
3) rolls/buns

```
#Trying support=0.05 and confidence=0.1
m= apriori(transactions_clean,parameter=list(support=.005, confidence=0.1))
```

Trying support=0.05 and confidence=0.1

```
## Apriori
##
## Parameter specification:
```

```
##  confidence minval smax arem  aval originalSupport maxtime support minlen
##         0.1    0.1    1 none FALSE            TRUE       5   0.005      1
##  maxlen target  ext
##      10  rules TRUE
##
## Algorithmic control:
##  filter tree heap memopt load sort verbose
##     0.1 TRUE TRUE  FALSE TRUE    2    TRUE
##
## Absolute minimum support count: 49
##
## set item appearances ...[0 item(s)] done [0.00s].
## set transactions ...[169 item(s), 9835 transaction(s)] done [0.00s].
## sorting and recoding items ... [120 item(s)] done [0.00s].
## creating transaction tree ... done [0.00s].
## checking subsets of size 1 2 3 4 done [0.00s].
## writing ... [1582 rule(s)] done [0.00s].
## creating S4 object  ... done [0.00s].
```

```
summary(m)
```

```
## set of 1582 rules
##
## rule length distribution (lhs + rhs):sizes
##   1   2   3   4
##   8 755 771  48
##
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   2.000   3.000   2.543   3.000   4.000
##
## summary of quality measures:
##     support           confidence        coverage             lift
##  Min.   :0.005084   Min.   :0.1000   Min.   :0.008134   Min.   :0.4457
##  1st Qu.:0.005897   1st Qu.:0.1454   1st Qu.:0.022979   1st Qu.:1.4732
##  Median :0.007321   Median :0.2189   Median :0.037112   Median :1.8174
##  Mean   :0.010537   Mean   :0.2557   Mean   :0.053306   Mean   :1.9028
##  3rd Qu.:0.010371   3rd Qu.:0.3315   3rd Qu.:0.058058   3rd Qu.:2.2444
##  Max.   :0.255516   Max.   :0.7000   Max.   :1.000000   Max.   :4.6399
##      count
##  Min.   :  50.0
##  1st Qu.:  58.0
##  Median :  72.0
##  Mean   : 103.6
##  3rd Qu.: 102.0
##  Max.   :2513.0
##
## mining info:
##                data ntransactions support confidence
##  transactions_clean          9835   0.005        0.1
##                                                                                call
##  apriori(data = transactions_clean, parameter = list(support = 0.005, confidence = 0.1))
```

This gives 1582 rules. Too many!!

Let's try to increase our confidence to 0.2

```r
m1= apriori(transactions_clean,parameter=list(support=.005, confidence=0.2))
```

```
## Apriori
##
## Parameter specification:
##  confidence minval smax arem  aval originalSupport maxtime support minlen
##         0.2    0.1    1 none FALSE            TRUE       5   0.005      1
##  maxlen target  ext
##      10  rules TRUE
##
## Algorithmic control:
##  filter tree heap memopt load sort verbose
##     0.1 TRUE TRUE  FALSE TRUE    2    TRUE
##
## Absolute minimum support count: 49
##
## set item appearances ...[0 item(s)] done [0.00s].
## set transactions ...[169 item(s), 9835 transaction(s)] done [0.00s].
## sorting and recoding items ... [120 item(s)] done [0.00s].
## creating transaction tree ... done [0.00s].
## checking subsets of size 1 2 3 4 done [0.00s].
## writing ... [873 rule(s)] done [0.00s].
## creating S4 object  ... done [0.00s].
```

```r
summary(m1)
```

```
## set of 873 rules
##
## rule length distribution (lhs + rhs):sizes
##   1   2   3   4
##   1 265 559  48
##
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   1.000   2.000   3.000   2.749   3.000   4.000
##
## summary of quality measures:
##     support           confidence        coverage             lift
##  Min.   :0.005084   Min.   :0.2000   Min.   :0.008134   Min.   :0.8991
##  1st Qu.:0.005796   1st Qu.:0.2517   1st Qu.:0.017285   1st Qu.:1.5570
##  Median :0.007219   Median :0.3156   Median :0.024504   Median :1.9415
##  Mean   :0.010254   Mean   :0.3459   Mean   :0.033379   Mean   :2.0134
##  3rd Qu.:0.010269   3rd Qu.:0.4249   3rd Qu.:0.033452   3rd Qu.:2.3571
##  Max.   :0.255516   Max.   :0.7000   Max.   :1.000000   Max.   :4.0855
##      count
##  Min.   :  50.0
##  1st Qu.:  57.0
##  Median :  71.0
##  Mean   : 100.9
##  3rd Qu.: 101.0
##  Max.   :2513.0
##
## mining info:
##                data ntransactions support confidence
##  transactions_clean          9835   0.005        0.2
```

```
##                                                                                 call
##  apriori(data = transactions_clean, parameter = list(support = 0.005, confidence = 0.2))
```

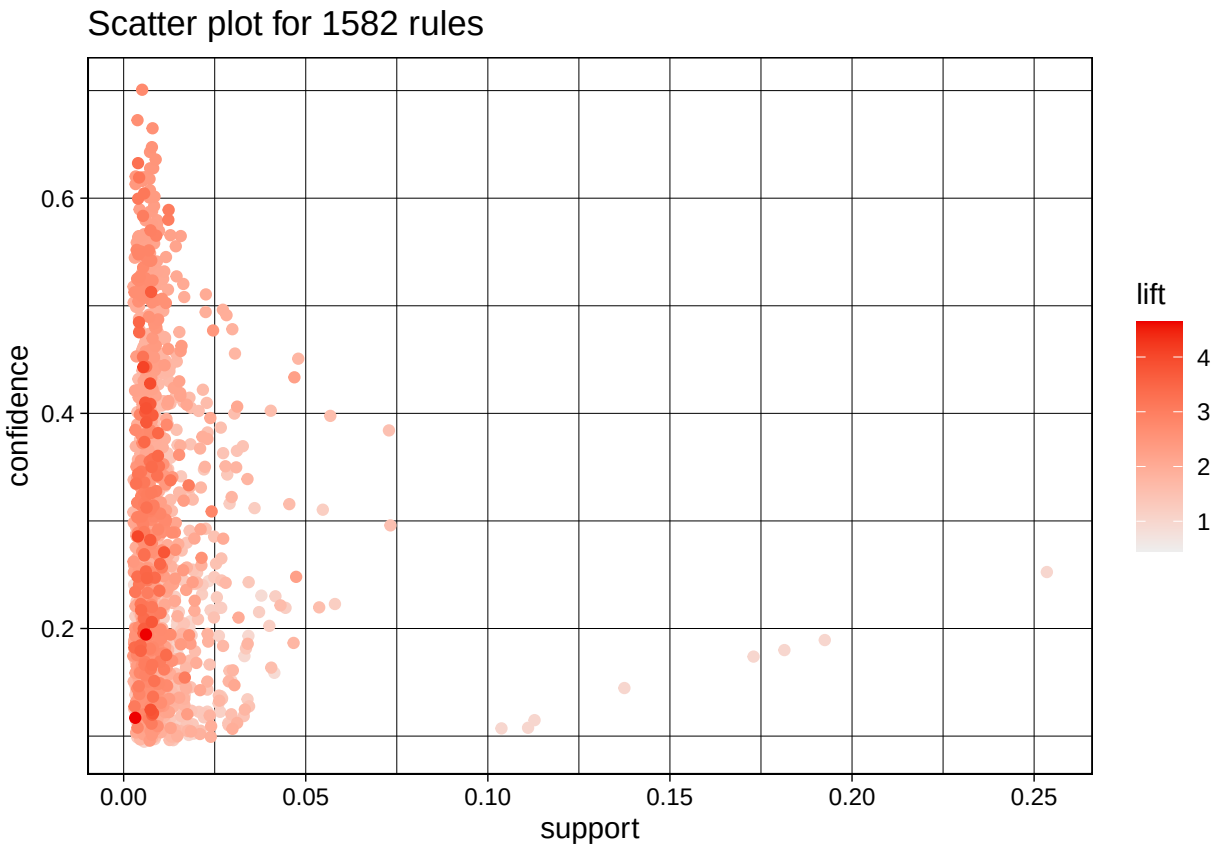
Now, we have 873 rules. Still pretty high!

```
# plot all the rules in (support, confidence) space
plot(m,jitters=0)
```

```
## Warning: Unknown control parameters: jitters
```

```
## Available control parameters (with default values):
## main  =  Scatter plot for 1582 rules
## colors    =  c("#EE0000FF", "#EEEEEEFF")
## jitter    =  NA
## engine    =  ggplot2
## verbose   =  FALSE
```

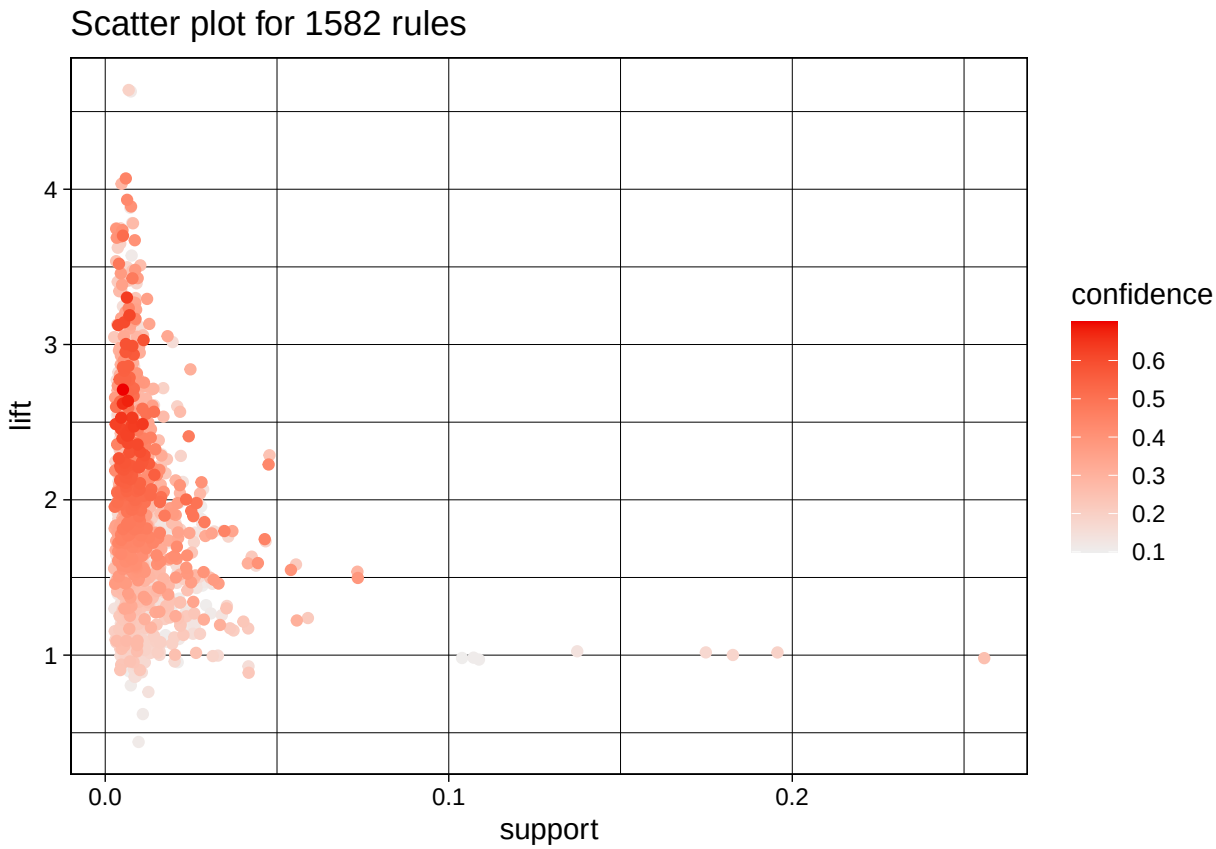
```
## To reduce overplotting, jitter is added! Use jitter = 0 to prevent jitter.
```



N

```
plot(m, measure = c("support", "lift"), shading = "confidence")
```

```
## To reduce overplotting, jitter is added! Use jitter = 0 to prevent jitter.
```




```
#Using the subsets obtained from plots to identify the approximate lift and confidence thresholds
#inspect(subset(m, ci=onfidence >0.4 ))
#inspect(subset(m, lift >2))
inspect(subset(m, confidence > 0.4 & lift >2))
```

```
##       lhs                          rhs                    support confidence    coverage     lift c
## [1]   {herbs}                   => {root vegetables}  0.007015760  0.4312500 0.016268429 3.956477
## [2]   {herbs}                   => {other vegetables} 0.007727504  0.4750000 0.016268429 2.454874
## [3]   {baking powder}           => {other vegetables} 0.007320793  0.4137931 0.017691917 2.138547
## [4]   {baking powder}           => {whole milk}       0.009252669  0.5229885 0.017691917 2.046793
## [5]   {soft cheese}             => {other vegetables} 0.007117438  0.4166667 0.017081851 2.153398
## [6]   {grapes}                  => {other vegetables} 0.009049314  0.4045455 0.022369090 2.090754
## [7]   {onions}                  => {other vegetables} 0.014234875  0.4590164 0.031011693 2.372268
## [8]   {hamburger meat}          => {other vegetables} 0.013828165  0.4159021 0.033248602 2.149447
## [9]   {chicken}                 => {other vegetables} 0.017895272  0.4170616 0.042907982 2.155439
## [10]  {whipped/sour cream}      => {other vegetables} 0.028876462  0.4028369 0.071682766 2.081924
## [11]  {root vegetables}         => {other vegetables} 0.047381800  0.4347015 0.108998475 2.246605
## [12]  {oil,
##        whole milk}              => {other vegetables} 0.005083884  0.4504505 0.011286223 2.327998
## [13]  {onions,
##        root vegetables}         => {other vegetables} 0.005693950  0.6021505 0.009456024 3.112008
## [14]  {onions,
##        whole milk}              => {other vegetables} 0.006609049  0.5462185 0.012099644 2.822942
## [15]  {hamburger meat,
##        whole milk}              => {other vegetables} 0.006304016  0.4275862 0.014743264 2.209832
## [16]  {hygiene articles,
##        other vegetables}        => {whole milk}       0.005185562  0.5425532 0.009557702 2.123363
```

```
## [17]  {hygiene articles,
##        whole milk}               => {other vegetables} 0.005185562  0.4047619 0.012811388 2.091872
## [18]  {other vegetables,
##        sugar}                    => {whole milk}       0.006304016  0.5849057 0.010777834 2.289115
## [19]  {sugar,
##        whole milk}               => {other vegetables} 0.006304016  0.4189189 0.015048297 2.165038
## [20]  {long life bakery product,
##        other vegetables}         => {whole milk}       0.005693950  0.5333333 0.010676157 2.087279
## [21]  {long life bakery product,
##        whole milk}               => {other vegetables} 0.005693950  0.4210526 0.013523132 2.176065
## [22]  {cream cheese ,
##        yogurt}                   => {other vegetables} 0.005287239  0.4262295 0.012404677 2.202820
## [23]  {cream cheese ,
##        yogurt}                   => {whole milk}       0.006609049  0.5327869 0.012404677 2.085141
## [24]  {cream cheese ,
##        whole milk}               => {yogurt}           0.006609049  0.4012346 0.016471784 2.876197
## [25]  {cream cheese ,
##        whole milk}               => {other vegetables} 0.006710727  0.4074074 0.016471784 2.105545
## [26]  {chicken,
##        root vegetables}          => {other vegetables} 0.005693950  0.5233645 0.010879512 2.704829
## [27]  {chicken,
##        root vegetables}          => {whole milk}       0.005998983  0.5514019 0.010879512 2.157993
## [28]  {chicken,
##        rolls/buns}               => {whole milk}       0.005287239  0.5473684 0.009659380 2.142208
## [29]  {chicken,
##        whole milk}               => {other vegetables} 0.008439248  0.4797688 0.017590239 2.479520
## [30]  {coffee,
##        yogurt}                   => {whole milk}       0.005083884  0.5208333 0.009761057 2.038359
## [31]  {frozen vegetables,
##        root vegetables}          => {other vegetables} 0.006100661  0.5263158 0.011591256 2.720082
## [32]  {frozen vegetables,
##        root vegetables}          => {whole milk}       0.006202339  0.5350877 0.011591256 2.094146
## [33]  {frozen vegetables,
##        yogurt}                   => {other vegetables} 0.005287239  0.4262295 0.012404677 2.202820
## [34]  {frozen vegetables,
##        other vegetables}         => {whole milk}       0.009659380  0.5428571 0.017793594 2.124552
## [35]  {frozen vegetables,
##        whole milk}               => {other vegetables} 0.009659380  0.4726368 0.020437214 2.442661
## [36]  {beef,
##        root vegetables}          => {other vegetables} 0.007930859  0.4561404 0.017386884 2.357404
## [37]  {beef,
##        other vegetables}         => {root vegetables}  0.007930859  0.4020619 0.019725470 3.688692
## [38]  {beef,
##        yogurt}                   => {other vegetables} 0.005185562  0.4434783 0.011692933 2.291965
## [39]  {beef,
##        yogurt}                   => {whole milk}       0.006100661  0.5217391 0.011692933 2.041904
## [40]  {beef,
##        rolls/buns}               => {other vegetables} 0.005795628  0.4253731 0.013624809 2.198395
## [41]  {beef,
##        whole milk}               => {other vegetables} 0.009252669  0.4354067 0.021250635 2.250250
## [42]  {curd,
##        whipped/sour cream}       => {whole milk}       0.005897306  0.5631068 0.010472801 2.203802
## [43]  {curd,
##        tropical fruit}           => {yogurt}           0.005287239  0.5148515 0.010269446 3.690645
```

```
## [44]  {curd,
##        tropical fruit}           => {other vegetables} 0.005287239  0.5148515 0.010269446 2.660833
## [45]  {curd,
##        tropical fruit}           => {whole milk}       0.006507372  0.6336634 0.010269446 2.479936
## [46]  {curd,
##        root vegetables}          => {other vegetables} 0.005490595  0.5046729 0.010879512 2.608228
## [47]  {curd,
##        root vegetables}          => {whole milk}       0.006202339  0.5700935 0.010879512 2.231146
## [48]  {curd,
##        yogurt}                   => {whole milk}       0.010066090  0.5823529 0.017285206 2.279125
## [49]  {curd,
##        rolls/buns}               => {whole milk}       0.005897306  0.5858586 0.010066090 2.292845
## [50]  {curd,
##        other vegetables}         => {whole milk}       0.009862735  0.5739645 0.017183528 2.246296
## [51]  {pork,
##        root vegetables}          => {other vegetables} 0.007015760  0.5149254 0.013624809 2.661214
## [52]  {pork,
##        rolls/buns}               => {other vegetables} 0.005592272  0.4954955 0.011286223 2.560798
## [53]  {pork,
##        rolls/buns}               => {whole milk}       0.006202339  0.5495495 0.011286223 2.150744
## [54]  {pork,
##        whole milk}               => {other vegetables} 0.010167768  0.4587156 0.022165735 2.370714
## [55]  {frankfurter,
##        tropical fruit}           => {whole milk}       0.005185562  0.5483871 0.009456024 2.146195
## [56]  {frankfurter,
##        yogurt}                   => {whole milk}       0.006202339  0.5545455 0.011184545 2.170296
## [57]  {bottled beer,
##        yogurt}                   => {whole milk}       0.005185562  0.5604396 0.009252669 2.193364
## [58]  {brown bread,
##        tropical fruit}           => {whole milk}       0.005693950  0.5333333 0.010676157 2.087279
## [59]  {brown bread,
##        root vegetables}          => {whole milk}       0.005693950  0.5600000 0.010167768 2.191643
## [60]  {domestic eggs,
##        margarine}                => {whole milk}       0.005185562  0.6219512 0.008337570 2.434099
## [61]  {margarine,
##        root vegetables}          => {other vegetables} 0.005897306  0.5321101 0.011082867 2.750028
## [62]  {margarine,
##        rolls/buns}               => {whole milk}       0.007930859  0.5379310 0.014743264 2.105273
## [63]  {butter,
##        domestic eggs}            => {whole milk}       0.005998983  0.6210526 0.009659380 2.430582
## [64]  {butter,
##        whipped/sour cream}       => {other vegetables} 0.005795628  0.5700000 0.010167768 2.945849
## [65]  {butter,
##        whipped/sour cream}       => {whole milk}       0.006710727  0.6600000 0.010167768 2.583008
## [66]  {butter,
##        citrus fruit}             => {whole milk}       0.005083884  0.5555556 0.009150991 2.174249
## [67]  {bottled water,
##        butter}                   => {whole milk}       0.005388917  0.6022727 0.008947636 2.357084
## [68]  {butter,
##        tropical fruit}           => {other vegetables} 0.005490595  0.5510204 0.009964413 2.847759
## [69]  {butter,
##        tropical fruit}           => {whole milk}       0.006202339  0.6224490 0.009964413 2.436047
## [70]  {butter,
##        root vegetables}          => {other vegetables} 0.006609049  0.5118110 0.012913066 2.645119
```

```
## [71]  {butter,
##        root vegetables}          => {whole milk}       0.008235892  0.6377953 0.012913066 2.496107
## [72]  {butter,
##        yogurt}                   => {other vegetables} 0.006405694  0.4375000 0.014641586 2.261068
## [73]  {butter,
##        yogurt}                   => {whole milk}       0.009354347  0.6388889 0.014641586 2.500387
## [74]  {butter,
##        rolls/buns}               => {other vegetables} 0.005693950  0.4242424 0.013421454 2.192551
## [75]  {butter,
##        other vegetables}         => {whole milk}       0.011489578  0.5736041 0.020030503 2.244885
## [76]  {butter,
##        whole milk}               => {other vegetables} 0.011489578  0.4169742 0.027554652 2.154987
## [77]  {newspapers,
##        root vegetables}          => {other vegetables} 0.005998983  0.5221239 0.011489578 2.698417
## [78]  {domestic eggs,
##        whipped/sour cream}       => {other vegetables} 0.005083884  0.5102041 0.009964413 2.636814
## [79]  {domestic eggs,
##        whipped/sour cream}       => {whole milk}       0.005693950  0.5714286 0.009964413 2.236371
## [80]  {domestic eggs,
##        pip fruit}                => {whole milk}       0.005388917  0.6235294 0.008642603 2.440275
## [81]  {citrus fruit,
##        domestic eggs}            => {whole milk}       0.005693950  0.5490196 0.010371124 2.148670
## [82]  {domestic eggs,
##        tropical fruit}           => {whole milk}       0.006914082  0.6071429 0.011387900 2.376144
## [83]  {domestic eggs,
##        root vegetables}          => {other vegetables} 0.007320793  0.5106383 0.014336553 2.639058
## [84]  {domestic eggs,
##        root vegetables}          => {whole milk}       0.008540925  0.5957447 0.014336553 2.331536
## [85]  {domestic eggs,
##        soda}                     => {other vegetables} 0.005083884  0.4098361 0.012404677 2.118097
## [86]  {domestic eggs,
##        yogurt}                   => {other vegetables} 0.005795628  0.4042553 0.014336553 2.089254
## [87]  {domestic eggs,
##        yogurt}                   => {whole milk}       0.007727504  0.5390071 0.014336553 2.109485
## [88]  {domestic eggs,
##        other vegetables}         => {whole milk}       0.012302999  0.5525114 0.022267412 2.162336
## [89]  {domestic eggs,
##        whole milk}               => {other vegetables} 0.012302999  0.4101695 0.029994916 2.119820
## [90]  {fruit/vegetable juice,
##        tropical fruit}           => {other vegetables} 0.006609049  0.4814815 0.013726487 2.488371
## [91]  {fruit/vegetable juice,
##        root vegetables}          => {other vegetables} 0.006609049  0.5508475 0.011997966 2.846865
## [92]  {fruit/vegetable juice,
##        root vegetables}          => {whole milk}       0.006507372  0.5423729 0.011997966 2.122657
## [93]  {fruit/vegetable juice,
##        yogurt}                   => {other vegetables} 0.008235892  0.4402174 0.018708693 2.275112
## [94]  {pip fruit,
##        whipped/sour cream}       => {other vegetables} 0.005592272  0.6043956 0.009252669 3.123610
## [95]  {pip fruit,
##        whipped/sour cream}       => {whole milk}       0.005998983  0.6483516 0.009252669 2.537421
## [96]  {citrus fruit,
##        whipped/sour cream}       => {other vegetables} 0.005693950  0.5233645 0.010879512 2.704829
## [97]  {citrus fruit,
##        whipped/sour cream}       => {whole milk}       0.006304016  0.5794393 0.010879512 2.267722
```

```
## [98]  {sausage,
##        whipped/sour cream}        => {whole milk}       0.005083884  0.5617978 0.009049314 2.198679
## [99]  {tropical fruit,
##        whipped/sour cream}        => {yogurt}           0.006202339  0.4485294 0.013828165 3.215224
## [100] {tropical fruit,
##        whipped/sour cream}        => {other vegetables} 0.007829181  0.5661765 0.013828165 2.926088
## [101] {tropical fruit,
##        whipped/sour cream}        => {whole milk}       0.007930859  0.5735294 0.013828165 2.244593
## [102] {root vegetables,
##        whipped/sour cream}        => {other vegetables} 0.008540925  0.5000000 0.017081851 2.584078
## [103] {root vegetables,
##        whipped/sour cream}        => {whole milk}       0.009456024  0.5535714 0.017081851 2.166484
## [104] {whipped/sour cream,
##        yogurt}                    => {other vegetables} 0.010167768  0.4901961 0.020742247 2.533410
## [105] {whipped/sour cream,
##        yogurt}                    => {whole milk}       0.010879512  0.5245098 0.020742247 2.052747
## [106] {rolls/buns,
##        whipped/sour cream}        => {other vegetables} 0.006710727  0.4583333 0.014641586 2.368738
## [107] {rolls/buns,
##        whipped/sour cream}        => {whole milk}       0.007829181  0.5347222 0.014641586 2.092715
## [108] {whipped/sour cream,
##        whole milk}                => {other vegetables} 0.014641586  0.4542587 0.032231825 2.347679
## [109] {citrus fruit,
##        pip fruit}                 => {tropical fruit}   0.005592272  0.4044118 0.013828165 3.854060
## [110] {citrus fruit,
##        pip fruit}                 => {other vegetables} 0.005897306  0.4264706 0.013828165 2.204066
## [111] {pip fruit,
##        sausage}                   => {whole milk}       0.005592272  0.5188679 0.010777834 2.030667
## [112] {pip fruit,
##        tropical fruit}            => {other vegetables} 0.009456024  0.4626866 0.020437214 2.391236
## [113] {pip fruit,
##        root vegetables}           => {other vegetables} 0.008134215  0.5228758 0.015556685 2.702304
## [114] {pip fruit,
##        root vegetables}           => {whole milk}       0.008947636  0.5751634 0.015556685 2.250988
## [115] {pip fruit,
##        yogurt}                    => {other vegetables} 0.008134215  0.4519774 0.017996950 2.335890
## [116] {pip fruit,
##        yogurt}                    => {whole milk}       0.009557702  0.5310734 0.017996950 2.078435
## [117] {other vegetables,
##        pip fruit}                 => {whole milk}       0.013523132  0.5175097 0.026131164 2.025351
## [118] {pip fruit,
##        whole milk}                => {other vegetables} 0.013523132  0.4493243 0.030096594 2.322178
## [119] {pastry,
##        root vegetables}           => {other vegetables} 0.005897306  0.5370370 0.010981190 2.775491
## [120] {pastry,
##        root vegetables}           => {whole milk}       0.005693950  0.5185185 0.010981190 2.029299
## [121] {pastry,
##        yogurt}                    => {whole milk}       0.009150991  0.5172414 0.017691917 2.024301
## [122] {citrus fruit,
##        tropical fruit}            => {other vegetables} 0.009049314  0.4540816 0.019928826 2.346765
## [123] {citrus fruit,
##        root vegetables}           => {other vegetables} 0.010371124  0.5862069 0.017691917 3.029608
## [124] {citrus fruit,
##        root vegetables}           => {whole milk}       0.009150991  0.5172414 0.017691917 2.024301
```

```
## [125] {citrus fruit,
##        whole milk}               => {other vegetables} 0.013014743  0.4266667 0.030503305 2.205080
## [126] {root vegetables,
##        shopping bags}            => {other vegetables} 0.006609049  0.5158730 0.012811388 2.666112
## [127] {bottled water,
##        sausage}                  => {other vegetables} 0.005083884  0.4237288 0.011997966 2.189896
## [128] {sausage,
##        tropical fruit}           => {other vegetables} 0.005998983  0.4306569 0.013929842 2.225702
## [129] {sausage,
##        tropical fruit}           => {whole milk}       0.007219115  0.5182482 0.013929842 2.028241
## [130] {root vegetables,
##        sausage}                  => {other vegetables} 0.006812405  0.4557823 0.014946619 2.355554
## [131] {root vegetables,
##        sausage}                  => {whole milk}       0.007727504  0.5170068 0.014946619 2.023383
## [132] {sausage,
##        yogurt}                   => {other vegetables} 0.008134215  0.4145078 0.019623793 2.142241
## [133] {bottled water,
##        root vegetables}          => {other vegetables} 0.007015760  0.4480519 0.015658363 2.315602
## [134] {root vegetables,
##        tropical fruit}           => {other vegetables} 0.012302999  0.5845411 0.021047280 3.020999
## [135] {root vegetables,
##        tropical fruit}           => {whole milk}       0.011997966  0.5700483 0.021047280 2.230969
## [136] {tropical fruit,
##        yogurt}                   => {other vegetables} 0.012302999  0.4201389 0.029283172 2.171343
## [137] {tropical fruit,
##        yogurt}                   => {whole milk}       0.015149975  0.5173611 0.029283172 2.024770
## [138] {tropical fruit,
##        whole milk}               => {other vegetables} 0.017081851  0.4038462 0.042297916 2.087140
## [139] {root vegetables,
##        soda}                     => {other vegetables} 0.008235892  0.4426230 0.018607016 2.287544
## [140] {root vegetables,
##        yogurt}                   => {other vegetables} 0.012913066  0.5000000 0.025826131 2.584078
## [141] {root vegetables,
##        yogurt}                   => {whole milk}       0.014539908  0.5629921 0.025826131 2.203354
## [142] {rolls/buns,
##        root vegetables}          => {other vegetables} 0.012201322  0.5020921 0.024300966 2.594890
## [143] {rolls/buns,
##        root vegetables}          => {whole milk}       0.012709710  0.5230126 0.024300966 2.046888
## [144] {root vegetables,
##        whole milk}               => {other vegetables} 0.023182511  0.4740125 0.048906965 2.449770
## [145] {other vegetables,
##        yogurt}                   => {whole milk}       0.022267412  0.5128806 0.043416370 2.007235
## [146] {fruit/vegetable juice,
##        other vegetables,
##        yogurt}                   => {whole milk}       0.005083884  0.6172840 0.008235892 2.415833
## [147] {fruit/vegetable juice,
##        whole milk,
##        yogurt}                   => {other vegetables} 0.005083884  0.5376344 0.009456024 2.778578
## [148] {fruit/vegetable juice,
##        other vegetables,
##        whole milk}               => {yogurt}           0.005083884  0.4854369 0.010472801 3.479790
## [149] {other vegetables,
##        root vegetables,
##        whipped/sour cream}       => {whole milk}       0.005185562  0.6071429 0.008540925 2.376144
```

```
## [150] {root vegetables,
##        whipped/sour cream,
##        whole milk}               => {other vegetables} 0.005185562  0.5483871 0.009456024 2.834150
## [151] {other vegetables,
##        whipped/sour cream,
##        yogurt}                   => {whole milk}       0.005592272  0.5500000 0.010167768 2.152507
## [152] {whipped/sour cream,
##        whole milk,
##        yogurt}                   => {other vegetables} 0.005592272  0.5140187 0.010879512 2.656529
## [153] {other vegetables,
##        pip fruit,
##        root vegetables}          => {whole milk}       0.005490595  0.6750000 0.008134215 2.641713
## [154] {pip fruit,
##        root vegetables,
##        whole milk}               => {other vegetables} 0.005490595  0.6136364 0.008947636 3.171368
## [155] {other vegetables,
##        pip fruit,
##        whole milk}               => {root vegetables}  0.005490595  0.4060150 0.013523132 3.724961
## [156] {other vegetables,
##        pip fruit,
##        yogurt}                   => {whole milk}       0.005083884  0.6250000 0.008134215 2.446031
## [157] {pip fruit,
##        whole milk,
##        yogurt}                   => {other vegetables} 0.005083884  0.5319149 0.009557702 2.749019
## [158] {citrus fruit,
##        other vegetables,
##        root vegetables}          => {whole milk}       0.005795628  0.5588235 0.010371124 2.187039
## [159] {citrus fruit,
##        root vegetables,
##        whole milk}               => {other vegetables} 0.005795628  0.6333333 0.009150991 3.273165
## [160] {citrus fruit,
##        other vegetables,
##        whole milk}               => {root vegetables}  0.005795628  0.4453125 0.013014743 4.085493
## [161] {root vegetables,
##        tropical fruit,
##        yogurt}                   => {whole milk}       0.005693950  0.7000000 0.008134215 2.739554
## [162] {root vegetables,
##        tropical fruit,
##        whole milk}               => {yogurt}           0.005693950  0.4745763 0.011997966 3.401937
## [163] {other vegetables,
##        root vegetables,
##        tropical fruit}           => {whole milk}       0.007015760  0.5702479 0.012302999 2.231750
## [164] {root vegetables,
##        tropical fruit,
##        whole milk}               => {other vegetables} 0.007015760  0.5847458 0.011997966 3.022057
## [165] {other vegetables,
##        tropical fruit,
##        whole milk}               => {root vegetables}  0.007015760  0.4107143 0.017081851 3.768074
## [166] {other vegetables,
##        tropical fruit,
##        yogurt}                   => {whole milk}       0.007625826  0.6198347 0.012302999 2.425816
## [167] {tropical fruit,
##        whole milk,
##        yogurt}                   => {other vegetables} 0.007625826  0.5033557 0.015149975 2.601421
```

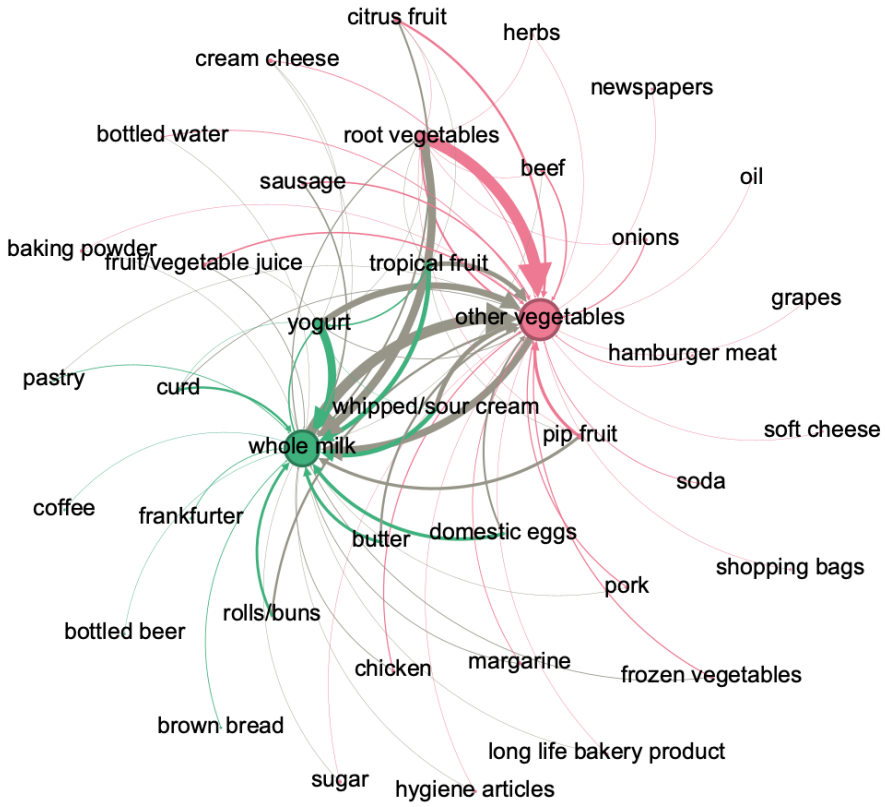
```
## [168] {other vegetables,
##        tropical fruit,
##        whole milk}                => {yogurt}           0.007625826  0.4464286 0.017081851 3.200164
## [169] {other vegetables,
##        root vegetables,
##        yogurt}                    => {whole milk}       0.007829181  0.6062992 0.012913066 2.372842
## [170] {root vegetables,
##        whole milk,
##        yogurt}                    => {other vegetables} 0.007829181  0.5384615 0.014539908 2.782853
## [171] {rolls/buns,
##        root vegetables,
##        whole milk}                => {other vegetables} 0.006202339  0.4880000 0.012709710 2.522060
## [172] {other vegetables,
##        rolls/buns,
##        yogurt}                    => {whole milk}       0.005998983  0.5221239 0.011489578 2.043410
```

172 rules.

Lets plot the graph to visualize associations

```
grocery_graph = associations2igraph(subset(m, subset=lift >2 & confidence >=0.4), associationsAsNodes =
igraph::write_graph(grocery_graph, file='grocery_vis.graphml', format = "graphml")
```

Association



Findings:

1. As seen from the bar plot earlier, whole milk and other vegetables are the most bought items (high degree).
2. We can see two clusters here-one centered around "whole milk" and other centered around "other vegetables". Purchase of other items often lead to purchase of these items.
3. Probability of purchasing Whole milk increases when there is purchase of yogurt, curd,rolls/buns.
4. Probability of purchasing other vegetables increase when people purchase root vegetables or fruits (pip fruits/tropical fruits/citrus fruits)
5. We can see that there is association between purchase of "whole milk" and other **dairy products** like yogurt, curd, butter while "other vegetables: is mainly associated with purchase of **fresh produce** like fruits and vegetables and items like beef and pork.