Final\_ARM

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## Code for final Project

### Setting working directory for my data sets

setwd("C:/Users/nicktinsley/OneDrive/Syracuse/R code/IST 707/data/finalProject")

### Loading Libraries for our discovery

library(arules)

## Loading required package: Matrix

##   
## Attaching package: 'arules'

## The following objects are masked from 'package:base':  
##   
## abbreviate, write

library(arulesViz)  
library(plyr)  
library(dplyr)

##   
## Attaching package: 'dplyr'

## The following objects are masked from 'package:plyr':  
##   
## arrange, count, desc, failwith, id, mutate, rename, summarise,  
## summarize

## The following objects are masked from 'package:arules':  
##   
## intersect, recode, setdiff, setequal, union

## The following objects are masked from 'package:stats':  
##   
## filter, lag

## The following objects are masked from 'package:base':  
##   
## intersect, setdiff, setequal, union

library(funModeling)

## Loading required package: Hmisc

## Loading required package: lattice

## Loading required package: survival

## Loading required package: Formula

## Loading required package: ggplot2

##   
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:dplyr':  
##   
## src, summarize

## The following objects are masked from 'package:plyr':  
##   
## is.discrete, summarize

## The following objects are masked from 'package:base':  
##   
## format.pval, units

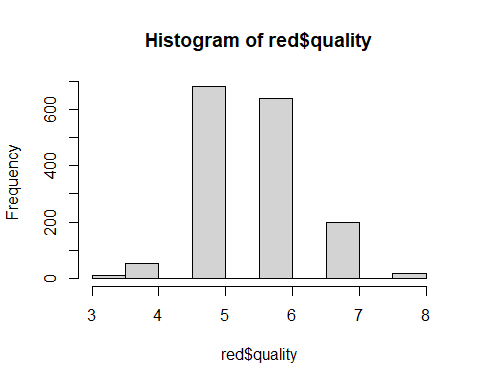
## funModeling v.1.9.4 :)  
## Examples and tutorials at livebook.datascienceheroes.com  
## / Now in Spanish: librovivodecienciadedatos.ai

### Load data sets

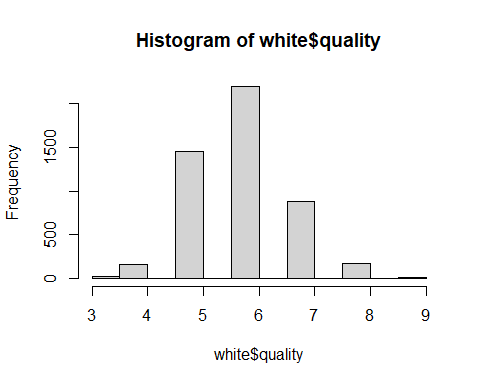
red <- read.csv2("red.csv")  
white <- read.csv2("white.csv")

### Viewing Data

View(red[red$quality > 5,])  
  
hist(red$quality)



hist(white$quality)



### Discretize Categories

##quality 5 - 7 mid ##quality < 5 low ##quality > 7 high

### Munge data set

1. Convert char to factor

red <- red %>% mutate\_if(is.character, funs(as.factor))

## Warning: `funs()` was deprecated in dplyr 0.8.0.  
## Please use a list of either functions or lambdas:   
##   
## # Simple named list:   
## list(mean = mean, median = median)  
##   
## # Auto named with `tibble::lst()`:   
## tibble::lst(mean, median)  
##   
## # Using lambdas  
## list(~ mean(., trim = .2), ~ median(., na.rm = TRUE))  
## This warning is displayed once every 8 hours.  
## Call `lifecycle::last\_lifecycle\_warnings()` to see where this warning was generated.

str(red)

## 'data.frame': 1599 obs. of 12 variables:  
## $ fixed.acidity : Factor w/ 96 levels "10","10.1","10.2",..: 71 75 75 13 71 71 76 70 75 72 ...  
## $ volatile.acidity : Factor w/ 143 levels "0.12","0.16",..: 77 113 89 13 77 69 57 67 53 42 ...  
## $ citric.acid : Factor w/ 80 levels "0","0.01","0.02",..: 1 1 5 57 1 1 7 1 3 37 ...  
## $ residual.sugar : Factor w/ 91 levels "0.9","1.2","1.3",..: 11 31 26 11 11 10 6 2 20 73 ...  
## $ chlorides : Factor w/ 153 levels "0.012","0.034",..: 40 62 56 39 40 39 33 29 37 35 ...  
## $ free.sulfur.dioxide : Factor w/ 60 levels "1","10","11",..: 3 18 7 9 3 5 7 7 60 9 ...  
## $ total.sulfur.dioxide: Factor w/ 144 levels "10","100","101",..: 75 109 95 102 75 81 100 60 57 4 ...  
## $ density : Factor w/ 436 levels "0.99007","0.9902",..: 343 272 288 355 343 343 240 101 272 343 ...  
## $ pH : Factor w/ 89 levels "2.74","2.86",..: 64 33 39 29 64 64 43 52 49 48 ...  
## $ sulphates : Factor w/ 96 levels "0.33","0.37",..: 19 31 28 21 19 19 9 10 20 43 ...  
## $ alcohol : Factor w/ 65 levels "10","10.0333333333333",..: 57 63 63 63 57 57 57 1 58 7 ...  
## $ quality : int 5 5 5 6 5 5 5 7 7 5 ...

white <- white %>% mutate\_if(is.character, funs(as.factor))  
str(white)

## 'data.frame': 4898 obs. of 12 variables:  
## $ fixed.acidity : Factor w/ 68 levels "10","10.2","10.3",..: 38 30 50 41 41 50 29 38 30 50 ...  
## $ volatile.acidity : Factor w/ 125 levels "0.08","0.085",..: 37 43 39 29 29 39 47 37 43 27 ...  
## $ citric.acid : Factor w/ 87 levels "0","0.01","0.02",..: 37 35 41 33 33 41 17 37 35 44 ...  
## $ residual.sugar : Factor w/ 310 levels "0.6","0.7","0.8",..: 190 18 258 286 286 258 261 190 18 16 ...  
## $ chlorides : Factor w/ 160 levels "0.009","0.012",..: 35 39 40 48 48 40 35 35 39 34 ...  
## $ free.sulfur.dioxide : Factor w/ 132 levels "10","101","105",..: 66 17 41 68 68 41 41 66 17 36 ...  
## $ total.sulfur.dioxide: Factor w/ 251 levels "10","100","101",..: 76 36 249 94 94 249 40 76 36 32 ...  
## $ density : Factor w/ 890 levels "0.98711","0.98713",..: 879 472 561 602 602 561 545 879 472 454 ...  
## $ pH : Factor w/ 103 levels "2.72","2.74",..: 24 54 50 43 43 50 42 24 54 46 ...  
## $ sulphates : Factor w/ 79 levels "0.22","0.23",..: 23 27 22 18 18 22 25 23 27 23 ...  
## $ alcohol : Factor w/ 104 levels "10","10.0333333333333",..: 88 95 3 104 104 3 98 88 95 22 ...  
## $ quality : int 6 6 6 6 6 6 6 6 6 6 ...

1. Discretize the quality attribute

red$quality\_disc <- cut(red$quality, breaks = c(0,4,6,Inf),  
 labels=c("low","mid","high"))  
  
table(red$quality, red$quality\_disc)

##   
## low mid high  
## 3 10 0 0  
## 4 53 0 0  
## 5 0 681 0  
## 6 0 638 0  
## 7 0 0 199  
## 8 0 0 18

white$quality\_disc <- cut(white$quality, breaks = c(0,4,6,Inf),  
 labels=c("low","mid","high"))  
  
table(white$quality, white$quality\_disc)

##   
## low mid high  
## 3 20 0 0  
## 4 163 0 0  
## 5 0 1457 0  
## 6 0 2198 0  
## 7 0 0 880  
## 8 0 0 175  
## 9 0 0 5

3 . Remove quality attribute so it does not create unecesarry rules

red <- red %>% select(-quality)  
white <- white %>% select(-quality)

1. Create one data set for all wines to see if rules for each compare with combined DS

red\_white <- rbind(red,white)

### Create some rules for discovery

* Red Wine Rules

rules\_highQ <- apriori(data=red, parameter = list(supp=0.001, conf=0.08,minlen=2),  
 appearance = list(default="rhs",lhs="quality\_disc=high"),  
 control=list(verbose=T))

## Apriori  
##   
## Parameter specification:  
## confidence minval smax arem aval originalSupport maxtime support minlen  
## 0.08 0.1 1 none FALSE TRUE 5 0.001 2  
## 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: 1   
##   
## set item appearances ...[1 item(s)] done [0.00s].  
## set transactions ...[1456 item(s), 1599 transaction(s)] done [0.01s].  
## sorting and recoding items ... [1094 item(s)] done [0.00s].  
## creating transaction tree ... done [0.00s].  
## checking subsets of size 1 2 done [0.00s].  
## writing ... [5 rule(s)] done [0.00s].  
## creating S4 object ... done [0.00s].

rules\_highQ <- sort(rules\_highQ, decreasing = T, by = "lift")  
inspect(rules\_highQ)

## lhs rhs support confidence  
## [1] {quality\_disc=high} => {residual.sugar=2.4} 0.01313321 0.09677419  
## [2] {quality\_disc=high} => {free.sulfur.dioxide=6} 0.01876173 0.13824885  
## [3] {quality\_disc=high} => {residual.sugar=1.8} 0.01313321 0.09677419  
## [4] {quality\_disc=high} => {residual.sugar=2.1} 0.01125704 0.08294931  
## [5] {quality\_disc=high} => {residual.sugar=2.2} 0.01125704 0.08294931  
## coverage lift count  
## [1] 0.1357098 1.799325 21   
## [2] 0.1357098 1.601883 30   
## [3] 0.1357098 1.199550 21   
## [4] 0.1357098 1.036218 18   
## [5] 0.1357098 1.012488 18

#mid   
rules\_midQ <- apriori(data=red, parameter = list(supp=0.001, conf=0.08,minlen=2),  
 appearance = list(default="rhs",lhs="quality\_disc=mid"),  
 control=list(verbose=T))

## Apriori  
##   
## Parameter specification:  
## confidence minval smax arem aval originalSupport maxtime support minlen  
## 0.08 0.1 1 none FALSE TRUE 5 0.001 2  
## 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: 1   
##   
## set item appearances ...[1 item(s)] done [0.00s].  
## set transactions ...[1456 item(s), 1599 transaction(s)] done [0.01s].  
## sorting and recoding items ... [1094 item(s)] done [0.00s].  
## creating transaction tree ... done [0.00s].  
## checking subsets of size 1 2 done [0.00s].  
## writing ... [5 rule(s)] done [0.00s].  
## creating S4 object ... done [0.00s].

rules\_midQ <- sort(rules\_midQ, decreasing = T, by = "lift")  
inspect(rules\_midQ)

## lhs rhs support confidence coverage   
## [1] {quality\_disc=mid} => {alcohol=9.5} 0.08567855 0.10386657 0.8248906  
## [2] {quality\_disc=mid} => {residual.sugar=1.9} 0.06816760 0.08263836 0.8248906  
## [3] {quality\_disc=mid} => {residual.sugar=2} 0.08505316 0.10310842 0.8248906  
## [4] {quality\_disc=mid} => {citric.acid=0} 0.06941839 0.08415466 0.8248906  
## [5] {quality\_disc=mid} => {residual.sugar=2.2} 0.06629143 0.08036391 0.8248906  
## lift count  
## [1] 1.1948391 137   
## [2] 1.1293910 109   
## [3] 1.0568613 136   
## [4] 1.0194190 111   
## [5] 0.9809305 106

#low  
rules\_lowQ <- apriori(data=red, parameter = list(supp=0.001, conf=0.08,minlen=2),  
 appearance = list(default="rhs",lhs="quality\_disc=low"),  
 control=list(verbose=T))

## Apriori  
##   
## Parameter specification:  
## confidence minval smax arem aval originalSupport maxtime support minlen  
## 0.08 0.1 1 none FALSE TRUE 5 0.001 2  
## 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: 1   
##   
## set item appearances ...[1 item(s)] done [0.00s].  
## set transactions ...[1456 item(s), 1599 transaction(s)] done [0.01s].  
## sorting and recoding items ... [1094 item(s)] done [0.00s].  
## creating transaction tree ... done [0.00s].  
## checking subsets of size 1 2 done [0.00s].  
## writing ... [9 rule(s)] done [0.00s].  
## creating S4 object ... done [0.00s].

rules\_lowQ <- sort(rules\_lowQ, decreasing = T, by = "lift")  
inspect(rules\_lowQ)

## lhs rhs support confidence  
## [1] {quality\_disc=low} => {total.sulfur.dioxide=14} 0.003752345 0.0952381   
## [2] {quality\_disc=low} => {sulphates=0.57} 0.003752345 0.0952381   
## [3] {quality\_disc=low} => {alcohol=9.6} 0.003752345 0.0952381   
## [4] {quality\_disc=low} => {citric.acid=0} 0.008130081 0.2063492   
## [5] {quality\_disc=low} => {residual.sugar=2.1} 0.006879300 0.1746032   
## [6] {quality\_disc=low} => {free.sulfur.dioxide=5} 0.005003127 0.1269841   
## [7] {quality\_disc=low} => {free.sulfur.dioxide=6} 0.005628518 0.1428571   
## [8] {quality\_disc=low} => {residual.sugar=2.2} 0.004377736 0.1111111   
## [9] {quality\_disc=low} => {residual.sugar=2} 0.003752345 0.0952381   
## coverage lift count  
## [1] 0.03939962 4.6147186 6   
## [2] 0.03939962 2.7688312 6   
## [3] 0.03939962 2.5811138 6   
## [4] 0.03939962 2.4996392 13   
## [5] 0.03939962 2.1811756 11   
## [6] 0.03939962 1.9523810 8   
## [7] 0.03939962 1.6552795 9   
## [8] 0.03939962 1.3562341 7   
## [9] 0.03939962 0.9761905 6

* White Wine Rules

rules\_wht <- apriori(white, parameter=list(supp=0.001, conf=0.9, maxlen=4))

## Apriori  
##   
## Parameter specification:  
## confidence minval smax arem aval originalSupport maxtime support minlen  
## 0.9 0.1 1 none FALSE TRUE 5 0.001 1  
## maxlen target ext  
## 4 rules TRUE  
##   
## Algorithmic control:  
## filter tree heap memopt load sort verbose  
## 0.1 TRUE TRUE FALSE TRUE 2 TRUE  
##   
## Absolute minimum support count: 4   
##   
## set item appearances ...[0 item(s)] done [0.00s].  
## set transactions ...[2312 item(s), 4898 transaction(s)] done [0.02s].  
## sorting and recoding items ... [1127 item(s)] done [0.00s].  
## creating transaction tree ... done [0.00s].  
## checking subsets of size 1 2 3 4

## Warning in apriori(white, parameter = list(supp = 0.001, conf = 0.9, maxlen  
## = 4)): Mining stopped (maxlen reached). Only patterns up to a length of 4  
## returned!

## done [0.04s].  
## writing ... [33152 rule(s)] done [0.02s].  
## creating S4 object ... done [0.01s].

rules\_wht <- sort(rules\_wht, decreasing = TRUE, by ="confidence")  
inspect(rules\_wht[1:50])

## lhs rhs support   
## [1] {density=0.99922} => {quality\_disc=mid} 0.001020825  
## [2] {citric.acid=0.69} => {quality\_disc=mid} 0.001020825  
## [3] {density=0.99815} => {pH=3.27} 0.001020825  
## [4] {density=0.99815} => {free.sulfur.dioxide=31} 0.001020825  
## [5] {density=0.99815} => {quality\_disc=mid} 0.001020825  
## [6] {volatile.acidity=0.62} => {quality\_disc=mid} 0.001020825  
## [7] {density=0.99398} => {quality\_disc=mid} 0.001020825  
## [8] {density=0.99152} => {quality\_disc=mid} 0.001020825  
## [9] {residual.sugar=16.7} => {quality\_disc=mid} 0.001020825  
## [10] {free.sulfur.dioxide=77} => {quality\_disc=mid} 0.001020825  
## [11] {free.sulfur.dioxide=76} => {quality\_disc=mid} 0.001020825  
## [12] {density=0.99596} => {quality\_disc=mid} 0.001020825  
## [13] {volatile.acidity=0.185} => {quality\_disc=mid} 0.001020825  
## [14] {citric.acid=0.05} => {quality\_disc=mid} 0.001020825  
## [15] {density=0.99306} => {quality\_disc=mid} 0.001020825  
## [16] {density=0.99266} => {quality\_disc=mid} 0.001020825  
## [17] {density=0.99368} => {quality\_disc=mid} 0.001020825  
## [18] {density=0.99676} => {quality\_disc=mid} 0.001020825  
## [19] {density=0.99692} => {quality\_disc=mid} 0.001020825  
## [20] {density=0.99566} => {quality\_disc=mid} 0.001020825  
## [21] {density=0.99907} => {residual.sugar=15.6} 0.001020825  
## [22] {density=0.99907} => {free.sulfur.dioxide=67} 0.001020825  
## [23] {density=0.99907} => {total.sulfur.dioxide=210} 0.001020825  
## [24] {density=0.99907} => {sulphates=0.68} 0.001020825  
## [25] {density=0.99907} => {pH=3.06} 0.001020825  
## [26] {density=0.99907} => {chlorides=0.049} 0.001020825  
## [27] {density=0.99907} => {volatile.acidity=0.33} 0.001020825  
## [28] {density=0.99907} => {fixed.acidity=7.4} 0.001020825  
## [29] {density=0.99907} => {citric.acid=0.26} 0.001020825  
## [30] {density=0.99907} => {alcohol=9.5} 0.001020825  
## [31] {density=0.99907} => {quality\_disc=mid} 0.001020825  
## [32] {residual.sugar=16.4} => {quality\_disc=mid} 0.001020825  
## [33] {density=0.99154} => {quality\_disc=mid} 0.001020825  
## [34] {density=0.99534} => {quality\_disc=mid} 0.001020825  
## [35] {total.sulfur.dioxide=231} => {quality\_disc=mid} 0.001020825  
## [36] {residual.sugar=16.65} => {quality\_disc=mid} 0.001020825  
## [37] {density=0.99428} => {quality\_disc=mid} 0.001020825  
## [38] {total.sulfur.dioxide=238} => {quality\_disc=mid} 0.001020825  
## [39] {density=0.99699} => {quality\_disc=mid} 0.001020825  
## [40] {density=0.99582} => {quality\_disc=mid} 0.001020825  
## [41] {citric.acid=0.73} => {quality\_disc=mid} 0.001020825  
## [42] {density=0.98936} => {quality\_disc=high} 0.001020825  
## [43] {chlorides=0.071} => {quality\_disc=mid} 0.001020825  
## [44] {pH=3.58} => {quality\_disc=mid} 0.001020825  
## [45] {density=0.99862} => {residual.sugar=16} 0.001020825  
## [46] {density=0.99862} => {total.sulfur.dioxide=113} 0.001020825  
## [47] {density=0.99862} => {citric.acid=0.2} 0.001020825  
## [48] {density=0.99862} => {fixed.acidity=5.7} 0.001020825  
## [49] {density=0.99862} => {alcohol=8.9} 0.001020825  
## [50] {density=0.99862} => {free.sulfur.dioxide=41} 0.001020825  
## confidence coverage lift count  
## [1] 1 0.001020825 1.340082 5   
## [2] 1 0.001020825 1.340082 5   
## [3] 1 0.001020825 55.659091 5   
## [4] 1 0.001020825 37.106061 5   
## [5] 1 0.001020825 1.340082 5   
## [6] 1 0.001020825 1.340082 5   
## [7] 1 0.001020825 1.340082 5   
## [8] 1 0.001020825 1.340082 5   
## [9] 1 0.001020825 1.340082 5   
## [10] 1 0.001020825 1.340082 5   
## [11] 1 0.001020825 1.340082 5   
## [12] 1 0.001020825 1.340082 5   
## [13] 1 0.001020825 1.340082 5   
## [14] 1 0.001020825 1.340082 5   
## [15] 1 0.001020825 1.340082 5   
## [16] 1 0.001020825 1.340082 5   
## [17] 1 0.001020825 1.340082 5   
## [18] 1 0.001020825 1.340082 5   
## [19] 1 0.001020825 1.340082 5   
## [20] 1 0.001020825 1.340082 5   
## [21] 1 0.001020825 349.857143 5   
## [22] 1 0.001020825 222.636364 5   
## [23] 1 0.001020825 212.956522 5   
## [24] 1 0.001020825 111.318182 5   
## [25] 1 0.001020825 42.591304 5   
## [26] 1 0.001020825 36.827068 5   
## [27] 1 0.001020825 36.552239 5   
## [28] 1 0.001020825 25.247423 5   
## [29] 1 0.001020825 22.365297 5   
## [30] 1 0.001020825 21.482456 5   
## [31] 1 0.001020825 1.340082 5   
## [32] 1 0.001020825 1.340082 5   
## [33] 1 0.001020825 1.340082 5   
## [34] 1 0.001020825 1.340082 5   
## [35] 1 0.001020825 1.340082 5   
## [36] 1 0.001020825 1.340082 5   
## [37] 1 0.001020825 1.340082 5   
## [38] 1 0.001020825 1.340082 5   
## [39] 1 0.001020825 1.340082 5   
## [40] 1 0.001020825 1.340082 5   
## [41] 1 0.001020825 1.340082 5   
## [42] 1 0.001020825 4.620755 5   
## [43] 1 0.001020825 1.340082 5   
## [44] 1 0.001020825 1.340082 5   
## [45] 1 0.001020825 489.800000 5   
## [46] 1 0.001020825 80.295082 5   
## [47] 1 0.001020825 69.971429 5   
## [48] 1 0.001020825 55.659091 5   
## [49] 1 0.001020825 51.557895 5   
## [50] 1 0.001020825 47.096154 5

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* Combined Red White Rules

rules\_redwht <- apriori(red\_white, parameter=list(supp=0.001, conf=0.9, maxlen=4))

## Apriori  
##   
## Parameter specification:  
## confidence minval smax arem aval originalSupport maxtime support minlen  
## 0.9 0.1 1 none FALSE TRUE 5 0.001 1  
## maxlen target ext  
## 4 rules TRUE  
##   
## Algorithmic control:  
## filter tree heap memopt load sort verbose  
## 0.1 TRUE TRUE FALSE TRUE 2 TRUE  
##   
## Absolute minimum support count: 6   
##   
## set item appearances ...[0 item(s)] done [0.00s].  
## set transactions ...[2655 item(s), 6497 transaction(s)] done [0.04s].  
## sorting and recoding items ... [1203 item(s)] done [0.00s].  
## creating transaction tree ... done [0.00s].  
## checking subsets of size 1 2 3 4

## Warning in apriori(red\_white, parameter = list(supp = 0.001, conf = 0.9, :  
## Mining stopped (maxlen reached). Only patterns up to a length of 4 returned!

## done [0.03s].  
## writing ... [12192 rule(s)] done [0.01s].  
## creating S4 object ... done [0.01s].

rules\_redwht <- sort(rules\_redwht, decreasing = T, by="confidence")  
inspect(rules\_redwht[1:50])

## lhs rhs support   
## [1] {density=0.99718} => {quality\_disc=mid} 0.001077420  
## [2] {density=0.99746} => {quality\_disc=mid} 0.001077420  
## [3] {total.sulfur.dioxide=234} => {quality\_disc=mid} 0.001077420  
## [4] {density=0.99754} => {quality\_disc=mid} 0.001077420  
## [5] {chlorides=0.112} => {quality\_disc=mid} 0.001077420  
## [6] {density=0.99551} => {quality\_disc=mid} 0.001077420  
## [7] {chlorides=0.157} => {quality\_disc=mid} 0.001077420  
## [8] {total.sulfur.dioxide=220} => {quality\_disc=mid} 0.001077420  
## [9] {free.sulfur.dioxide=72} => {quality\_disc=mid} 0.001077420  
## [10] {density=0.99545} => {quality\_disc=mid} 0.001077420  
## [11] {total.sulfur.dioxide=240} => {quality\_disc=mid} 0.001077420  
## [12] {density=0.99976} => {quality\_disc=mid} 0.001077420  
## [13] {density=0.99815} => {quality\_disc=mid} 0.001077420  
## [14] {total.sulfur.dioxide=222} => {quality\_disc=mid} 0.001077420  
## [15] {density=0.99675} => {quality\_disc=mid} 0.001077420  
## [16] {residual.sugar=16.3} => {quality\_disc=mid} 0.001077420  
## [17] {density=0.9985} => {quality\_disc=mid} 0.001077420  
## [18] {density=0.99562} => {quality\_disc=mid} 0.001077420  
## [19] {volatile.acidity=0.335} => {quality\_disc=mid} 0.001077420  
## [20] {density=0.99296} => {quality\_disc=mid} 0.001077420  
## [21] {chlorides=0.117} => {quality\_disc=mid} 0.001077420  
## [22] {chlorides=0.111} => {quality\_disc=mid} 0.001077420  
## [23] {density=0.99946} => {quality\_disc=mid} 0.001077420  
## [24] {free.sulfur.dioxide=48.5} => {residual.sugar=12.8} 0.001077420  
## [25] {free.sulfur.dioxide=48.5} => {density=0.9986} 0.001077420  
## [26] {free.sulfur.dioxide=48.5} => {chlorides=0.053} 0.001077420  
## [27] {free.sulfur.dioxide=48.5} => {alcohol=9.1} 0.001077420  
## [28] {free.sulfur.dioxide=48.5} => {volatile.acidity=0.19} 0.001077420  
## [29] {free.sulfur.dioxide=48.5} => {pH=3.14} 0.001077420  
## [30] {free.sulfur.dioxide=48.5} => {sulphates=0.49} 0.001077420  
## [31] {free.sulfur.dioxide=48.5} => {fixed.acidity=7.4} 0.001077420  
## [32] {free.sulfur.dioxide=48.5} => {citric.acid=0.3} 0.001077420  
## [33] {free.sulfur.dioxide=48.5} => {quality\_disc=high} 0.001077420  
## [34] {density=0.99596} => {quality\_disc=mid} 0.001077420  
## [35] {alcohol=13.7} => {quality\_disc=high} 0.001077420  
## [36] {density=0.99244} => {quality\_disc=mid} 0.001231338  
## [37] {total.sulfur.dioxide=211} => {quality\_disc=mid} 0.001231338  
## [38] {density=0.99884} => {quality\_disc=mid} 0.001231338  
## [39] {density=0.99544} => {quality\_disc=mid} 0.001231338  
## [40] {density=0.99388} => {quality\_disc=mid} 0.001231338  
## [41] {density=0.99807} => {residual.sugar=13.9} 0.001231338  
## [42] {density=0.99807} => {pH=2.94} 0.001231338  
## [43] {density=0.99807} => {total.sulfur.dioxide=155} 0.001231338  
## [44] {density=0.99807} => {chlorides=0.057} 0.001231338  
## [45] {density=0.99807} => {free.sulfur.dioxide=45} 0.001231338  
## [46] {density=0.99807} => {alcohol=8.8} 0.001231338  
## [47] {density=0.99807} => {sulphates=0.41} 0.001231338  
## [48] {density=0.99807} => {volatile.acidity=0.19} 0.001231338  
## [49] {density=0.99807} => {fixed.acidity=7.3} 0.001231338  
## [50] {density=0.99807} => {citric.acid=0.27} 0.001231338  
## confidence coverage lift count  
## [1] 1 0.001077420 1.306192 7   
## [2] 1 0.001077420 1.306192 7   
## [3] 1 0.001077420 1.306192 7   
## [4] 1 0.001077420 1.306192 7   
## [5] 1 0.001077420 1.306192 7   
## [6] 1 0.001077420 1.306192 7   
## [7] 1 0.001077420 1.306192 7   
## [8] 1 0.001077420 1.306192 7   
## [9] 1 0.001077420 1.306192 7   
## [10] 1 0.001077420 1.306192 7   
## [11] 1 0.001077420 1.306192 7   
## [12] 1 0.001077420 1.306192 7   
## [13] 1 0.001077420 1.306192 7   
## [14] 1 0.001077420 1.306192 7   
## [15] 1 0.001077420 1.306192 7   
## [16] 1 0.001077420 1.306192 7   
## [17] 1 0.001077420 1.306192 7   
## [18] 1 0.001077420 1.306192 7   
## [19] 1 0.001077420 1.306192 7   
## [20] 1 0.001077420 1.306192 7   
## [21] 1 0.001077420 1.306192 7   
## [22] 1 0.001077420 1.306192 7   
## [23] 1 0.001077420 1.306192 7   
## [24] 1 0.001077420 259.880000 7   
## [25] 1 0.001077420 106.508197 7   
## [26] 1 0.001077420 48.125926 7   
## [27] 1 0.001077420 38.904192 7   
## [28] 1 0.001077420 37.773256 7   
## [29] 1 0.001077420 33.663212 7   
## [30] 1 0.001077420 32.979695 7   
## [31] 1 0.001077420 27.298319 7   
## [32] 1 0.001077420 19.278932 7   
## [33] 1 0.001077420 5.087706 7   
## [34] 1 0.001077420 1.306192 7   
## [35] 1 0.001077420 5.087706 7   
## [36] 1 0.001231338 1.306192 8   
## [37] 1 0.001231338 1.306192 8   
## [38] 1 0.001231338 1.306192 8   
## [39] 1 0.001231338 1.306192 8   
## [40] 1 0.001231338 1.306192 8   
## [41] 1 0.001231338 341.947368 8   
## [42] 1 0.001231338 166.589744 8   
## [43] 1 0.001231338 162.425000 8   
## [44] 1 0.001231338 83.294872 8   
## [45] 1 0.001231338 62.471154 8   
## [46] 1 0.001231338 59.605505 8   
## [47] 1 0.001231338 46.741007 8   
## [48] 1 0.001231338 37.773256 8   
## [49] 1 0.001231338 29.265766 8   
## [50] 1 0.001231338 27.529661 8

rules\_rdwht\_mid <- apriori(data=red\_white, parameter = list(supp=0.001, conf=0.9,maxlen=4),  
 appearance = list(default="lhs",rhs="quality\_disc=mid"),  
 control=list(verbose=T))

## Apriori  
##   
## Parameter specification:  
## confidence minval smax arem aval originalSupport maxtime support minlen  
## 0.9 0.1 1 none FALSE TRUE 5 0.001 1  
## maxlen target ext  
## 4 rules TRUE  
##   
## Algorithmic control:  
## filter tree heap memopt load sort verbose  
## 0.1 TRUE TRUE FALSE TRUE 2 TRUE  
##   
## Absolute minimum support count: 6   
##   
## set item appearances ...[1 item(s)] done [0.00s].  
## set transactions ...[2655 item(s), 6497 transaction(s)] done [0.03s].  
## sorting and recoding items ... [1203 item(s)] done [0.00s].  
## creating transaction tree ... done [0.00s].  
## checking subsets of size 1 2 3 4

## Warning in apriori(data = red\_white, parameter = list(supp = 0.001, conf =  
## 0.9, : Mining stopped (maxlen reached). Only patterns up to a length of 4  
## returned!

## done [0.04s].  
## writing ... [2286 rule(s)] done [0.01s].  
## creating S4 object ... done [0.00s].

rules\_rdwht\_mid <- sort(rules\_rdwht\_mid, decreasing = T, by="lift")  
inspect(rules\_rdwht\_mid[1:10])

## lhs rhs support confidence  
## [1] {total.sulfur.dioxide=234} => {quality\_disc=mid} 0.00107742 1   
## [2] {total.sulfur.dioxide=222} => {quality\_disc=mid} 0.00107742 1   
## [3] {density=0.99976} => {quality\_disc=mid} 0.00107742 1   
## [4] {total.sulfur.dioxide=220} => {quality\_disc=mid} 0.00107742 1   
## [5] {density=0.99815} => {quality\_disc=mid} 0.00107742 1   
## [6] {density=0.99946} => {quality\_disc=mid} 0.00107742 1   
## [7] {density=0.99562} => {quality\_disc=mid} 0.00107742 1   
## [8] {chlorides=0.111} => {quality\_disc=mid} 0.00107742 1   
## [9] {density=0.99754} => {quality\_disc=mid} 0.00107742 1   
## [10] {density=0.99551} => {quality\_disc=mid} 0.00107742 1   
## coverage lift count  
## [1] 0.00107742 1.306192 7   
## [2] 0.00107742 1.306192 7   
## [3] 0.00107742 1.306192 7   
## [4] 0.00107742 1.306192 7   
## [5] 0.00107742 1.306192 7   
## [6] 0.00107742 1.306192 7   
## [7] 0.00107742 1.306192 7   
## [8] 0.00107742 1.306192 7   
## [9] 0.00107742 1.306192 7   
## [10] 0.00107742 1.306192 7

rules\_rdwht\_high <- apriori(data=red\_white, parameter = list(supp=0.001, conf=0.9,maxlen=4),  
 appearance = list(default="lhs",rhs="quality\_disc=high"),  
 control=list(verbose=T))

## Apriori  
##   
## Parameter specification:  
## confidence minval smax arem aval originalSupport maxtime support minlen  
## 0.9 0.1 1 none FALSE TRUE 5 0.001 1  
## maxlen target ext  
## 4 rules TRUE  
##   
## Algorithmic control:  
## filter tree heap memopt load sort verbose  
## 0.1 TRUE TRUE FALSE TRUE 2 TRUE  
##   
## Absolute minimum support count: 6   
##   
## set item appearances ...[1 item(s)] done [0.00s].  
## set transactions ...[2655 item(s), 6497 transaction(s)] done [0.04s].  
## sorting and recoding items ... [1203 item(s)] done [0.00s].  
## creating transaction tree ... done [0.00s].  
## checking subsets of size 1 2 3 4

## Warning in apriori(data = red\_white, parameter = list(supp = 0.001, conf =  
## 0.9, : Mining stopped (maxlen reached). Only patterns up to a length of 4  
## returned!

## done [0.03s].  
## writing ... [918 rule(s)] done [0.01s].  
## creating S4 object ... done [0.00s].

rules\_rdwht\_high <- sort(rules\_rdwht\_high, decreasing = T, by="lift")  
inspect(rules\_rdwht\_high[1:10])

## lhs rhs support confidence coverage lift count  
## [1] {alcohol=13.7} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7  
## [2] {free.sulfur.dioxide=48.5} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7  
## [3] {density=0.99807} => {quality\_disc=high} 0.001231338 1 0.001231338 5.087706 8  
## [4] {residual.sugar=12.8,   
## free.sulfur.dioxide=48.5} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7  
## [5] {free.sulfur.dioxide=48.5,   
## density=0.9986} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7  
## [6] {chlorides=0.053,   
## free.sulfur.dioxide=48.5} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7  
## [7] {free.sulfur.dioxide=48.5,   
## alcohol=9.1} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7  
## [8] {volatile.acidity=0.19,   
## free.sulfur.dioxide=48.5} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7  
## [9] {free.sulfur.dioxide=48.5,   
## pH=3.14} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7  
## [10] {free.sulfur.dioxide=48.5,   
## sulphates=0.49} => {quality\_disc=high} 0.001077420 1 0.001077420 5.087706 7