

STAFinal

Hyeon Gu Kim, Shakirah Oladokun, Jazline Keli

Visual story telling part 1: green buildings

Understanding of the Dataset

In this section I will explore and learn about data presented in greenbuildings.csv

Let see how many buildings in the dataset total and how many of them are green buildings.

```
library(rafalib)
library(ggplot2)
## Read CSV file
blds = read.csv("/Users/macintosh/Documents/R studio/greenbuildings.csv")

## Calculate total number of buildings
num_blds = nrow(blds)
prtst = paste0("Number of buildings in greenbuildings.csv = ", num_blds)
print(prtst)

## [1] "Number of buildings in greenbuildings.csv = 7894"

## Calculating green buildings
num_green_blds = sum(blds$LEED)+sum(blds$Energystar)
prtst = paste0("Number of green buildings = ", num_green_blds)
print(prtst)

## [1] "Number of green buildings = 692"
```

Data cleaning

I noticed that a handful of the buildings in the data set had very low occupancy rates (less than 10% of available space occupied). I decided to remove these buildings from consideration, on the theory that these buildings might have something weird going on with them, and could potentially distort the analysis.

Let's find buildings with occupancy rate less than 10%

```
##
num_low_occup_blds = sum(blds$leasing_rate <= 10)

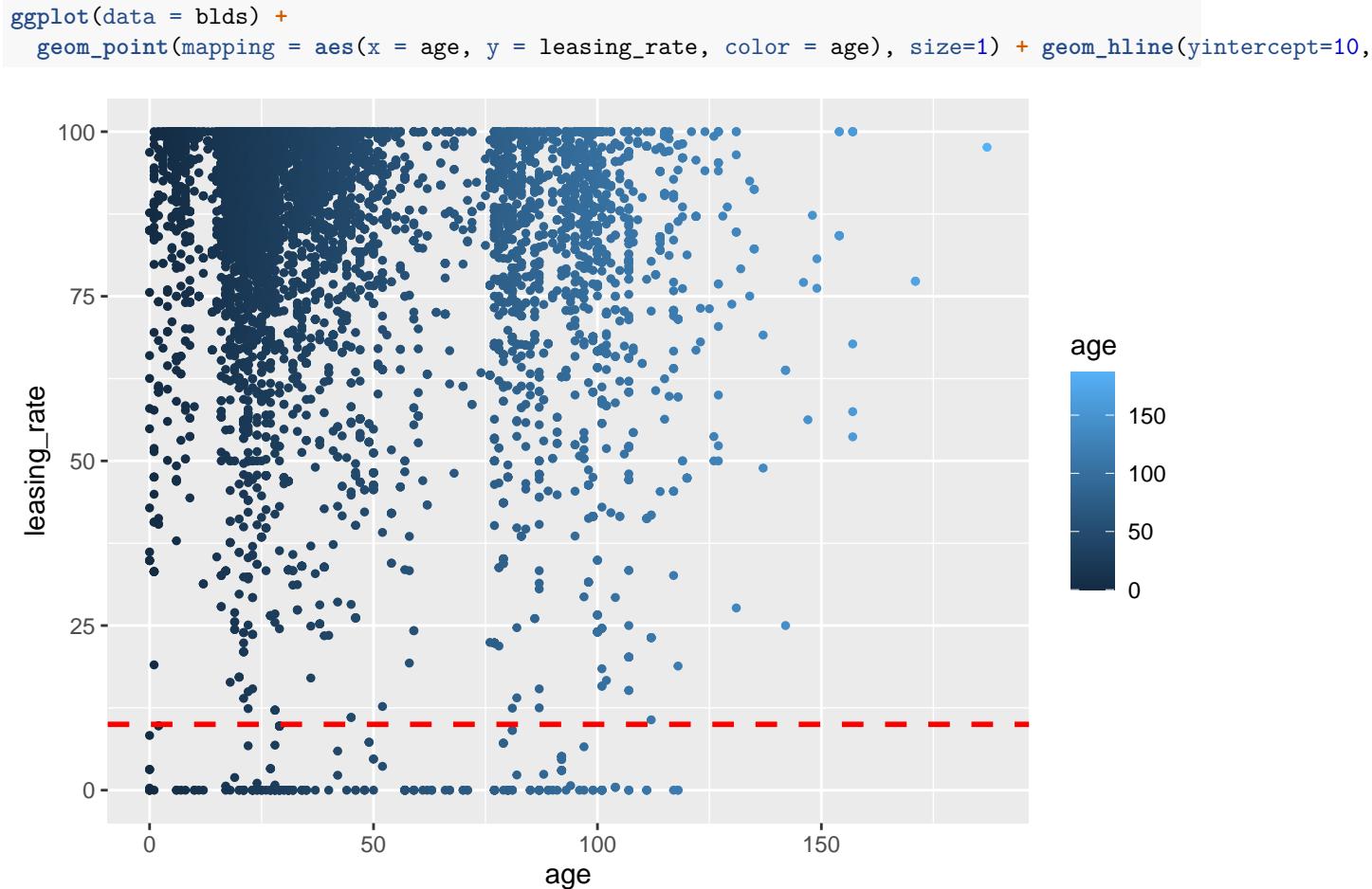
low_occup_blds_pct = (num_low_occup_blds/num_blds)*100
low_occup_blds_pct = round(low_occup_blds_pct, 2)

prtst = paste0("The number of buildings with occupancy rates <= 10% is ", num_low_occup_blds, " and that is ", low_occup_blds_pct, "% of all buildings")

print(prtst)

## [1] "The number of buildings with occupancy rates <= 10% is 215 and that constitutes only 2.72% of all buildings"
```

The graph below shows that there are some buildings that are below 10% occupancy.



Let's remove low-occupancy buildings from the dataset

```
blds = subset(blds, blds$leasing_rate > 10)
num_blds = nrow(blds)
prtst = paste0(num_blds)
print(prtst)
```

[1] "7679"

Create two datasets - one for green buildings and another one for non-green buildings

```
green_blds = subset(blds, (blds$LEED | blds$Energystar ))
nrow(green_blds)
```

[1] 684

```
non_green_blds = subset(blds, (!blds$LEED & !blds$Energystar ))
nrow(non_green_blds)
```

[1] 6995

```
nrow(green_blds) + nrow(non_green_blds)
```

[1] 7679

Let's check developer's median prices for non-green and green buildings

```

med_rent_non_green = median(non_green_bldgs$Rent)
print(med_rent_non_green)

## [1] 25.03

med_rent_green = median(green_bldgs$Rent)
print(med_rent_green)

## [1] 27.6

diff_median_rent = med_rent_green - med_rent_non_green
print(diff_median_rent)

## [1] 2.57

```

They look to be correct

Rent Distribution Characteristics

Now let's look at different distribution characteristics for the Rent

We start with drawing Box plots.

A box plot (or “box-and-whisker plot”) is an alternative to a histogram to give a quick visual display of the main features of a set of data.

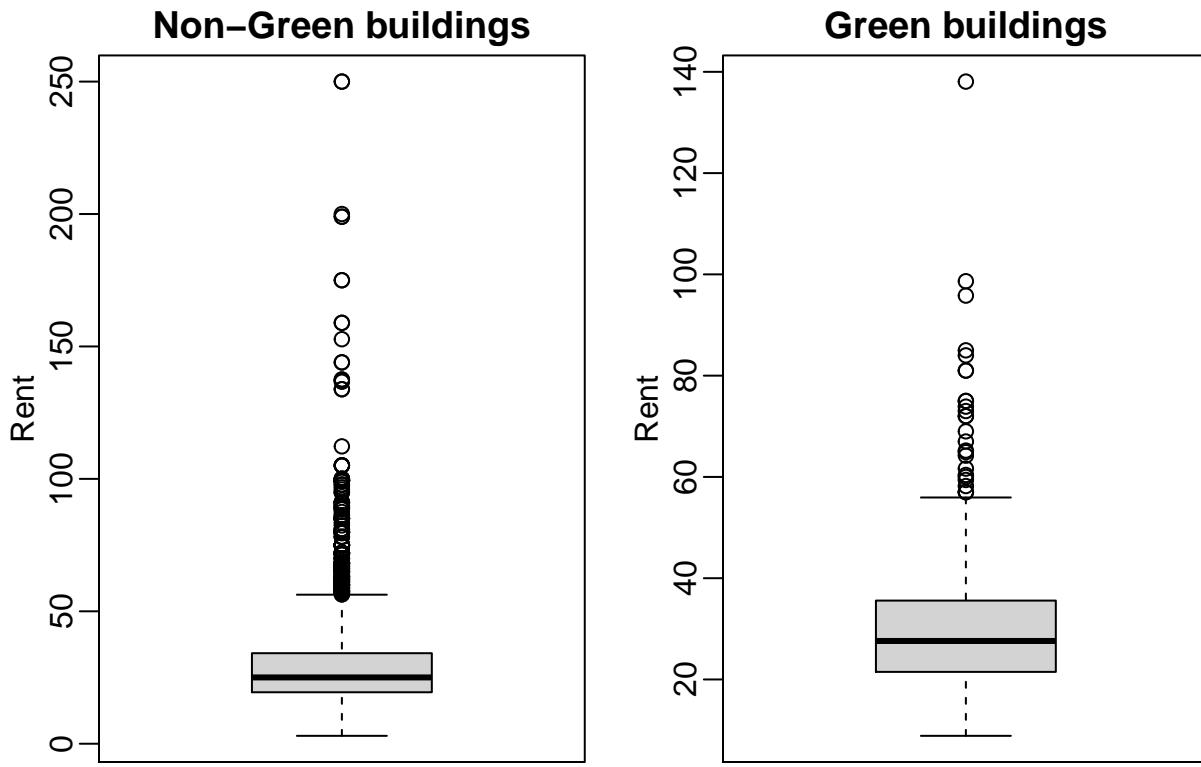
```

mypar(1,2)

boxplot(non_green_bldgs$Rent, data=non_green_bldgs, ylab="Rent", main="Non-Green buildings")

boxplot(green_bldgs$Rent, data=green_bldgs, ylab="Rent", main="Green buildings")

```



Now let's look at Rent histograms

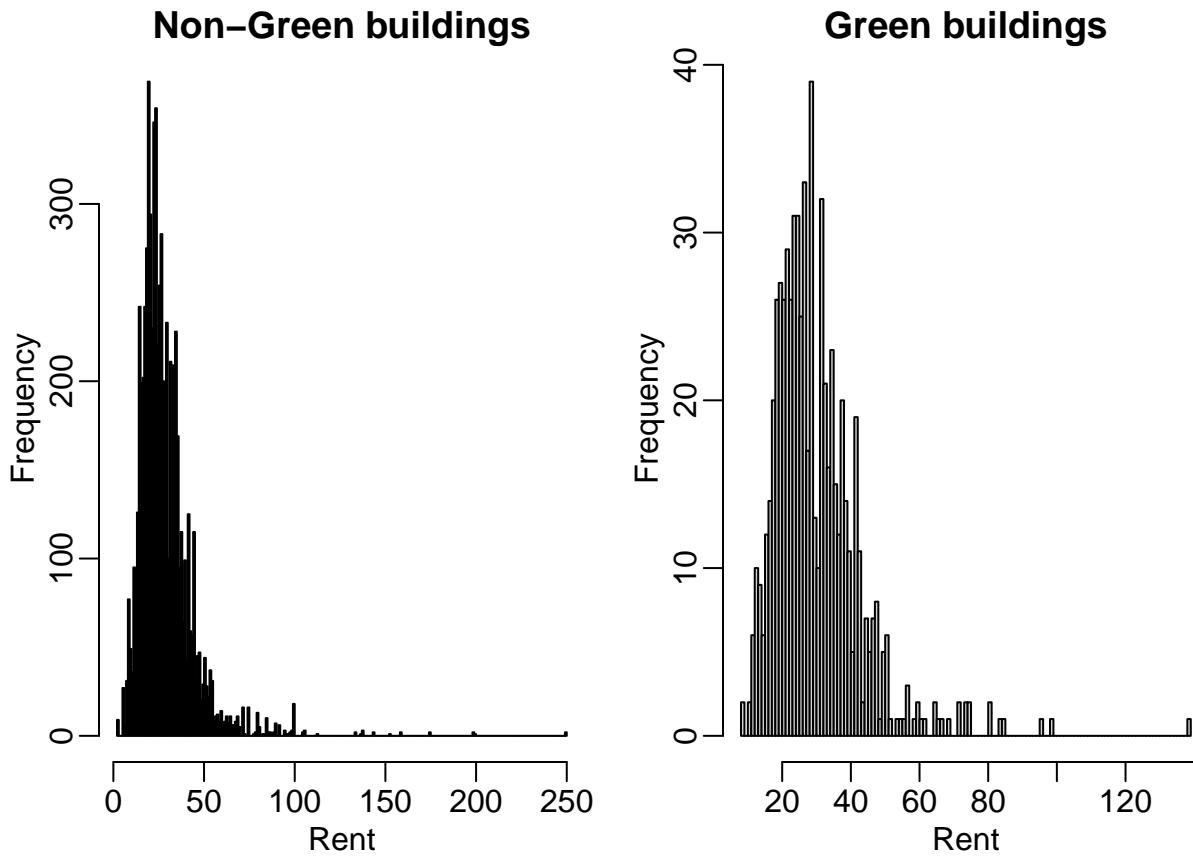
```
mypar(1,2)

smallest <- floor( min(non_green_blds$Rent) )
largest <- ceiling( max(non_green_blds$Rent) )
bins <- seq(smallest, largest)

hist(non_green_blds$Rent, breaks=bins, xlab="Rent", main="Non-Green buildings")

smallest <- floor( min(green_blds$Rent) )
largest <- ceiling( max(green_blds$Rent) )
bins <- seq(smallest, largest)

hist(green_blds$Rent, breaks=bins, xlab="Rent", main="Green buildings")
```



We still see some outliers above “upper whisker” that could potentially distort the analysis.

So let's cleanup both datasets by removing building with rents above “upper whisker”, recreate box plots and histograms and then can use mean for Rent.

We can find “lower whisker” and “upper whisker” values using `boxplot.stats()`. The “lower whisker” is the first number and the “upper whisker” is the last (5th) number in `$stats`

```
boxplot.stats(non_green_blds$Rent, do.conf = FALSE, do.out = FALSE)
```

```
## $stats
## [1]  2.98 19.43 25.03 34.18 56.27
##
## $n
## [1] 6995
##
## $conf
## NULL
##
## $out
## numeric(0)
```

```
boxplot.stats(green_blds$Rent, do.conf = FALSE, do.out = FALSE)
```

```
## $stats
## [1]  8.870 21.495 27.600 35.580 55.940
##
## $n
## [1] 684
```

```

##  

## $conf  

## NULL  

##  

## $out  

## numeric(0)

non_green_blds_clean = subset(non_green_blds, non_green_blds$Rent < 56.27)
green_blds_clean = subset(green_blds, green_blds$Rent < 55.94)

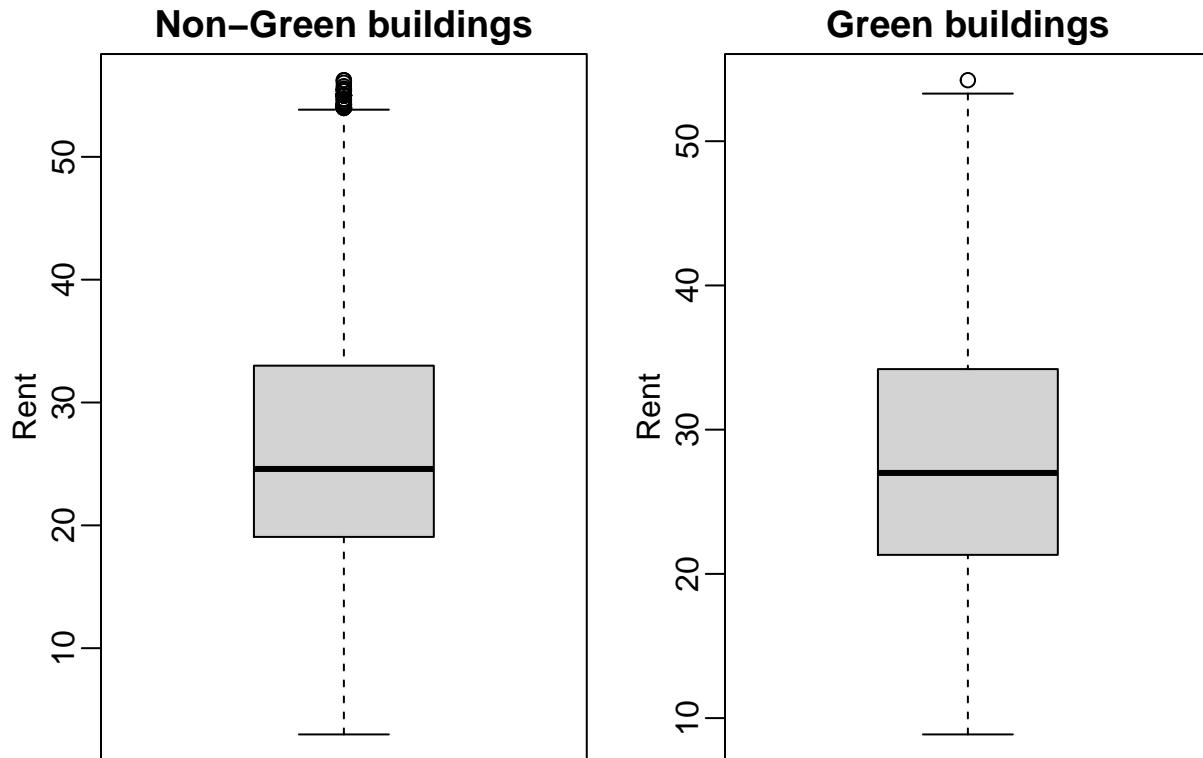
```

Now let's redraw box plots

```
mypar(1,2)
```

```
boxplot(non_green_blds_clean$Rent, data=non_green_blds_clean, ylab="Rent", main="Non-Green buildings")

boxplot(green_blds_clean$Rent, data=green_blds_clean, ylab="Rent", main="Green buildings")
```



Now let's look at Rent histograms after cleaning

```
mypar(1,2)
```

```
smallest <- floor( min(non_green_blds_clean$Rent) )
largest <- ceiling( max(non_green_blds_clean$Rent) )
bins <- seq(smallest, largest)

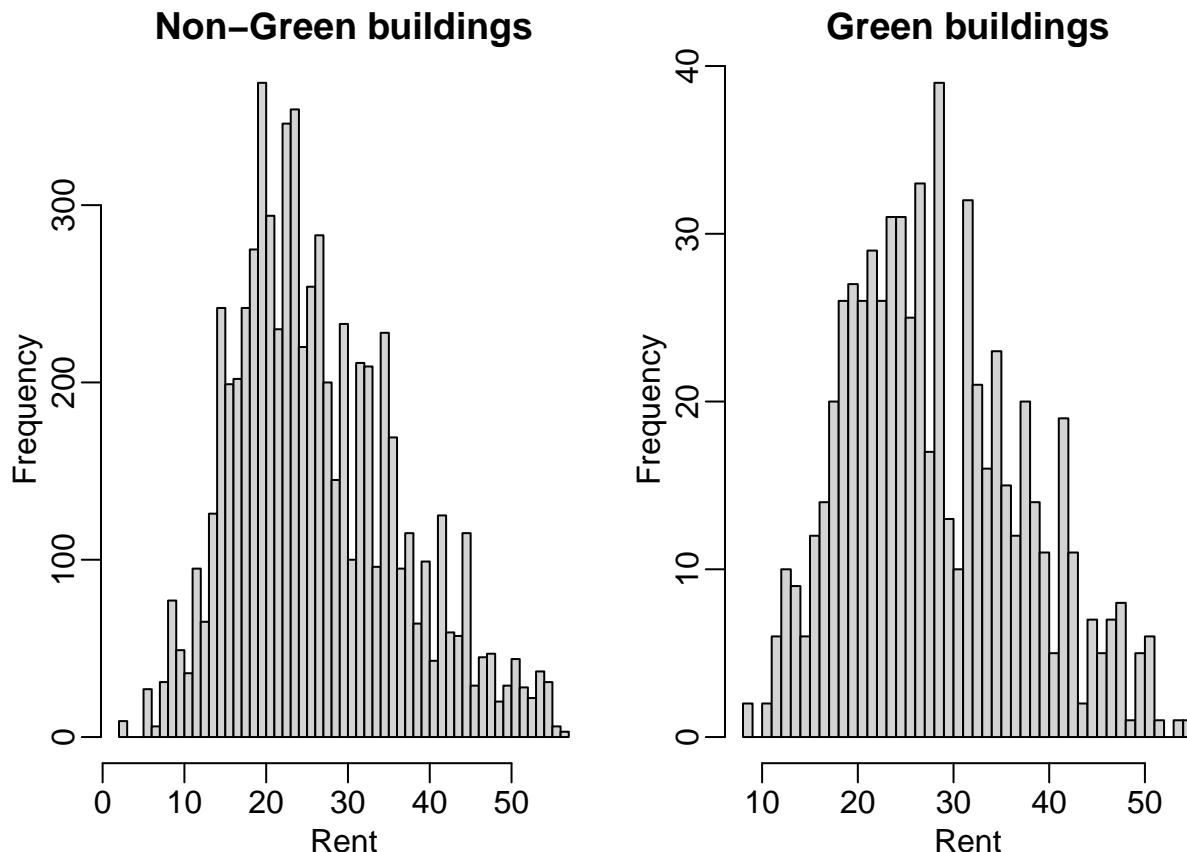
hist(non_green_blds_clean$Rent, breaks=bins, xlab="Rent", main="Non-Green buildings")
```

```

smallest <- floor( min(green_blds_clean$Rent) )
largest <- ceiling( max(green_blds_clean$Rent) )
bins <- seq(smallest, largest)

hist(green_blds_clean$Rent, breaks=bins, xlab="Rent", main="Green buildings")

```



Those histograms look close to normal distribution. So we can use mean to compare rental prices

```

mean_rent_non_green = mean (non_green_blds_clean$Rent)
print(mean_rent_non_green)

```

```
## [1] 26.42848
```

```
mean_rent_green = mean(green_blds_clean$Rent)
print(mean_rent_green)
```

```
## [1] 28.27734
```

```
diff_mean_rent = mean_rent_green - mean_rent_non_green
print(diff_mean_rent)
```

```
## [1] 1.848861
```

Now we can see that more accurate analysis results in less price difference between green and non-green rents which is \$1.85 vs. \$2.60

###REPORT GREENBUILDINGS Firstly we decided to re-explore and learn about the data by calculating the total number of buildings and the total number of green buildings, then decided to do some data cleaning by removing the buildings with occupancy rate less than 10%. The amount of total buildings reduced by 215,

from 7,894 to 7,679. After that we proceeded to create two subsets, one with the green buildings and one with non-green buildings and then calculated the median of those different subsets. We then wanted to look at the distribution characteristics for the rent starting with Box plot and then Histograms. With the box plots we saw that there were some outliers above “upper whisker” that could potentially distort the analysis, so we decided to clean it up by removing building with rents above “upper whisker”. For the histogram it was very much negatively skewed, so we decided to recreate both. We used boxplot. Stats() to measure the upper whiskers , subset the data into the two groups and measure them to be less than the highest upper whisker value, this gave us a new clean data set for both green buildings and non-green buildings. After that we performed analysis with the box plot which appeared with less outliers and the histogram was also more normally distributed. The final step was to recalculate the mean of the different buildings and we concluded that we cannot agree with the conclusions of her on-staff stats gurus. The results found from this analysis was \$1.85 more which was lower than \$2.60 they had calculated, meaning the additional revenue is also not coherent. It stills seems like a good financial move even though it will take longer to recuperate the costs (10.8 years).

Visual story telling part 2: flights at ABIA

Exploring flights dataset

We checked the frequency of flights by month. Looks like June has the highest frequency but the overall frequencies are well-distributed across every months.

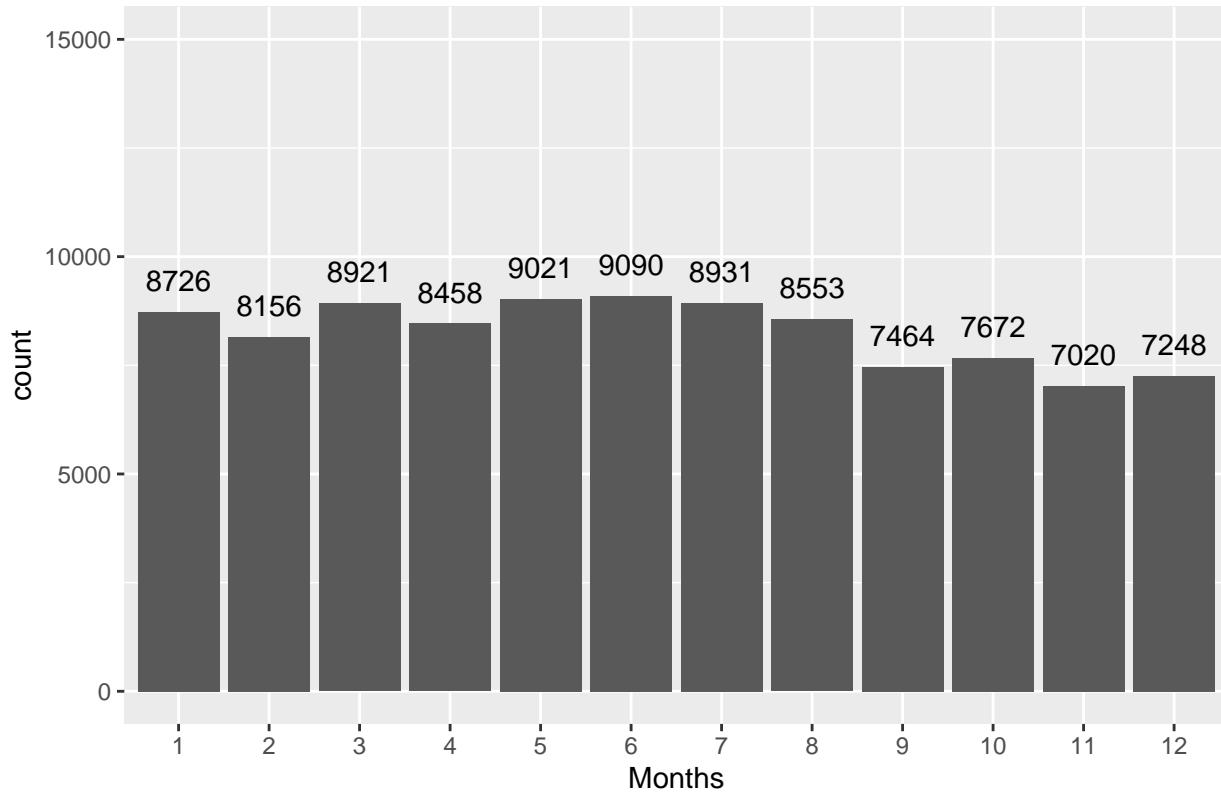
```
library(tidyverse)

## -- Attaching packages -----
## v tibble  3.0.3      v dplyr    1.0.0
## v tidyverse 1.1.0      v stringr  1.4.0
## v readr    1.3.1      v forcats  0.5.0
## v purrr   0.3.4

## -- Conflicts -----
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()   masks stats::lag()

## Read CSV file
flights = read.csv("/Users/macintosh/Documents/R studio/ABIA.csv")
#airports = read.csv("/Users/macintosh/Documents/R studio/airport-codes.csv")
num_flights = nrow(flights)
ggplot(flights, aes(Month)) + geom_bar() + geom_text(stat='count', aes(label=..count..), vjust=-1) +
  scale_x_discrete(name ="Months", limits=c("1", "2", "3", "4", "5", "6", "7", "8", "9", "10", "11", "12"))
  ggttitle("Flight Frequency by Month")
```

Flight Frequency by Month

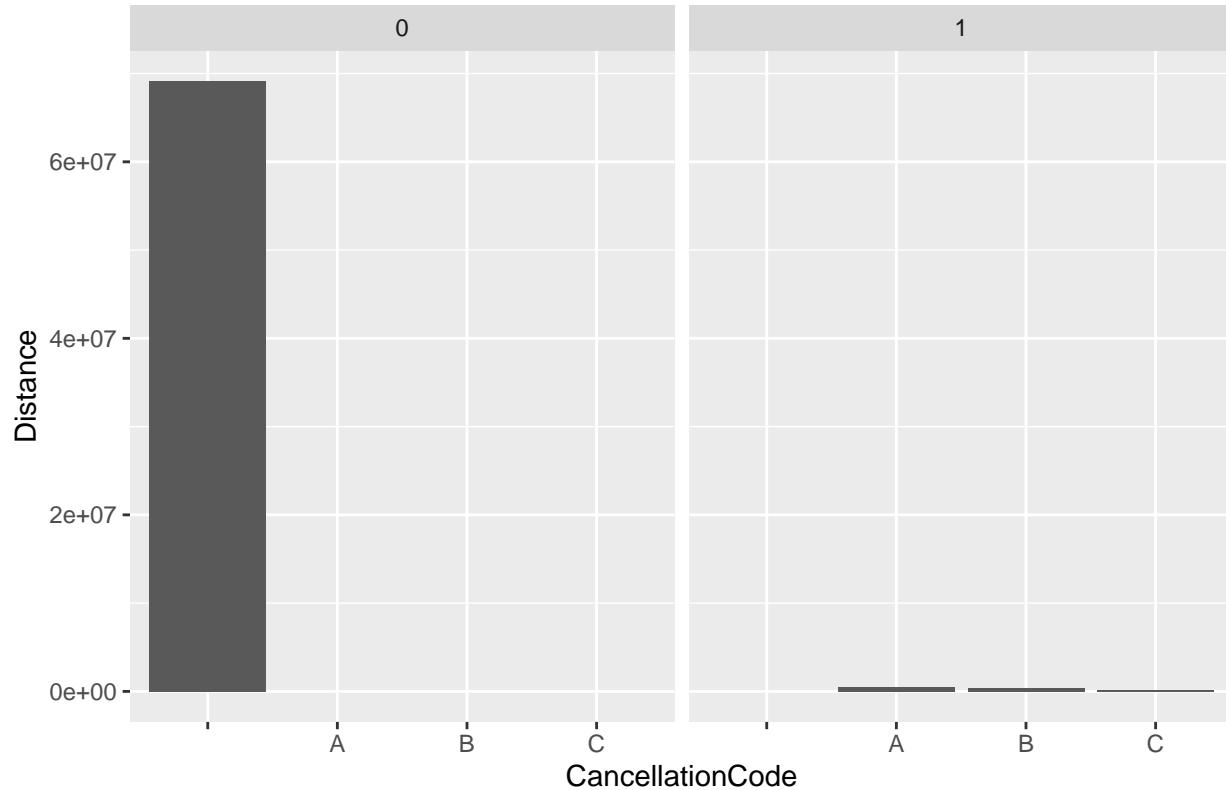


We decided to explore why the flights were canceled. Notice that there are comparably very small number of cancelled flights.

```
numCancel <- nrow(flights[which(flights$Cancelled == 1),])
numNotCancel <- nrow(flights[which(flights$Cancelled == 0),])

ggplot(data = flights) +
  geom_bar(mapping = aes(x=CancellationCode, y=Distance), stat='identity') +
  facet_wrap(~Cancelled) +
  labs(title="Cancelled (1) vs Not Cancelled(0)")
```

Cancelled (1) vs Not Cancelled(0)



Now let's dig in the reason of canceled flights. Looks like the most of the reason for cancellation is due to carrier. Note that there is zero security reason for cancellation.

```
head(flights[which(flights$Cancelled == 1),])

##      Year Month DayofMonth DayOfWeek DepTime CRSDepTime ArrTime CRSArrTime
## 250 2008     1         1         2       NA        646      NA       922
## 251 2008     1         1         2       NA       1740      NA      1835
## 252 2008     1         1         2       NA       1525      NA      1625
## 253 2008     1         1         2       NA       1915      NA      2015
## 254 2008     1         1         2       NA       1620      NA      1710
## 255 2008     1         1         2       NA       1735      NA      1835
##      UniqueCarrier FlightNum TailNum ActualElapsedTime CRSElapsedTime AirTime
## 250          00      5972  N726SK                  NA           156      NA
## 251          WN      2880                  NA            55      NA
## 252          AA      1128                  NA            60      NA
## 253          AA      1566                  NA            60      NA
## 254          WN      2793                  NA            50      NA
## 255          AA       479                  NA            60      NA
##      ArrDelay DepDelay Origin Dest Distance TaxiIn TaxiOut Cancelled
## 250        NA       NA    AUS   ORD      978      NA      NA       1
## 251        NA       NA    AUS   DAL      189      NA      NA       1
## 252        NA       NA    AUS   DFW      190      NA      NA       1
## 253        NA       NA    AUS   DFW      190      NA      NA       1
## 254        NA       NA   DAL   AUS      189      NA      NA       1
## 255        NA       NA   DFW   AUS      190      NA      NA       1
##      CancellationCode Diverted CarrierDelay WeatherDelay NASDelay SecurityDelay
```

```

## 250          B    0     NA     NA     NA     NA
## 251          A    0     NA     NA     NA     NA
## 252          A    0     NA     NA     NA     NA
## 253          A    0     NA     NA     NA     NA
## 254          A    0     NA     NA     NA     NA
## 255          A    0     NA     NA     NA     NA
##      LateAircraftDelay
## 250          NA
## 251          NA
## 252          NA
## 253          NA
## 254          NA
## 255          NA

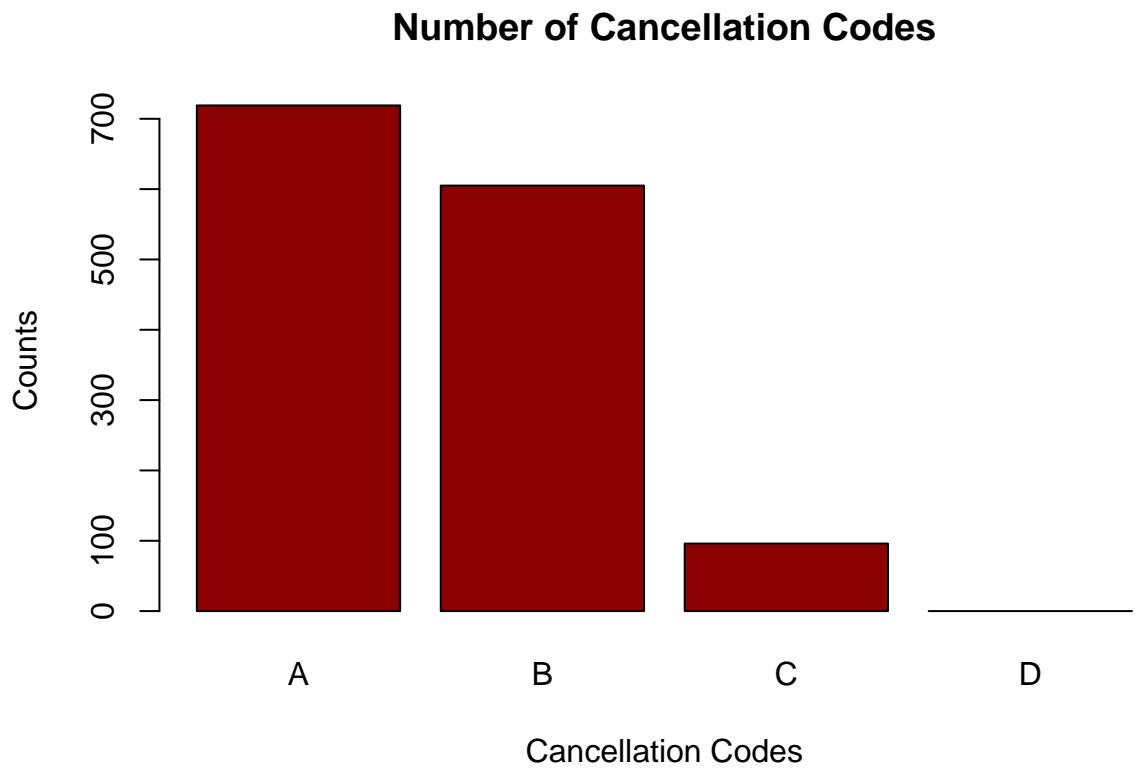
numA <- nrow(flights[which(flights$CancellationCode=="A"), ])
numB <- nrow(flights[which(flights$CancellationCode=="B"), ])
numC <- nrow(flights[which(flights$CancellationCode=="C"), ])
numD <- nrow(flights[which(flights$CancellationCode=="D"), ])

numCancel <- c(numA, numB, numC, numD)

cancel_code_count = data.frame("A"=numA, "B"=numB, "C"=numC, "D"=numD)
#cancel_code_count = t(cancel_code_count)

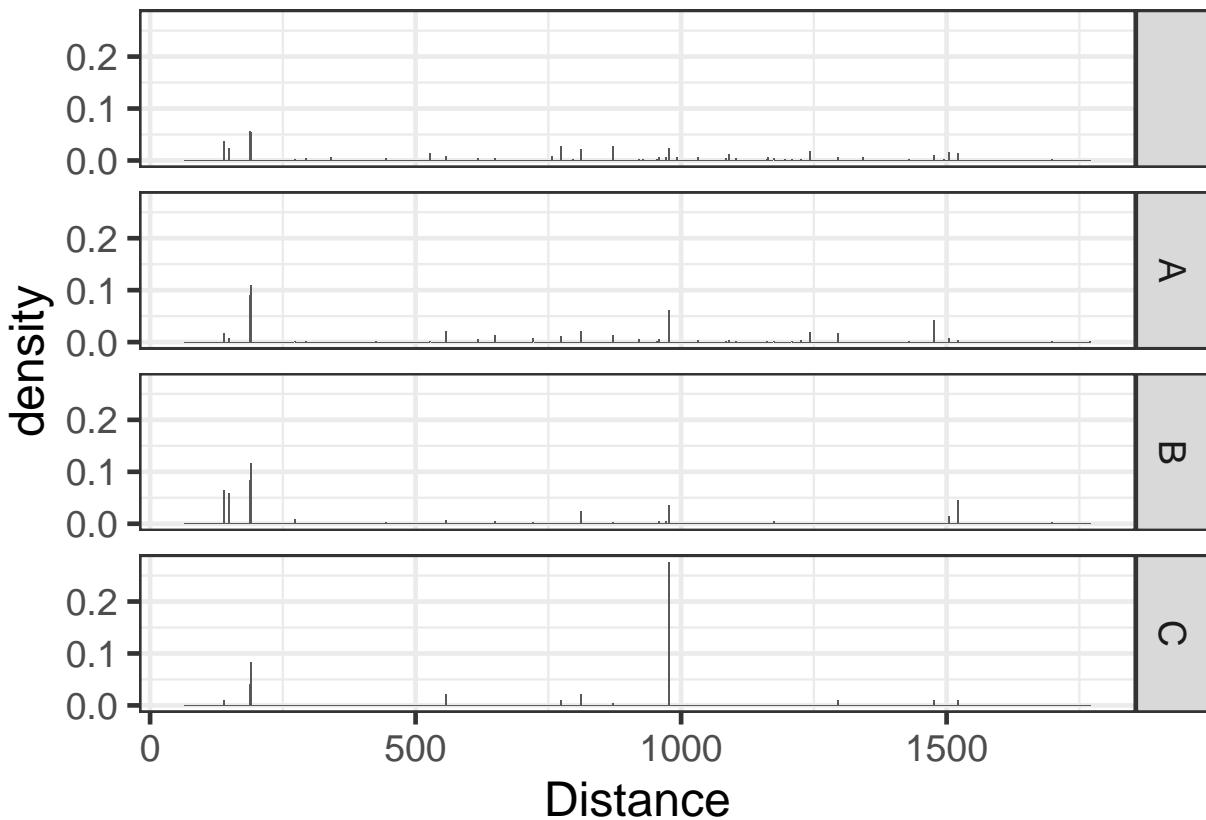
barplot(numCancel, main = "Number of Cancellation Codes",
xlab = "Cancellation Codes",
ylab = "Counts",
names.arg = c("A", "B", "C", "D"),
col = "darkred")

```



Here, we can observe that most of cancellation had comparably short distances. However, the cancellation code “C”, which is the cancellation due to NAS, had one big spike when the distance is near 1000. This indicates that in year 2008, there were lots of flight cancellation due to the national aviation system (NAS) that refer to a broad set of conditions.

```
ggplot(data=flights) +
  geom_histogram(aes(x=Distance, stat(density)), binwidth=2) +
  facet_grid(CancellationCode~.) +
  theme_bw(base_size=18)
```



Portfolio Modeling

Portfolio 1

For this first portfolio, we chose the following ETFs: JPEM = JPMorgan Diversified Return Emerging Markets Equity ETF VGT = Vanguard Information Technology ETF SCHZ = Schwab U.S. Aggregate Bond ETF XOM = iShares J.P. Morgan USD Emerging Markets Bond ETF USO = United States Oil Fund

And we loaded these stocks' data sets from January 9th, 2015. Then we adjusted Open, High, Low, Close prices for splits and dividends. We combined all the data matrices into one for close-to-close returns. From this matrix, we could get overall view of the each stocks' returns of each days. The plots below indicates close positive correlation between the close-to-close returns of JPEM and that of VGT, JPEM and XOM, and VGT and XOM.

```
library(mosaic)

## Loading required package: lattice
## Loading required package: ggformula
## Loading required package: ggstance
##
## Attaching package: 'ggstance'

## The following objects are masked from 'package:ggplot2':
## 
##     geom_errorbarh, GeomErrorbarh
## 
```

```

## New to ggformula? Try the tutorials:
## learnr::run_tutorial("introduction", package = "ggformula")
## learnr::run_tutorial("refining", package = "ggformula")

## Loading required package: mosaicData
## Loading required package: Matrix
##
## Attaching package: 'Matrix'
## The following objects are masked from 'package:tidyr':
## 
##     expand, pack, unpack
## Registered S3 method overwritten by 'mosaic':
##   method           from
##   fortify.SpatialPolygonsDataFrame ggplot2
##
## The 'mosaic' package masks several functions from core packages in order to add
## additional features. The original behavior of these functions should not be affected by this.
## 
## Note: If you use the Matrix package, be sure to load it BEFORE loading mosaic.
## 
## Have you tried the ggformula package for your plots?
##
## Attaching package: 'mosaic'
## The following object is masked from 'package:Matrix':
## 
##     mean
## The following objects are masked from 'package:dplyr':
## 
##     count, do, tally
## The following object is masked from 'package:purrr':
## 
##     cross
## The following object is masked from 'package:ggplot2':
## 
##     stat
## The following objects are masked from 'package:stats':
## 
##     binom.test, cor, cor.test, cov, fivenum, IQR, median, prop.test,
##     quantile, sd, t.test, var
## The following objects are masked from 'package:base':
## 
##     max, mean, min, prod, range, sample, sum
library(quantmod)

## Loading required package: xts
## Loading required package: zoo

```

```

## 
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
## 
##     as.Date, as.Date.numeric

## 
## Attaching package: 'xts'

## The following objects are masked from 'package:dplyr':
## 
##     first, last

## Loading required package: TTR

## Registered S3 method overwritten by 'quantmod':
##   method           from
##   as.zoo.data.frame zoo

## Version 0.4-0 included new data defaults. See ?getSymbols.

library(foreach)

## 
## Attaching package: 'foreach'

## The following objects are masked from 'package:purrr':
## 
##     accumulate, when

# Import a few stocks
# JPEM = JPMorgan Diversified Return Emerging Markets Equity ETF
# VGT = Vanguard Information Technology ETF
# SCHZ = Schwab U.S. Aggregate Bond ETF
# XOM = iShares J.P. Morgan USD Emerging Markets Bond ETF
# USO = United States Oil Fund
mystocks = c("JPEM", "VGT", "SCHZ", "XOM", "USO")
getSymbols(mystocks, from = "2015-01-09")

## 'getSymbols' currently uses auto.assign=TRUE by default, but will
## use auto.assign=FALSE in 0.5-0. You will still be able to use
## 'loadSymbols' to automatically load data. getOption("getSymbols.env")
## and getOption("getSymbols.auto.assign") will still be checked for
## alternate defaults.

## 
## This message is shown once per session and may be disabled by setting
## options("getSymbols.warning4.0"=FALSE). See ?getSymbols for details.

## [1] "JPEM" "VGT"  "SCHZ" "XOM"  "USO"

for(ticker in mystocks) {
  expr = paste0(ticker, "a = adjustOHLC(", ticker, ")")
  eval(parse(text=expr))
}

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/JPEM?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

```

```

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/JPEM?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/VGT?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/VGT?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/SCHZ?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/SCHZ?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/USO?
## period1=-2208988800&period2=1597795200&interval=1d&events=div&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/USO?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/USO?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

head(JPEMa)

##          JPEM.Open JPEM.High JPEM.Low JPEM.Close JPEM.Volume JPEM.Adjusted
## 2015-01-09  44.30710  44.36001 44.30710   44.35134      1200    44.35134
## 2015-01-12  44.78505  44.78505 44.16050   44.16050      4000    44.16050
## 2015-01-13  44.16050  44.16050 44.16050   44.16050       0     44.16050
## 2015-01-14  44.16050  44.16050 44.16050   44.16050       0     44.16050
## 2015-01-15  44.43808  44.43808 44.43808   44.43808      200    44.43808
## 2015-01-16  44.43808  44.43808 44.43808   44.43808       0     44.43808

# Combine all the returns in a matrix
all_returns = cbind( C1C1(JPEMa),
                     C1C1(VGTA),
                     C1C1(SCHZA),
                     C1C1(XOMA),
                     C1C1(USOa))

head(all_returns)

##          C1C1.JPEMa    C1C1.VGTA    C1C1.SCHZA    C1C1.XOMA    C1C1.USOa

```

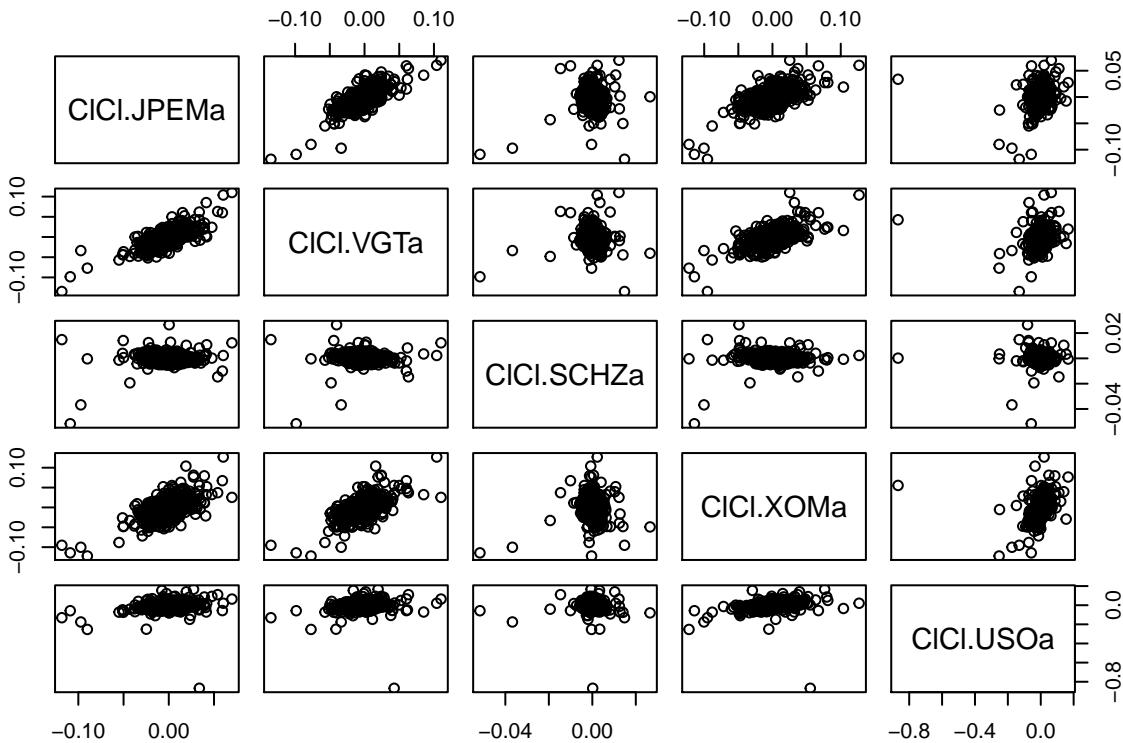
```

## 2015-01-09      NA      NA      NA      NA      NA
## 2015-01-12 -0.004302777 -0.012684990 0.001707132 -0.019218198 -0.04759304
## 2015-01-13  0.000000000 -0.000194637 0.000000000 -0.003653293  0.01206209
## 2015-01-14  0.000000000 -0.006035855 0.003029729 -0.002888911  0.03688987
## 2015-01-15  0.006285602 -0.015279109 0.004530829 -0.008691765 -0.04488231
## 2015-01-16  0.000000000  0.009846807 -0.004134505 0.024280621  0.05042975

all_returns = as.matrix(na.omit(all_returns))

# Compute the returns from the closing prices
pairs(all_returns)

```



We tried the bootstrap resampling on one random day just as a small simulation. In 2015-07-20, JPEM went down by -0.005505289, VGT went up by 0.00442037, SCH went down by -0.001932799, XOM went down by -0.0102893, and USO went down by -0.0176574. Then we set \$100,000 as our initial wealth and ran the bootstrap resampling 5000 times to estimate the 4-week (20 trading day) value at risk of each of your three portfolios at the 5% level. Each rows of the result of the simulation represent simulated future and each columns represent 15000 different simulated values of final wealth of this portfolio after 20 days. The histogram below shows the wealth distribution of this portfolio.

```

# Sample a random return from the empirical joint distribution
# This simulates a random day
return.today = resample(all_returns, 1, orig.ids=FALSE)

# Now simulate many different possible futures
# just repeating the above block thousands of times
initial_wealth = 100000
sim1 = foreach(i=1:15000, .combine='rbind') %do% {

```

```

total_wealth = initial_wealth
weights = c(0.2, 0.2, 0.2, 0.2, 0.2)
holdings = weights * total_wealth
n_days = 20
wealthtracker = rep(0, n_days)
for(today in 1:n_days) {
  return.today = resample(all_returns, 1, orig.ids=FALSE)
  holdings = holdings + holdings*return.today
  total_wealth = sum(holdings)
  wealthtracker[today] = total_wealth
}
wealthtracker
}

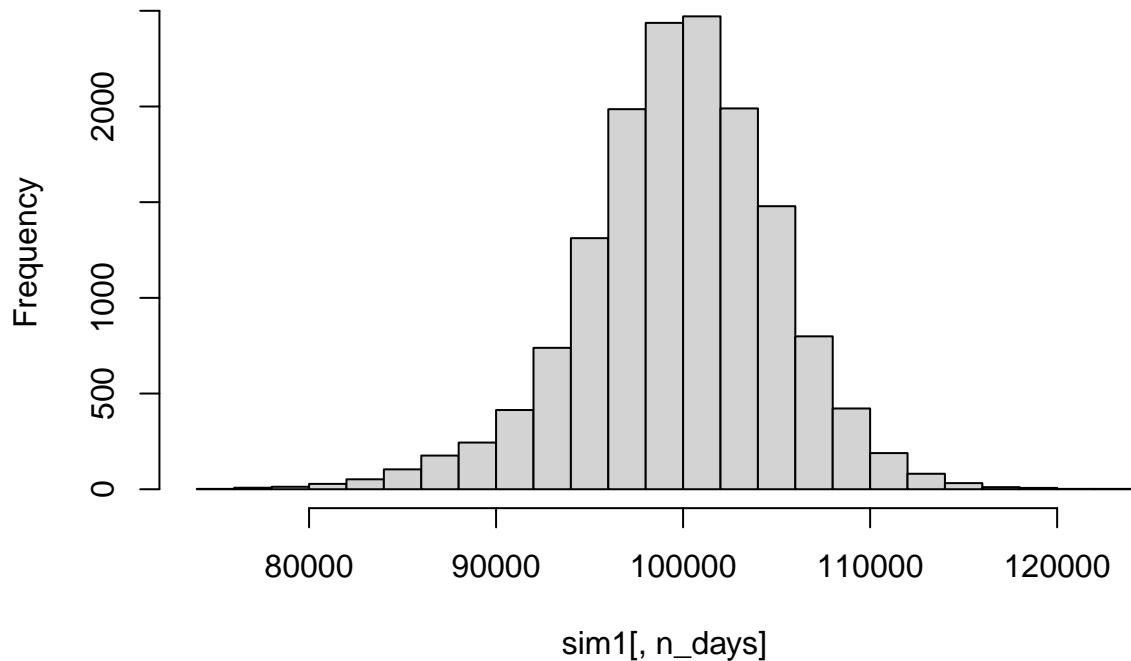
# each row is a simulated trajectory (simulated future)
# each column is a data
head(sim1)

##          [,1]      [,2]      [,3]      [,4]      [,5]      [,6]      [,7]
## result.1 99723.17 98819.12 97906.80 97630.05 97239.48 97042.99 96412.67
## result.2 99882.16 100141.09 100705.34 101137.00 101097.95 100858.94 102286.71
## result.3 100271.17 100669.37 100293.48 99631.77 98303.08 98895.56 99061.37
## result.4 100168.48 105158.61 105324.81 104774.71 105828.56 104758.12 105247.18
## result.5 99840.96 100135.88 98915.89 98459.37 97865.31 98011.01 98288.40
## result.6 100257.87 99633.77 95905.56 96615.49 96762.23 96925.80 99050.44
##          [,8]      [,9]      [,10]     [,11]     [,12]     [,13]     [,14]
## result.1 96746.65 97113.68 97867.56 98867.04 100456.85 96749.78 98604.32
## result.2 103104.97 103315.00 103136.01 101379.24 102300.88 102117.06 101177.29
## result.3 99327.06 98615.76 98141.00 100291.38 100477.43 100518.10 100556.96
## result.4 107367.30 107364.34 106445.64 106371.57 106297.55 104888.05 104895.06
## result.5 98262.35 99032.54 98199.62 98831.20 98911.61 98655.32 99100.93
## result.6 100027.80 100225.54 100014.79 99951.30 99362.48 99235.45 97276.61
##          [,15]     [,16]     [,17]     [,18]     [,19]     [,20]
## result.1 98748.76 99553.24 98421.97 98906.68 100308.03 100446.87
## result.2 101637.69 101345.47 100676.97 99800.88 98064.11 98753.83
## result.3 101006.55 102992.98 102852.70 102822.95 102614.53 103465.99
## result.4 105490.09 105223.48 104617.21 103632.13 104141.84 105734.21
## result.5 101660.11 101728.98 101637.15 100910.91 100831.01 100951.53
## result.6 96701.28 97178.73 96622.35 96515.13 97666.83 98118.26

hist(sim1[,n_days], 25)

```

Histogram of sim1[, n_days]



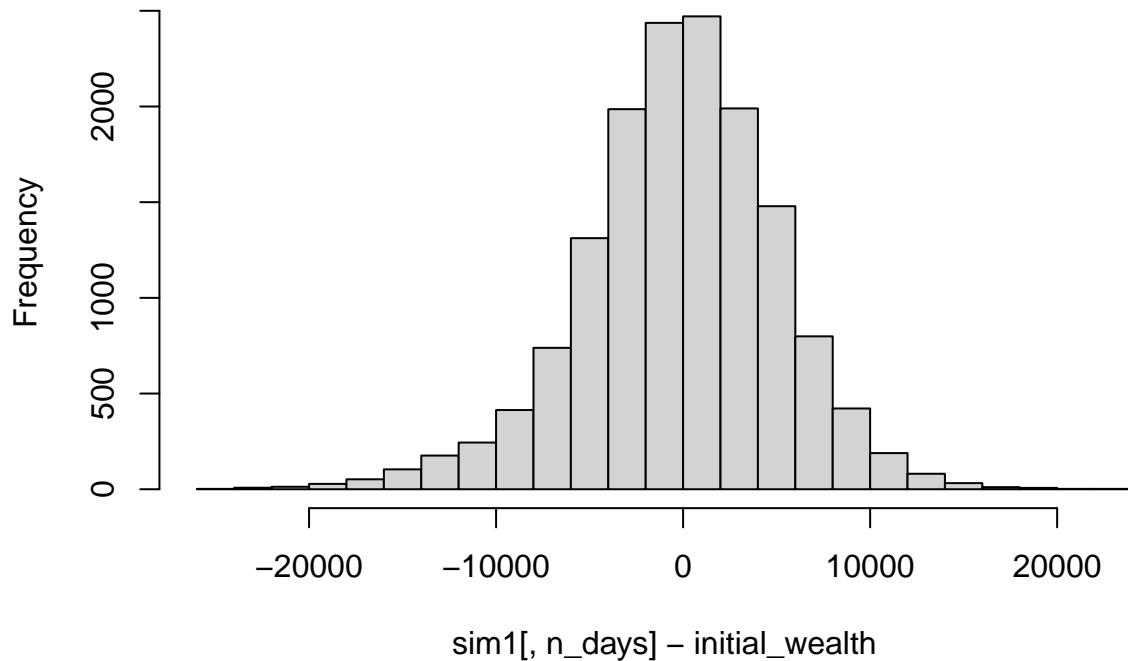
As we expected from the graph above, we are expecting to loss about 124.25 dollars with Value at Risk of 9322.883 dollars. This means that 5% of this simulated future has a loss worse than 9322.883 dollars and the rest (95%) are better than losing 9322.883 dollars.

```
# Profit/loss
mean(sim1[,n_days]) # 99875.75

## [1] 99790.98
mean(sim1[,n_days] - initial_wealth) #-124.2499

## [1] -209.0186
hist(sim1[,n_days]- initial_wealth, breaks=30) #
```

Histogram of sim1[, n_days] – initial_wealth



```
# 5% value at risk:  
quantile(sim1[,n_days] - initial_wealth, prob=0.05) # -9322.883
```

```
##      5%  
## -9356.251
```

Portfolio 2

Let's construct our second portfolio. This time, we used the following 6 ETFs: VNQ = Vanguard Real Estate Index Fund CPER = United States Copper Index Fund RWO = SPDR DJ Wilshire Global Real Estate ETF ITB = iShares U.S. Home Construction ETF XME = SPDR S&P Metals & Mining ETF XLK = Technology Select Sector SPDR Fund

We chose these ETFs because we wanted to concentrate on real estate and metal market. So we chose real estate ETF (VNQ), global real estate ETF (RWO), buildings and construction ETF (ITB), copper ETF (CPER), metals and mining (XME), and technology ETF (XLK). We extracted data from May 22, 2008. The plots below show more correlation between each ETFs than that of the previous portfolio, except CPER which seems no correlation between all the other ETFs.

```
mystocks2 = c("VNQ", "CPER", "RWO", "ITB", "XME", "XLK")  
getSymbols(mystocks2, from="2008-05-22")  
  
## pausing 1 second between requests for more than 5 symbols  
## pausing 1 second between requests for more than 5 symbols  
## [1] "VNQ" "CPER" "RWO" "ITB" "XME" "XLK"  
for(ticker in mystocks2) {  
  expr = paste0(ticker, "a = adjustOHLC(", ticker, ")")
```

```

    eval(parse(text=expr))
}

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/VNQ?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/VNQ?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/CPER?
## period1=-2208988800&period2=1597795200&interval=1d&events=div&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/CPER?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/CPER?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/RWO?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/RWO?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/ITB?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/ITB?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/XME?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/XME?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

```

```

##  readTableHeader

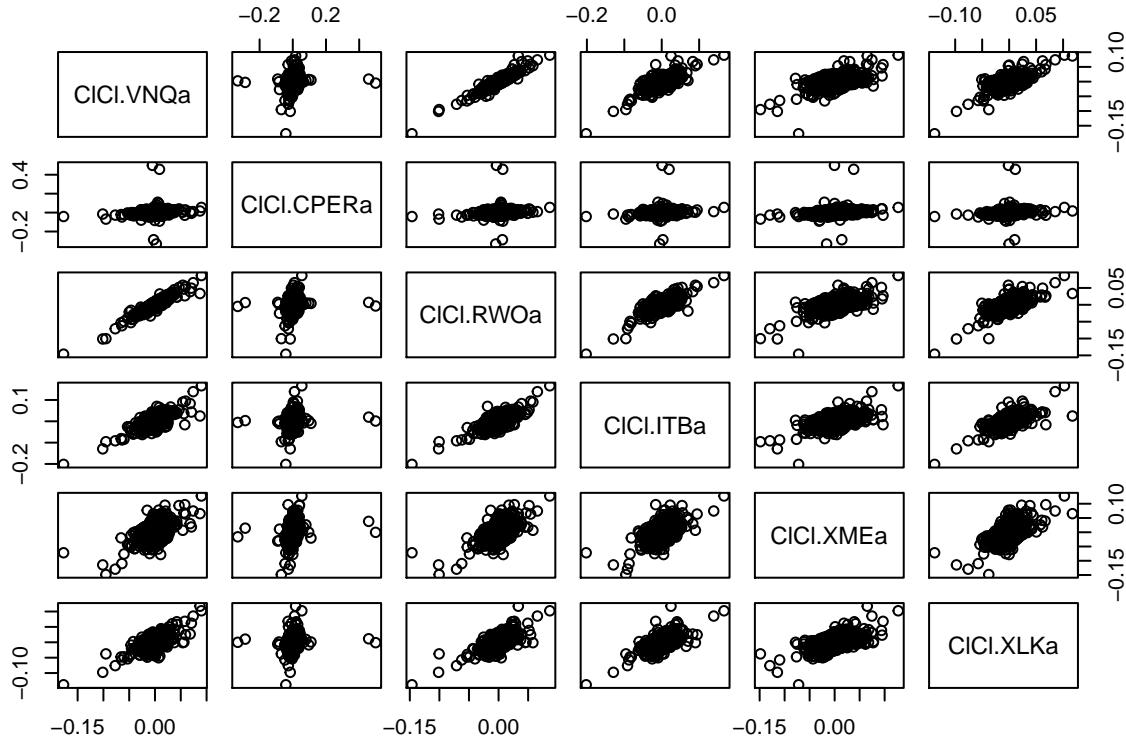
## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/XLK?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##  readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/XLK?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##  readTableHeader

# Combine all the returns in a matrix
all_returns2 = cbind( C1C1(VNQa) ,
                      C1C1(CPERa) ,
                      C1C1(RWOa) ,
                      C1C1(ITBa) ,
                      C1C1(XMEd) ,
                      C1C1(XLKa) )
all_returns2 = as.matrix(na.omit(all_returns2))

# Compute the returns from the closing prices
pairs(all_returns2)

```



Here, we splitted the weights into 6 (0.166 per ETFs) and ran simulation using bootstrap resampling under the same condition as before.

```

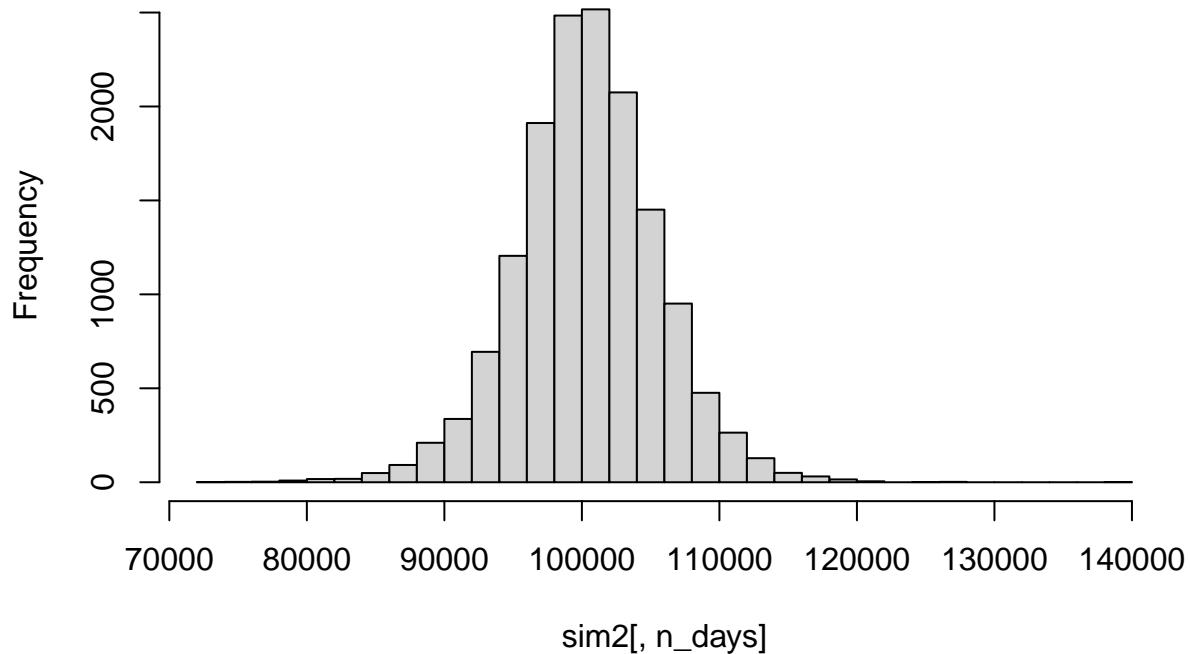
# Now simulate many different possible futures
# just repeating the above block thousands of times
initial_wealth = 100000
sim2 = foreach(i=1:15000, .combine='rbind') %do% {
  total_wealth = initial_wealth
  weights = c(0.166, 0.166, 0.166, 0.166, 0.166, 0.166)
  holdings = weights * total_wealth
  n_days = 20
  wealthtracker = rep(0, n_days)
  for(today in 1:n_days) {
    return.today = resample(all_returns2, 1, orig.ids=FALSE)
    holdings = holdings + holdings*return.today
    total_wealth = sum(holdings)
    wealthtracker[today] = total_wealth
  }
  wealthtracker
}
# each row is a simulated trajectory (simulated future)
# each column is a data
head(sim2)

##          [,1]      [,2]      [,3]      [,4]      [,5]      [,6]      [,7]
## result.1 99620.03 99820.08 98593.92 97995.20 98267.98 98847.73 97668.99
## result.2 99281.73 98277.02 97554.75 99071.64 99172.61 99571.97 99579.51
## result.3 100253.63 100985.55 101212.46 99885.75 99952.07 100111.65 99732.73
## result.4 98783.26 97904.72 98048.95 97691.88 97151.76 96324.55 97990.11
## result.5 98189.21 99890.04 100186.96 100371.67 100829.29 100570.33 99824.60
## result.6 99655.86 99743.28 99056.99 99530.03 100242.68 100621.28 100440.60
##          [,8]      [,9]      [,10]     [,11]     [,12]     [,13]     [,14]
## result.1 98815.39 99291.68 100802.34 99489.14 99761.51 99025.03 98840.56
## result.2 99238.09 98629.24 98973.04 99041.36 97475.53 97898.76 98010.07
## result.3 100293.93 99342.64 99666.11 99397.43 99161.85 97707.92 98010.45
## result.4 97627.84 97407.70 98501.45 98747.70 98367.44 96868.37 96987.95
## result.5 98773.97 98478.12 98115.54 97584.06 97285.82 97381.48 98460.77
## result.6 99972.82 100461.78 102097.99 102346.10 101666.07 101978.58 103704.10
##          [,15]     [,16]     [,17]     [,18]     [,19]     [,20]
## result.1 99529.91 99704.17 99146.01 100053.94 99658.60 100422.35
## result.2 97914.28 97937.48 99351.76 97973.09 97526.14 97735.39
## result.3 98683.72 100611.86 100053.36 99550.20 103259.98 104011.34
## result.4 97444.42 96548.60 95188.79 93308.34 92575.16 92583.56
## result.5 97328.51 97966.31 98111.70 98572.66 98293.52 99385.74
## result.6 103144.42 102068.75 99087.75 98855.86 100400.12 101246.28

hist(sim2[,n_days], 25)

```

Histogram of sim2[, n_days]



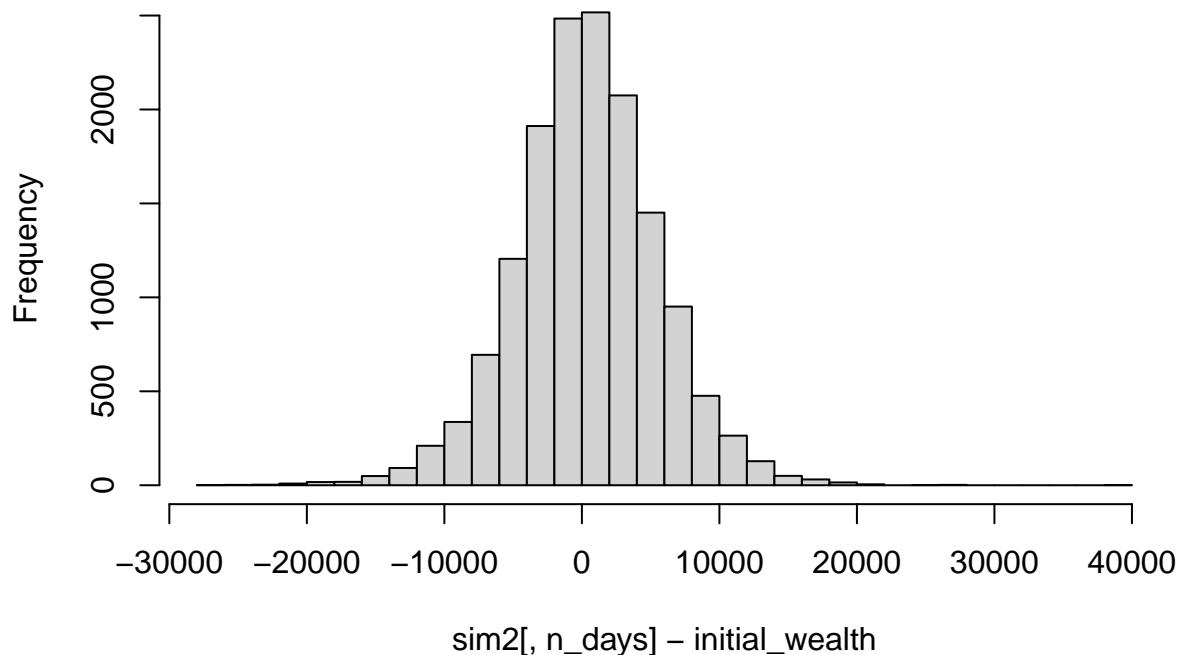
Now we are getting profit of 303.8911 dollars with value at risk 8028.351 dollars. This means that 5% of this simulated future has a loss worse than 8028.351 dollars and the rest (95%) are better than losing 8028.351 dollars.

```
# Profit/loss
mean(sim2[,n_days]) # 100303.9

## [1] 100392
mean(sim2[,n_days] - initial_wealth) #303.8911

## [1] 392.0145
hist(sim2[,n_days] - initial_wealth, breaks=30)
```

Histogram of sim2[, n_days] – initial_wealth



```
# 5% value at risk:
quantile(sim2[,n_days] - initial_wealth, prob=0.05) # -8028.351
```

```
##      5%
## -7963.14
```

Portfolio 3

Lastly, here is our thrid portfolio. This portfolio contains following 8 ETFs: VHT = Vanguard Healthcare ETF DBA = Invesco DB Agriculture Fund PDBC = Invesco Optimum Yield Diversified Commodity Strategy No K-1 ETF GNR = SPDR S&P Global Natural Resources ETF IJK = iShares S&P MidCap 400 Growth ETF PHO = Invesco Water Resources ETF FMAT = Fidelity MSCI Materials Index ETF XLP = Consumer Staples Select Sector SPDR Fund

For this portfolio, we chose ETFs that are related to natural material and biotech. When we did the same process as before and observed the plot below, we could see that the ETFs most likely have positive correlation between each other. Note that some pairs are showing almost neutral correlation each other (such as VHT and DBA, VHT and PDBC, DBA and GNR, etc...)

```
mystocks3 = c("VHT", "DBA", "PDBC", "GNR", "IJK", "PHO", "FMAT", "XLP")
getSymbols(mystocks3, from="2014-11-07")
```

```
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols
## pausing 1 second between requests for more than 5 symbols

## [1] "VHT"   "DBA"   "PDBC"  "GNR"   "IJK"   "PHO"   "FMAT"  "XLP"
```

```

for(ticker in mystocks3) {
  expr = paste0(ticker, "a = adjustOHLC(", ticker, ")")
  eval(parse(text=expr))
}

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/VHT?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/VHT?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/DBA?
## period1=-2208988800&period2=1597795200&interval=1d&events=div&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/DBA?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/DBA?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/PDBC?
## period1=-2208988800&period2=1597795200&interval=1d&events=div&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/PDBC?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/PDBC?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/GNR?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/GNR?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/IJK?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

```

```

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/IJK?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/PHO?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query1.finance.yahoo.com/v7/finance/download/PHO?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/FMAT?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/FMAT?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/XLP?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

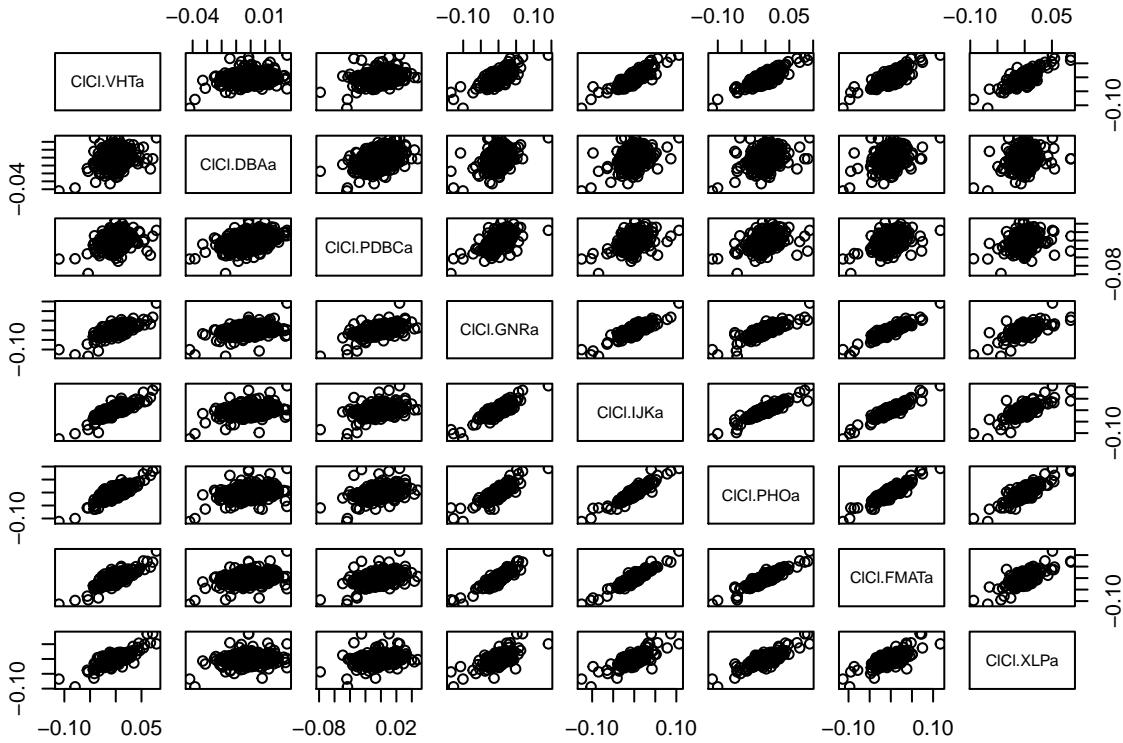
## Warning in read.table(file = file, header = header, sep = sep, quote
## = quote, : 'https://query2.finance.yahoo.com/v7/finance/download/XLP?
## period1=-2208988800&period2=1597795200&interval=1d&events=split&crumb=DsHaGyhZ9EF'
##   readTableHeader

# Combine all the returns in a matrix
all_returns3 = cbind( C1C1(VHTa),
                      C1C1(DBAa),
                      C1C1(PDBCa),
                      C1C1(GNRa),
                      C1C1(IJKa),
                      C1C1(PHOa),
                      C1C1(FMATA),
                      C1C1(XLPA))

all_returns3 = as.matrix(na.omit(all_returns3))

# Compute the returns from the closing prices
pairs(all_returns3)

```



Since we had 8 ETFs, we equally splitted the weights for each ETFs (0.125) and ran the simulation using bootstrap resampling 15000 times.

```
initial_wealth = 100000
sim3 = foreach(i=1:15000, .combine='rbind') %do% {
  total_wealth = initial_wealth
  weights = c(0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125, 0.125)
  holdings = weights * total_wealth
  n_days = 20
  wealthtracker = rep(0, n_days)
  for(today in 1:n_days) {
    return.today = resample(all_returns3, 1, orig.ids=FALSE)
    holdings = holdings + holdings*return.today
    total_wealth = sum(holdings)
    wealthtracker[today] = total_wealth
  }
  wealthtracker
}
# each row is a simulated trajectory (simulated future)
# each column is a data
head(sim3)
```

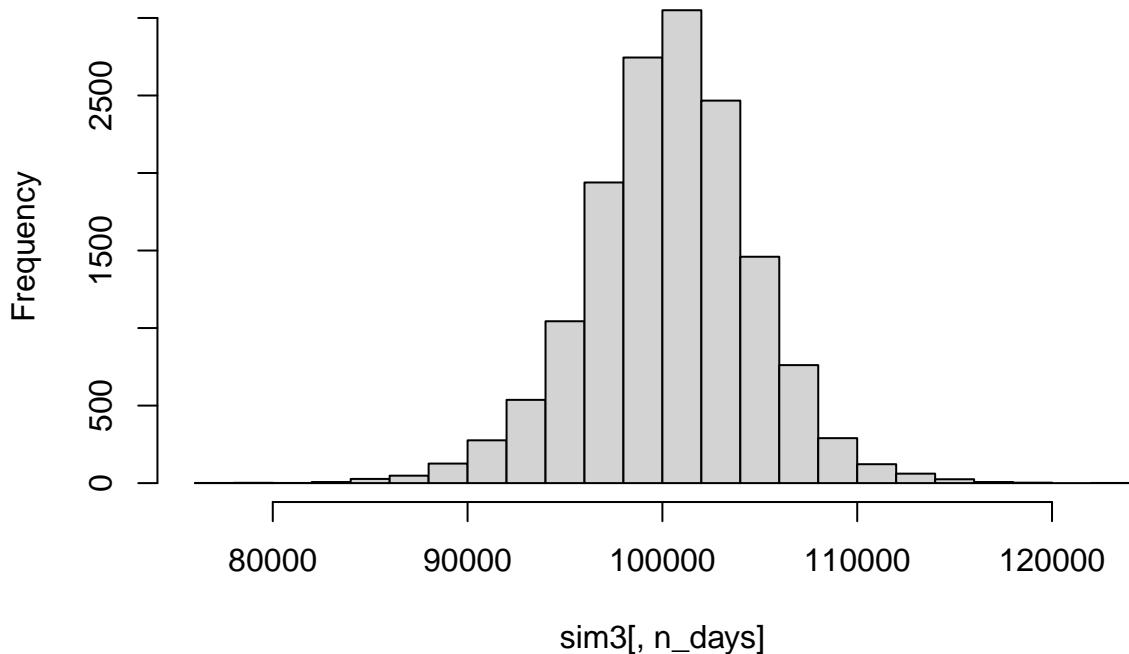
| | [,1] | [,2] | [,3] | [,4] | [,5] | [,6] | [,7] |
|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| ## result.1 | 100465.68 | 99350.16 | 98865.16 | 97401.44 | 97492.85 | 97753.64 | 96872.64 |
| ## result.2 | 100192.48 | 97656.67 | 97538.85 | 98218.03 | 98278.03 | 98228.35 | 98599.30 |
| ## result.3 | 100953.75 | 101789.36 | 102347.68 | 102615.20 | 102746.22 | 103002.83 | 103038.60 |
| ## result.4 | 100724.35 | 100715.56 | 100837.93 | 100767.36 | 100856.50 | 104123.66 | 104514.62 |
| ## result.5 | 98817.30 | 99371.85 | 99024.51 | 98917.15 | 97645.11 | 98041.55 | 98335.81 |

```

## result.6 99437.89 100365.07 100450.11 100478.99 100593.65 99967.04 101469.58
##          [,8]      [,9]      [,10]     [,11]     [,12]     [,13]     [,14]
## result.1 96658.15 96368.92 96479.27 96009.57 94834.23 92950.25 93013.54
## result.2 99078.42 99181.30 101103.06 101638.58 101111.95 101915.57 101830.14
## result.3 101737.60 101495.92 101656.96 100639.16 101490.35 101128.42 101002.47
## result.4 104217.08 104281.43 102949.95 102711.48 102372.25 102040.81 101694.29
## result.5 99345.58 99619.33 98317.52 98056.79 97607.17 98091.61 97642.11
## result.6 102999.19 102888.76 102743.41 102177.23 102264.77 103221.60 103511.69
##          [,15]     [,16]     [,17]     [,18]     [,19]     [,20]
## result.1 92744.70 92913.23 93118.50 92940.41 93083.57 93166.78
## result.2 100373.82 98788.32 99755.37 98430.59 98853.25 97847.04
## result.3 101848.70 101644.80 101561.01 101457.01 101561.24 101866.39
## result.4 102150.36 102039.86 101985.63 102586.68 101554.83 101535.97
## result.5 95562.55 95612.57 95731.30 95717.57 95019.77 93423.00
## result.6 104389.39 103865.93 103097.67 103373.48 102150.65 104666.22
hist(sim3[,n_days], 25)

```

Histogram of sim3[, n_days]



Our third portfolio shows mean of 100358.8 dollars, indicating 358.8479 dollars profit with value at risk 6844.874 dollars. This means that 5% of this simulated future has a loss worse than 6844.874 dollars and the rest (95%) are better than losing 6844.874 dollars.

```

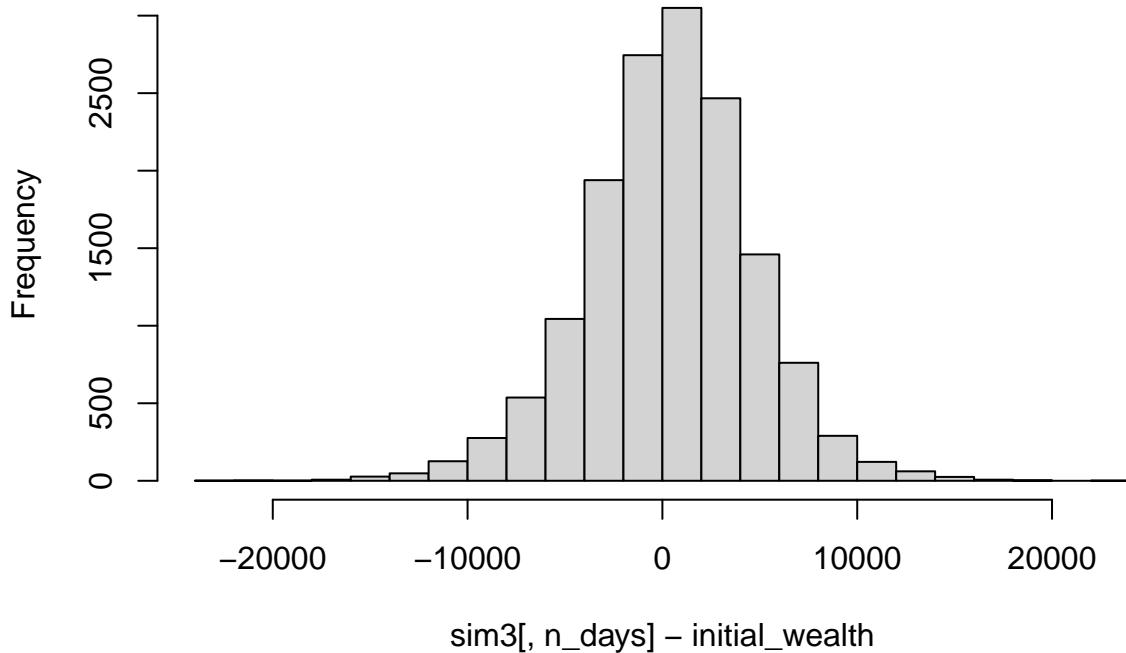
# Profit/loss
mean(sim3[,n_days]) # 100358.8

## [1] 100385.9
mean(sim3[,n_days] - initial_wealth) #358.8479

```

```
## [1] 385.9471
hist(sim3[,n_days] - initial_wealth, breaks=30)
```

Histogram of sim3[, n_days] – initial_wealth



```
# 5% value at risk:
quantile(sim3[,n_days] - initial_wealth, prob=0.05) # -6844.874
```

```
##      5%
## -6799.271
```

To sum up, we could get these results from our three portfolios: Portfolio 1 (5 random ETFs): loss = \$124.2499, VaR = \$9322.883 Portfolio 2 (6 related ETFs): profit = \$303.8911, VaR = \$8028.351 Portfolio 3 (8 related ETFs): profit = \$358.8479, VaR = \$6844.874

In conclusion, throughout our three simulations utilizing bootstrap resampling technique, we discovered that choosing random (unrelated) ETFs is definitely not profitable choice. While some might claim that splitting ETFs into various unrelated assets of ETF is profitable way because of its wide range of ETFs, our simulation denies that notion. Rather, our simulations indicate that choosing related ETFs in fact gives better results and profit. Also note that the VaR has gotten low as we added more related ETFs. Therefore, we could conclude that investing into related ETFs is the better way of getting profit with low VaR than investing into random ETFs.

Market segmentation

Data Cleaning

We divided columns by relevant interests. For example, we gathered sport columns like “sports_fandom”, “sports_playing” and “personal training”. This results more sorted data set by their relevant interests.

```

library(ggplot2)
library(LICORS) # for kmeans++
library(foreach)
library(mosaic)
library(tidyverse)

data <- read.csv("social_marketing.csv")
# reorder the columns
sns <- data[, -6]
sns$uncategorized <- data[, 6]

data2 <- read.csv("social_marketing.csv", row.names = 1)
sns_reordered <- data2[, c(1,2,4,29, 9,10,15,28, 18,8, 30,16, 32,27,23,14, 6,17,31, 20,13,24, 3,22,19, 21)]

```

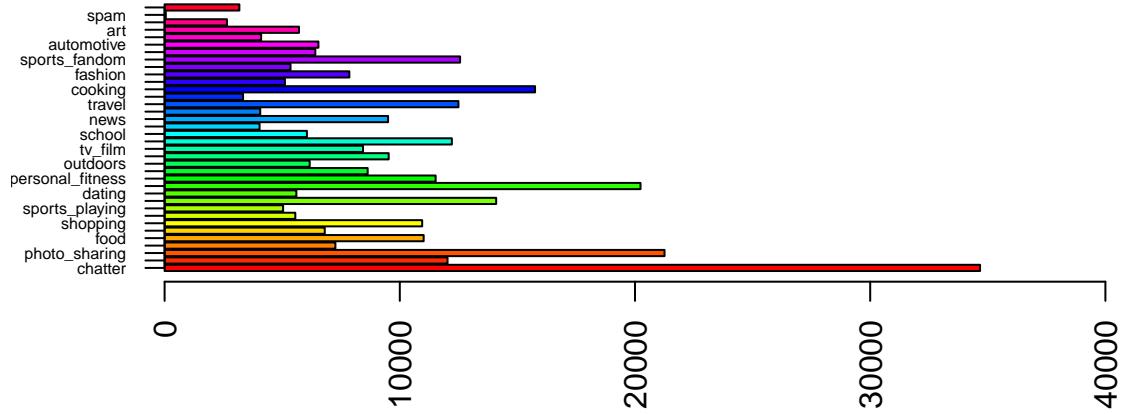
Before we dive into data analysis, let's first see the total distribution across the interests. Note that "chatter" is the highest, followed by "photo_sharing". This is a straightforward information since most of posts in Twitter can be fall into these two categories. One interesting aspect is that "health_nutrition" is the highest except "chatter" and "photo_sharing". This roughly indicates that many of the brand's followers are interested in health and nutrient. Maybe that was the reason why they followed the brand NutrientH20, which our group guessed as nutrition brand as the name of the brand indicates.

```

par(mar=c(11,4,4,4))
barplot(colSums(sns_reordered), horiz=TRUE, xlim=c(0, 40000), main="Total Distribution Across the Interests")

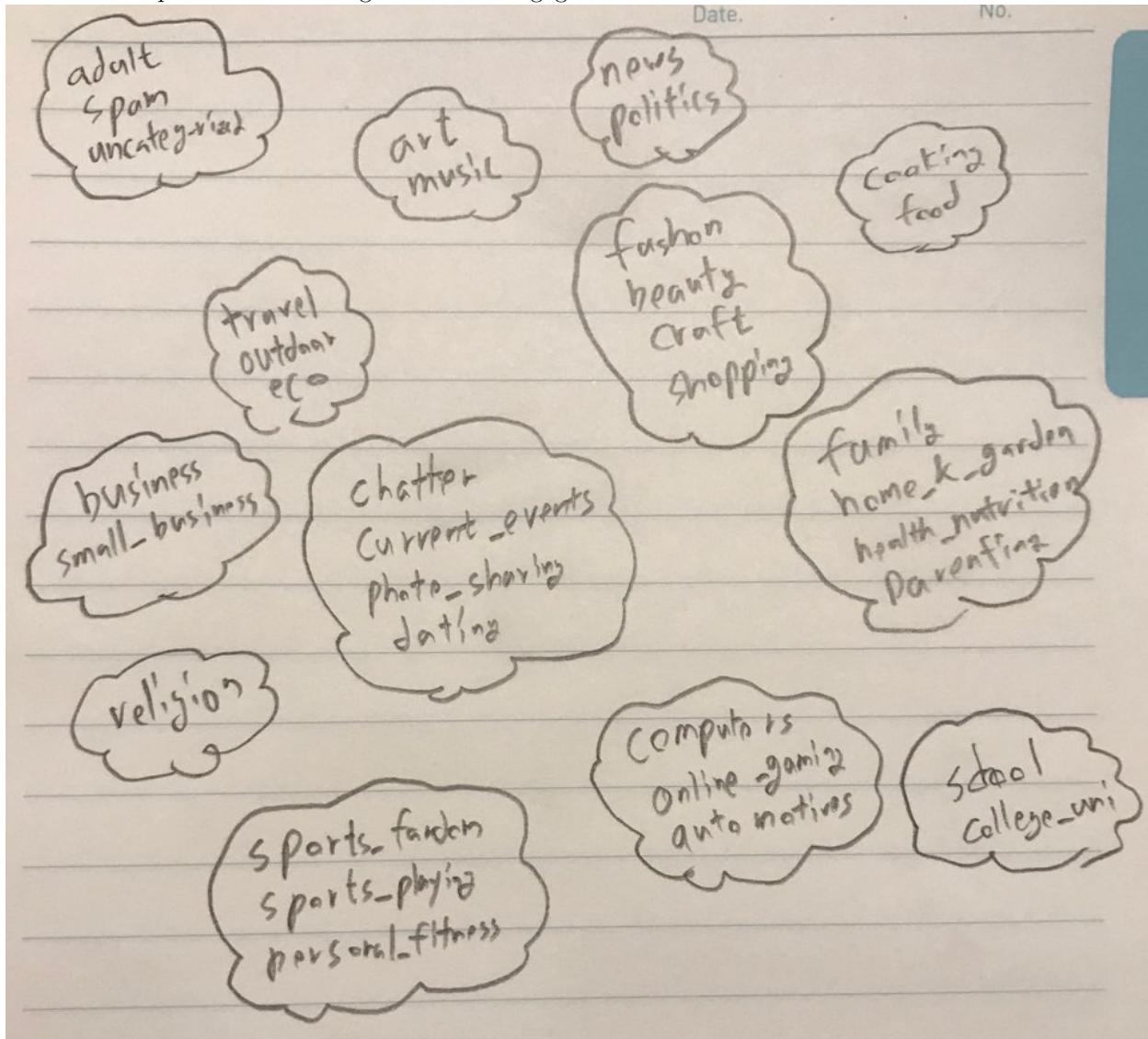
```

Total Distribution Across the Interests



PCA The picture below shows our group's definition of market segmentation. We divided each related interests into separate groups. For example, we gathered "family", "home_&_garden", "health_nutrition", and "parenting" as family-related group. We also gathered "travel", "eco", and "outdoor" as travel-

related group. There are 13 clusters in total in our drawing. Note that this is mere a rough-draft of our entire process. We thought this drawing gives nice overview of our 36 interests in the dataset.



In order to perform PCA, we first measured means of all interests and created a new data frame. Then we created a correlation matrix to see overall correlation between each interests in our data set. Although the matrix shows not many correlation, there are some strong positive correlation which indicates that we could reduce the dimensionality. Interestingly enough, we could observe that some of our “prediction” of above drawing actually are represented in below correlation matrix. For example, “politics” has strong correlation with “news” and “beauty” has strong correlation with fashion. However, there are some correlations that we did not expect: “food”, “sports_fandom”, “religion” and “parenting”, and “travel” and “politics”. Recall that this data was achieved from human annotators. Such unexpected correlation might be influenced by inevitable error by annotators.

```

sns_results = sns %>%
  group_by(X) %>%
  summarize_all(mean) %>%
  column_to_rownames(var="X")

# a look at the correlation matrix

```

```

head(cor(sns_results))

##          chatter current_events      travel photo_sharing    tv_film
## chatter      1.00000000  0.15621116  0.01466681  0.53626660 0.01289863
## current_events 0.15621116  1.00000000  0.05094616  0.14595286 0.07767346
## travel       0.01466681  0.05094616  1.00000000  0.02406795 0.09698995
## photo_sharing 0.53626660  0.14595286  0.02406795  1.00000000 0.02117091
## tv_film       0.01289863  0.07767346  0.09698995  0.02117091 1.00000000
## sports_fandom 0.01439263  0.06178037 -0.00870919  0.01992100 0.03075880
##                      sports_fandom   politics        food     family home_and_garden
## chatter           0.01439263  0.05144838 -0.004704080 0.07917038  0.07015760
## current_events   0.06178037  0.06828273  0.059767526 0.06336701  0.05351146
## travel            -0.00870919  0.66021000  0.075142216 0.01753476  0.04093187
## photo_sharing    0.01992100  0.03976700  0.006802181 0.09858794  0.08395511
## tv_film           0.03075880  0.03225454  0.080683325 0.02177639  0.10659105
## sports_fandom    1.00000000  0.06709790  0.532638366 0.43781038  0.08482199
##                      music        news online_gaming shopping
## chatter           0.09131777 -0.001163561  0.004784789 0.58337322
## current_events   0.07236614  0.060284226 -0.001645689 0.15014362
## travel            0.03864032  0.250616947  0.013222873 0.01990778
## photo_sharing    0.14618817 -0.011980028  0.037234010 0.53562102
## tv_film           0.27483223  0.067440558  0.035331802 0.04162464
## sports_fandom    0.05453751  0.200289676  0.024760877 0.02626127
##                      health_nutrition college_uni sports_playing cooking
## chatter           0.003727738  0.03399144  0.06107395 0.0020816423
## current_events   0.019863015  0.03095266  0.03072078 0.0467164788
## travel            -0.011922499  0.05383514  0.05496195 0.0175974884
## photo_sharing    0.034804791  0.06149484  0.09869699 0.3605909943
## tv_film           -0.001790684  0.20421826  0.10326318 0.0006017955
## sports_fandom    -0.011229255  0.02645641  0.07104991 0.0076921174
##                      eco   computers business outdoors crafts
## chatter           0.15511774  0.072489571 0.16610690 -0.006597319 0.11174145
## current_events   0.07690347  0.054824859 0.07458087  0.017898948 0.07372363
## travel            0.06143429  0.602934879 0.16184567  0.027133231 0.08695379
## photo_sharing    0.17341168  0.093000186 0.17863635  0.032783874 0.11094571
## tv_film           0.06282547 -0.005485945 0.10114738  0.028928541 0.18468945
## sports_fandom    0.08585083  0.050633295 0.06813277  0.062217647 0.20118860
##                      automotive      art religion beauty parenting
## chatter           0.13376735 -0.005076772 -0.023111699 0.02636423 0.02074252
## current_events   0.07244481  0.053477246  0.067694509 0.07011221 0.05023716
## travel            -0.00278411  0.086394257  0.063933064 0.01256552 0.04234113
## photo_sharing    0.11524903  0.024752344  0.003299888 0.31796590 0.04116965
## tv_film           0.02050753  0.498771827  0.045027564 0.01678311 -0.00178809
## sports_fandom    0.23964647  0.022319534 0.637974843 0.12286324 0.60771812
##                      dating school personal_fitness fashion
## chatter           0.184452453 0.11667862  0.0327477067 0.06331429
## current_events   0.031045863 0.06804713  0.0383886537 0.05590622
## travel            0.086756030 0.02219954  -0.0052992453 0.02601565
## photo_sharing    0.028511721 0.10620924  0.0625236821 0.34724880
## tv_film           0.004170894 0.02502227  -0.0004447435 0.01760887
## sports_fandom    0.016925530 0.49310619  0.0142720768 0.03076729
##                      small_business      spam adult uncategorized
## chatter           0.11673062 0.004603242 0.015372712 0.0669934396
## current_events   0.06549793 0.019402989 0.016764279 0.0296742259

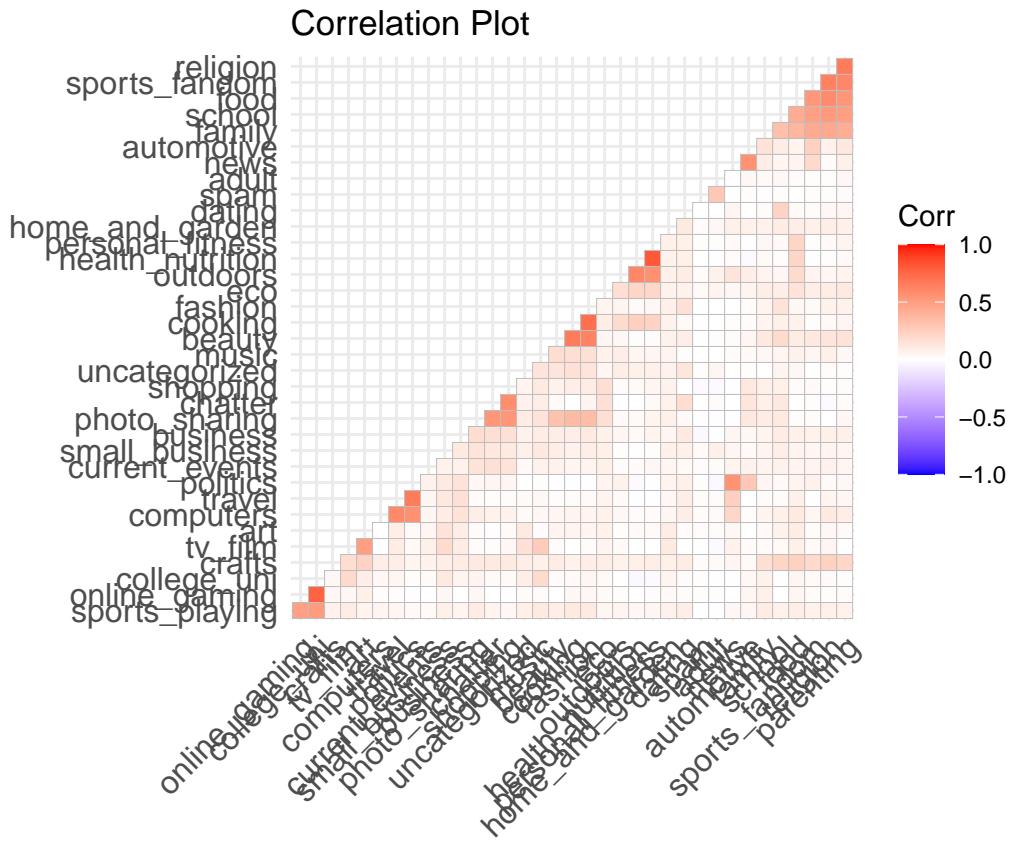
```

```

## travel          0.11695071  0.022773349  0.020244743  0.0308655618
## photo_sharing  0.13811239 -0.008664858 -0.012707084  0.0963980989
## tv_film         0.18879824 -0.004210646 -0.021700249  0.1632789878
## sports_fandom   0.04866224  0.008957464  0.007986164 -0.0005287314

# looks a mess -- reorder the variables by hierarchical clustering
ggcorrplot::ggcorrplot(cor(sns_results), title="Correlation Plot", type="lower", hc.order = TRUE)

```



We performed PCA and created the variance plot of each PCs. Obviously, the first PC has the highest variance while others share somewhat similar behaviors.

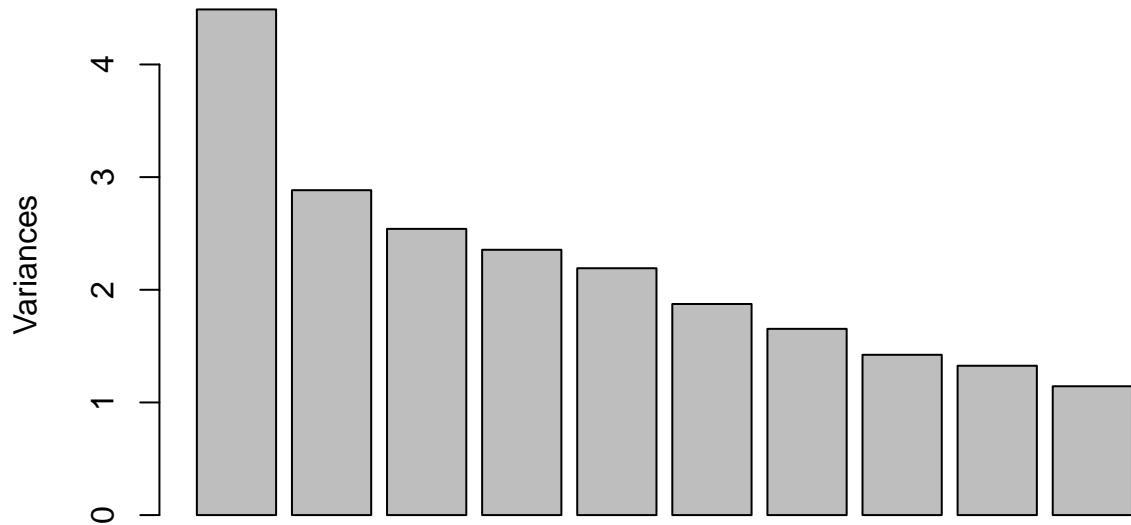
```

# Now look at PCA of the (average) survey responses.
# This is a common way to treat survey data
PCAsns = prcomp(sns_results, scale=TRUE)

## variance plot
plot(PCAsns)

```

PCAsns



```
#summary(PCAsns)
```

We checked the number of PCs by creating an elbow plot. The elbow plot below shows the knee around 11 PCs. So we could narrow our 36 PCs down to 11 PCs.

```
# std dev of each PCs
std_dev <- PCAsns$sdev

# Variances of each PCs
pca_var <- std_dev^2
# check first 10 variance
pca_var[1:10]

## [1] 4.488436 2.884020 2.540463 2.354914 2.191213 1.873759 1.653216 1.422705
## [9] 1.325425 1.143411

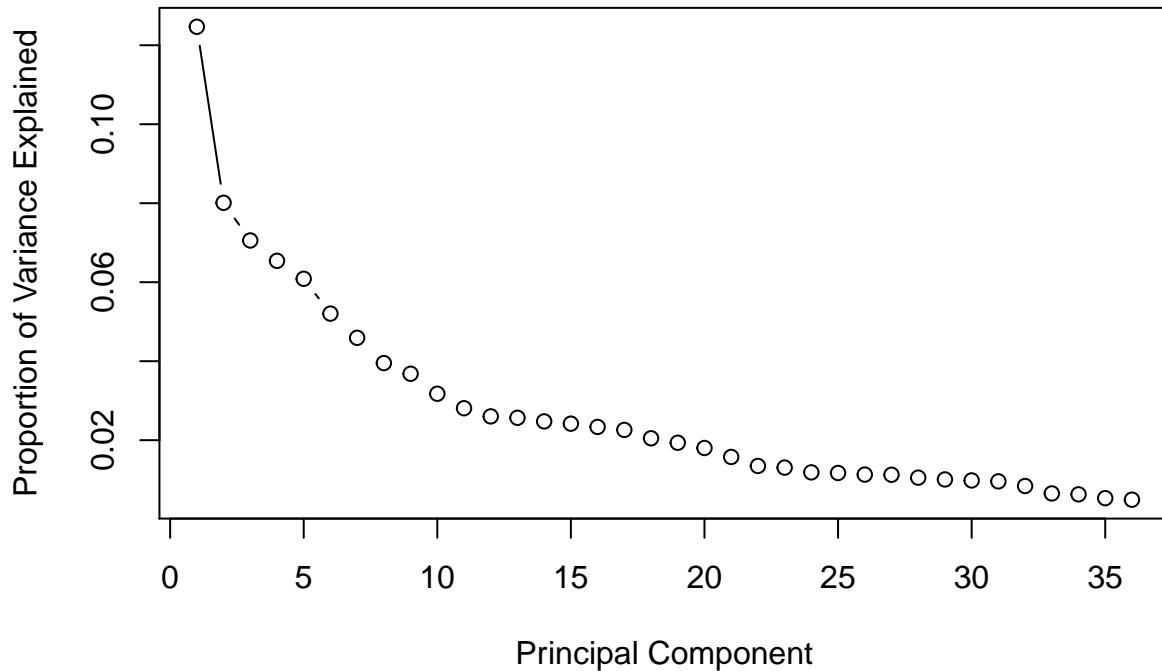
# We want to find the components which explain the maximum variance.
# Higher variance retains more information

# To compute the proportion of variance explained by each component,
# we simply divide the variance by sum of total variance.

# proportion of variance explained
prop_var <- pca_var / sum(pca_var)
prop_var[1:10]

## [1] 0.12467878 0.08011168 0.07056843 0.06541427 0.06086704 0.05204886
## [7] 0.04592267 0.03951959 0.03681735 0.03176140
```

```
plot(prop_var, xlab = "Principal Component",
      ylab = "Proportion of Variance Explained",
      type = "b")
```



```
# create a tidy summary of the loadings
loadings_summary = PCA$rotation %>%
  as.data.frame() %>%
  rownames_to_column('Interest')

loadings_summary %>%
  select(Interest, PC1) %>%
  arrange(desc(PC1))
```

| | Interest | PC1 |
|-------|---------------|------------|
| ## 1 | religion | 0.29709999 |
| ## 2 | food | 0.29690952 |
| ## 3 | parenting | 0.29400412 |
| ## 4 | sports_fandom | 0.28773177 |
| ## 5 | school | 0.28063791 |
| ## 6 | family | 0.24426866 |
| ## 7 | beauty | 0.20151836 |
| ## 8 | crafts | 0.19362762 |
| ## 9 | cooking | 0.18880850 |
| ## 10 | fashion | 0.18388185 |
| ## 11 | photo_sharing | 0.18027952 |
| ## 12 | eco | 0.14533561 |

```

## 13      computers 0.14333124
## 14      outdoors 0.14260424
## 15 personal_fitness 0.13750109
## 16      business 0.13501004
## 17      shopping 0.13299500
## 18      automotive 0.13132522
## 19      politics 0.13026617
## 20 sports_playing 0.13021653
## 21      news 0.12764328
## 22      chatter 0.12599239
## 23 health_nutrition 0.12420109
## 24      music 0.12408921
## 25 small_business 0.11904181
## 26      travel 0.11664903
## 27 home_and_garden 0.11576501
## 28      dating 0.10515646
## 29      art 0.09794933
## 30      tv_film 0.09745666
## 31 current_events 0.09723669
## 32 uncategorized 0.09443507
## 33 college_uni 0.09415672
## 34 online_gaming 0.07388979
## 35      adult 0.02673097
## 36      spam 0.01146092

```

```

loadings_summary %>%
  select(Interest, PC2) %>%
  arrange(desc(PC2))

```

| | Interest | PC2 |
|-------|-----------------|--------------|
| ## 1 | sports_fandom | 0.316923635 |
| ## 2 | religion | 0.316152778 |
| ## 3 | parenting | 0.295082234 |
| ## 4 | food | 0.237808675 |
| ## 5 | school | 0.197572367 |
| ## 6 | family | 0.196253208 |
| ## 7 | news | 0.036198891 |
| ## 8 | automotive | 0.031564108 |
| ## 9 | crafts | 0.021623185 |
| ## 10 | adult | 0.006918154 |
| ## 11 | spam | 0.004551609 |
| ## 12 | politics | -0.013939964 |
| ## 13 | computers | -0.037334899 |
| ## 14 | travel | -0.039947269 |
| ## 15 | home_and_garden | -0.046803486 |
| ## 16 | art | -0.060347094 |
| ## 17 | current_events | -0.064036499 |
| ## 18 | dating | -0.071535239 |
| ## 19 | tv_film | -0.079352508 |
| ## 20 | online_gaming | -0.083591578 |
| ## 21 | eco | -0.085321972 |
| ## 22 | small_business | -0.094048059 |
| ## 23 | business | -0.098782574 |
| ## 24 | sports_playing | -0.108595355 |
| ## 25 | outdoors | -0.113581774 |

```

## 26      college_uni -0.115959664
## 27          music -0.144259544
## 28 personal_fitness -0.144611756
## 29 uncategorized -0.146498856
## 30 health_nutrition -0.146577761
## 31      chatter -0.197225501
## 32      beauty -0.208609941
## 33      shopping -0.209852847
## 34      fashion -0.279799725
## 35 photo_sharing -0.303077634
## 36      cooking -0.314287972

```

K Means Clustering

Before we perform K-Means Clustering, we scaled our PCA values and created an elbow plot for the right number of K. Among 20 Ks, the elbow plot shows a knee near when K equals 12. Interestingly enough, this was very close to what we roughly predicted when we drew the picture above. Although the correlation matrix showed some unexpected correlation, we thought this was interesting fact to note.

```

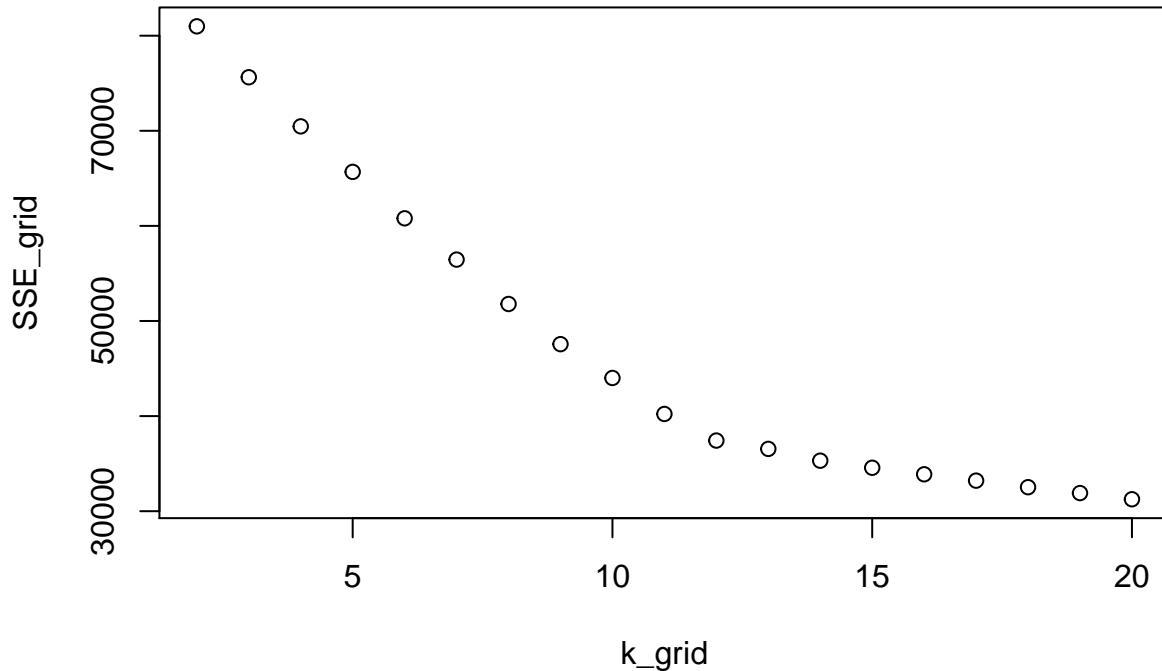
X <- as.data.frame(PCAsns$x[, 1:11])

sns_scaled = scale(X, center=TRUE, scale=TRUE)

k_grid = seq(2, 20, by=1)
SSE_grid = foreach(k = k_grid, .combine="c") %do%{
  cluster_k = kmeans(sns_scaled, k, nstart=50)
  cluster_k$tot.withinss
}

## Warning: did not converge in 10 iterations
plot(k_grid, SSE_grid)

```



We then performed K-Means Clustering with 25 different random initializations. The table below shows the centers of the clusters.

```
# Extract the centers and scales from the rescaled data (which are named attributes)
mu = attr(sns_scaled, "scaled:center")
sigma = attr(sns_scaled, "scaled:scale")

# Run k-means with 6 clusters and 25 starts
clust1 = kmeans(sns_scaled, 13, nstart=25)
# 25 different random initialization and the result of the algorithm is the best of those 25 so it's likely to be good

# What are the clusters?
clust1$center[1,]*sigma + mu

##          PC1         PC2         PC3         PC4         PC5         PC6
##  0.52930714 -0.76980246  0.59650667 -2.22685231 -4.30730048  0.02137664
##          PC7         PC8         PC9         PC10        PC11
##  1.93251539 -0.40323621  0.03897100  0.06715427  0.62877690

#clust1$center[2,]*sigma + mu
#clust1$center[4,]*sigma + mu
```

We also tried K Means++, but its sum of within-cluster sum of squares is actually higher and its between-cluster sum of squares is lower than regular K Means. So we decided to stick with regular K Means clustering as our model.

```
# Using kmeans++ initialization
clust2 = kmeanspp(sns_scaled, k=13, nstart=25)
```

```

# Compare versus within-cluster average distances from the first run
clust1$withinss

## [1] 2457.576 2640.571 3412.800 2809.921 3149.200 3410.373 1808.466 1528.304
## [9] 3248.229 4619.389 1696.195 3514.914 2252.921

clust2$withinss

## [1] 1827.5151 834.8267 2663.6108 1176.6322 2768.9192 3737.9929 2450.8734
## [8] 3432.7271 2236.0410 2150.5515 6347.3606 3157.2124 3355.9310

sum(clust1$withinss)

## [1] 36548.86

sum(clust2$withinss)

## [1] 36140.19

clust1$tot.withinss

## [1] 36548.86

clust2$tot.withinss

## [1] 36140.19

clust1$betweenss

## [1] 50142.14

clust2$betweenss

## [1] 50550.81

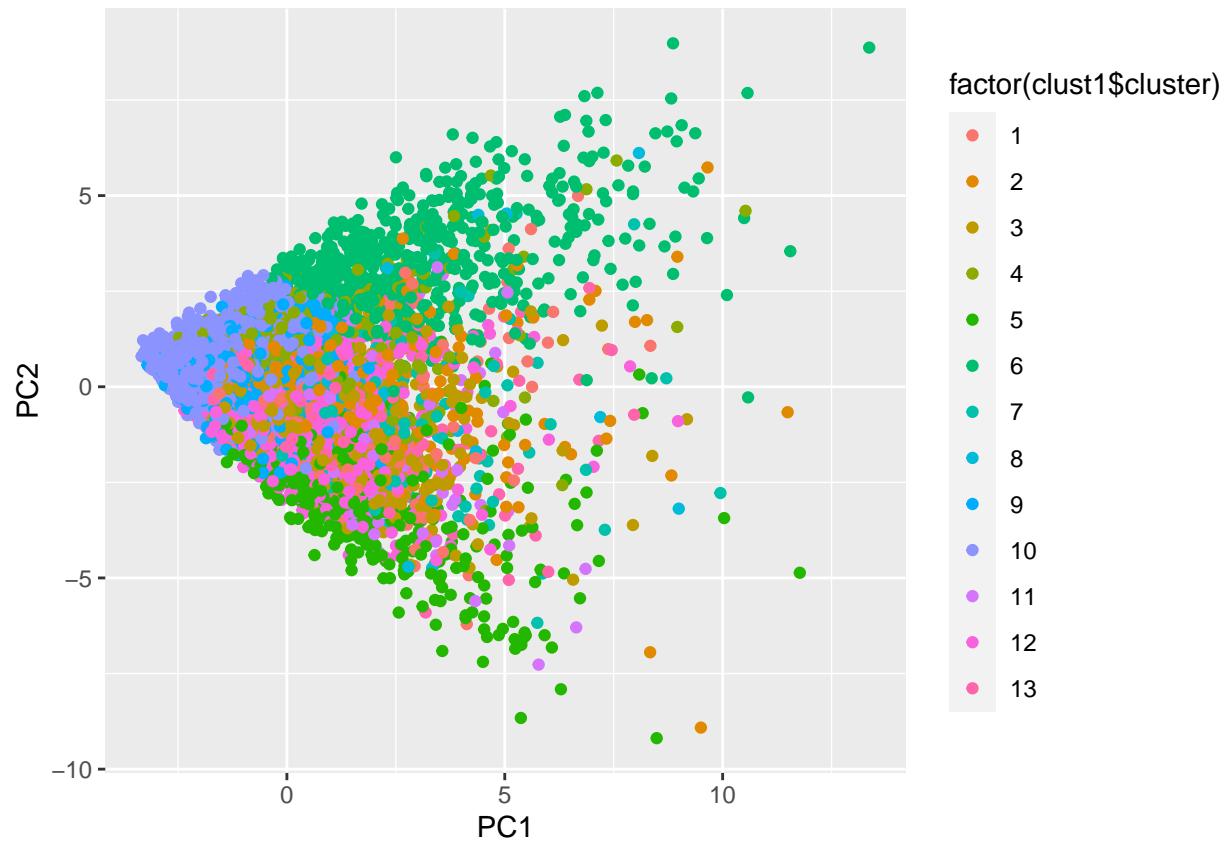
```

Now we plotted the result as shown below. All plots share similar behavior: It looks like other clusters are moving towards the cluster 1. Below is the plot of PC1 and PC2.

```

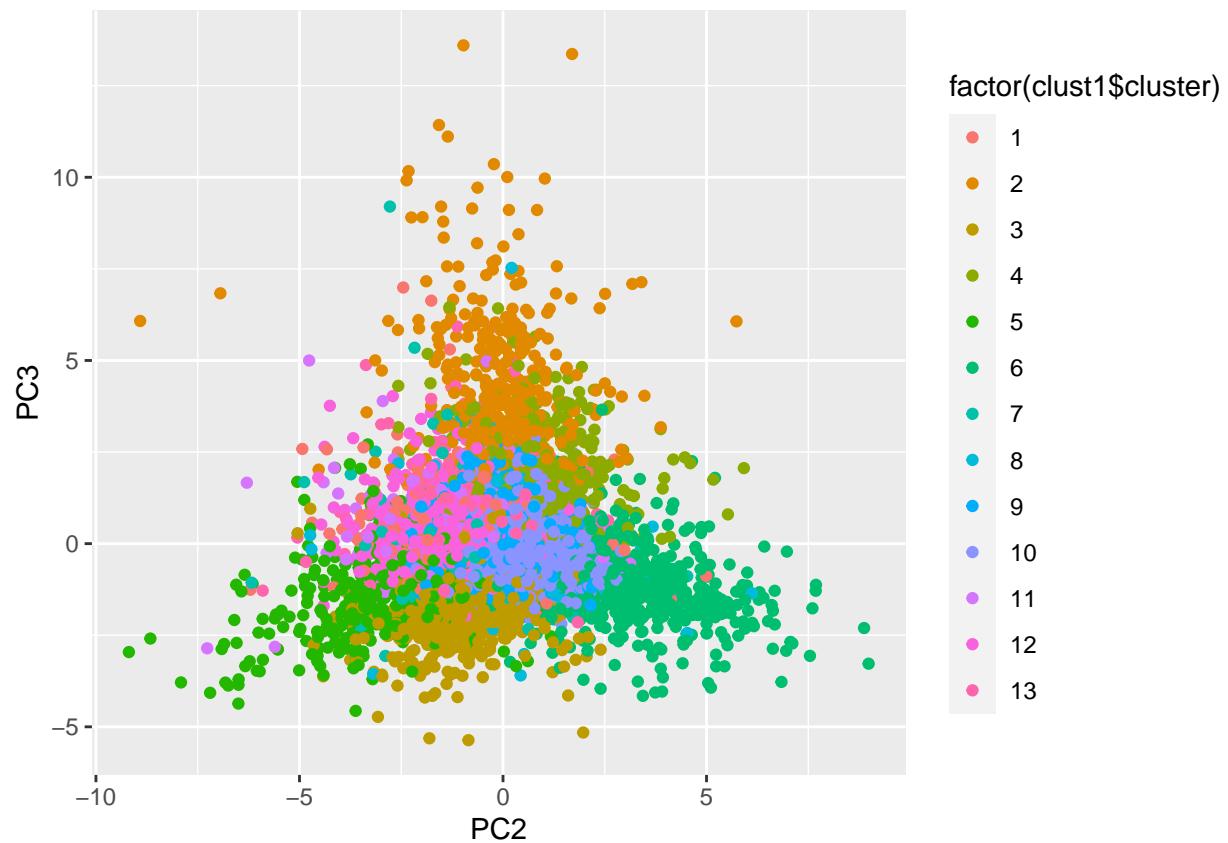
# plot
qplot(PC1, PC2, data=X, color=factor(clust1$cluster))

```



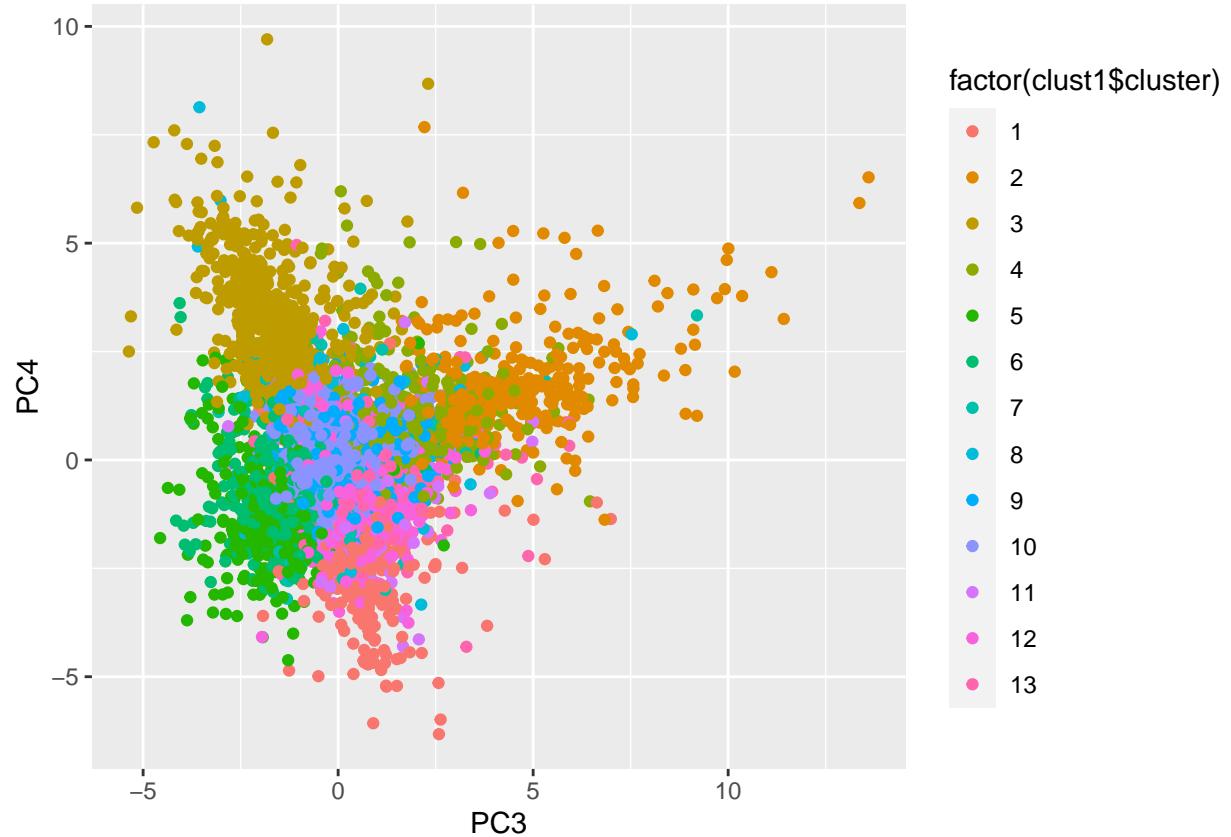
Below is the plot of PC2 and PC3

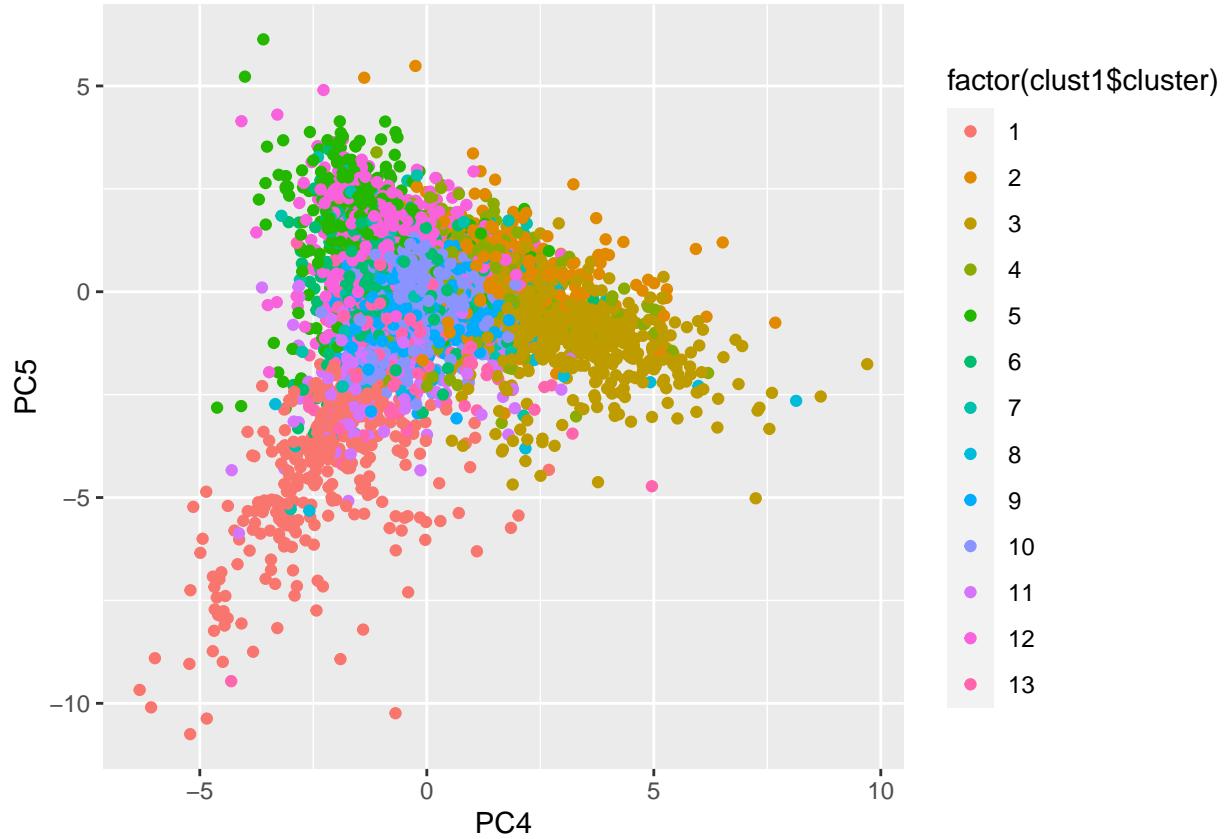
```
qplot(PC2, PC3, data=X, color=factor(clust1$cluster))
```



Below is the plot of PC3 and PC4

```
qplot(PC3, PC4, data=X, color=factor(clust1$cluster))
```





```
for (i in seq(1:13)) {
  print(paste("Number of Cluster ", i, ":", length(which(clust1$cluster == i))))
}
```

```
## [1] "Number of Cluster 1 : 351"
## [1] "Number of Cluster 2 : 349"
## [1] "Number of Cluster 3 : 701"
## [1] "Number of Cluster 4 : 466"
## [1] "Number of Cluster 5 : 461"
## [1] "Number of Cluster 6 : 607"
## [1] "Number of Cluster 7 : 218"
## [1] "Number of Cluster 8 : 84"
## [1] "Number of Cluster 9 : 1044"
## [1] "Number of Cluster 10 : 2246"
## [1] "Number of Cluster 11 : 222"
## [1] "Number of Cluster 12 : 859"
## [1] "Number of Cluster 13 : 274"
```

Author Attribution

For this problem, we utilized “tm” library for reading our text data sets. The “readPlain” function reads in English texts so that we can work on it in our R studio environment. Then we loaded our C50train data set by “Sys.glob” function. This function allows us to load all the data we need inside the C50train folder. After that, we had 50 training article data (2500 in total). We then cleaned up the file names by using “strsplit” function so that our file names look like “AaronPressman106247newsML.txt”. We used “VectorSource” function in order to create a vector source of our data. Then we used “Corpus” function so that we can make kind of a dataframe that contains 2500 articles.

```

install.packages('tm', repos="http://cran.us.r-project.org")

##
## The downloaded binary packages are in
## /var/folders/w3/z6pvwvds5mz40qs1b6y0xlb00000gn/T//RtmpyzEksR downloaded_packages
install.packages('e1071', repos="http://cran.us.r-project.org")

##
## The downloaded binary packages are in
## /var/folders/w3/z6pvwvds5mz40qs1b6y0xlb00000gn/T//RtmpyzEksR downloaded_packages
install.packages('gmodels', repos="http://cran.us.r-project.org")

##
## The downloaded binary packages are in
## /var/folders/w3/z6pvwvds5mz40qs1b6y0xlb00000gn/T//RtmpyzEksR downloaded_packages
library(tm)

## Loading required package: NLP

##
## Attaching package: 'NLP'

## The following object is masked from 'package:ggplot2':
##
##     annotate

##
## Attaching package: 'tm'

## The following object is masked from 'package:mosaic':
##
##     inspect

library(tidyverse)
library(slam)
library(proxy)

##
## Attaching package: 'proxy'

## The following object is masked from 'package:Matrix':
##
##     as.matrix

## The following objects are masked from 'package:stats':
##
##     as.dist, dist

## The following object is masked from 'package:base':
##
##     as.matrix

library(tidyr)
library(glmnet)

## Loaded glmnet 4.0-2

```

```

library(e1071)
library(gmodels)
library(caret)

##
## Attaching package: 'caret'

## The following object is masked from 'package:mosaic':
##
##      dotPlot

## The following object is masked from 'package:purrr':
##
##      lift

readerPlain = function(fname){
  readPlain(elem=list(content=readLines(fname)),
            id=fname, language='en') }

## Test it on Adam Smith
#adam = readerPlain("/Users/macintosh/Documents/R studio/division_of_labor.txt")
#adam
#meta(adam)
#content(adam)

# load all 50 training articles (2500 total)
fileNames <- Sys.glob("/Users/macintosh/Documents/R studio/ReutersC50/C50train/*/*.txt")
articles_train = lapply(fileNames, readerPlain)
#fileNames

# Clean up the file names
mynames = fileNames %>%
  { strsplit(., '/', fixed=TRUE) } %>%
  { lapply(., tail, n=2) } %>%
  { lapply(., paste0, collapse = '') } %>%
  unlist

# Rename the articles
#author_names <- c()

#for (i in seq(1, length(fileNames))){
#  name <- strsplit(fileNames[i], split = "/")[[1]][8]
#  author_names <- append(author_names, name)
#}
#mynames
names(articles_train) = mynames

documents_raw = Corpus(VectorSource(articles_train))

```

For preprocessing and tokenization steps, we utilized “content_transformer” function to remove numbers, punctuation, excess white-spaces, and converting everything into lowercase. Then we used “tm_map” to map these into the corpus dataframe.

```

## Some pre-processing/tokenization steps.
## tm_map just maps some function to every document in the corpus
my_documents = documents_raw %>%

```

```

tm_map(content_transformer(tolower)) %>%          # make everything lowercase
tm_map(content_transformer(removeNumbers)) %>%      # remove numbers
tm_map(content_transformer(removePunctuation)) %>%    # remove punctuation
tm_map(content_transformer(stripWhitespace))        # remove excess white-space

## Warning in tm_map.SimpleCorpus(., content_transformer(tolower)): transformation
## drops documents

## Warning in tm_map.SimpleCorpus(., content_transformer(removeNumbers)):
## transformation drops documents

## Warning in tm_map.SimpleCorpus(., content_transformer(removePunctuation)):
## transformation drops documents

## Warning in tm_map.SimpleCorpus(., content_transformer(stripWhitespace)):
## transformation drops documents

```

Then we removed stopwords. Among two built-in stopwords, we decided to use “en” which is just basic English stopwords.

```

my_documents = tm_map(my_documents, content_transformer(removeWords), stopwords("en"))

## Warning in tm_map.SimpleCorpus(my_documents, content_transformer(removeWords), :
## transformation drops documents

```

We created a doc-term-matrix from the corpus. This matrix shows 99% sparsity which indicates that there are 99% of data which are zeros.

```

DTM_train = DocumentTermMatrix(my_documents)
DTM_train # some basic summary statistics

```

```

## <<DocumentTermMatrix (documents: 2500, terms: 32571)>>
## Non-/sparse entries: 540361/80887139
## Sparsity           : 99%
## Maximal term length: 46
## Weighting          : term frequency (tf)

```

We explored some functions for the doc-term-matrix from the corpus such as “inspect”, “findFreqTerms”, and “findAssocs”. We used word “genetic” that we used in our class for finding association terms.

```
inspect(DTM_train)
```

```

## <<DocumentTermMatrix (documents: 2500, terms: 32571)>>
## Non-/sparse entries: 540361/80887139
## Sparsity           : 99%
## Maximal term length: 46
## Weighting          : term frequency (tf)
## Sample             :
## Terms
## Docs  billion character company market million new percent said will year
## 111    0         4       0     3     2     3       0     6     4     1
## 130    0         4       1     1     5     0       2     1     1     4
## 142    3         4       1     3     1     2       1     9     6     8
## 2127   4         4       1     2     0     7       7     5    11     7
## 2133   2         4       0     1     0     0       5     7     3     4
## 2139   0         4       1     7     0     1      14    23     9     2
## 2140   4         4       0     0     0     2       3    12    15     3
## 599    1         4       5    11     0     0       0    16     1     2
## 763    0         4       0     4     0     3       0    20     3    10

```

```

##    766      0      4      0      7      0      4      0     20      4     10
head(findFreqTerms(DTM_train, 50))

## [1] "access"    "accounts"   "agencies"   "alliance"   "also"       "announced"
findAssocs(DTM_train, "genetic", .5)

## $genetic
##          abi        tests      arthritis      cancers      cystic
##          0.97      0.91      0.87      0.87      0.87
##          diabetes    disorders dystrophy      rheumatoid underclass
##          0.87      0.87      0.87      0.87      0.87
##          genetics  detrimental actuaries      defects insure
##          0.86      0.76      0.74      0.73      0.71
##          expectancy fibrosis diagnose susceptibility lifestyles
##          0.71      0.71      0.71      0.71      0.71
##          commonplace infancy profession chadwick euroscreen
##          0.71      0.69      0.62      0.56      0.56
##          geneticist hereditary huntingtons payoffs predisposition
##          0.56      0.56      0.56      0.56      0.56
##          twitching  untreatable makeup undergone testing
##          0.56      0.56      0.55      0.55      0.52
##          wishing
##          0.50

```

As our final preprocessing step, we removed the terms that have low frequency (removing the “long tail”). We utilized “removeSparseTerms” to remove any sparse terms in our document-term matrix. We set the maximal allowed sparsity of 95%. Such reduced our terms into 802 terms instead of about 32571 terms. Then we built TF IDF weights matrix as our final step for data analysis.

```

DTM_train = removeSparseTerms(DTM_train, 0.95)
DTM_train

## <<DocumentTermMatrix (documents: 2500, terms: 802)>>
## Non-/sparse entries: 283186/1721814
## Sparsity           : 86%
## Maximal term length: 24
## Weighting          : term frequency (tf)
# construct TF IDF weights -- might be useful if we wanted to use these
# as features in a predictive model
tfidf_train = weightTfIdf(DTM_train)

```

PCA

Before we dive into the model, we decided to do PCA in order to reduce the dimensionality of our data set. We dropped all zeros in order to make our process smooth. The “prcomp” function automatically chose 785 (columns) rather than 2500 (rows) because it automatically chooses the lower number between the two.

```

# Now PCA on term frequencies
tfidf_matix = as.matrix(tfidf_train) # make it into a matrix since prcomp requires matrix format.
summary(colSums(tfidf_matix))

##      Min. 1st Qu. Median      Mean 3rd Qu.      Max.
##      0.000  4.514  6.029  6.749  8.111 29.607

```

```

scrub_cols = which(colSums(tfidf_matix) == 0) # drops all zeros
tfidf_matix = tfidf_matix[, -scrub_cols]

pca_train = prcomp(tfidf_matix, scale=TRUE) # since without "rank" parameter, it automatically select t
#summary(pca_train)

# Look at the loadings
pca_train$rotation[order(abs(pca_train$rotation[,1]),decreasing=TRUE),1] [1:25]

##      beijing      china      chinese      chinas      share      million
## -0.14235799 -0.13615984 -0.12356205 -0.11744223  0.11622822  0.11419658
##    analysts     earnings     quarter     percent     leader     analyst
##  0.11090428  0.10930980  0.10907596  0.10539498 -0.10444837  0.10433585
##   beijings     profits     profit      hong     political     communist
## -0.10364432  0.10280410  0.10188136 -0.09821782 -0.09714371 -0.09647188
##     cchina     official     kong     officials     rose     government
## -0.09445094 -0.09358866 -0.09343287 -0.09332476  0.09036083 -0.08974060
##     human
## -0.08837110

pca_train$rotation[order(abs(pca_train$rotation[,2]),decreasing=TRUE),2] [1:25]

##          corp      communications        new      companies
## -0.11798420      -0.11317581     -0.11192299     -0.10817292
##       company           deal         will      internet
## -0.10792766      -0.10029516     -0.09955620     -0.09784312
##      forecast          beijing       chinas     customers
##  0.09702771      0.09683071     0.09579163     -0.09483727
##      percent          services      profit telecommunications
##  0.09258526      -0.09093179     0.09046046     -0.08908398
##       network           china      chinese       inc
## -0.08885564      0.08837686     0.08751040     -0.08571284
##      industry          networks      results      rise
## -0.08515680      -0.08412059     0.08377678     0.08367041
##      figures
##  0.08272540

```

As expected, the graph below shows that the first component is the highest. However, the components after the first component are gradually decreasing. This is because our data set is so big that the components after the first component don't have much difference. In other words, the weight distribution of each components are small compared to that of the example in our class which has total 50 components.

```

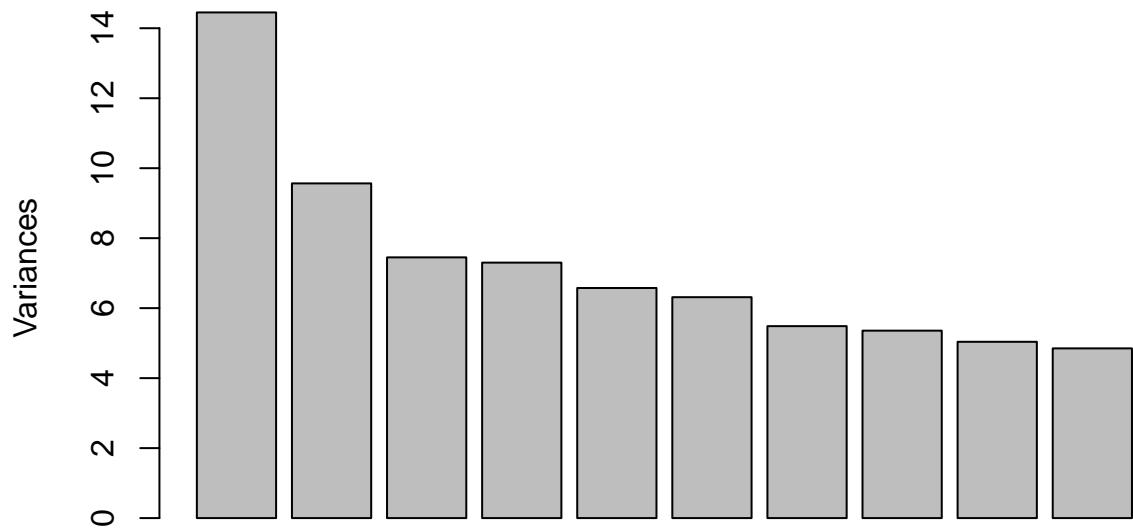
head(pca_train$x[,1:2])

##
## Docs      PC1      PC2
## 1 -1.168643 -4.453972
## 2 -1.437397 -4.909173
## 3 -1.962232 -2.241976
## 4 -3.245998 -3.010290
## 5 -2.652355 -3.571162
## 6 -2.060551 -2.374588

# plot PCA components' variances
plot(pca_train)

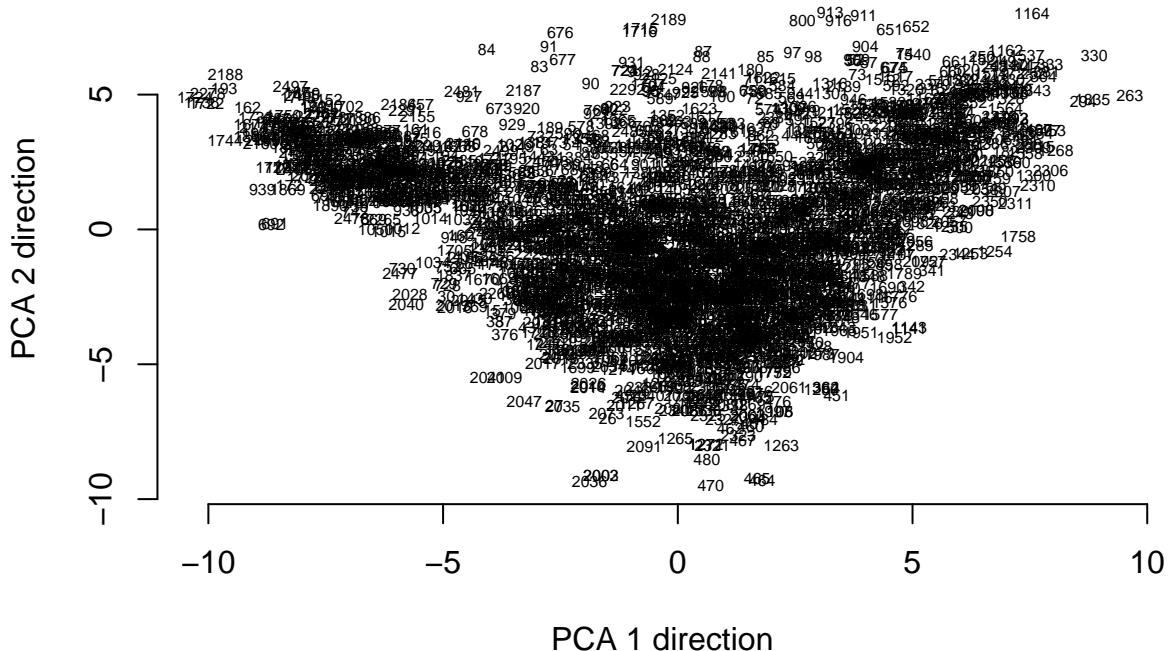
```

pca_train



The graph below looks very messy. This is happening because we are trying to represent the whole data using only the first and second components. Since there are 785 components in total, the significance of the first and second components are comparably small.

```
plot(pca_train$x[,1:2], xlab="PCA 1 direction", ylab="PCA 2 direction", bty="n",
      type='n'); text(pca_train$x[,1:2], labels = 1:length(articles_train), cex=0.5)
```



```
# Let's check 2002 and 2036 -> looks like the article is about communications
head(content(articles_train[[2002]]))
```

```
## [1] "An obscure part of the new telecommunications law could restrict how phone companies use confide
## [2] "The law pits consumer advocates who fear an onslaught of telemarketers and a loss of personal p
## [3] "The data, which include billing records and calling patterns, are taking on added importance as
## [4] "\"Everybody wants to use these data -- subject to the law -- for their marketing efforts, given
## [5] "The Federal Communications Commission is drafting rules to spell out the limits set by Congress
## [6] "Few curbs existed before the new telecom law. The new FCC rules -- which stem from a provision :
```

```
head(content(articles_train[[2036]]))
```

```
## [1] "Regulators set aside a chunk of airwaves Thursday to let schools, businesses, communities and o
## [2] "The Federal Communications Commission's decision, for example, will allow a school to create a l
## [3] "That way, the school can avoid the costs of rewiring a building with high-capacity phone lines :
## [4] "\"In many buildings, including schools, a wireless connection will be a cost-effective alternati
## [5] "Hospitals, community groups, companies and libraries also could create local high-speed network
## [6] "Users of the new spectrum will not need an FCC license, just like users of baby monitors and co
```

In order to choose the number of components, we checked the variances of each components and created an elbow plot. Since the variance between 200 components and 785 components is small (we thought it is not worthy to take hundreds more components to improve small amount), we decided to choose 200 components. By using PCA, we could reduce the dimension into 25% of the entire components.

```
# std dev of each PCs
std_dev <- pca_train$sdev
```

```
# Variances of each PCs
```

```

pca_var <- std_dev^2
# check first 10 variance
pca_var[1:10]

## [1] 14.451386 9.565554 7.451499 7.300913 6.575546 6.313443 5.485331
## [8] 5.356479 5.038364 4.850376

# We want to find the components which explain the maximum variance.
# Higher variance retains more information

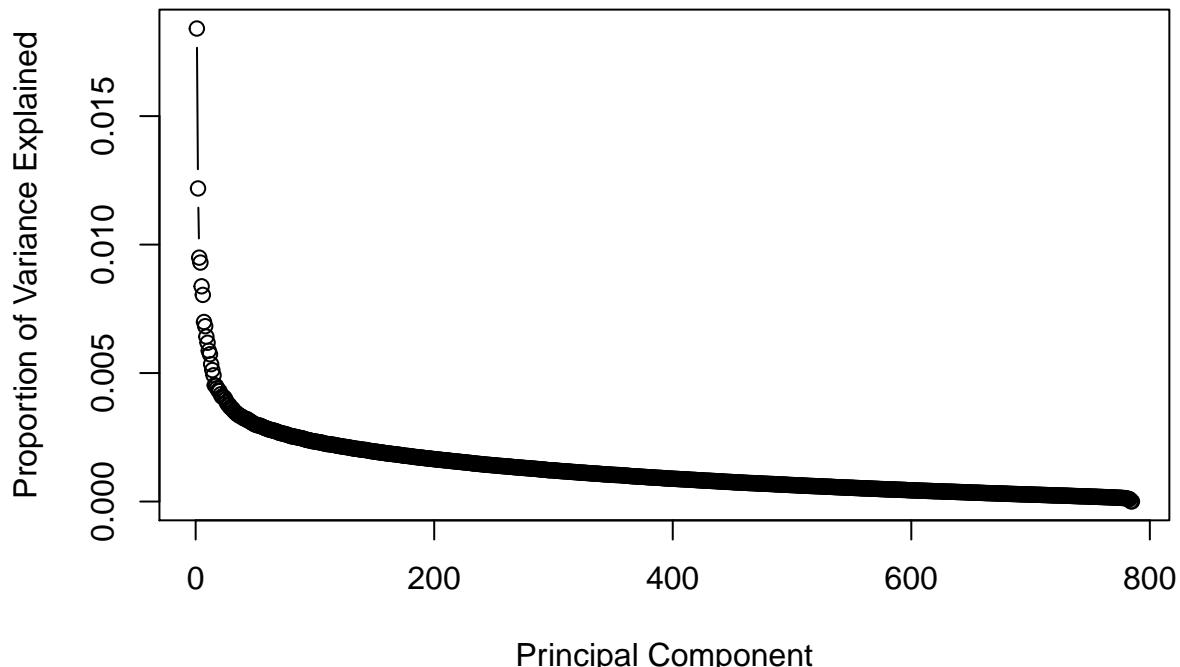
# To compute the proportion of variance explained by each component,
# we simply divide the variance by sum of total variance.

# proportion of variance explained
prop_var <- pca_var / sum(pca_var)
prop_var[1:10]

## [1] 0.018409409 0.012185419 0.009492355 0.009300526 0.008376492 0.008042602
## [7] 0.006987683 0.006823541 0.006418299 0.006178823

plot(prop_var, xlab = "Principal Component",
      ylab = "Proportion of Variance Explained",
      type = "b")

```



```

## Naive Bayes Classification With 200 components that we achieved from previous PCA process, we used
C50train data to build Naive Bayes Classification model. Note that we also added "pseudo-count" into our
trainng data in order to avoid any zero probability in our C50test set.

```

```

author_names <- c()

for (i in seq(1, length(fileNames))){
  name <- strsplit(fileNames[i], split = "/")[[1]][8]
  author_names <- append(author_names, name)
}

pca_df <- as.data.frame(pca_train$x[,1:200])
pca_df <- cbind("Authors" = as.factor(author_names), pca_df)

x_nB <- pca_df[,2:201]
y_nB <- pca_df[,1]

tr = 0.8
n = nrow(pca_df)
d = ncol(pca_df)
train_set = sort(sample.int(n, floor(tr*n)))
test_set = setdiff(1:n, train_set)

X_train = x_nB + 1/d # smoothing
y_train = y_nB
#X_test = x_nB[test_set,]
#y_test = y_nB[test_set]

nb_model <- naiveBayes(X_train, y_train)
#nb_model
#yhat_train <- predict(nb_model, X_test) # 0.682
#confusionMatrix(yhat_train, y_test)

```

We then loaded the real test data set (C50test). Since our model was fitted by the data set from data cleaning and PCA, we also did the same process on our C50test data set. One thing to note is that the graph below shows the first component of our C50test data set is little higher than our C50train data set while the second component is little lower than our C50train data set. And the rest components share similar behaviors.

```

# load the test data
fileNamesTest <- Sys.glob("/Users/macintosh/Documents/R studio/ReutersC50/C50test/*/*.txt")
articles_Test = lapply(fileNamesTest, readerPlain)

mynamesTest = fileNamesTest %>%
  { strsplit(., '/', fixed=TRUE) } %>%
  { lapply(., tail, n=2) } %>%
  { lapply(., paste0, collapse = '') } %>%
  unlist

names(articles_Test) = mynamesTest

documents_raw_Test = Corpus(VectorSource(articles_Test))

my_documents_Test = documents_raw_Test %>%
  tm_map(content_transformer(tolower)) %>% # make everything lowercase
  tm_map(content_transformer(removeNumbers)) %>% # remove numbers
  tm_map(content_transformer(removePunctuation)) %>% # remove punctuation
  tm_map(content_transformer(stripWhitespace)) %>% # remove excess white-space

```

```

## Warning in tm_map.SimpleCorpus(., content_transformer(tolower)): transformation
## drops documents

## Warning in tm_map.SimpleCorpus(., content_transformer(removeNumbers)):
## transformation drops documents

## Warning in tm_map.SimpleCorpus(., content_transformer(removePunctuation)):
## transformation drops documents

## Warning in tm_map.SimpleCorpus(., content_transformer(stripWhitespace)):
## transformation drops documents

my_documents_Test = tm_map(my_documents_Test, content_transformer(removeWords), stopwords("en"))

## Warning in tm_map.SimpleCorpus(my_documents_Test,
## content_transformer(removeWords), : transformation drops documents

DTM_test = DocumentTermMatrix(my_documents_Test)
DTM_test = removeSparseTerms(DTM_test, 0.95)
tfidf_test = weightTfIdf(DTM_test)

# Now PCA on term frequencies
tfidf_test_matix = as.matrix(tfidf_test) # make it into a matrix since prcomp requires matrix format.
summary(colSums(tfidf_test_matix))

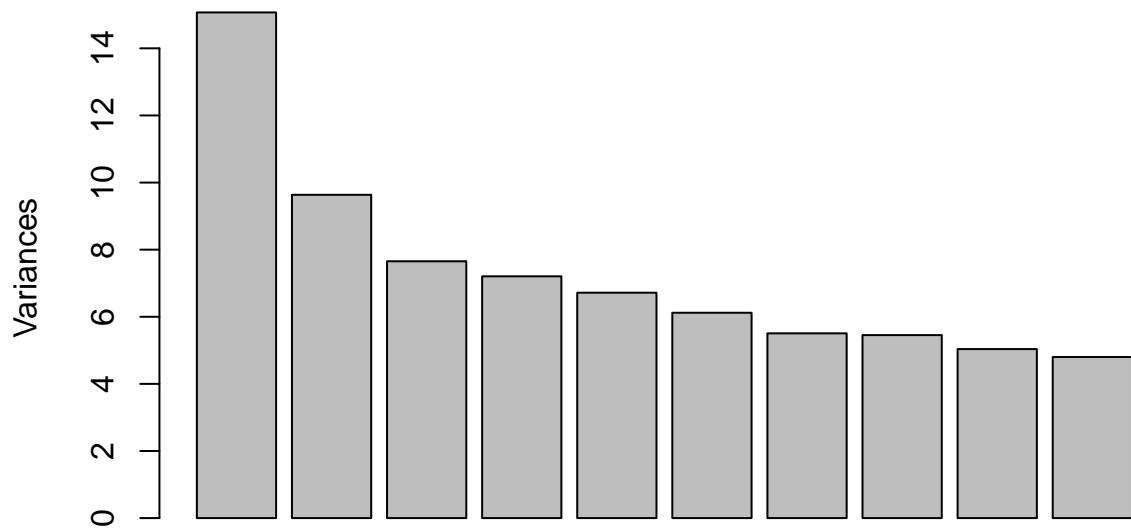
##      Min. 1st Qu. Median    Mean 3rd Qu.    Max.
## 0.000   4.514   5.973   6.653   8.004  33.499

scrub_cols = which(colSums(tfidf_test_matix) == 0) # drops all zeros
tfidf_test_matix = tfidf_test_matix[, -scrub_cols]

pca_test = prcomp(tfidf_test_matix, scale=TRUE)
plot(pca_test)

```

pca_test



And we tested our model with C50test data. We also added “pseudo-count” as before. We utilized “confusionMatrix” from “caret” library in order to observe our model’s accuracy score. We got 0.8788 as our accuracy score. It is quite impressive that Naive Bayes Classification’s performance on text classification.

```
pca_test_df <- as.data.frame(pca_test$x[,1:200])
pca_test_df <- cbind("Authors" = as.factor(author_names), pca_test_df)

x_test_nB <- pca_test_df[,2:201]
y_test_nB <- pca_test_df[,1]

#tr = 0.8
#n = nrow(pca_df)
#d = ncol(pca_df)
#train_set = sort(sample.int(n, floor(tr*n)))
#test_set = setdiff(1:n, train_set)

X_test = x_nB + 1/d # smoothing
y_test = y_nB
#X_test = x_nB[test_set,]
#y_test = y_nB[test_set]

# prediction
yhat <- predict(nb_model, X_test) # 0.8788
confusionMatrix(yhat, y_test)

## Confusion Matrix and Statistics
##
```

```

##          Reference
## Prediction AaronPressman AlanCrosby AlexanderSmith BenjaminKangLim
##   AaronPressman        48         0         0         0
##   AlanCrosby           0        44         0         0
##   AlexanderSmith        0         0        42         0
##   BenjaminKangLim        0         0         0        45
##   BernardHickey          0         0         0         0
##   BradDorfman            0         1         0         0
##   DarrenSchuettler        0         0         0         0
##   DavidLawder             0         0         0         0
##   EdnaFernandes          0         0         0         0
##   EricAuchard             0         0         0         0
##   FumikoFujisaki          0         0         0         0
##   GrahamEarnshaw          1         1         0         0
##   HeatherScoffield        0         0         0         0
##   JaneMacartney           0         0         0         0
##   JanLopatka              0         2         0         0
##   JimGilchrist             0         0         0         0
##   JoeOrtiz                 0         0         2         0
##   JohnMastrini            0         2         0         0
##   JonathanBirt              0         0         0         0
##   JoWinterbottom            0         0         0         0
##   KarlPenhaul              0         0         0         1
##   KeithWeir                  0         0         0         0
##   KevinDrawbaugh            0         0         0         0
##   KevinMorrison             0         0         0         0
##   KirstinRidley             0         0         1         0
##   KouroshKarimkhany         0         0         0         0
##   LydiaZajc                  0         0         0         0
##   LynneO'Donnell            0         0         0         0
##   LynnleyBrowning            0         0         0         0
##   MarcelMichelson            0         0         0         0
##   MarkBendeich               0         0         0         0
##   MartinWolk                  0         0         1         0
##   MatthewBunce                0         0         0         0
##   MichaelConnor               0         0         1         0
##   MureDickie                  0         0         0         1
##   NickLouth                   0         0         3         1
##   PatriciaCommins             0         0         0         0
##   PeterHumphrey                0         0         0         0
##   PierreTran                  0         0         0         0
##   RobinSidel                  0         0         0         0
##   RogerFillion                 1         0         0         0
##   SamuelPerry                  0         0         0         0
##   SarahDavison                  0         0         0         0
##   ScottHillis                  0         0         0         1
##   SimonCowell                  0         0         0         0
##   TanEeLyn                     0         0         0         0
##   TheresePoletti                0         0         0         0
##   TimFarrand                   0         0         0         0
##   ToddNissen                   0         0         0         0
##   WilliamKazer                  0         0         0         1
##          Reference
## Prediction BernardHickey BradDorfman DarrenSchuettler DavidLawder

```

| ## | AaronPressman | 1 | 0 | 0 | 2 |
|------------------|-------------------|-------------|----------------|----------------|----|
| ## | AlanCrosby | 0 | 0 | 0 | 0 |
| ## | AlexanderSmith | 0 | 0 | 0 | 0 |
| ## | BenjaminKangLim | 0 | 0 | 0 | 0 |
| ## | BernardHickey | 42 | 0 | 0 | 0 |
| ## | BradDorfman | 0 | 47 | 0 | 0 |
| ## | DarrenSchuettler | 0 | 0 | 47 | 0 |
| ## | DavidLawder | 0 | 0 | 0 | 39 |
| ## | EdnaFernandes | 0 | 0 | 0 | 0 |
| ## | EricAuchard | 0 | 0 | 0 | 0 |
| ## | FumikoFujisaki | 0 | 0 | 0 | 0 |
| ## | GrahamEarnshaw | 0 | 0 | 0 | 0 |
| ## | HeatherScoffield | 0 | 0 | 0 | 0 |
| ## | JaneMacartney | 0 | 0 | 0 | 0 |
| ## | JanLopatka | 0 | 0 | 0 | 0 |
| ## | JimGilchrist | 0 | 0 | 0 | 0 |
| ## | JoeOrtiz | 0 | 0 | 0 | 0 |
| ## | JohnMastrini | 0 | 0 | 0 | 1 |
| ## | JonathanBirt | 0 | 0 | 0 | 0 |
| ## | JoWinterbottom | 0 | 0 | 0 | 0 |
| ## | KarlPenhaul | 2 | 0 | 1 | 1 |
| ## | KeithWeir | 0 | 0 | 0 | 0 |
| ## | KevinDrawbaugh | 0 | 0 | 0 | 0 |
| ## | KevinMorrison | 2 | 0 | 0 | 0 |
| ## | KirstinRidley | 0 | 0 | 0 | 0 |
| ## | KouroshKarimkhany | 0 | 0 | 0 | 0 |
| ## | LydiaZajc | 0 | 0 | 2 | 0 |
| ## | LynneO'Donnell | 0 | 0 | 0 | 0 |
| ## | LynnleyBrowning | 0 | 0 | 0 | 0 |
| ## | MarcelMichelson | 0 | 0 | 0 | 0 |
| ## | MarkBendeich | 1 | 0 | 0 | 0 |
| ## | MartinWolk | 0 | 1 | 0 | 0 |
| ## | MatthewBunce | 0 | 0 | 0 | 0 |
| ## | MichaelConnor | 0 | 0 | 0 | 1 |
| ## | MureDickie | 0 | 0 | 0 | 0 |
| ## | NickLouth | 0 | 0 | 0 | 0 |
| ## | PatriciaCommins | 0 | 0 | 0 | 0 |
| ## | PeterHumphrey | 0 | 0 | 0 | 0 |
| ## | PierreTran | 0 | 0 | 0 | 1 |
| ## | RobinSidel | 0 | 0 | 0 | 0 |
| ## | RogerFillion | 0 | 0 | 0 | 0 |
| ## | SamuelPerry | 0 | 1 | 0 | 1 |
| ## | SarahDavison | 0 | 0 | 0 | 0 |
| ## | ScottHillis | 0 | 0 | 0 | 0 |
| ## | SimonCowell | 0 | 0 | 0 | 0 |
| ## | TanEeLyn | 0 | 0 | 0 | 0 |
| ## | TheresePoletti | 1 | 0 | 0 | 2 |
| ## | TimFarrand | 1 | 0 | 0 | 0 |
| ## | ToddNissen | 0 | 1 | 0 | 2 |
| ## | WilliamKazer | 0 | 0 | 0 | 0 |
| ## | Reference | | | | |
| ## Prediction | EdnaFernandes | EricAuchard | FumikoFujisaki | GrahamEarnshaw | |
| ## AaronPressman | 1 | 0 | 0 | 0 | |
| ## AlanCrosby | 0 | 0 | 0 | 0 | |

| | Reference | HeatherScoffield | JaneMacartney | JanLopatka | JimGilchrist |
|----------------------|-----------|------------------|---------------|------------|--------------|
| ## Prediction | | | | | |
| ## AaronPressman | | 1 | 0 | 0 | 1 |
| ## AlanCrosby | | 0 | 0 | 0 | 0 |
| ## AlexanderSmith | | 0 | 0 | 0 | 0 |
| ## BenjaminKangLim | | 0 | 3 | 0 | 0 |
| ## BernardHickey | | 0 | 0 | 0 | 0 |
| ## BradDorfman | | 0 | 0 | 0 | 1 |
| ## DarrenSchuettler | | 0 | 0 | 0 | 0 |
| ## DavidLawder | | 0 | 0 | 0 | 0 |
| ## EdnaFernandes | 44 | 0 | 0 | 0 | 0 |
| ## EricAuchard | 0 | 40 | 0 | 0 | 0 |
| ## FumikoFujisaki | 0 | 0 | 48 | 0 | 0 |
| ## GrahamEarnshaw | 0 | 0 | 2 | | 43 |
| ## HeatherScoffield | 0 | 0 | 0 | 0 | 0 |
| ## JaneMacartney | 0 | 0 | 0 | 0 | 0 |
| ## JanLopatka | 0 | 0 | 0 | 0 | 0 |
| ## JimGilchrist | 0 | 0 | 0 | 0 | 0 |
| ## JoeOrtiz | 0 | 0 | 0 | 0 | 0 |
| ## JohnMastrini | 0 | 0 | 0 | 0 | 0 |
| ## JonathanBirt | 0 | 0 | 0 | 0 | 0 |
| ## JoWinterbottom | 1 | 0 | 0 | 0 | 0 |
| ## KarlPenhaul | 0 | 0 | 0 | 0 | 0 |
| ## KeithWeir | 1 | 0 | 0 | 0 | 0 |
| ## KevinDrawbaugh | 0 | 0 | 0 | 0 | 0 |
| ## KevinMorrison | 0 | 0 | 0 | 0 | 0 |
| ## KirstinRidley | 0 | 0 | 0 | 0 | 0 |
| ## KouroshKarimkhany | 0 | 1 | 0 | 0 | 0 |
| ## LydiaZajc | 0 | 0 | 0 | 0 | 0 |
| ## LynneO'Donnell | 0 | 0 | 0 | 0 | 0 |
| ## LynnleyBrowning | 0 | 0 | 0 | 0 | 1 |
| ## MarcelMichelson | 0 | 0 | 0 | 0 | 0 |
| ## MarkBendeich | 0 | 0 | 0 | 0 | 0 |
| ## MartinWolk | 0 | 0 | 0 | 0 | 0 |
| ## MatthewBunce | 0 | 0 | 0 | 0 | 0 |
| ## MichaelConnor | 0 | 0 | 0 | 0 | 1 |
| ## MureDickie | 0 | 0 | 0 | 0 | 0 |
| ## NickLouth | 0 | 2 | 0 | 0 | 0 |
| ## PatriciaCommins | 0 | 0 | 0 | 0 | 0 |
| ## PeterHumphrey | 0 | 0 | 0 | 0 | 0 |
| ## PierreTran | 0 | 0 | 0 | 0 | 0 |
| ## RobinSidel | 0 | 0 | 0 | 0 | 0 |
| ## RogerFillion | 0 | 0 | 0 | 0 | 0 |
| ## SamuelPerry | 0 | 2 | 0 | 0 | 1 |
| ## SarahDavison | 0 | 0 | 0 | 0 | 0 |
| ## ScottHillis | 0 | 0 | 0 | 0 | 0 |
| ## SimonCowell | 0 | 0 | 0 | 0 | 0 |
| ## TanEeLyn | 0 | 0 | 0 | 0 | 0 |
| ## TheresePoletti | 0 | 5 | 0 | 0 | 0 |
| ## TimFarrand | 3 | 0 | 0 | 0 | 0 |
| ## ToddNissen | 0 | 0 | 0 | 0 | 0 |
| ## WilliamKazer | 0 | 0 | 0 | 0 | 3 |

| | | | | | |
|----|-------------------|----------|--------------|--------------|----------------|
| ## | BernardHickey | 0 | 0 | 0 | 0 |
| ## | BradDorfman | 0 | 0 | 0 | 0 |
| ## | DarrenSchuettler | 0 | 0 | 0 | 0 |
| ## | DavidLawder | 0 | 0 | 0 | 0 |
| ## | EdnaFernandes | 0 | 0 | 0 | 0 |
| ## | EricAuchard | 0 | 0 | 0 | 0 |
| ## | FumikoFujisaki | 0 | 0 | 0 | 0 |
| ## | GrahamEarnshaw | 0 | 1 | 0 | 0 |
| ## | HeatherScoffield | 47 | 0 | 0 | 0 |
| ## | JaneMacartney | 0 | 39 | 0 | 0 |
| ## | JanLopatka | 0 | 0 | 42 | 0 |
| ## | JimGilchrist | 0 | 0 | 0 | 48 |
| ## | JoeOrtiz | 0 | 0 | 0 | 0 |
| ## | JohnMastrini | 0 | 0 | 5 | 0 |
| ## | JonathanBirt | 0 | 0 | 0 | 0 |
| ## | JoWinterbottom | 0 | 0 | 0 | 0 |
| ## | KarlPenhaul | 2 | 0 | 0 | 0 |
| ## | KeithWeir | 0 | 0 | 0 | 0 |
| ## | KevinDrawbaugh | 0 | 0 | 0 | 0 |
| ## | KevinMorrison | 0 | 0 | 0 | 1 |
| ## | KirstinRidley | 0 | 0 | 0 | 0 |
| ## | KouroshKarimkhany | 0 | 0 | 0 | 0 |
| ## | LydiaZajc | 0 | 0 | 0 | 0 |
| ## | LynneO'Donnell | 0 | 0 | 0 | 0 |
| ## | LynnleyBrowning | 0 | 1 | 0 | 0 |
| ## | MarcelMichelson | 0 | 0 | 0 | 0 |
| ## | MarkBendeich | 0 | 0 | 0 | 0 |
| ## | MartinWolk | 0 | 0 | 0 | 0 |
| ## | MatthewBunce | 0 | 0 | 3 | 0 |
| ## | MichaelConnor | 0 | 0 | 0 | 0 |
| ## | MureDickie | 0 | 3 | 0 | 0 |
| ## | NickLouth | 0 | 0 | 0 | 0 |
| ## | PatriciaCommins | 0 | 0 | 0 | 0 |
| ## | PeterHumphrey | 0 | 0 | 0 | 0 |
| ## | PierreTran | 0 | 0 | 0 | 0 |
| ## | RobinSidel | 0 | 0 | 0 | 0 |
| ## | RogerFillion | 0 | 0 | 0 | 0 |
| ## | SamuelPerry | 0 | 0 | 0 | 0 |
| ## | SarahDavison | 0 | 0 | 0 | 0 |
| ## | ScottHillis | 0 | 1 | 0 | 0 |
| ## | SimonCowell | 0 | 0 | 0 | 0 |
| ## | TanEeLyn | 0 | 1 | 0 | 0 |
| ## | TheresePoletti | 0 | 0 | 0 | 0 |
| ## | TimFarrand | 0 | 0 | 0 | 0 |
| ## | ToddNissen | 0 | 0 | 0 | 0 |
| ## | WilliamKazer | 0 | 1 | 0 | 0 |
| ## | Reference | | | | |
| ## | Prediction | JoeOrtiz | JohnMastrini | JonathanBirt | JoWinterbottom |
| ## | AaronPressman | 0 | 0 | 1 | 0 |
| ## | AlanCrosby | 0 | 0 | 0 | 0 |
| ## | AlexanderSmith | 1 | 0 | 0 | 1 |
| ## | BenjaminKangLim | 0 | 0 | 0 | 0 |
| ## | BernardHickey | 0 | 0 | 0 | 0 |
| ## | BradDorfman | 0 | 0 | 0 | 0 |

| | | | | |
|----------------------|-------------|-----------|----------------|---------------|
| ## DarrenSchuettler | 0 | 0 | 0 | 0 |
| ## DavidLawder | 0 | 0 | 0 | 0 |
| ## EdnaFernandes | 0 | 0 | 0 | 0 |
| ## EricAuchard | 0 | 0 | 0 | 0 |
| ## FumikoFujisaki | 0 | 0 | 0 | 0 |
| ## GrahamEarnshaw | 0 | 0 | 0 | 0 |
| ## HeatherScoffield | 0 | 0 | 0 | 0 |
| ## JaneMacartney | 0 | 0 | 0 | 0 |
| ## JanLopatka | 0 | 2 | 0 | 0 |
| ## JimGilchrist | 0 | 0 | 0 | 0 |
| ## JoeOrtiz | 44 | 0 | 0 | 1 |
| ## JohnMastrini | 0 | 43 | 0 | 0 |
| ## JonathanBirt | 0 | 0 | 44 | 1 |
| ## JoWinterbottom | 0 | 0 | 1 | 45 |
| ## KarlPenhaul | 0 | 0 | 0 | 0 |
| ## KeithWeir | 1 | 0 | 0 | 0 |
| ## KevinDrawbaugh | 0 | 1 | 0 | 0 |
| ## KevinMorrison | 0 | 0 | 0 | 0 |
| ## KirstinRidley | 0 | 0 | 0 | 0 |
| ## KouroshKarimkhany | 0 | 0 | 0 | 0 |
| ## LydiaZajc | 0 | 0 | 0 | 0 |
| ## LynneO'Donnell | 0 | 0 | 0 | 0 |
| ## LynnleyBrowning | 0 | 0 | 0 | 0 |
| ## MarcelMichelson | 0 | 0 | 0 | 0 |
| ## MarkBendeich | 0 | 0 | 0 | 0 |
| ## MartinWolk | 0 | 0 | 0 | 0 |
| ## MatthewBunce | 0 | 0 | 0 | 0 |
| ## MichaelConnor | 0 | 0 | 0 | 0 |
| ## MureDickie | 0 | 0 | 0 | 0 |
| ## NickLouth | 0 | 0 | 0 | 0 |
| ## PatriciaCommins | 0 | 0 | 0 | 0 |
| ## PeterHumphrey | 0 | 0 | 0 | 0 |
| ## PierreTran | 1 | 0 | 0 | 0 |
| ## RobinSidel | 0 | 0 | 0 | 0 |
| ## RogerFillion | 0 | 0 | 0 | 0 |
| ## SamuelPerry | 1 | 1 | 0 | 0 |
| ## SarahDavison | 1 | 3 | 0 | 0 |
| ## ScottHillis | 0 | 0 | 0 | 0 |
| ## SimonCowell | 1 | 0 | 0 | 0 |
| ## TanEeLyn | 0 | 0 | 0 | 0 |
| ## TheresePoletti | 0 | 0 | 0 | 0 |
| ## TimFarrand | 0 | 0 | 4 | 2 |
| ## ToddNissen | 0 | 0 | 0 | 0 |
| ## WilliamKazer | 0 | 0 | 0 | 0 |
| ## | Reference | | | |
| ## Prediction | KarlPenhaul | KeithWeir | KevinDrawbaugh | KevinMorrison |
| ## AaronPressman | 0 | 0 | 0 | 0 |
| ## AlanCrosby | 0 | 0 | 0 | 0 |
| ## AlexanderSmith | 0 | 0 | 0 | 0 |
| ## BenjaminKangLim | 0 | 0 | 0 | 0 |
| ## BernardHickey | 0 | 0 | 0 | 6 |
| ## BradDorfman | 0 | 0 | 0 | 0 |
| ## DarrenSchuettler | 0 | 0 | 0 | 0 |
| ## DavidLawder | 0 | 0 | 0 | 0 |

| | | Reference | KirstinRidley | KouroshKarimkhany | LydiaZajc | LynneO'Donnell |
|----------------------|--|-----------|---------------|-------------------|-----------|----------------|
| ## Prediction | | | | | | |
| ## AaronPressman | | 3 | 0 | 0 | 0 | 0 |
| ## AlanCrosby | | 0 | 0 | 0 | 0 | 0 |
| ## AlexanderSmith | | 1 | 0 | 0 | 0 | 0 |
| ## BenjaminKangLim | | 0 | 0 | 0 | 0 | 0 |
| ## BernardHickey | | 0 | 0 | 0 | 0 | 0 |
| ## BradDorfman | | 0 | 0 | 0 | 0 | 0 |
| ## DarrenSchuettler | | 0 | 0 | 0 | 0 | 0 |
| ## DavidLawder | | 0 | 0 | 0 | 0 | 0 |
| ## EdnaFernandes | | 0 | 0 | 0 | 0 | 0 |
| ## EricAuchard | | 0 | 1 | 0 | 0 | 0 |
| ## FumikoFujisaki | | 0 | 0 | 0 | 0 | 0 |
| ## GrahamEarnshaw | | 0 | 0 | 0 | 0 | 0 |
| ## HeatherScoffield | | 0 | 0 | 0 | 0 | 0 |
| ## JaneMacartney | | 0 | 0 | 0 | 0 | 0 |
| ## JanLopatka | | 0 | 0 | 0 | 0 | 0 |
| ## JimGilchrist | | 0 | 0 | 0 | 0 | 0 |
| ## JoeOrtiz | | 0 | 0 | 0 | 0 | 0 |
| ## JohnMastrini | | 0 | 0 | 0 | 0 | 0 |
| ## JonathanBirt | | 0 | 2 | 0 | 0 | 0 |
| ## JoWinterbottom | | 0 | 0 | 0 | 0 | 0 |
| ## KarlPenhaul | | 45 | 0 | 0 | 0 | 0 |
| ## KeithWeir | | 0 | 44 | 0 | 0 | 0 |
| ## KevinDrawbaugh | | 0 | 0 | 50 | 0 | 0 |
| ## KevinMorrison | | 0 | 0 | 0 | 41 | 0 |
| ## KirstinRidley | | 0 | 1 | 0 | 0 | 0 |
| ## KouroshKarimkhany | | 0 | 0 | 0 | 0 | 0 |
| ## LydiaZajc | | 0 | 0 | 0 | 0 | 0 |
| ## LynneO'Donnell | | 0 | 0 | 0 | 0 | 0 |
| ## LynnleyBrowning | | 1 | 0 | 0 | 0 | 0 |
| ## MarcelMichelson | | 0 | 0 | 0 | 0 | 0 |
| ## MarkBendeich | | 0 | 0 | 0 | 2 | 0 |
| ## MartinWolk | | 0 | 0 | 0 | 0 | 0 |
| ## MatthewBunce | | 2 | 0 | 0 | 0 | 0 |
| ## MichaelConnor | | 0 | 0 | 0 | 0 | 0 |
| ## MureDickie | | 0 | 0 | 0 | 0 | 0 |
| ## NickLouth | | 0 | 2 | 0 | 0 | 0 |
| ## PatriciaCommins | | 0 | 0 | 0 | 0 | 0 |
| ## PeterHumphrey | | 0 | 0 | 0 | 0 | 0 |
| ## PierreTran | | 0 | 0 | 0 | 0 | 0 |
| ## RobinSidel | | 0 | 0 | 0 | 0 | 0 |
| ## RogerFillion | | 0 | 0 | 0 | 0 | 0 |
| ## SamuelPerry | | 0 | 0 | 0 | 1 | 0 |
| ## SarahDavison | | 1 | 0 | 0 | 0 | 0 |
| ## ScottHillis | | 0 | 0 | 0 | 0 | 0 |
| ## SimonCowell | | 0 | 0 | 0 | 0 | 0 |
| ## TanEeLyn | | 0 | 0 | 0 | 0 | 0 |
| ## TheresePoletti | | 0 | 0 | 0 | 0 | 0 |
| ## TimFarrand | | 0 | 0 | 0 | 0 | 0 |
| ## ToddNissen | | 0 | 0 | 0 | 0 | 0 |
| ## WilliamKazer | | 1 | 0 | 0 | 0 | 0 |

```

## FumikoFujisaki      0      0      0      0
## GrahamEarnshaw     0      0      0      0
## HeatherScoffield    0      0      0      0
## JaneMacartney       0      0      0      0
## JanLopatka          0      0      0      0
## JimGilchrist         0      0      0      0
## JoeOrtiz             0      0      0      0
## JohnMastrini        0      0      0      0
## JonathanBirt         0      0      0      0
## JoWinterbottom       2      0      0      0
## KarlPenhaul          0      0      2      0
## KeithWeir             0      0      0      0
## KevinDrawbaugh        0      0      0      0
## KevinMorrison         0      0      0      0
## KirstinRidley        38     0      0      0
## KouroshKarimkhany   0      47     0      0
## LydiaZajc             0      0      44    0
## LynneO'Donnell        0      0      0      49
## LynnleyBrowning       0      0      0      0
## MarcelMichelson       0      0      0      0
## MarkBendeich          0      0      0      0
## MartinWolk            0      1      2      0
## MatthewBunce          0      0      0      0
## MichaelConnor         1      0      1      0
## MureDickie            0      0      0      0
## NickLouth              2      0      0      0
## PatriciaCommins       0      0      0      0
## PeterHumphrey         0      0      0      0
## PierreTran            0      0      0      0
## RobinSidel            0      0      0      0
## RogerFillion          0      0      0      0
## SamuelPerry           1      0      0      0
## SarahDavison          0      0      0      0
## ScottHillis            0      0      0      0
## SimonCowell           0      0      0      0
## TanEeLyn               0      0      0      1
## TheresePoletti         0      1      1      0
## TimFarrand             2      0      0      0
## ToddNissen             0      0      0      0
## WilliamKazer           0      0      0      0
##                               Reference
## Prediction      LynnleyBrowning MarcelMichelson MarkBendeich MartinWolk
## AaronPressman      0            1            0            0
## AlanCrosby          0            0            0            0
## AlexanderSmith      0            0            0            0
## BenjaminKangLim     0            0            0            0
## BernardHickey        0            0            0            0
## BradDorfman          0            0            0            0
## DarrenSchuettler     0            0            0            0
## DavidLawder          0            0            0            0
## EdnaFernandes        0            0            0            0
## EricAuchard          0            0            0            0
## FumikoFujisaki       0            0            0            0
## GrahamEarnshaw      0            0            0            0

```

| ## | HeatherScoffield | 0 | 0 | 0 |
|----|-------------------|--------------|---------------|------------|
| ## | JaneMacartney | 0 | 0 | 0 |
| ## | JanLopatka | 0 | 0 | 0 |
| ## | JimGilchrist | 0 | 0 | 0 |
| ## | JoeOrtiz | 0 | 0 | 0 |
| ## | JohnMastrini | 0 | 0 | 0 |
| ## | JonathanBirt | 0 | 0 | 0 |
| ## | JoWinterbottom | 0 | 0 | 0 |
| ## | KarlPenhaul | 0 | 1 | 0 |
| ## | KeithWeir | 0 | 0 | 0 |
| ## | KevinDrawbaugh | 0 | 0 | 0 |
| ## | KevinMorrison | 0 | 0 | 2 |
| ## | KirstinRidley | 0 | 0 | 0 |
| ## | KouroshKarimkhany | 0 | 0 | 0 |
| ## | LydiaZajc | 0 | 0 | 0 |
| ## | LynneO'Donnell | 0 | 0 | 0 |
| ## | LynnleyBrowning | 50 | 0 | 0 |
| ## | MarcelMichelson | 0 | 47 | 0 |
| ## | MarkBendeich | 0 | 0 | 47 |
| ## | MartinWolk | 0 | 0 | 0 |
| ## | MatthewBunce | 0 | 0 | 0 |
| ## | MichaelConnor | 0 | 0 | 0 |
| ## | MureDickie | 0 | 0 | 0 |
| ## | NickLouth | 0 | 0 | 0 |
| ## | PatriciaCommins | 0 | 0 | 1 |
| ## | PeterHumphrey | 0 | 0 | 0 |
| ## | PierreTran | 0 | 0 | 0 |
| ## | RobinSidel | 0 | 0 | 0 |
| ## | RogerFillion | 0 | 0 | 0 |
| ## | SamuelPerry | 0 | 1 | 0 |
| ## | SarahDavison | 0 | 0 | 0 |
| ## | ScottHillis | 0 | 0 | 0 |
| ## | SimonCowell | 0 | 0 | 0 |
| ## | TanEeLyn | 0 | 0 | 0 |
| ## | TheresePoletti | 0 | 0 | 0 |
| ## | TimFarrand | 0 | 0 | 0 |
| ## | ToddNissen | 0 | 0 | 0 |
| ## | WilliamKazer | 0 | 0 | 0 |
| ## | Reference | | | |
| ## | Prediction | MatthewBunce | MichaelConnor | MureDickie |
| ## | AaronPressman | 0 | 1 | 0 |
| ## | AlanCrosby | 0 | 0 | 0 |
| ## | AlexanderSmith | 0 | 0 | 0 |
| ## | BenjaminKangLim | 0 | 0 | 1 |
| ## | BernardHickey | 0 | 0 | 0 |
| ## | BradDorfman | 0 | 0 | 0 |
| ## | DarrenSchuettler | 0 | 0 | 0 |
| ## | DavidLawder | 0 | 0 | 0 |
| ## | EdnaFernandes | 0 | 0 | 0 |
| ## | EricAuchard | 0 | 0 | 0 |
| ## | FumikoFujisaki | 0 | 0 | 0 |
| ## | GrahamEarnshaw | 0 | 0 | 0 |
| ## | HeatherScoffield | 0 | 0 | 0 |
| ## | JaneMacartney | 0 | 2 | 0 |

| | | | | | |
|----------------------|-----------|-----------------|---------------|------------|------------|
| ## JanLopatka | 0 | 0 | 0 | 0 | |
| ## JimGilchrist | 0 | 0 | 0 | 0 | |
| ## JoeOrtiz | 0 | 0 | 0 | 0 | |
| ## JohnMastrini | 1 | 0 | 0 | 0 | |
| ## JonathanBirt | 0 | 0 | 0 | 0 | |
| ## JoWinterbottom | 0 | 0 | 0 | 0 | |
| ## KarlPenhaul | 2 | 0 | 1 | 0 | |
| ## KeithWeir | 0 | 0 | 0 | 0 | |
| ## KevinDrawbaugh | 0 | 5 | 0 | 0 | |
| ## KevinMorrison | 0 | 0 | 0 | 0 | |
| ## KirstinRidley | 0 | 0 | 0 | 0 | |
| ## KouroshKarimkhany | 0 | 0 | 0 | 0 | |
| ## LydiaZajc | 0 | 0 | 0 | 0 | |
| ## LynneO'Donnell | 0 | 0 | 0 | 0 | |
| ## LynnleyBrowning | 0 | 0 | 0 | 0 | |
| ## MarcelMichelson | 0 | 0 | 0 | 0 | |
| ## MarkBendeich | 0 | 0 | 0 | 0 | |
| ## MartinWolk | 0 | 0 | 0 | 0 | |
| ## MatthewBunce | 47 | 0 | 0 | 0 | |
| ## MichaelConnor | 0 | 42 | 0 | 1 | |
| ## MureDickie | 0 | 0 | 40 | 0 | |
| ## NickLouth | 0 | 0 | 1 | 48 | |
| ## PatriciaCommins | 0 | 0 | 0 | 0 | |
| ## PeterHumphrey | 0 | 0 | 2 | 0 | |
| ## PierreTran | 0 | 0 | 0 | 0 | |
| ## RobinSidel | 0 | 0 | 0 | 0 | |
| ## RogerFillion | 0 | 0 | 0 | 0 | |
| ## SamuelPerry | 0 | 0 | 0 | 0 | |
| ## SarahDavison | 0 | 0 | 0 | 0 | |
| ## ScottHillis | 0 | 0 | 1 | 0 | |
| ## SimonCowell | 0 | 0 | 0 | 0 | |
| ## TanEeLyn | 0 | 0 | 0 | 0 | |
| ## TheresePoletti | 0 | 2 | 0 | 0 | |
| ## TimFarrand | 0 | 0 | 0 | 0 | |
| ## ToddNissen | 0 | 0 | 0 | 0 | |
| ## WilliamKazer | 0 | 0 | 2 | 0 | |
| ## | Reference | | | | |
| ## Prediction | | PatriciaCommins | PeterHumphrey | PierreTran | RobinSidel |
| ## AaronPressman | | 0 | 0 | 0 | 0 |
| ## AlanCrosby | | 0 | 0 | 1 | 0 |
| ## AlexanderSmith | | 0 | 0 | 0 | 0 |
| ## BenjaminKangLim | | 0 | 1 | 0 | 0 |
| ## BernardHickey | | 0 | 0 | 0 | 0 |
| ## BradDorfman | | 1 | 0 | 0 | 1 |
| ## DarrenSchuettler | | 0 | 0 | 0 | 0 |
| ## DavidLawder | | 0 | 0 | 0 | 0 |
| ## EdnaFernandes | | 0 | 0 | 0 | 0 |
| ## EricAuchard | | 1 | 0 | 0 | 0 |
| ## FumikoFujisaki | | 0 | 0 | 0 | 0 |
| ## GrahamEarnshaw | | 0 | 0 | 0 | 0 |
| ## HeatherScoffield | | 0 | 0 | 0 | 0 |
| ## JaneMacartney | | 0 | 0 | 0 | 0 |
| ## JanLopatka | | 0 | 0 | 0 | 0 |
| ## JimGilchrist | | 0 | 0 | 0 | 0 |

| | | | | |
|----------------------|--------------|-------------|--------------|-------------|
| ## JoeOrtiz | 0 | 0 | 0 | 0 |
| ## JohnMastrini | 0 | 0 | 0 | 0 |
| ## JonathanBirt | 1 | 0 | 0 | 0 |
| ## JoWinterbottom | 0 | 0 | 0 | 0 |
| ## KarlPenhaul | 0 | 0 | 0 | 0 |
| ## KeithWeir | 0 | 0 | 0 | 0 |
| ## KevinDrawbaugh | 2 | 0 | 0 | 0 |
| ## KevinMorrison | 0 | 0 | 0 | 0 |
| ## KirstinRidley | 0 | 0 | 0 | 0 |
| ## KouroshKarimkhany | 0 | 0 | 0 | 0 |
| ## LydiaZajc | 0 | 0 | 0 | 0 |
| ## LynneO'Donnell | 0 | 0 | 0 | 0 |
| ## LynnleyBrowning | 0 | 0 | 0 | 0 |
| ## MarcelMichelson | 0 | 0 | 4 | 0 |
| ## MarkBendeich | 0 | 0 | 0 | 0 |
| ## MartinWolk | 1 | 0 | 0 | 0 |
| ## MatthewBunce | 0 | 0 | 0 | 0 |
| ## MichaelConnor | 0 | 0 | 0 | 0 |
| ## MureDickie | 0 | 1 | 0 | 0 |
| ## NickLouth | 0 | 0 | 0 | 0 |
| ## PatriciaCommins | 42 | 0 | 0 | 0 |
| ## PeterHumphrey | 0 | 46 | 0 | 0 |
| ## PierreTran | 0 | 0 | 45 | 0 |
| ## RobinSidel | 0 | 0 | 0 | 49 |
| ## RogerFillion | 0 | 0 | 0 | 0 |
| ## SamuelPerry | 0 | 0 | 0 | 0 |
| ## SarahDavison | 0 | 0 | 0 | 0 |
| ## ScottHillis | 0 | 0 | 0 | 0 |
| ## SimonCowell | 0 | 0 | 0 | 0 |
| ## TanEeLyn | 0 | 2 | 0 | 0 |
| ## TheresePoletti | 2 | 0 | 0 | 0 |
| ## TimFarrand | 0 | 0 | 0 | 0 |
| ## ToddNissen | 0 | 0 | 0 | 0 |
| ## WilliamKazer | 0 | 0 | 0 | 0 |
| ## | Reference | | | |
| ## Prediction | RogerFillion | SamuelPerry | SarahDavison | ScottHillis |
| ## AaronPressman | 0 | 0 | 0 | 0 |
| ## AlanCrosby | 0 | 0 | 0 | 1 |
| ## AlexanderSmith | 0 | 0 | 0 | 0 |
| ## BenjaminKangLim | 0 | 0 | 0 | 3 |
| ## BernardHickey | 0 | 0 | 0 | 0 |
| ## BradDorfman | 0 | 0 | 0 | 0 |
| ## DarrenSchuettler | 1 | 0 | 0 | 0 |
| ## DavidLawder | 0 | 0 | 0 | 0 |
| ## EdnaFernandes | 0 | 0 | 0 | 0 |
| ## EricAuchard | 0 | 2 | 0 | 0 |
| ## FumikoFujisaki | 0 | 0 | 0 | 0 |
| ## GrahamEarnshaw | 0 | 0 | 1 | 0 |
| ## HeatherScoffield | 0 | 0 | 0 | 0 |
| ## JaneMacartney | 0 | 0 | 0 | 1 |
| ## JanLopatka | 0 | 0 | 0 | 0 |
| ## JimGilchrist | 0 | 0 | 1 | 0 |
| ## JoeOrtiz | 0 | 0 | 0 | 0 |
| ## JohnMastrini | 0 | 0 | 0 | 0 |

| | | | | | |
|----------------------|-------------|----------|----------------|------------|------------|
| ## JonathanBirt | 0 | 0 | 0 | 0 | |
| ## JoWinterbottom | 0 | 0 | 0 | 0 | |
| ## KarlPenhaul | 0 | 0 | 0 | 0 | |
| ## KeithWeir | 0 | 0 | 0 | 0 | |
| ## KevinDrawbaugh | 0 | 1 | 0 | 0 | |
| ## KevinMorrison | 0 | 0 | 0 | 0 | |
| ## KirstinRidley | 0 | 0 | 0 | 0 | |
| ## KouroshKarimkhany | 0 | 1 | 0 | 0 | |
| ## LydiaZajc | 0 | 0 | 0 | 0 | |
| ## LynneO'Donnell | 0 | 0 | 0 | 0 | |
| ## LynnleyBrowning | 0 | 0 | 0 | 0 | |
| ## MarcelMichelson | 0 | 0 | 0 | 0 | |
| ## MarkBendeich | 0 | 0 | 0 | 0 | |
| ## MartinWolk | 0 | 0 | 0 | 0 | |
| ## MatthewBunce | 0 | 0 | 0 | 0 | |
| ## MichaelConnor | 0 | 0 | 0 | 0 | |
| ## MureDickie | 0 | 0 | 0 | 3 | |
| ## NickLouth | 1 | 0 | 0 | 0 | |
| ## PatriciaCommins | 0 | 0 | 0 | 0 | |
| ## PeterHumphrey | 0 | 0 | 0 | 4 | |
| ## PierreTran | 0 | 0 | 0 | 0 | |
| ## RobinSidel | 0 | 0 | 1 | 0 | |
| ## RogerFillion | 48 | 0 | 0 | 0 | |
| ## SamuelPerry | 0 | 43 | 0 | 1 | |
| ## SarahDavison | 0 | 0 | 45 | 0 | |
| ## ScottHillis | 0 | 0 | 1 | 34 | |
| ## SimonCowell | 0 | 0 | 0 | 0 | |
| ## TanEeLyn | 0 | 0 | 1 | 1 | |
| ## TheresePoletti | 0 | 3 | 0 | 1 | |
| ## TimFarrand | 0 | 0 | 0 | 0 | |
| ## ToddNissen | 0 | 0 | 0 | 0 | |
| ## WilliamKazer | 0 | 0 | 0 | 1 | |
| ## | Reference | | | | |
| ## Prediction | SimonCowell | TanEeLyn | TheresePoletti | TimFarrand | ToddNissen |
| ## AaronPressman | 2 | 0 | 0 | 1 | 0 |
| ## AlanCrosby | 0 | 0 | 0 | 0 | 0 |
| ## AlexanderSmith | 1 | 0 | 0 | 1 | 0 |
| ## BenjaminKangLim | 0 | 0 | 0 | 0 | 0 |
| ## BernardHickey | 0 | 0 | 0 | 0 | 0 |
| ## BradDorfman | 0 | 0 | 0 | 0 | 1 |
| ## DarrenSchuettler | 0 | 0 | 0 | 0 | 0 |
| ## DavidLawder | 0 | 0 | 0 | 0 | 8 |
| ## EdnaFernandes | 1 | 0 | 0 | 0 | 0 |
| ## EricAuchard | 0 | 0 | 3 | 0 | 0 |
| ## FumikoFujisaki | 0 | 0 | 0 | 0 | 0 |
| ## GrahamEarnshaw | 0 | 0 | 0 | 0 | 0 |
| ## HeatherScoffield | 0 | 0 | 0 | 0 | 0 |
| ## JaneMacartney | 0 | 1 | 0 | 0 | 0 |
| ## JanLopatka | 0 | 1 | 0 | 0 | 0 |
| ## JimGilchrist | 0 | 3 | 0 | 0 | 0 |
| ## JoeOrtiz | 1 | 0 | 0 | 0 | 0 |
| ## JohnMastrini | 0 | 0 | 0 | 0 | 0 |
| ## JonathanBirt | 0 | 0 | 0 | 0 | 0 |
| ## JoWinterbottom | 0 | 0 | 0 | 0 | 0 |

| | | | | | |
|----------------------|----|--------------|----|----|----|
| ## KarlPenhaul | 2 | 0 | 0 | 1 | 0 |
| ## KeithWeir | 0 | 0 | 0 | 0 | 0 |
| ## KevinDrawbaugh | 1 | 0 | 1 | 0 | 2 |
| ## KevinMorrison | 0 | 0 | 0 | 0 | 0 |
| ## KirstinRidley | 1 | 0 | 0 | 0 | 0 |
| ## KouroshKarimkhany | 0 | 0 | 1 | 0 | 0 |
| ## LydiaZajc | 0 | 0 | 0 | 0 | 0 |
| ## LynneO'Donnell | 0 | 1 | 0 | 0 | 0 |
| ## LynnleyBrowning | 0 | 0 | 0 | 0 | 0 |
| ## MarcelMichelson | 0 | 0 | 0 | 0 | 0 |
| ## MarkBendeich | 0 | 1 | 0 | 0 | 0 |
| ## MartinWolk | 0 | 0 | 0 | 1 | 0 |
| ## MatthewBunce | 0 | 0 | 0 | 0 | 0 |
| ## MichaelConnor | 0 | 0 | 0 | 0 | 0 |
| ## MureDickie | 0 | 2 | 0 | 0 | 0 |
| ## NickLouth | 0 | 0 | 0 | 0 | 1 |
| ## PatriciaCommins | 0 | 0 | 0 | 0 | 0 |
| ## PeterHumphrey | 0 | 10 | 0 | 0 | 0 |
| ## PierreTran | 0 | 0 | 0 | 0 | 0 |
| ## RobinSidel | 0 | 0 | 0 | 0 | 0 |
| ## RogerFillion | 0 | 0 | 0 | 0 | 0 |
| ## SamuelPerry | 0 | 0 | 0 | 0 | 0 |
| ## SarahDavison | 0 | 0 | 0 | 0 | 0 |
| ## ScottHillis | 0 | 0 | 0 | 0 | 0 |
| ## SimonCowell | 41 | 0 | 0 | 0 | 0 |
| ## TanEeLyn | 0 | 31 | 0 | 0 | 0 |
| ## TheresePoletti | 0 | 0 | 45 | 0 | 4 |
| ## TimFarrand | 0 | 0 | 0 | 46 | 0 |
| ## ToddNissen | 0 | 0 | 0 | 0 | 34 |
| ## WilliamKazer | 0 | 0 | 0 | 0 | 0 |
| ## | | Reference | | | |
| ## Prediction | | WilliamKazer | | | |
| ## AaronPressman | 0 | | | | |
| ## AlanCrosby | 0 | | | | |
| ## AlexanderSmith | 0 | | | | |
| ## BenjaminKangLim | 2 | | | | |
| ## BernardHickey | 0 | | | | |
| ## BradDorfman | 0 | | | | |
| ## DarrenSchuettler | 0 | | | | |
| ## DavidLawder | 0 | | | | |
| ## EdnaFernandes | 0 | | | | |
| ## EricAuchard | 0 | | | | |
| ## FumikoFujisaki | 0 | | | | |
| ## GrahamEarnshaw | 2 | | | | |
| ## HeatherScoffield | 0 | | | | |
| ## JaneMacartney | 1 | | | | |
| ## JanLopatka | 0 | | | | |
| ## JimGilchrist | 0 | | | | |
| ## JoeOrtiz | 0 | | | | |
| ## JohnMastrini | 0 | | | | |
| ## JonathanBirt | 0 | | | | |
| ## JoWinterbottom | 0 | | | | |
| ## KarlPenhaul | 0 | | | | |
| ## KeithWeir | 0 | | | | |

```

## KevinDrawbaugh          0
## KevinMorrison           0
## KirstinRidley           0
## KouroshKarimkhany       0
## LydiaZajc                0
## LynneO'Donnell           0
## LynnleyBrowning           0
## MarcelMichelson           0
## MarkBendeich               0
## MartinWolk                0
## MatthewBunce               0
## MichaelConnor              0
## MureDickie                  1
## NickLouth                   1
## PatriciaCommins            0
## PeterHumphrey              0
## PierreTran                  0
## RobinSidel                  0
## RogerFillion                 0
## SamuelPerry                  0
## SarahDavison                 0
## ScottHillis                  1
## SimonCowell                  0
## TanEeLyn                     0
## TheresePoletti                0
## TimFarrand                  0
## ToddNissen                  0
## WilliamKazer                  42
##
## Overall Statistics
##
##                         Accuracy : 0.8788
##                         95% CI : (0.8654, 0.8913)
##      No Information Rate : 0.02
##      P-Value [Acc > NIR] : < 2.2e-16
##
##                         Kappa : 0.8763
##
##      Mcnemar's Test P-Value : NA
##
## Statistics by Class:
##
##                         Class: AaronPressman Class: AlanCrosby
##      Sensitivity                  0.9600          0.8800
##      Specificity                  0.9939          0.9992
##      Pos Pred Value                0.7619          0.9565
##      Neg Pred Value                0.9992          0.9976
##      Prevalence                      0.0200          0.0200
##      Detection Rate                  0.0192          0.0176
##      Detection Prevalence             0.0252          0.0184
##      Balanced Accuracy                 0.9769          0.9396
##
##                         Class: AlexanderSmith Class: BenjaminKangLim
##      Sensitivity                  0.8400          0.9000
##      Specificity                  0.9980          0.9959

```

| | | | |
|----------------------------|-----------------------|-----------------|--------|
| ## Pos Pred Value | 0.8936 | 0.8182 | |
| ## Neg Pred Value | 0.9967 | 0.9980 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0168 | 0.0180 | |
| ## Detection Prevalence | 0.0188 | 0.0220 | |
| ## Balanced Accuracy | 0.9190 | 0.9480 | |
| ## Class: BernardHickey | Class: BradDorfman | | |
| ## Sensitivity | 0.8400 | 0.9400 | |
| ## Specificity | 0.9976 | 0.9976 | |
| ## Pos Pred Value | 0.8750 | 0.8868 | |
| ## Neg Pred Value | 0.9967 | 0.9988 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0168 | 0.0188 | |
| ## Detection Prevalence | 0.0192 | 0.0212 | |
| ## Balanced Accuracy | 0.9188 | 0.9688 | |
| ## Class: DarrenSchuettler | Class: DavidLawder | | |
| ## Sensitivity | 0.9400 | 0.7800 | |
| ## Specificity | 0.9996 | 0.9967 | |
| ## Pos Pred Value | 0.9792 | 0.8298 | |
| ## Neg Pred Value | 0.9988 | 0.9955 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0188 | 0.0156 | |
| ## Detection Prevalence | 0.0192 | 0.0188 | |
| ## Balanced Accuracy | 0.9698 | 0.8884 | |
| ## Class: EdnaFernandes | Class: EricAuchard | | |
| ## Sensitivity | 0.8800 | 0.8000 | |
| ## Specificity | 0.9992 | 0.9971 | |
| ## Pos Pred Value | 0.9565 | 0.8511 | |
| ## Neg Pred Value | 0.9976 | 0.9959 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0176 | 0.0160 | |
| ## Detection Prevalence | 0.0184 | 0.0188 | |
| ## Balanced Accuracy | 0.9396 | 0.8986 | |
| ## Class: FumikoFujisaki | Class: GrahamEarnshaw | | |
| ## Sensitivity | 0.9600 | 0.8600 | |
| ## Specificity | 1.0000 | 0.9967 | |
| ## Pos Pred Value | 1.0000 | 0.8431 | |
| ## Neg Pred Value | 0.9992 | 0.9971 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0192 | 0.0172 | |
| ## Detection Prevalence | 0.0192 | 0.0204 | |
| ## Balanced Accuracy | 0.9800 | 0.9284 | |
| ## Class: HeatherScoffield | Class: JaneMacartney | | |
| ## Sensitivity | 0.9400 | 0.7800 | |
| ## Specificity | 1.0000 | 0.9980 | |
| ## Pos Pred Value | 1.0000 | 0.8864 | |
| ## Neg Pred Value | 0.9988 | 0.9955 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0188 | 0.0156 | |
| ## Detection Prevalence | 0.0188 | 0.0176 | |
| ## Balanced Accuracy | 0.9700 | 0.8890 | |
| ## Class: JanLopatka | Class: JimGilchrist | Class: JoeOrtiz | |
| ## Sensitivity | 0.8400 | 0.9600 | 0.8800 |
| ## Specificity | 0.9980 | 0.9984 | 0.9984 |

| | | | |
|-------------------------|------------------------|--------------------------|------------------|
| ## Pos Pred Value | 0.8936 | 0.9231 | 0.9167 |
| ## Neg Pred Value | 0.9967 | 0.9992 | 0.9976 |
| ## Prevalence | 0.0200 | 0.0200 | 0.0200 |
| ## Detection Rate | 0.0168 | 0.0192 | 0.0176 |
| ## Detection Prevalence | 0.0188 | 0.0208 | 0.0192 |
| ## Balanced Accuracy | 0.9190 | 0.9792 | 0.9392 |
| ## | Class: JohnMastrini | Class: JonathanBirt | |
| ## Sensitivity | 0.8600 | 0.8800 | |
| ## Specificity | 0.9963 | 0.9984 | |
| ## Pos Pred Value | 0.8269 | 0.9167 | |
| ## Neg Pred Value | 0.9971 | 0.9976 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0172 | 0.0176 | |
| ## Detection Prevalence | 0.0208 | 0.0192 | |
| ## Balanced Accuracy | 0.9282 | 0.9392 | |
| ## | Class: JoWinterbottom | Class: KarlPenhaul | Class: KeithWeir |
| ## Sensitivity | 0.9000 | 0.9000 | 0.8800 |
| ## Specificity | 0.9984 | 0.9935 | 0.9992 |
| ## Pos Pred Value | 0.9184 | 0.7377 | 0.9565 |
| ## Neg Pred Value | 0.9980 | 0.9979 | 0.9976 |
| ## Prevalence | 0.0200 | 0.0200 | 0.0200 |
| ## Detection Rate | 0.0180 | 0.0180 | 0.0176 |
| ## Detection Prevalence | 0.0196 | 0.0244 | 0.0184 |
| ## Balanced Accuracy | 0.9492 | 0.9467 | 0.9396 |
| ## | Class: KevinDrawbaugh | Class: KevinMorrison | |
| ## Sensitivity | 1.0000 | 0.8200 | |
| ## Specificity | 0.9947 | 0.9980 | |
| ## Pos Pred Value | 0.7937 | 0.8913 | |
| ## Neg Pred Value | 1.0000 | 0.9963 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0200 | 0.0164 | |
| ## Detection Prevalence | 0.0252 | 0.0184 | |
| ## Balanced Accuracy | 0.9973 | 0.9090 | |
| ## | Class: KirstinRidley | Class: KouroshKarimkhany | |
| ## Sensitivity | 0.7600 | 0.9400 | |
| ## Specificity | 0.9988 | 0.9988 | |
| ## Pos Pred Value | 0.9268 | 0.9400 | |
| ## Neg Pred Value | 0.9951 | 0.9988 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0152 | 0.0188 | |
| ## Detection Prevalence | 0.0164 | 0.0200 | |
| ## Balanced Accuracy | 0.8794 | 0.9694 | |
| ## | Class: LydiaZajc | Class: LynneO'Donnell | |
| ## Sensitivity | 0.8800 | 0.9800 | |
| ## Specificity | 0.9992 | 0.9996 | |
| ## Pos Pred Value | 0.9565 | 0.9800 | |
| ## Neg Pred Value | 0.9976 | 0.9996 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0176 | 0.0196 | |
| ## Detection Prevalence | 0.0184 | 0.0200 | |
| ## Balanced Accuracy | 0.9396 | 0.9898 | |
| ## | Class: LynnleyBrowning | Class: MarcelMichelson | |
| ## Sensitivity | 1.0000 | 0.9400 | |
| ## Specificity | 0.9988 | 0.9984 | |

| | | | |
|-------------------------|------------------------|----------------------|-----------------------|
| ## Pos Pred Value | 0.9434 | 0.9216 | |
| ## Neg Pred Value | 1.0000 | 0.9988 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0200 | 0.0188 | |
| ## Detection Prevalence | 0.0212 | 0.0204 | |
| ## Balanced Accuracy | 0.9994 | 0.9692 | |
| ## | Class: MarkBendeich | Class: MartinWolk | Class: MatthewBunce |
| ## Sensitivity | 0.9400 | 0.9200 | 0.9400 |
| ## Specificity | 0.9984 | 0.9971 | 0.9980 |
| ## Pos Pred Value | 0.9216 | 0.8679 | 0.9038 |
| ## Neg Pred Value | 0.9988 | 0.9984 | 0.9988 |
| ## Prevalence | 0.0200 | 0.0200 | 0.0200 |
| ## Detection Rate | 0.0188 | 0.0184 | 0.0188 |
| ## Detection Prevalence | 0.0204 | 0.0212 | 0.0208 |
| ## Balanced Accuracy | 0.9692 | 0.9586 | 0.9690 |
| ## | Class: MichaelConnor | Class: MureDickie | Class: NickLouth |
| ## Sensitivity | 0.8400 | 0.8000 | 0.9600 |
| ## Specificity | 0.9976 | 0.9955 | 0.9943 |
| ## Pos Pred Value | 0.8750 | 0.7843 | 0.7742 |
| ## Neg Pred Value | 0.9967 | 0.9959 | 0.9992 |
| ## Prevalence | 0.0200 | 0.0200 | 0.0200 |
| ## Detection Rate | 0.0168 | 0.0160 | 0.0192 |
| ## Detection Prevalence | 0.0192 | 0.0204 | 0.0248 |
| ## Balanced Accuracy | 0.9188 | 0.8978 | 0.9771 |
| ## | Class: PatriciaCommins | Class: PeterHumphrey | |
| ## Sensitivity | 0.8400 | 0.9200 | |
| ## Specificity | 0.9996 | 0.9935 | |
| ## Pos Pred Value | 0.9767 | 0.7419 | |
| ## Neg Pred Value | 0.9967 | 0.9984 | |
| ## Prevalence | 0.0200 | 0.0200 | |
| ## Detection Rate | 0.0168 | 0.0184 | |
| ## Detection Prevalence | 0.0172 | 0.0248 | |
| ## Balanced Accuracy | 0.9198 | 0.9567 | |
| ## | Class: PierreTran | Class: RobinSidel | Class: RogerFillion |
| ## Sensitivity | 0.9000 | 0.9800 | 0.9600 |
| ## Specificity | 0.9992 | 0.9996 | 0.9996 |
| ## Pos Pred Value | 0.9574 | 0.9800 | 0.9796 |
| ## Neg Pred Value | 0.9980 | 0.9996 | 0.9992 |
| ## Prevalence | 0.0200 | 0.0200 | 0.0200 |
| ## Detection Rate | 0.0180 | 0.0196 | 0.0192 |
| ## Detection Prevalence | 0.0188 | 0.0200 | 0.0196 |
| ## Balanced Accuracy | 0.9496 | 0.9898 | 0.9798 |
| ## | Class: SamuelPerry | Class: SarahDavison | Class: ScottHillis |
| ## Sensitivity | 0.8600 | 0.900 | 0.6800 |
| ## Specificity | 0.9951 | 0.998 | 0.9976 |
| ## Pos Pred Value | 0.7818 | 0.900 | 0.8500 |
| ## Neg Pred Value | 0.9971 | 0.998 | 0.9935 |
| ## Prevalence | 0.0200 | 0.020 | 0.0200 |
| ## Detection Rate | 0.0172 | 0.018 | 0.0136 |
| ## Detection Prevalence | 0.0220 | 0.020 | 0.0160 |
| ## Balanced Accuracy | 0.9276 | 0.949 | 0.8388 |
| ## | Class: SimonCowell | Class: TanEeLyn | Class: TheresePoletti |
| ## Sensitivity | 0.8200 | 0.6200 | 0.9000 |
| ## Specificity | 0.9996 | 0.9976 | 0.9902 |

| | 0.9762 | 0.8378 | 0.6522 |
|-------------------------|-------------------|-------------------|---------------------|
| ## Pos Pred Value | 0.9963 | 0.9923 | 0.9979 |
| ## Neg Pred Value | 0.0200 | 0.0200 | 0.0200 |
| ## Prevalence | 0.0164 | 0.0124 | 0.0180 |
| ## Detection Rate | 0.0168 | 0.0148 | 0.0276 |
| ## Detection Prevalence | 0.0168 | 0.0148 | 0.0276 |
| ## Balanced Accuracy | 0.9098 | 0.8088 | 0.9451 |
| ## | Class: TimFarrand | Class: ToddNissen | Class: WilliamKazer |
| ## Sensitivity | 0.9200 | 0.6800 | 0.8400 |
| ## Specificity | 0.9951 | 0.9988 | 0.9963 |
| ## Pos Pred Value | 0.7931 | 0.9189 | 0.8235 |
| ## Neg Pred Value | 0.9984 | 0.9935 | 0.9967 |
| ## Prevalence | 0.0200 | 0.0200 | 0.0200 |
| ## Detection Rate | 0.0184 | 0.0136 | 0.0168 |
| ## Detection Prevalence | 0.0232 | 0.0148 | 0.0204 |
| ## Balanced Accuracy | 0.9576 | 0.8394 | 0.9182 |

Association rule mining

Since our data file is text file, we utilized “read.transactions” function from “arule” library to convert our text data into transaction data with dropping duplicates at the same time. As a result, we now have 9835 transactions (rows) with 169 unique food names (columns).

```
if (!require("arules")) install.packages('arules', repos="http://cran.us.r-project.org")

## Loading required package: arules

##
## Attaching package: 'arules'

## The following object is masked from 'package:tm':
##
##     inspect

## The following objects are masked from 'package:mosaic':
##
##     inspect, lhs, rhs

## The following object is masked from 'package:dplyr':
##
##     recode

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

library(arules)
library(tidyverse)
library(arulesViz)

## Loading required package: grid

## Registered S3 methods overwritten by 'registry':
##   method           from
##   print.registry_field proxy
##   print.registry_entry proxy

## Registered S3 method overwritten by 'seriation':
##   method           from
##   reorder.hclust gclus
```

```

# load the data using arule
transactions <- arules::read.transactions(
  file="groceries.txt",
  format = c("basket"),
  sep = ",",
  cols =NULL,
  rm.duplicates = 1,
  skip = 0
)

#check
head(transactions@itemInfo$labels)

## [1] "abrasive cleaner" "artif. sweetener" "baby cosmetics"    "baby food"
## [5] "bags"           "baking powder"

print(paste("There are ", transactions@data@Dim[2], "transactions with ", transactions@data@Dim[1], "it"))

## [1] "There are 9835 transactions with 169 items."

Among those 169 food names, the most frequent items are “whole milk”, “other vegetables”, “rolls/buns”, “soda”, and “yogurt”.

summary(transactions)

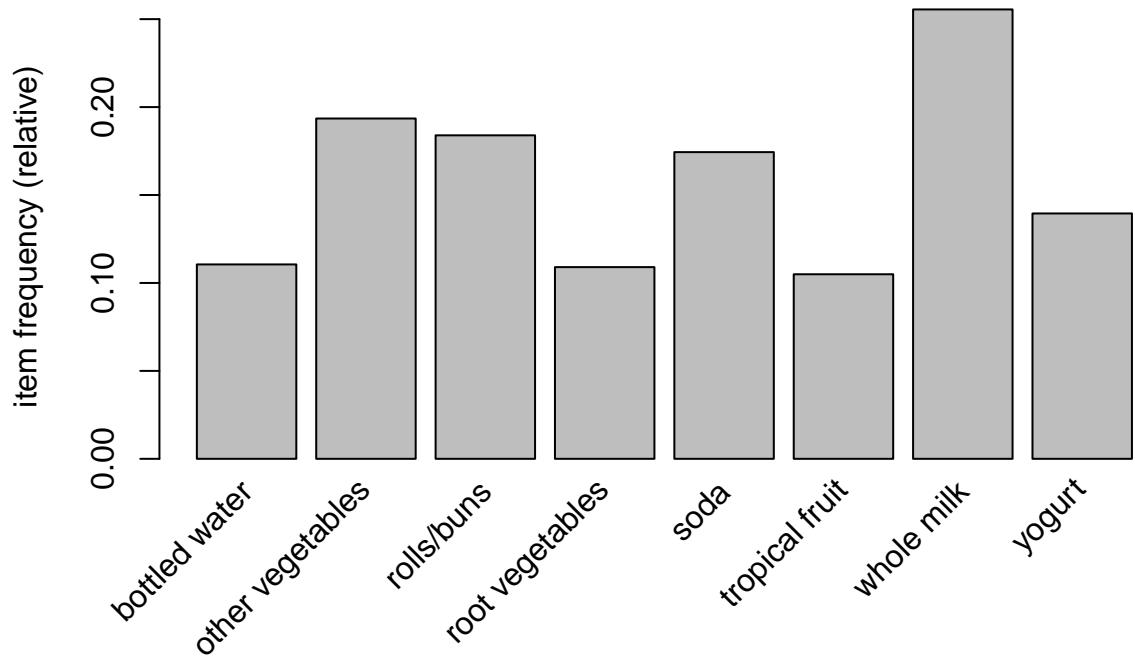
## transactions as itemMatrix in sparse format with
## 9835 rows (elements/itemsets/transactions) and
## 169 columns (items) and a density of 0.02609146
##
## most frequent items:
##      whole milk other vegetables      rolls/buns          soda
##      2513                1903            1809            1715
##      yogurt              (Other)
##      1372                34055
##
## element (itemset/transaction) length distribution:
## sizes
##   1   2   3   4   5   6   7   8   9   10  11  12  13  14  15  16
## 2159 1643 1299 1005 855 645 545 438 350 246 182 117 78 77 55 46
##   17  18  19  20  21  22  23  24  26  27  28  29  32
##   29  14  14   9  11   4   6   1   1   1   1   3   1
##
##      Min. 1st Qu. Median     Mean 3rd Qu.     Max.
##      1.000  2.000  3.000  4.409  6.000  32.000
##
## includes extended item information - examples:
##      labels
## 1 abrasive cleaner
## 2 artif. sweetener
## 3 baby cosmetics

```

The bar graph below shows the items that have frequency above 10% support. As we expected, we got “whole milk” as the highest, followed by “other vegetables” and “rolls/buns”.

```
itemFrequencyPlot(transactions, support = 0.1, main = "item frequency plot above support 10%")
```

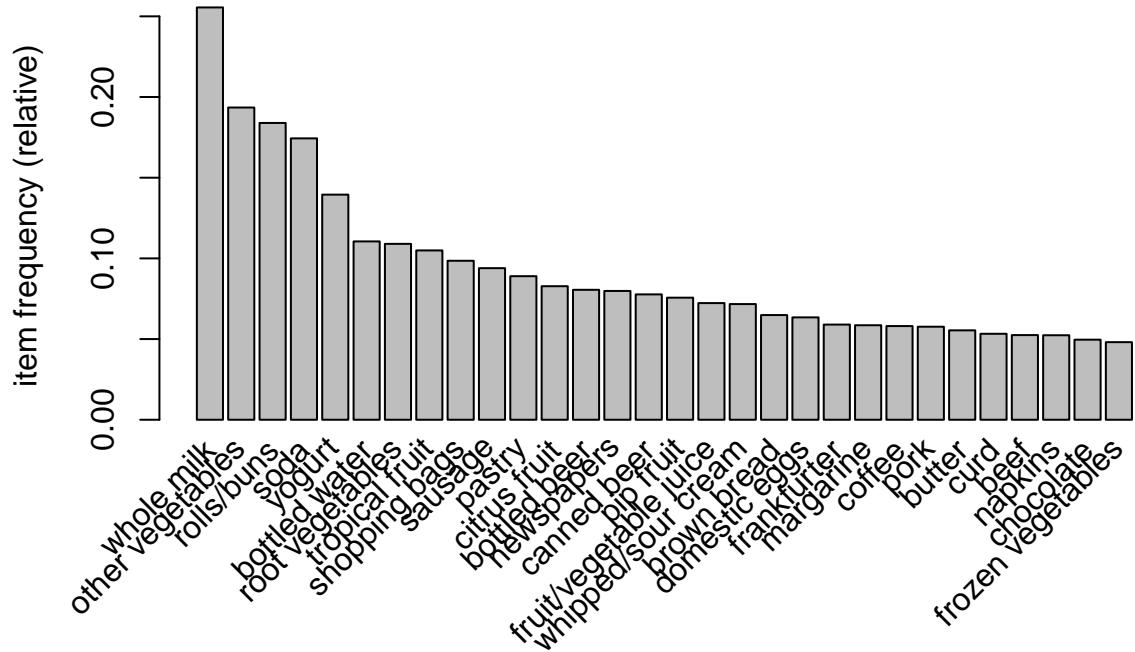
item frequency plot above support 10%



The graph below shows top 30 items with highest item frequency.

```
itemFrequencyPlot(transactions, topN=30, main = "Top 30 Item Frequency")
```

Top 30 Item Frequency



We ran the “apriori” function. When we inspected, we could observe that “bottled water”, “tropical fruit”, “root vegetables”, “soda”, “yogurt”, “rolls/buns”, “other vegetables” and “whole milk” have empty Left Hand Side (LHS). This means that these items are so popular items that these item is most likely to be purchased no matter what conditional probability of LHS. It is also worthy to note that the lift values of these popular items are 1.

```
# Run apriori
itemrules = apriori(transactions, parameter=list(support=.005, confidence=.1, maxlen=5))

## 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
##         5   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].

```

```
inspect(itemrules)[1:5, ]
```

| | lhs | rhs | support | confidence | coverage |
|---------|-----------------------|-----------------------|-------------|------------|---------------|
| ## [1] | {} | => {bottled water} | 0.110523640 | 0.1105236 | 1.000000000 1 |
| ## [2] | {} | => {tropical fruit} | 0.104931368 | 0.1049314 | 1.000000000 1 |
| ## [3] | {} | => {root vegetables} | 0.108998475 | 0.1089985 | 1.000000000 1 |
| ## [4] | {} | => {soda} | 0.174377224 | 0.1743772 | 1.000000000 1 |
| ## [5] | {} | => {yogurt} | 0.139501779 | 0.1395018 | 1.000000000 1 |
| ## [6] | {} | => {rolls/buns} | 0.183934926 | 0.1839349 | 1.000000000 1 |
| ## [7] | {} | => {other vegetables} | 0.193492628 | 0.1934926 | 1.000000000 1 |
| ## [8] | {} | => {whole milk} | 0.255516014 | 0.2555160 | 1.000000000 1 |
| ## [9] | {cake bar} | => {whole milk} | 0.005592272 | 0.4230769 | 0.013218099 1 |
| ## [10] | {dishes} | => {other vegetables} | 0.005998983 | 0.3410405 | 0.017590239 1 |
| ## [11] | {dishes} | => {whole milk} | 0.005287239 | 0.3005780 | 0.017590239 1 |
| ## [12] | {mustard} | => {whole milk} | 0.005185562 | 0.4322034 | 0.011997966 1 |
| ## [13] | {pot plants} | => {whole milk} | 0.006914082 | 0.4000000 | 0.017285206 1 |
| ## [14] | {chewing gum} | => {soda} | 0.005388917 | 0.2560386 | 0.021047280 1 |
| ## [15] | {chewing gum} | => {whole milk} | 0.005083884 | 0.2415459 | 0.021047280 0 |
| ## [16] | {canned fish} | => {other vegetables} | 0.005083884 | 0.3378378 | 0.015048297 1 |
| ## [17] | {pasta} | => {whole milk} | 0.006100661 | 0.4054054 | 0.015048297 1 |
| ## [18] | {herbs} | => {root vegetables} | 0.007015760 | 0.4312500 | 0.016268429 3 |
| ## [19] | {herbs} | => {other vegetables} | 0.007727504 | 0.4750000 | 0.016268429 2 |
| ## [20] | {herbs} | => {whole milk} | 0.007727504 | 0.4750000 | 0.016268429 1 |
| ## [21] | {processed cheese} | => {soda} | 0.005287239 | 0.3190184 | 0.016573462 1 |
| ## [22] | {processed cheese} | => {other vegetables} | 0.005490595 | 0.3312883 | 0.016573462 1 |
| ## [23] | {processed cheese} | => {whole milk} | 0.007015760 | 0.4233129 | 0.016573462 1 |
| ## [24] | {semi-finished bread} | => {other vegetables} | 0.005185562 | 0.2931034 | 0.017691917 1 |
| ## [25] | {semi-finished bread} | => {whole milk} | 0.007117438 | 0.4022989 | 0.017691917 1 |
| ## [26] | {beverages} | => {yogurt} | 0.005490595 | 0.2109375 | 0.026029487 1 |
| ## [27] | {beverages} | => {rolls/buns} | 0.005388917 | 0.2070312 | 0.026029487 1 |
| ## [28] | {beverages} | => {other vegetables} | 0.005185562 | 0.1992188 | 0.026029487 1 |
| ## [29] | {beverages} | => {whole milk} | 0.006812405 | 0.2617188 | 0.026029487 1 |
| ## [30] | {ice cream} | => {soda} | 0.006100661 | 0.2439024 | 0.025012710 1 |
| ## [31] | {ice cream} | => {other vegetables} | 0.005083884 | 0.2032520 | 0.025012710 1 |
| ## [32] | {ice cream} | => {whole milk} | 0.005897306 | 0.2357724 | 0.025012710 0 |
| ## [33] | {detergent} | => {other vegetables} | 0.006405694 | 0.3333333 | 0.019217082 1 |
| ## [34] | {detergent} | => {whole milk} | 0.008947636 | 0.4656085 | 0.019217082 1 |
| ## [35] | {pickled vegetables} | => {other vegetables} | 0.006405694 | 0.3579545 | 0.017895272 1 |
| ## [36] | {pickled vegetables} | => {whole milk} | 0.007117438 | 0.3977273 | 0.017895272 1 |
| ## [37] | {baking powder} | => {other vegetables} | 0.007320793 | 0.4137931 | 0.017691917 2 |
| ## [38] | {baking powder} | => {whole milk} | 0.009252669 | 0.5229885 | 0.017691917 2 |
| ## [39] | {flour} | => {other vegetables} | 0.006304016 | 0.3625731 | 0.017386884 1 |
| ## [40] | {flour} | => {whole milk} | 0.008439248 | 0.4853801 | 0.017386884 1 |
| ## [41] | {soft cheese} | => {yogurt} | 0.005998983 | 0.3511905 | 0.017081851 2 |
| ## [42] | {soft cheese} | => {rolls/buns} | 0.005388917 | 0.3154762 | 0.017081851 1 |
| ## [43] | {soft cheese} | => {other vegetables} | 0.007117438 | 0.4166667 | 0.017081851 2 |
| ## [44] | {soft cheese} | => {whole milk} | 0.007524148 | 0.4404762 | 0.017081851 1 |
| ## [45] | {specialty bar} | => {soda} | 0.007219115 | 0.2639405 | 0.027351296 1 |
| ## [46] | {specialty bar} | => {rolls/buns} | 0.005592272 | 0.2044610 | 0.027351296 1 |
| ## [47] | {specialty bar} | => {other vegetables} | 0.005592272 | 0.2044610 | 0.027351296 1 |
| ## [48] | {specialty bar} | => {whole milk} | 0.006507372 | 0.2379182 | 0.027351296 0 |

| | | | | | | |
|----------|-----------------------|-----------------------|-------------|-----------|-------------|---|
| ## [49] | {misc. beverages} | => {bottled water} | 0.005287239 | 0.1863799 | 0.028368073 | 1 |
| ## [50] | {misc. beverages} | => {soda} | 0.007320793 | 0.2580645 | 0.028368073 | 1 |
| ## [51] | {misc. beverages} | => {other vegetables} | 0.005592272 | 0.1971326 | 0.028368073 | 1 |
| ## [52] | {misc. beverages} | => {whole milk} | 0.007015760 | 0.2473118 | 0.028368073 | 0 |
| ## [53] | {grapes} | => {tropical fruit} | 0.006100661 | 0.2727273 | 0.022369090 | 2 |
| ## [54] | {grapes} | => {other vegetables} | 0.009049314 | 0.4045455 | 0.022369090 | 2 |
| ## [55] | {grapes} | => {whole milk} | 0.007320793 | 0.3272727 | 0.022369090 | 1 |
| ## [56] | {cat food} | => {yogurt} | 0.006202339 | 0.2663755 | 0.023284189 | 1 |
| ## [57] | {cat food} | => {other vegetables} | 0.006507372 | 0.2794760 | 0.023284189 | 1 |
| ## [58] | {cat food} | => {whole milk} | 0.008845958 | 0.3799127 | 0.023284189 | 1 |
| ## [59] | {specialty chocolate} | => {soda} | 0.006304016 | 0.2073579 | 0.030401627 | 1 |
| ## [60] | {specialty chocolate} | => {rolls/buns} | 0.005592272 | 0.1839465 | 0.030401627 | 1 |
| ## [61] | {specialty chocolate} | => {other vegetables} | 0.006100661 | 0.2006689 | 0.030401627 | 1 |
| ## [62] | {specialty chocolate} | => {whole milk} | 0.008032537 | 0.2642140 | 0.030401627 | 1 |
| ## [63] | {meat} | => {sausage} | 0.005287239 | 0.2047244 | 0.025826131 | 2 |
| ## [64] | {meat} | => {root vegetables} | 0.005083884 | 0.1968504 | 0.025826131 | 1 |
| ## [65] | {meat} | => {soda} | 0.005490595 | 0.2125984 | 0.025826131 | 1 |
| ## [66] | {meat} | => {yogurt} | 0.005287239 | 0.2047244 | 0.025826131 | 1 |
| ## [67] | {meat} | => {rolls/buns} | 0.006914082 | 0.2677165 | 0.025826131 | 1 |
| ## [68] | {meat} | => {other vegetables} | 0.009964413 | 0.3858268 | 0.025826131 | 1 |
| ## [69] | {meat} | => {whole milk} | 0.009964413 | 0.3858268 | 0.025826131 | 1 |
| ## [70] | {frozen meals} | => {tropical fruit} | 0.005490595 | 0.1935484 | 0.028368073 | 1 |
| ## [71] | {frozen meals} | => {soda} | 0.006202339 | 0.2186380 | 0.028368073 | 1 |
| ## [72] | {frozen meals} | => {yogurt} | 0.006202339 | 0.2186380 | 0.028368073 | 1 |
| ## [73] | {frozen meals} | => {other vegetables} | 0.007524148 | 0.2652330 | 0.028368073 | 1 |
| ## [74] | {frozen meals} | => {whole milk} | 0.009862735 | 0.3476703 | 0.028368073 | 1 |
| ## [75] | {hard cheese} | => {sausage} | 0.005185562 | 0.2116183 | 0.024504321 | 2 |
| ## [76] | {hard cheese} | => {root vegetables} | 0.005592272 | 0.2282158 | 0.024504321 | 2 |
| ## [77] | {hard cheese} | => {yogurt} | 0.006405694 | 0.2614108 | 0.024504321 | 1 |
| ## [78] | {hard cheese} | => {rolls/buns} | 0.005897306 | 0.2406639 | 0.024504321 | 1 |
| ## [79] | {hard cheese} | => {other vegetables} | 0.009456024 | 0.3858921 | 0.024504321 | 1 |
| ## [80] | {hard cheese} | => {whole milk} | 0.010066090 | 0.4107884 | 0.024504321 | 1 |
| ## [81] | {butter milk} | => {pip fruit} | 0.005083884 | 0.1818182 | 0.027961362 | 2 |
| ## [82] | {butter milk} | => {tropical fruit} | 0.005490595 | 0.1963636 | 0.027961362 | 1 |
| ## [83] | {butter milk} | => {root vegetables} | 0.005083884 | 0.1818182 | 0.027961362 | 1 |
| ## [84] | {butter milk} | => {yogurt} | 0.008540925 | 0.3054545 | 0.027961362 | 2 |
| ## [85] | {butter milk} | => {rolls/buns} | 0.007625826 | 0.2727273 | 0.027961362 | 1 |
| ## [86] | {butter milk} | => {other vegetables} | 0.010371124 | 0.3709091 | 0.027961362 | 1 |
| ## [87] | {butter milk} | => {whole milk} | 0.011591256 | 0.4145455 | 0.027961362 | 1 |
| ## [88] | {candy} | => {tropical fruit} | 0.005388917 | 0.1802721 | 0.029893238 | 1 |
| ## [89] | {candy} | => {soda} | 0.008642603 | 0.2891156 | 0.029893238 | 1 |
| ## [90] | {candy} | => {yogurt} | 0.005490595 | 0.1836735 | 0.029893238 | 1 |
| ## [91] | {candy} | => {rolls/buns} | 0.007117438 | 0.2380952 | 0.029893238 | 1 |
| ## [92] | {candy} | => {other vegetables} | 0.006914082 | 0.2312925 | 0.029893238 | 1 |
| ## [93] | {candy} | => {whole milk} | 0.008235892 | 0.2755102 | 0.029893238 | 1 |
| ## [94] | {ham} | => {white bread} | 0.005083884 | 0.1953125 | 0.026029487 | 4 |
| ## [95] | {white bread} | => {ham} | 0.005083884 | 0.1207729 | 0.042094560 | 4 |
| ## [96] | {ham} | => {tropical fruit} | 0.005388917 | 0.2070312 | 0.026029487 | 1 |
| ## [97] | {ham} | => {yogurt} | 0.006710727 | 0.2578125 | 0.026029487 | 1 |
| ## [98] | {ham} | => {rolls/buns} | 0.006914082 | 0.2656250 | 0.026029487 | 1 |
| ## [99] | {ham} | => {other vegetables} | 0.009150991 | 0.3515625 | 0.026029487 | 1 |
| ## [100] | {ham} | => {whole milk} | 0.011489578 | 0.4414062 | 0.026029487 | 1 |
| ## [101] | {sliced cheese} | => {sausage} | 0.007015760 | 0.2863071 | 0.024504321 | 3 |
| ## [102] | {sliced cheese} | => {tropical fruit} | 0.005287239 | 0.2157676 | 0.024504321 | 2 |

```

## [103] {sliced cheese} => {root vegetables} 0.005592272 0.2282158 0.024504321 2
## [104] {sliced cheese} => {soda} 0.005083884 0.2074689 0.024504321 1
## [105] {sliced cheese} => {yogurt} 0.008032537 0.3278008 0.024504321 2
## [106] {sliced cheese} => {rolls/buns} 0.007625826 0.3112033 0.024504321 1
## [107] {sliced cheese} => {other vegetables} 0.009049314 0.3692946 0.024504321 1
## [108] {sliced cheese} => {whole milk} 0.010777834 0.4398340 0.024504321 1
## [109] {UHT-milk} => {bottled water} 0.007320793 0.2188450 0.033451957 1
## [110] {UHT-milk} => {soda} 0.007625826 0.2279635 0.033451957 1
## [111] {UHT-milk} => {yogurt} 0.007422471 0.2218845 0.033451957 1
## [112] {UHT-milk} => {rolls/buns} 0.006405694 0.1914894 0.033451957 1
## [113] {UHT-milk} => {other vegetables} 0.008134215 0.2431611 0.033451957 1
## [114] {oil} => {root vegetables} 0.007015760 0.2500000 0.028063040 2
## [115] {oil} => {yogurt} 0.005287239 0.1884058 0.028063040 1
## [116] {oil} => {rolls/buns} 0.005083884 0.1811594 0.028063040 0
## [117] {oil} => {other vegetables} 0.009964413 0.3550725 0.028063040 1
## [118] {oil} => {whole milk} 0.011286223 0.4021739 0.028063040 1
## [119] {onions} => {whipped/sour cream} 0.005083884 0.1639344 0.031011693 2
## [120] {onions} => {citrus fruit} 0.005592272 0.1803279 0.031011693 2
## [121] {onions} => {bottled water} 0.005897306 0.1901639 0.031011693 1
## [122] {onions} => {tropical fruit} 0.005693950 0.1836066 0.031011693 1
## [123] {onions} => {root vegetables} 0.009456024 0.3049180 0.031011693 2
## [124] {onions} => {soda} 0.005287239 0.1704918 0.031011693 0
## [125] {onions} => {yogurt} 0.007219115 0.2327869 0.031011693 1
## [126] {onions} => {rolls/buns} 0.006812405 0.2196721 0.031011693 1
## [127] {onions} => {other vegetables} 0.014234875 0.4590164 0.031011693 2
## [128] {onions} => {whole milk} 0.012099644 0.3901639 0.031011693 1
## [129] {berries} => {whipped/sour cream} 0.009049314 0.2721713 0.033248602 3
## [130] {whipped/sour cream} => {berries} 0.009049314 0.1262411 0.071682766 3
## [131] {berries} => {citrus fruit} 0.005388917 0.1620795 0.033248602 1
## [132] {berries} => {tropical fruit} 0.006710727 0.2018349 0.033248602 1
## [133] {berries} => {root vegetables} 0.006609049 0.1987768 0.033248602 1
## [134] {berries} => {soda} 0.007320793 0.2201835 0.033248602 1
## [135] {berries} => {yogurt} 0.010574479 0.3180428 0.033248602 2
## [136] {berries} => {rolls/buns} 0.006609049 0.1987768 0.033248602 1
## [137] {berries} => {other vegetables} 0.010269446 0.3088685 0.033248602 1
## [138] {berries} => {whole milk} 0.011794611 0.3547401 0.033248602 1
## [139] {hamburger meat} => {sausage} 0.005185562 0.1559633 0.033248602 1
## [140] {hamburger meat} => {root vegetables} 0.006202339 0.1865443 0.033248602 1
## [141] {hamburger meat} => {soda} 0.005795628 0.1743119 0.033248602 0
## [142] {hamburger meat} => {yogurt} 0.006507372 0.1957187 0.033248602 1
## [143] {hamburger meat} => {rolls/buns} 0.008642603 0.2599388 0.033248602 1
## [144] {hamburger meat} => {other vegetables} 0.013828165 0.4159021 0.033248602 2
## [145] {hamburger meat} => {whole milk} 0.014743264 0.4434251 0.033248602 1
## [146] {hygiene articles} => {napkins} 0.006100661 0.1851852 0.032943569 3
## [147] {napkins} => {hygiene articles} 0.006100661 0.1165049 0.052364006 3
## [148] {hygiene articles} => {citrus fruit} 0.005287239 0.1604938 0.032943569 1
## [149] {hygiene articles} => {shopping bags} 0.005185562 0.1574074 0.032943569 1
## [150] {hygiene articles} => {bottled water} 0.005693950 0.1728395 0.032943569 1
## [151] {hygiene articles} => {tropical fruit} 0.006710727 0.2037037 0.032943569 1
## [152] {hygiene articles} => {root vegetables} 0.005388917 0.1635802 0.032943569 1
## [153] {hygiene articles} => {soda} 0.007015760 0.2129630 0.032943569 1
## [154] {hygiene articles} => {yogurt} 0.007320793 0.2222222 0.032943569 1
## [155] {hygiene articles} => {rolls/buns} 0.005897306 0.1790123 0.032943569 0
## [156] {hygiene articles} => {other vegetables} 0.009557702 0.2901235 0.032943569 1

```

| | | | | | | |
|----------|----------------------------|-------------------------------|-------------|-----------|-------------|---|
| ## [157] | {hygiene articles} | => {whole milk} | 0.012811388 | 0.3888889 | 0.032943569 | 1 |
| ## [158] | {salty snack} | => {fruit/vegetable juice} | 0.005998983 | 0.1586022 | 0.037824098 | 2 |
| ## [159] | {salty snack} | => {whipped/sour cream} | 0.005185562 | 0.1370968 | 0.037824098 | 1 |
| ## [160] | {salty snack} | => {pastry} | 0.005185562 | 0.1370968 | 0.037824098 | 1 |
| ## [161] | {salty snack} | => {shopping bags} | 0.005998983 | 0.1586022 | 0.037824098 | 1 |
| ## [162] | {salty snack} | => {sausage} | 0.005287239 | 0.1397849 | 0.037824098 | 1 |
| ## [163] | {salty snack} | => {tropical fruit} | 0.005592272 | 0.1478495 | 0.037824098 | 1 |
| ## [164] | {salty snack} | => {soda} | 0.009354347 | 0.2473118 | 0.037824098 | 1 |
| ## [165] | {salty snack} | => {yogurt} | 0.006202339 | 0.1639785 | 0.037824098 | 1 |
| ## [166] | {salty snack} | => {other vegetables} | 0.010777834 | 0.2849462 | 0.037824098 | 1 |
| ## [167] | {salty snack} | => {whole milk} | 0.011184545 | 0.2956989 | 0.037824098 | 1 |
| ## [168] | {sugar} | => {margarine} | 0.005490595 | 0.1621622 | 0.033858668 | 2 |
| ## [169] | {sugar} | => {pastry} | 0.005185562 | 0.1531532 | 0.033858668 | 1 |
| ## [170] | {sugar} | => {root vegetables} | 0.006405694 | 0.1891892 | 0.033858668 | 1 |
| ## [171] | {sugar} | => {soda} | 0.007320793 | 0.2162162 | 0.033858668 | 1 |
| ## [172] | {sugar} | => {yogurt} | 0.006914082 | 0.2042042 | 0.033858668 | 1 |
| ## [173] | {sugar} | => {rolls/buns} | 0.007015760 | 0.2072072 | 0.033858668 | 1 |
| ## [174] | {sugar} | => {other vegetables} | 0.010777834 | 0.3183183 | 0.033858668 | 1 |
| ## [175] | {sugar} | => {whole milk} | 0.015048297 | 0.4444444 | 0.033858668 | 1 |
| ## [176] | {waffles} | => {chocolate} | 0.005795628 | 0.1507937 | 0.038434164 | 3 |
| ## [177] | {chocolate} | => {waffles} | 0.005795628 | 0.1168033 | 0.049618709 | 3 |
| ## [178] | {waffles} | => {whipped/sour cream} | 0.005083884 | 0.1322751 | 0.038434164 | 1 |
| ## [179] | {waffles} | => {pastry} | 0.007015760 | 0.1825397 | 0.038434164 | 2 |
| ## [180] | {waffles} | => {shopping bags} | 0.005490595 | 0.1428571 | 0.038434164 | 1 |
| ## [181] | {waffles} | => {tropical fruit} | 0.006100661 | 0.1587302 | 0.038434164 | 1 |
| ## [182] | {waffles} | => {root vegetables} | 0.006609049 | 0.1719577 | 0.038434164 | 1 |
| ## [183] | {waffles} | => {soda} | 0.009557702 | 0.2486772 | 0.038434164 | 1 |
| ## [184] | {waffles} | => {yogurt} | 0.007524148 | 0.1957672 | 0.038434164 | 1 |
| ## [185] | {waffles} | => {rolls/buns} | 0.009150991 | 0.2380952 | 0.038434164 | 1 |
| ## [186] | {waffles} | => {other vegetables} | 0.010066090 | 0.2619048 | 0.038434164 | 1 |
| ## [187] | {waffles} | => {whole milk} | 0.012709710 | 0.3306878 | 0.038434164 | 1 |
| ## [188] | {long life bakery product} | => {chocolate} | 0.005287239 | 0.1413043 | 0.037417387 | 2 |
| ## [189] | {chocolate} | => {long life bakery product} | 0.005287239 | 0.1065574 | 0.049618709 | 2 |
| ## [190] | {long life bakery product} | => {fruit/vegetable juice} | 0.006202339 | 0.1657609 | 0.037417387 | 2 |
| ## [191] | {long life bakery product} | => {whipped/sour cream} | 0.005795628 | 0.1548913 | 0.037417387 | 2 |
| ## [192] | {long life bakery product} | => {pastry} | 0.005897306 | 0.1576087 | 0.037417387 | 1 |
| ## [193] | {long life bakery product} | => {shopping bags} | 0.005388917 | 0.1440217 | 0.037417387 | 1 |
| ## [194] | {long life bakery product} | => {sausage} | 0.005388917 | 0.1440217 | 0.037417387 | 1 |
| ## [195] | {long life bakery product} | => {tropical fruit} | 0.006304016 | 0.1684783 | 0.037417387 | 1 |
| ## [196] | {long life bakery product} | => {root vegetables} | 0.005287239 | 0.1413043 | 0.037417387 | 1 |
| ## [197] | {long life bakery product} | => {soda} | 0.007625826 | 0.2038043 | 0.037417387 | 1 |
| ## [198] | {long life bakery product} | => {yogurt} | 0.008744281 | 0.2336957 | 0.037417387 | 1 |
| ## [199] | {long life bakery product} | => {rolls/buns} | 0.007930859 | 0.2119565 | 0.037417387 | 1 |
| ## [200] | {long life bakery product} | => {other vegetables} | 0.010676157 | 0.2853261 | 0.037417387 | 1 |
| ## [201] | {long life bakery product} | => {whole milk} | 0.013523132 | 0.3614130 | 0.037417387 | 1 |
| ## [202] | {dessert} | => {curd} | 0.005185562 | 0.1397260 | 0.037112354 | 2 |
| ## [203] | {dessert} | => {fruit/vegetable juice} | 0.005998983 | 0.1616438 | 0.037112354 | 2 |
| ## [204] | {dessert} | => {pastry} | 0.005388917 | 0.1452055 | 0.037112354 | 1 |
| ## [205] | {dessert} | => {shopping bags} | 0.006202339 | 0.1671233 | 0.037112354 | 1 |
| ## [206] | {dessert} | => {sausage} | 0.005897306 | 0.1589041 | 0.037112354 | 1 |
| ## [207] | {dessert} | => {bottled water} | 0.005185562 | 0.1397260 | 0.037112354 | 1 |
| ## [208] | {dessert} | => {tropical fruit} | 0.006304016 | 0.1698630 | 0.037112354 | 1 |
| ## [209] | {dessert} | => {root vegetables} | 0.005795628 | 0.1561644 | 0.037112354 | 1 |
| ## [210] | {dessert} | => {soda} | 0.009862735 | 0.2657534 | 0.037112354 | 1 |

```

## [211] {dessert}          => {yogurt}           0.009862735 0.2657534 0.037112354 1
## [212] {dessert}          => {rolls/buns}       0.006812405 0.1835616 0.037112354 0
## [213] {dessert}          => {other vegetables} 0.011591256 0.3123288 0.037112354 1
## [214] {dessert}          => {whole milk}        0.013726487 0.3698630 0.037112354 1
## [215] {canned beer}       => {shopping bags}    0.011387900 0.1465969 0.077681749 1
## [216] {shopping bags}     => {canned beer}        0.011387900 0.1155831 0.098525674 1
## [217] {canned beer}       => {bottled water}      0.008032537 0.1034031 0.077681749 0
## [218] {canned beer}       => {soda}              0.013828165 0.1780105 0.077681749 1
## [219] {canned beer}       => {rolls/buns}        0.011286223 0.1452880 0.077681749 0
## [220] {canned beer}       => {other vegetables} 0.009049314 0.1164921 0.077681749 0
## [221] {canned beer}       => {whole milk}         0.008845958 0.1138743 0.077681749 0
## [222] {cream cheese}      => {curd}              0.005083884 0.1282051 0.039654296 2
## [223] {cream cheese}      => {domestic eggs}      0.005083884 0.1282051 0.039654296 2
## [224] {cream cheese}      => {fruit/vegetable juice} 0.005693950 0.1435897 0.039654296 1
## [225] {cream cheese}      => {whipped/sour cream} 0.006405694 0.1615385 0.039654296 2
## [226] {cream cheese}      => {pip fruit}         0.006100661 0.1538462 0.039654296 2
## [227] {cream cheese}      => {citrus fruit}       0.005693950 0.1435897 0.039654296 1
## [228] {cream cheese}      => {shopping bags}      0.005592272 0.1410256 0.039654296 1
## [229] {cream cheese}      => {sausage}           0.005592272 0.1410256 0.039654296 1
## [230] {cream cheese}      => {bottled water}       0.005897306 0.1487179 0.039654296 1
## [231] {cream cheese}      => {tropical fruit}     0.007219115 0.1820513 0.039654296 1
## [232] {cream cheese}      => {root vegetables}    0.007524148 0.1897436 0.039654296 1
## [233] {cream cheese}      => {soda}               0.006812405 0.1717949 0.039654296 0
## [234] {cream cheese}      => {yogurt}             0.012404677 0.3128205 0.039654296 2
## [235] {cream cheese}      => {rolls/buns}        0.009964413 0.2512821 0.039654296 1
## [236] {cream cheese}      => {other vegetables} 0.013726487 0.3461538 0.039654296 1
## [237] {cream cheese}      => {whole milk}         0.016471784 0.4153846 0.039654296 1
## [238] {chicken}            => {frozen vegetables} 0.006710727 0.1563981 0.042907982 3
## [239] {frozen vegetables} => {chicken}            0.006710727 0.1395349 0.048093543 3
## [240] {chicken}            => {pork}               0.005795628 0.1350711 0.042907982 2
## [241] {pork}               => {chicken}           0.005795628 0.1005291 0.057651246 2
## [242] {chicken}            => {butter}             0.005795628 0.1350711 0.042907982 2
## [243] {butter}              => {chicken}           0.005795628 0.1045872 0.055414337 2
## [244] {chicken}            => {newspapers}         0.005185562 0.1208531 0.042907982 1
## [245] {chicken}            => {domestic eggs}      0.006202339 0.1445498 0.042907982 2
## [246] {chicken}            => {whipped/sour cream} 0.007219115 0.1682464 0.042907982 2
## [247] {whipped/sour cream} => {chicken}           0.007219115 0.1007092 0.071682766 2
## [248] {chicken}            => {citrus fruit}       0.006914082 0.1611374 0.042907982 1
## [249] {chicken}            => {sausage}            0.005287239 0.1232227 0.042907982 1
## [250] {chicken}            => {bottled water}      0.005287239 0.1232227 0.042907982 1
## [251] {chicken}            => {tropical fruit}     0.006405694 0.1492891 0.042907982 1
## [252] {chicken}            => {root vegetables}    0.010879512 0.2535545 0.042907982 2
## [253] {chicken}            => {soda}               0.008337570 0.1943128 0.042907982 1
## [254] {chicken}            => {yogurt}             0.008337570 0.1943128 0.042907982 1
## [255] {chicken}            => {rolls/buns}        0.009659380 0.2251185 0.042907982 1
## [256] {chicken}            => {other vegetables} 0.017895272 0.4170616 0.042907982 2
## [257] {chicken}            => {whole milk}         0.017590239 0.4099526 0.042907982 1
## [258] {white bread}         => {frankfurter}        0.005185562 0.1231884 0.042094560 2
## [259] {white bread}         => {domestic eggs}      0.005795628 0.1376812 0.042094560 2
## [260] {white bread}         => {fruit/vegetable juice} 0.007422471 0.1763285 0.042094560 2
## [261] {fruit/vegetable juice} => {white bread}        0.007422471 0.1026723 0.072292832 2
## [262] {white bread}         => {whipped/sour cream} 0.005490595 0.1304348 0.042094560 1
## [263] {white bread}         => {pip fruit}          0.006609049 0.1570048 0.042094560 2
## [264] {white bread}         => {pastry}             0.005592272 0.1328502 0.042094560 1

```

| | | | | | | |
|----------|-------------------------|----------------------------|-------------|-----------|-------------|---|
| ## [265] | {white bread} | => {shopping bags} | 0.007422471 | 0.1763285 | 0.042094560 | 1 |
| ## [266] | {white bread} | => {sausage} | 0.007219115 | 0.1714976 | 0.042094560 | 1 |
| ## [267] | {white bread} | => {tropical fruit} | 0.008744281 | 0.2077295 | 0.042094560 | 1 |
| ## [268] | {white bread} | => {root vegetables} | 0.007930859 | 0.1884058 | 0.042094560 | 1 |
| ## [269] | {white bread} | => {soda} | 0.010269446 | 0.2439614 | 0.042094560 | 1 |
| ## [270] | {white bread} | => {yogurt} | 0.009049314 | 0.2149758 | 0.042094560 | 1 |
| ## [271] | {white bread} | => {rolls/buns} | 0.006507372 | 0.1545894 | 0.042094560 | 0 |
| ## [272] | {white bread} | => {other vegetables} | 0.013726487 | 0.3260870 | 0.042094560 | 1 |
| ## [273] | {white bread} | => {whole milk} | 0.017081851 | 0.4057971 | 0.042094560 | 1 |
| ## [274] | {chocolate} | => {butter} | 0.006202339 | 0.1250000 | 0.049618709 | 2 |
| ## [275] | {butter} | => {chocolate} | 0.006202339 | 0.1119266 | 0.055414337 | 2 |
| ## [276] | {chocolate} | => {newspapers} | 0.005490595 | 0.1106557 | 0.049618709 | 1 |
| ## [277] | {chocolate} | => {fruit/vegetable juice} | 0.006812405 | 0.1372951 | 0.049618709 | 1 |
| ## [278] | {chocolate} | => {pip fruit} | 0.006100661 | 0.1229508 | 0.049618709 | 1 |
| ## [279] | {chocolate} | => {pastry} | 0.008032537 | 0.1618852 | 0.049618709 | 1 |
| ## [280] | {chocolate} | => {citrus fruit} | 0.006405694 | 0.1290984 | 0.049618709 | 1 |
| ## [281] | {chocolate} | => {shopping bags} | 0.008134215 | 0.1639344 | 0.049618709 | 1 |
| ## [282] | {chocolate} | => {sausage} | 0.006609049 | 0.1331967 | 0.049618709 | 1 |
| ## [283] | {chocolate} | => {bottled water} | 0.005795628 | 0.1168033 | 0.049618709 | 1 |
| ## [284] | {chocolate} | => {tropical fruit} | 0.008134215 | 0.1639344 | 0.049618709 | 1 |
| ## [285] | {chocolate} | => {root vegetables} | 0.006405694 | 0.1290984 | 0.049618709 | 1 |
| ## [286] | {chocolate} | => {soda} | 0.013523132 | 0.2725410 | 0.049618709 | 1 |
| ## [287] | {chocolate} | => {yogurt} | 0.009252669 | 0.1864754 | 0.049618709 | 1 |
| ## [288] | {chocolate} | => {rolls/buns} | 0.011794611 | 0.2377049 | 0.049618709 | 1 |
| ## [289] | {chocolate} | => {other vegetables} | 0.012709710 | 0.2561475 | 0.049618709 | 1 |
| ## [290] | {chocolate} | => {whole milk} | 0.016675140 | 0.3360656 | 0.049618709 | 1 |
| ## [291] | {coffee} | => {fruit/vegetable juice} | 0.005998983 | 0.1033275 | 0.058057956 | 1 |
| ## [292] | {coffee} | => {whipped/sour cream} | 0.006100661 | 0.1050788 | 0.058057956 | 1 |
| ## [293] | {coffee} | => {pip fruit} | 0.006914082 | 0.1190893 | 0.058057956 | 1 |
| ## [294] | {coffee} | => {pastry} | 0.006914082 | 0.1190893 | 0.058057956 | 1 |
| ## [295] | {coffee} | => {citrus fruit} | 0.006405694 | 0.1103327 | 0.058057956 | 1 |
| ## [296] | {coffee} | => {shopping bags} | 0.009354347 | 0.1611208 | 0.058057956 | 1 |
| ## [297] | {coffee} | => {sausage} | 0.006914082 | 0.1190893 | 0.058057956 | 1 |
| ## [298] | {coffee} | => {bottled water} | 0.007320793 | 0.1260946 | 0.058057956 | 1 |
| ## [299] | {coffee} | => {tropical fruit} | 0.007117438 | 0.1225919 | 0.058057956 | 1 |
| ## [300] | {coffee} | => {root vegetables} | 0.007320793 | 0.1260946 | 0.058057956 | 1 |
| ## [301] | {coffee} | => {soda} | 0.009964413 | 0.1716287 | 0.058057956 | 0 |
| ## [302] | {coffee} | => {yogurt} | 0.009761057 | 0.1681261 | 0.058057956 | 1 |
| ## [303] | {coffee} | => {rolls/buns} | 0.010981190 | 0.1891419 | 0.058057956 | 1 |
| ## [304] | {coffee} | => {other vegetables} | 0.013421454 | 0.2311734 | 0.058057956 | 1 |
| ## [305] | {coffee} | => {whole milk} | 0.018708693 | 0.3222417 | 0.058057956 | 1 |
| ## [306] | {frozen vegetables} | => {pork} | 0.006405694 | 0.1331924 | 0.048093543 | 2 |
| ## [307] | {pork} | => {frozen vegetables} | 0.006405694 | 0.1111111 | 0.057651246 | 2 |
| ## [308] | {frozen vegetables} | => {frankfurter} | 0.005083884 | 0.1057082 | 0.048093543 | 1 |
| ## [309] | {frozen vegetables} | => {margarine} | 0.005083884 | 0.1057082 | 0.048093543 | 1 |
| ## [310] | {frozen vegetables} | => {butter} | 0.005795628 | 0.1205074 | 0.048093543 | 2 |
| ## [311] | {butter} | => {frozen vegetables} | 0.005795628 | 0.1045872 | 0.055414337 | 2 |
| ## [312] | {frozen vegetables} | => {domestic eggs} | 0.005185562 | 0.1078224 | 0.048093543 | 1 |
| ## [313] | {frozen vegetables} | => {fruit/vegetable juice} | 0.007829181 | 0.1627907 | 0.048093543 | 2 |
| ## [314] | {fruit/vegetable juice} | => {frozen vegetables} | 0.007829181 | 0.1082982 | 0.072292832 | 2 |
| ## [315] | {frozen vegetables} | => {whipped/sour cream} | 0.007930859 | 0.1649049 | 0.048093543 | 2 |
| ## [316] | {whipped/sour cream} | => {frozen vegetables} | 0.007930859 | 0.1106383 | 0.071682766 | 2 |
| ## [317] | {frozen vegetables} | => {pip fruit} | 0.007320793 | 0.1522199 | 0.048093543 | 2 |
| ## [318] | {frozen vegetables} | => {citrus fruit} | 0.006609049 | 0.1374207 | 0.048093543 | 1 |

| | | | | | | |
|----------|----------------------|-------------------------|-------------|-----------|-------------|---|
| ## [319] | {frozen vegetables} | => {sausage} | 0.005998983 | 0.1247357 | 0.048093543 | 1 |
| ## [320] | {frozen vegetables} | => {bottled water} | 0.006202339 | 0.1289641 | 0.048093543 | 1 |
| ## [321] | {frozen vegetables} | => {tropical fruit} | 0.008744281 | 0.1818182 | 0.048093543 | 1 |
| ## [322] | {frozen vegetables} | => {root vegetables} | 0.011591256 | 0.2410148 | 0.048093543 | 2 |
| ## [323] | {root vegetables} | => {frozen vegetables} | 0.011591256 | 0.1063433 | 0.108998475 | 2 |
| ## [324] | {frozen vegetables} | => {soda} | 0.008642603 | 0.1797040 | 0.048093543 | 1 |
| ## [325] | {frozen vegetables} | => {yogurt} | 0.012404677 | 0.2579281 | 0.048093543 | 1 |
| ## [326] | {frozen vegetables} | => {rolls/buns} | 0.010167768 | 0.2114165 | 0.048093543 | 1 |
| ## [327] | {frozen vegetables} | => {other vegetables} | 0.017793594 | 0.3699789 | 0.048093543 | 1 |
| ## [328] | {frozen vegetables} | => {whole milk} | 0.020437214 | 0.4249471 | 0.048093543 | 1 |
| ## [329] | {beef} | => {pork} | 0.007625826 | 0.1453488 | 0.052465684 | 2 |
| ## [330] | {pork} | => {beef} | 0.007625826 | 0.1322751 | 0.057651246 | 2 |
| ## [331] | {beef} | => {margarine} | 0.006202339 | 0.1182171 | 0.052465684 | 2 |
| ## [332] | {margarine} | => {beef} | 0.006202339 | 0.1059028 | 0.058566345 | 2 |
| ## [333] | {beef} | => {butter} | 0.005795628 | 0.1104651 | 0.052465684 | 1 |
| ## [334] | {butter} | => {beef} | 0.005795628 | 0.1045872 | 0.055414337 | 1 |
| ## [335] | {beef} | => {newspapers} | 0.006405694 | 0.1220930 | 0.052465684 | 1 |
| ## [336] | {beef} | => {domestic eggs} | 0.005998983 | 0.1143411 | 0.052465684 | 1 |
| ## [337] | {beef} | => {whipped/sour cream} | 0.006710727 | 0.1279070 | 0.052465684 | 1 |
| ## [338] | {beef} | => {pastry} | 0.006304016 | 0.1201550 | 0.052465684 | 1 |
| ## [339] | {beef} | => {citrus fruit} | 0.008439248 | 0.1608527 | 0.052465684 | 1 |
| ## [340] | {citrus fruit} | => {beef} | 0.008439248 | 0.1019656 | 0.082765633 | 1 |
| ## [341] | {beef} | => {sausage} | 0.005592272 | 0.1065891 | 0.052465684 | 1 |
| ## [342] | {beef} | => {bottled water} | 0.006202339 | 0.1182171 | 0.052465684 | 1 |
| ## [343] | {beef} | => {tropical fruit} | 0.007625826 | 0.1453488 | 0.052465684 | 1 |
| ## [344] | {beef} | => {root vegetables} | 0.017386884 | 0.3313953 | 0.052465684 | 3 |
| ## [345] | {root vegetables} | => {beef} | 0.017386884 | 0.1595149 | 0.108998475 | 3 |
| ## [346] | {beef} | => {soda} | 0.008134215 | 0.1550388 | 0.052465684 | 0 |
| ## [347] | {beef} | => {yogurt} | 0.011692933 | 0.2228682 | 0.052465684 | 1 |
| ## [348] | {beef} | => {rolls/buns} | 0.013624809 | 0.2596899 | 0.052465684 | 1 |
| ## [349] | {beef} | => {other vegetables} | 0.019725470 | 0.3759690 | 0.052465684 | 1 |
| ## [350] | {other vegetables} | => {beef} | 0.019725470 | 0.1019443 | 0.193492628 | 1 |
| ## [351] | {beef} | => {whole milk} | 0.021250635 | 0.4050388 | 0.052465684 | 1 |
| ## [352] | {curd} | => {margarine} | 0.006304016 | 0.1183206 | 0.053279105 | 2 |
| ## [353] | {margarine} | => {curd} | 0.006304016 | 0.1076389 | 0.058566345 | 2 |
| ## [354] | {curd} | => {butter} | 0.006812405 | 0.1278626 | 0.053279105 | 2 |
| ## [355] | {butter} | => {curd} | 0.006812405 | 0.1229358 | 0.055414337 | 2 |
| ## [356] | {curd} | => {newspapers} | 0.005693950 | 0.1068702 | 0.053279105 | 1 |
| ## [357] | {curd} | => {domestic eggs} | 0.006507372 | 0.1221374 | 0.053279105 | 1 |
| ## [358] | {domestic eggs} | => {curd} | 0.006507372 | 0.1025641 | 0.063446873 | 1 |
| ## [359] | {curd} | => {whipped/sour cream} | 0.010472801 | 0.1965649 | 0.053279105 | 2 |
| ## [360] | {whipped/sour cream} | => {curd} | 0.010472801 | 0.1460993 | 0.071682766 | 2 |
| ## [361] | {curd} | => {pip fruit} | 0.007829181 | 0.1469466 | 0.053279105 | 1 |
| ## [362] | {pip fruit} | => {curd} | 0.007829181 | 0.1034946 | 0.075648195 | 1 |
| ## [363] | {curd} | => {pastry} | 0.007524148 | 0.1412214 | 0.053279105 | 1 |
| ## [364] | {curd} | => {citrus fruit} | 0.007117438 | 0.1335878 | 0.053279105 | 1 |
| ## [365] | {curd} | => {shopping bags} | 0.005388917 | 0.1011450 | 0.053279105 | 1 |
| ## [366] | {curd} | => {sausage} | 0.007625826 | 0.1431298 | 0.053279105 | 1 |
| ## [367] | {curd} | => {bottled water} | 0.006100661 | 0.1145038 | 0.053279105 | 1 |
| ## [368] | {curd} | => {tropical fruit} | 0.010269446 | 0.1927481 | 0.053279105 | 1 |
| ## [369] | {curd} | => {root vegetables} | 0.010879512 | 0.2041985 | 0.053279105 | 1 |
| ## [370] | {curd} | => {soda} | 0.008134215 | 0.1526718 | 0.053279105 | 0 |
| ## [371] | {curd} | => {yogurt} | 0.017285206 | 0.3244275 | 0.053279105 | 2 |
| ## [372] | {yogurt} | => {curd} | 0.017285206 | 0.1239067 | 0.139501779 | 2 |

| | | | | | | |
|----------|----------------------|----------------------------|-------------|-----------|-------------|---|
| ## [373] | {curd} | => {rolls/buns} | 0.010066090 | 0.1889313 | 0.053279105 | 1 |
| ## [374] | {curd} | => {other vegetables} | 0.017183528 | 0.3225191 | 0.053279105 | 1 |
| ## [375] | {curd} | => {whole milk} | 0.026131164 | 0.4904580 | 0.053279105 | 1 |
| ## [376] | {whole milk} | => {curd} | 0.026131164 | 0.1022682 | 0.255516014 | 1 |
| ## [377] | {napkins} | => {newspapers} | 0.006202339 | 0.1184466 | 0.052364006 | 1 |
| ## [378] | {napkins} | => {domestic eggs} | 0.005998983 | 0.1145631 | 0.052364006 | 1 |
| ## [379] | {napkins} | => {fruit/vegetable juice} | 0.006914082 | 0.1320388 | 0.052364006 | 1 |
| ## [380] | {napkins} | => {whipped/sour cream} | 0.007219115 | 0.1378641 | 0.052364006 | 1 |
| ## [381] | {whipped/sour cream} | => {napkins} | 0.007219115 | 0.1007092 | 0.071682766 | 1 |
| ## [382] | {napkins} | => {pip fruit} | 0.006710727 | 0.1281553 | 0.052364006 | 1 |
| ## [383] | {napkins} | => {pastry} | 0.007015760 | 0.1339806 | 0.052364006 | 1 |
| ## [384] | {napkins} | => {citrus fruit} | 0.007625826 | 0.1456311 | 0.052364006 | 1 |
| ## [385] | {napkins} | => {shopping bags} | 0.007219115 | 0.1378641 | 0.052364006 | 1 |
| ## [386] | {napkins} | => {sausage} | 0.006710727 | 0.1281553 | 0.052364006 | 1 |
| ## [387] | {napkins} | => {bottled water} | 0.008642603 | 0.1650485 | 0.052364006 | 1 |
| ## [388] | {napkins} | => {tropical fruit} | 0.010066090 | 0.1922330 | 0.052364006 | 1 |
| ## [389] | {napkins} | => {root vegetables} | 0.009964413 | 0.1902913 | 0.052364006 | 1 |
| ## [390] | {napkins} | => {soda} | 0.011997966 | 0.2291262 | 0.052364006 | 1 |
| ## [391] | {napkins} | => {yogurt} | 0.012302999 | 0.2349515 | 0.052364006 | 1 |
| ## [392] | {napkins} | => {rolls/buns} | 0.011692933 | 0.2233010 | 0.052364006 | 1 |
| ## [393] | {napkins} | => {other vegetables} | 0.014438231 | 0.2757282 | 0.052364006 | 1 |
| ## [394] | {napkins} | => {whole milk} | 0.019725470 | 0.3766990 | 0.052364006 | 1 |
| ## [395] | {pork} | => {frankfurter} | 0.005897306 | 0.1022928 | 0.057651246 | 1 |
| ## [396] | {frankfurter} | => {pork} | 0.005897306 | 0.1000000 | 0.058973055 | 1 |
| ## [397] | {pork} | => {margarine} | 0.006405694 | 0.1111111 | 0.057651246 | 1 |
| ## [398] | {margarine} | => {pork} | 0.006405694 | 0.1093750 | 0.058566345 | 1 |
| ## [399] | {pork} | => {newspapers} | 0.006609049 | 0.1146384 | 0.057651246 | 1 |
| ## [400] | {pork} | => {whipped/sour cream} | 0.008235892 | 0.1428571 | 0.057651246 | 1 |
| ## [401] | {whipped/sour cream} | => {pork} | 0.008235892 | 0.1148936 | 0.071682766 | 1 |
| ## [402] | {pork} | => {pip fruit} | 0.006100661 | 0.1058201 | 0.057651246 | 1 |
| ## [403] | {pork} | => {pastry} | 0.006304016 | 0.1093474 | 0.057651246 | 1 |
| ## [404] | {pork} | => {citrus fruit} | 0.006507372 | 0.1128748 | 0.057651246 | 1 |
| ## [405] | {pork} | => {shopping bags} | 0.006405694 | 0.1111111 | 0.057651246 | 1 |
| ## [406] | {pork} | => {sausage} | 0.006507372 | 0.1128748 | 0.057651246 | 1 |
| ## [407] | {pork} | => {bottled water} | 0.007422471 | 0.1287478 | 0.057651246 | 1 |
| ## [408] | {pork} | => {tropical fruit} | 0.008540925 | 0.1481481 | 0.057651246 | 1 |
| ## [409] | {pork} | => {root vegetables} | 0.013624809 | 0.2363316 | 0.057651246 | 2 |
| ## [410] | {root vegetables} | => {pork} | 0.013624809 | 0.1250000 | 0.108998475 | 2 |
| ## [411] | {pork} | => {soda} | 0.011896289 | 0.2063492 | 0.057651246 | 1 |
| ## [412] | {pork} | => {yogurt} | 0.009557702 | 0.1657848 | 0.057651246 | 1 |
| ## [413] | {pork} | => {rolls/buns} | 0.011286223 | 0.1957672 | 0.057651246 | 1 |
| ## [414] | {pork} | => {other vegetables} | 0.021657346 | 0.3756614 | 0.057651246 | 1 |
| ## [415] | {other vegetables} | => {pork} | 0.021657346 | 0.1119285 | 0.193492628 | 1 |
| ## [416] | {pork} | => {whole milk} | 0.022165735 | 0.3844797 | 0.057651246 | 1 |
| ## [417] | {frankfurter} | => {brown bread} | 0.007117438 | 0.1206897 | 0.058973055 | 1 |
| ## [418] | {brown bread} | => {frankfurter} | 0.007117438 | 0.1097179 | 0.064870361 | 1 |
| ## [419] | {frankfurter} | => {margarine} | 0.006405694 | 0.1086207 | 0.058973055 | 1 |
| ## [420] | {margarine} | => {frankfurter} | 0.006405694 | 0.1093750 | 0.058566345 | 1 |
| ## [421] | {frankfurter} | => {domestic eggs} | 0.007015760 | 0.1189655 | 0.058973055 | 1 |
| ## [422] | {domestic eggs} | => {frankfurter} | 0.007015760 | 0.1105769 | 0.063446873 | 1 |
| ## [423] | {frankfurter} | => {whipped/sour cream} | 0.006202339 | 0.1051724 | 0.058973055 | 1 |
| ## [424] | {frankfurter} | => {pip fruit} | 0.007219115 | 0.1224138 | 0.058973055 | 1 |
| ## [425] | {frankfurter} | => {pastry} | 0.008337570 | 0.1413793 | 0.058973055 | 1 |
| ## [426] | {frankfurter} | => {citrus fruit} | 0.006507372 | 0.1103448 | 0.058973055 | 1 |

```

## [427] {frankfurter} => {shopping bags} 0.008235892 0.1396552 0.058973055 1
## [428] {frankfurter} => {sausage} 0.010066090 0.1706897 0.058973055 1
## [429] {sausage} => {frankfurter} 0.010066090 0.1071429 0.093950178 1
## [430] {frankfurter} => {bottled water} 0.007320793 0.1241379 0.058973055 1
## [431] {frankfurter} => {tropical fruit} 0.009456024 0.1603448 0.058973055 1
## [432] {frankfurter} => {root vegetables} 0.010167768 0.1724138 0.058973055 1
## [433] {frankfurter} => {soda} 0.011286223 0.1913793 0.058973055 1
## [434] {frankfurter} => {yogurt} 0.011184545 0.1896552 0.058973055 1
## [435] {frankfurter} => {rolls/buns} 0.019217082 0.3258621 0.058973055 1
## [436] {rolls/buns} => {frankfurter} 0.019217082 0.1044776 0.183934926 1
## [437] {frankfurter} => {other vegetables} 0.016471784 0.2793103 0.058973055 1
## [438] {frankfurter} => {whole milk} 0.020538892 0.3482759 0.058973055 1
## [439] {margarine} => {bottled beer} 0.006100661 0.1041667 0.058566345 1
## [440] {butter} => {bottled beer} 0.005795628 0.1045872 0.055414337 1
## [441] {bottled beer} => {bottled water} 0.015760041 0.1957071 0.080528724 1
## [442] {bottled water} => {bottled beer} 0.015760041 0.1425943 0.110523640 1
## [443] {bottled beer} => {tropical fruit} 0.008235892 0.1022727 0.080528724 0
## [444] {bottled beer} => {root vegetables} 0.009659380 0.1199495 0.080528724 1
## [445] {bottled beer} => {soda} 0.016980173 0.2108586 0.080528724 1
## [446] {bottled beer} => {yogurt} 0.009252669 0.1148990 0.080528724 0
## [447] {bottled beer} => {rolls/buns} 0.013624809 0.1691919 0.080528724 0
## [448] {bottled beer} => {other vegetables} 0.016166751 0.2007576 0.080528724 1
## [449] {bottled beer} => {whole milk} 0.020437214 0.2537879 0.080528724 0
## [450] {brown bread} => {margarine} 0.006507372 0.1003135 0.064870361 1
## [451] {margarine} => {brown bread} 0.006507372 0.1111111 0.058566345 1
## [452] {butter} => {brown bread} 0.005795628 0.1045872 0.055414337 1
## [453] {brown bread} => {newspapers} 0.007625826 0.1175549 0.064870361 1
## [454] {brown bread} => {domestic eggs} 0.006812405 0.1050157 0.064870361 1
## [455] {domestic eggs} => {brown bread} 0.006812405 0.1073718 0.063446873 1
## [456] {brown bread} => {fruit/vegetable juice} 0.008337570 0.1285266 0.064870361 1
## [457] {fruit/vegetable juice} => {brown bread} 0.008337570 0.1153305 0.072292832 1
## [458] {brown bread} => {pip fruit} 0.007625826 0.1175549 0.064870361 1
## [459] {pip fruit} => {brown bread} 0.007625826 0.1008065 0.075648195 1
## [460] {brown bread} => {pastry} 0.009659380 0.1489028 0.064870361 1
## [461] {pastry} => {brown bread} 0.009659380 0.1085714 0.088967972 1
## [462] {brown bread} => {citrus fruit} 0.008337570 0.1285266 0.064870361 1
## [463] {citrus fruit} => {brown bread} 0.008337570 0.1007371 0.082765633 1
## [464] {brown bread} => {shopping bags} 0.009252669 0.1426332 0.064870361 1
## [465] {brown bread} => {sausage} 0.010676157 0.1645768 0.064870361 1
## [466] {sausage} => {brown bread} 0.010676157 0.1136364 0.093950178 1
## [467] {brown bread} => {bottled water} 0.008235892 0.1269592 0.064870361 1
## [468] {brown bread} => {tropical fruit} 0.010676157 0.1645768 0.064870361 1
## [469] {tropical fruit} => {brown bread} 0.010676157 0.1017442 0.104931368 1
## [470] {brown bread} => {root vegetables} 0.010167768 0.1567398 0.064870361 1
## [471] {brown bread} => {soda} 0.012608033 0.1943574 0.064870361 1
## [472] {brown bread} => {yogurt} 0.014539908 0.2241379 0.064870361 1
## [473] {yogurt} => {brown bread} 0.014539908 0.1042274 0.139501779 1
## [474] {brown bread} => {rolls/buns} 0.012608033 0.1943574 0.064870361 1
## [475] {brown bread} => {other vegetables} 0.018708693 0.2884013 0.064870361 1
## [476] {brown bread} => {whole milk} 0.025216065 0.3887147 0.064870361 1
## [477] {margarine} => {butter} 0.006710727 0.1145833 0.058566345 2
## [478] {butter} => {margarine} 0.006710727 0.1211009 0.055414337 2
## [479] {margarine} => {newspapers} 0.007117438 0.1215278 0.058566345 1
## [480] {margarine} => {domestic eggs} 0.008337570 0.1423611 0.058566345 2

```

```

## [481] {domestic eggs}          => {margarine}           0.008337570 0.1314103 0.063446873 2
## [482] {margarine}            => {fruit/vegetable juice} 0.006202339 0.1059028 0.058566345 1
## [483] {margarine}            => {whipped/sour cream} 0.006812405 0.1163194 0.058566345 1
## [484] {margarine}            => {pip fruit}           0.008540925 0.1458333 0.058566345 1
## [485] {pip fruit}             => {margarine}           0.008540925 0.1129032 0.075648195 1
## [486] {margarine}            => {pastry}              0.006812405 0.1163194 0.058566345 1
## [487] {margarine}            => {citrus fruit}        0.007930859 0.1354167 0.058566345 1
## [488] {margarine}            => {sausage}             0.007117438 0.1215278 0.058566345 1
## [489] {margarine}            => {bottled water}       0.010269446 0.1753472 0.058566345 1
## [490] {margarine}            => {tropical fruit}     0.009354347 0.1597222 0.058566345 1
## [491] {margarine}            => {root vegetables}    0.011082867 0.1892361 0.058566345 1
## [492] {root vegetables}      => {margarine}           0.011082867 0.1016791 0.108998475 1
## [493] {margarine}            => {soda}                0.010167768 0.1736111 0.058566345 0
## [494] {margarine}            => {yogurt}              0.014234875 0.2430556 0.058566345 1
## [495] {yogurt}               => {margarine}           0.014234875 0.1020408 0.139501779 1
## [496] {margarine}            => {rolls/buns}         0.014743264 0.2517361 0.058566345 1
## [497] {margarine}            => {other vegetables}  0.019725470 0.3368056 0.058566345 1
## [498] {other vegetables}    => {margarine}           0.019725470 0.1019443 0.193492628 1
## [499] {margarine}            => {whole milk}          0.024199288 0.4131944 0.058566345 1
## [500] {butter}               => {newspapers}          0.005795628 0.1045872 0.055414337 1
## [501] {butter}               => {domestic eggs}       0.009659380 0.1743119 0.055414337 2
## [502] {domestic eggs}        => {butter}              0.009659380 0.1522436 0.063446873 2
## [503] {butter}               => {fruit/vegetable juice} 0.008032537 0.1449541 0.055414337 2
## [504] {fruit/vegetable juice}=> {butter}              0.008032537 0.1111111 0.072292832 2
## [505] {butter}               => {whipped/sour cream} 0.010167768 0.1834862 0.055414337 2
## [506] {whipped/sour cream}   => {butter}              0.010167768 0.1418440 0.071682766 2
## [507] {butter}               => {pip fruit}           0.007320793 0.1321101 0.055414337 1
## [508] {butter}               => {pastry}              0.007625826 0.1376147 0.055414337 1
## [509] {butter}               => {citrus fruit}        0.009150991 0.1651376 0.055414337 1
## [510] {citrus fruit}         => {butter}              0.009150991 0.1105651 0.082765633 1
## [511] {butter}               => {sausage}             0.008642603 0.1559633 0.055414337 1
## [512] {butter}               => {bottled water}       0.008947636 0.1614679 0.055414337 1
## [513] {butter}               => {tropical fruit}     0.009964413 0.1798165 0.055414337 1
## [514] {butter}               => {root vegetables}    0.012913066 0.2330275 0.055414337 2
## [515] {root vegetables}     => {butter}              0.012913066 0.1184701 0.108998475 2
## [516] {butter}               => {soda}                0.008845958 0.1596330 0.055414337 0
## [517] {butter}               => {yogurt}              0.014641586 0.2642202 0.055414337 1
## [518] {yogurt}               => {butter}              0.014641586 0.1049563 0.139501779 1
## [519] {butter}               => {rolls/buns}         0.013421454 0.2422018 0.055414337 1
## [520] {butter}               => {other vegetables}  0.020030503 0.3614679 0.055414337 1
## [521] {other vegetables}    => {butter}              0.020030503 0.1035208 0.193492628 1
## [522] {butter}               => {whole milk}          0.027554652 0.4972477 0.055414337 1
## [523] {whole milk}           => {butter}              0.027554652 0.1078392 0.255516014 1
## [524] {domestic eggs}        => {newspapers}          0.006914082 0.1089744 0.063446873 1
## [525] {newspapers}           => {fruit/vegetable juice} 0.008235892 0.1031847 0.079816980 1
## [526] {fruit/vegetable juice}=> {newspapers}          0.008235892 0.1139241 0.072292832 1
## [527] {whipped/sour cream}   => {newspapers}          0.007219115 0.1007092 0.071682766 1
## [528] {newspapers}           => {pastry}              0.008439248 0.1057325 0.079816980 1
## [529] {newspapers}           => {citrus fruit}        0.008337570 0.1044586 0.079816980 1
## [530] {citrus fruit}         => {newspapers}          0.008337570 0.1007371 0.082765633 1
## [531] {newspapers}           => {sausage}             0.008032537 0.1006369 0.079816980 1
## [532] {newspapers}           => {bottled water}       0.011286223 0.1414013 0.079816980 1
## [533] {bottled water}        => {newspapers}          0.011286223 0.1021159 0.110523640 1
## [534] {newspapers}           => {tropical fruit}     0.011794611 0.1477707 0.079816980 1

```

```

## [535] {tropical fruit}          => {newspapers}           0.011794611 0.1124031 0.104931368 1
## [536] {newspapers}            => {root vegetables}    0.011489578 0.1439490 0.079816980 1
## [537] {root vegetables}       => {newspapers}           0.011489578 0.1054104 0.108998475 1
## [538] {newspapers}            => {soda}                 0.014641586 0.1834395 0.079816980 1
## [539] {newspapers}            => {yogurt}                0.015353330 0.1923567 0.079816980 1
## [540] {yogurt}                 => {newspapers}           0.015353330 0.1100583 0.139501779 1
## [541] {newspapers}            => {rolls/buns}          0.019725470 0.2471338 0.079816980 1
## [542] {rolls/buns}            => {newspapers}           0.019725470 0.1072416 0.183934926 1
## [543] {newspapers}            => {other vegetables}   0.019318760 0.2420382 0.079816980 1
## [544] {newspapers}            => {whole milk}          0.027351296 0.3426752 0.079816980 1
## [545] {whole milk}             => {newspapers}           0.027351296 0.1070434 0.255516014 1
## [546] {domestic eggs}         => {fruit/vegetable juice} 0.008032537 0.1266026 0.063446873 1
## [547] {fruit/vegetable juice} => {domestic eggs}        0.008032537 0.1111111 0.072292832 1
## [548] {domestic eggs}         => {whipped/sour cream} 0.009964413 0.1570513 0.063446873 2
## [549] {whipped/sour cream}    => {domestic eggs}        0.009964413 0.1390071 0.071682766 2
## [550] {domestic eggs}         => {pip fruit}           0.008642603 0.1362179 0.063446873 1
## [551] {pip fruit}              => {domestic eggs}        0.008642603 0.1142473 0.075648195 1
## [552] {domestic eggs}         => {pastry}               0.009049314 0.1426282 0.063446873 1
## [553] {pastry}                 => {domestic eggs}        0.009049314 0.1017143 0.088967972 1
## [554] {domestic eggs}         => {citrus fruit}         0.010371124 0.1634615 0.063446873 1
## [555] {citrus fruit}           => {domestic eggs}        0.010371124 0.1253071 0.082765633 1
## [556] {domestic eggs}         => {shopping bags}        0.009049314 0.1426282 0.063446873 1
## [557] {domestic eggs}         => {sausage}              0.009557702 0.1506410 0.063446873 1
## [558] {sausage}                => {domestic eggs}        0.009557702 0.1017316 0.093950178 1
## [559] {domestic eggs}         => {bottled water}         0.009150991 0.1442308 0.063446873 1
## [560] {domestic eggs}         => {tropical fruit}        0.011387900 0.1794872 0.063446873 1
## [561] {tropical fruit}         => {domestic eggs}        0.011387900 0.1085271 0.104931368 1
## [562] {domestic eggs}         => {root vegetables}      0.014336553 0.2259615 0.063446873 2
## [563] {root vegetables}       => {domestic eggs}        0.014336553 0.1315299 0.108998475 2
## [564] {domestic eggs}         => {soda}                 0.012404677 0.1955128 0.063446873 1
## [565] {domestic eggs}         => {yogurt}                0.014336553 0.2259615 0.063446873 1
## [566] {yogurt}                  => {domestic eggs}        0.014336553 0.1027697 0.139501779 1
## [567] {domestic eggs}         => {rolls/buns}          0.015658363 0.2467949 0.063446873 1
## [568] {domestic eggs}         => {other vegetables}    0.022267412 0.3509615 0.063446873 1
## [569] {other vegetables}      => {domestic eggs}        0.022267412 0.1150815 0.193492628 1
## [570] {domestic eggs}         => {whole milk}           0.029994916 0.4727564 0.063446873 1
## [571] {whole milk}              => {domestic eggs}        0.029994916 0.1173896 0.255516014 1
## [572] {fruit/vegetable juice} => {whipped/sour cream} 0.009049314 0.1251758 0.072292832 1
## [573] {whipped/sour cream}    => {fruit/vegetable juice} 0.009049314 0.1262411 0.071682766 1
## [574] {fruit/vegetable juice}  => {pip fruit}            0.009557702 0.1322082 0.072292832 1
## [575] {pip fruit}                => {fruit/vegetable juice} 0.009557702 0.1263441 0.075648195 1
## [576] {fruit/vegetable juice}  => {pastry}               0.008540925 0.1181435 0.072292832 1
## [577] {fruit/vegetable juice}  => {citrus fruit}          0.010371124 0.1434599 0.072292832 1
## [578] {citrus fruit}             => {fruit/vegetable juice} 0.010371124 0.1253071 0.082765633 1
## [579] {fruit/vegetable juice}  => {shopping bags}        0.010676157 0.1476793 0.072292832 1
## [580] {shopping bags}           => {fruit/vegetable juice} 0.010676157 0.1083591 0.098525674 1
## [581] {fruit/vegetable juice}  => {sausage}              0.010066090 0.1392405 0.072292832 1
## [582] {sausage}                  => {fruit/vegetable juice} 0.010066090 0.1071429 0.093950178 1
## [583] {fruit/vegetable juice}  => {bottled water}          0.014234875 0.1969058 0.072292832 1
## [584] {bottled water}             => {fruit/vegetable juice} 0.014234875 0.1287948 0.110523640 1
## [585] {fruit/vegetable juice}  => {tropical fruit}        0.013726487 0.1898734 0.072292832 1
## [586] {tropical fruit}           => {fruit/vegetable juice} 0.013726487 0.1308140 0.104931368 1
## [587] {fruit/vegetable juice}  => {root vegetables}      0.011997966 0.1659634 0.072292832 1
## [588] {root vegetables}         => {fruit/vegetable juice} 0.011997966 0.1100746 0.108998475 1

```

```

## [589] {fruit/vegetable juice} => {soda} 0.018403660 0.2545710 0.072292832 1
## [590] {soda} => {fruit/vegetable juice} 0.018403660 0.1055394 0.174377224 1
## [591] {fruit/vegetable juice} => {yogurt} 0.018708693 0.2587904 0.072292832 1
## [592] {yogurt} => {fruit/vegetable juice} 0.018708693 0.1341108 0.139501779 1
## [593] {fruit/vegetable juice} => {rolls/buns} 0.014539908 0.2011252 0.072292832 1
## [594] {fruit/vegetable juice} => {other vegetables} 0.021047280 0.2911392 0.072292832 1
## [595] {other vegetables} => {fruit/vegetable juice} 0.021047280 0.1087756 0.193492628 1
## [596] {fruit/vegetable juice} => {whole milk} 0.026639553 0.3684951 0.072292832 1
## [597] {whole milk} => {fruit/vegetable juice} 0.026639553 0.1042579 0.255516014 1
## [598] {whipped/sour cream} => {pip fruit} 0.009252669 0.1290780 0.071682766 1
## [599] {pip fruit} => {whipped/sour cream} 0.009252669 0.1223118 0.075648195 1
## [600] {whipped/sour cream} => {pastry} 0.007524148 0.1049645 0.071682766 1
## [601] {whipped/sour cream} => {citrus fruit} 0.010879512 0.1517730 0.071682766 1
## [602] {citrus fruit} => {whipped/sour cream} 0.010879512 0.1314496 0.082765633 1
## [603] {whipped/sour cream} => {shopping bags} 0.007930859 0.1106383 0.071682766 1
## [604] {whipped/sour cream} => {sausage} 0.009049314 0.1262411 0.071682766 1
## [605] {whipped/sour cream} => {bottled water} 0.008744281 0.1219858 0.071682766 1
## [606] {whipped/sour cream} => {tropical fruit} 0.013828165 0.1929078 0.071682766 1
## [607] {tropical fruit} => {whipped/sour cream} 0.013828165 0.1317829 0.104931368 1
## [608] {whipped/sour cream} => {root vegetables} 0.017081851 0.2382979 0.071682766 2
## [609] {root vegetables} => {whipped/sour cream} 0.017081851 0.1567164 0.108998475 2
## [610] {whipped/sour cream} => {soda} 0.011591256 0.1617021 0.071682766 0
## [611] {whipped/sour cream} => {yogurt} 0.020742247 0.2893617 0.071682766 2
## [612] {yogurt} => {whipped/sour cream} 0.020742247 0.1486880 0.139501779 2
## [613] {whipped/sour cream} => {rolls/buns} 0.014641586 0.2042553 0.071682766 1
## [614] {whipped/sour cream} => {other vegetables} 0.028876462 0.4028369 0.071682766 2
## [615] {other vegetables} => {whipped/sour cream} 0.028876462 0.1492380 0.193492628 2
## [616] {whipped/sour cream} => {whole milk} 0.032231825 0.4496454 0.071682766 1
## [617] {whole milk} => {whipped/sour cream} 0.032231825 0.1261441 0.255516014 1
## [618] {pip fruit} => {pastry} 0.010676157 0.1411290 0.075648195 1
## [619] {pastry} => {pip fruit} 0.010676157 0.1200000 0.088967972 1
## [620] {pip fruit} => {citrus fruit} 0.013828165 0.1827957 0.075648195 2
## [621] {citrus fruit} => {pip fruit} 0.013828165 0.1670762 0.082765633 2
## [622] {pip fruit} => {shopping bags} 0.009354347 0.1236559 0.075648195 1
## [623] {pip fruit} => {sausage} 0.010777834 0.1424731 0.075648195 1
## [624] {sausage} => {pip fruit} 0.010777834 0.1147186 0.093950178 1
## [625] {pip fruit} => {bottled water} 0.010574479 0.1397849 0.075648195 1
## [626] {pip fruit} => {tropical fruit} 0.020437214 0.2701613 0.075648195 2
## [627] {tropical fruit} => {pip fruit} 0.020437214 0.1947674 0.104931368 2
## [628] {pip fruit} => {root vegetables} 0.015556685 0.2056452 0.075648195 1
## [629] {root vegetables} => {pip fruit} 0.015556685 0.1427239 0.108998475 1
## [630] {pip fruit} => {soda} 0.013319776 0.1760753 0.075648195 1
## [631] {pip fruit} => {yogurt} 0.017996950 0.2379032 0.075648195 1
## [632] {yogurt} => {pip fruit} 0.017996950 0.1290087 0.139501779 1
## [633] {pip fruit} => {rolls/buns} 0.013929842 0.1841398 0.075648195 1
## [634] {pip fruit} => {other vegetables} 0.026131164 0.3454301 0.075648195 1
## [635] {other vegetables} => {pip fruit} 0.026131164 0.1350499 0.193492628 1
## [636] {pip fruit} => {whole milk} 0.030096594 0.3978495 0.075648195 1
## [637] {whole milk} => {pip fruit} 0.030096594 0.1177875 0.255516014 1
## [638] {pastry} => {citrus fruit} 0.009761057 0.1097143 0.088967972 1
## [639] {citrus fruit} => {pastry} 0.009761057 0.1179361 0.082765633 1
## [640] {pastry} => {shopping bags} 0.011896289 0.1337143 0.088967972 1
## [641] {shopping bags} => {pastry} 0.011896289 0.1207430 0.098525674 1
## [642] {pastry} => {sausage} 0.012506355 0.1405714 0.088967972 1

```

```

## [643] {sausage}          => {pastry}          0.012506355 0.1331169 0.093950178 1
## [644] {pastry}           => {bottled water} 0.008947636 0.1005714 0.088967972 0
## [645] {pastry}           => {tropical fruit} 0.013218099 0.1485714 0.088967972 1
## [646] {tropical fruit}   => {pastry}          0.013218099 0.1259690 0.104931368 1
## [647] {pastry}           => {root vegetables} 0.010981190 0.1234286 0.088967972 1
## [648] {root vegetables}  => {pastry}          0.010981190 0.1007463 0.108998475 1
## [649] {pastry}           => {soda}             0.021047280 0.2365714 0.088967972 1
## [650] {soda}              => {pastry}          0.021047280 0.1206997 0.174377224 1
## [651] {pastry}           => {yogurt}          0.017691917 0.1988571 0.088967972 1
## [652] {yogurt}            => {pastry}          0.017691917 0.1268222 0.139501779 1
## [653] {pastry}           => {rolls/buns}     0.020945602 0.2354286 0.088967972 1
## [654] {rolls/buns}       => {pastry}          0.020945602 0.1138751 0.183934926 1
## [655] {pastry}           => {other vegetables} 0.022572445 0.2537143 0.088967972 1
## [656] {other vegetables} => {pastry}          0.022572445 0.1166579 0.193492628 1
## [657] {pastry}           => {whole milk}      0.033248602 0.3737143 0.088967972 1
## [658] {whole milk}        => {pastry}          0.033248602 0.1301234 0.255516014 1
## [659] {citrus fruit}      => {shopping bags} 0.009761057 0.1179361 0.082765633 1
## [660] {citrus fruit}      => {sausage}         0.011286223 0.1363636 0.082765633 1
## [661] {sausage}           => {citrus fruit}    0.011286223 0.1201299 0.093950178 1
## [662] {citrus fruit}      => {bottled water} 0.013523132 0.1633907 0.082765633 1
## [663] {bottled water}     => {citrus fruit}    0.013523132 0.1223551 0.110523640 1
## [664] {citrus fruit}      => {tropical fruit} 0.019928826 0.2407862 0.082765633 2
## [665] {tropical fruit}    => {citrus fruit}    0.019928826 0.1899225 0.104931368 2
## [666] {citrus fruit}      => {root vegetables} 0.017691917 0.2137592 0.082765633 1
## [667] {root vegetables}   => {citrus fruit}    0.017691917 0.1623134 0.108998475 1
## [668] {citrus fruit}      => {soda}             0.012811388 0.1547912 0.082765633 0
## [669] {citrus fruit}      => {yogurt}          0.021657346 0.2616708 0.082765633 1
## [670] {yogurt}             => {citrus fruit}    0.021657346 0.1552478 0.139501779 1
## [671] {citrus fruit}      => {rolls/buns}     0.016776817 0.2027027 0.082765633 1
## [672] {citrus fruit}      => {other vegetables} 0.028876462 0.3488943 0.082765633 1
## [673] {other vegetables}  => {citrus fruit}    0.028876462 0.1492380 0.193492628 1
## [674] {citrus fruit}      => {whole milk}      0.030503305 0.3685504 0.082765633 1
## [675] {whole milk}         => {citrus fruit}    0.030503305 0.1193792 0.255516014 1
## [676] {shopping bags}     => {sausage}         0.015658363 0.1589267 0.098525674 1
## [677] {sausage}            => {shopping bags} 0.015658363 0.1666667 0.093950178 1
## [678] {shopping bags}     => {bottled water} 0.010981190 0.1114551 0.098525674 1
## [679] {shopping bags}     => {tropical fruit} 0.013523132 0.1372549 0.098525674 1
## [680] {tropical fruit}    => {shopping bags} 0.013523132 0.1288760 0.104931368 1
## [681] {shopping bags}     => {root vegetables} 0.012811388 0.1300310 0.098525674 1
## [682] {root vegetables}   => {shopping bags} 0.012811388 0.1175373 0.108998475 1
## [683] {shopping bags}     => {soda}             0.024605999 0.2497420 0.098525674 1
## [684] {soda}                => {shopping bags} 0.024605999 0.1411079 0.174377224 1
## [685] {shopping bags}     => {yogurt}          0.015251652 0.1547988 0.098525674 1
## [686] {yogurt}              => {shopping bags} 0.015251652 0.1093294 0.139501779 1
## [687] {shopping bags}     => {rolls/buns}     0.019522115 0.1981424 0.098525674 1
## [688] {rolls/buns}         => {shopping bags} 0.019522115 0.1061360 0.183934926 1
## [689] {shopping bags}     => {other vegetables} 0.023182511 0.2352941 0.098525674 1
## [690] {other vegetables}  => {shopping bags} 0.023182511 0.1198108 0.193492628 1
## [691] {shopping bags}     => {whole milk}      0.024504321 0.2487100 0.098525674 0
## [692] {sausage}             => {bottled water} 0.011997966 0.1277056 0.093950178 1
## [693] {bottled water}      => {sausage}         0.011997966 0.1085557 0.110523640 1
## [694] {sausage}             => {tropical fruit} 0.013929842 0.1482684 0.093950178 1
## [695] {tropical fruit}    => {sausage}         0.013929842 0.1327519 0.104931368 1
## [696] {sausage}             => {root vegetables} 0.014946619 0.1590909 0.093950178 1

```

```

## [697] {root vegetables} => {sausage} 0.014946619 0.1371269 0.108998475 1
## [698] {sausage} => {soda} 0.024300966 0.2586580 0.093950178 1
## [699] {soda} => {sausage} 0.024300966 0.1393586 0.174377224 1
## [700] {sausage} => {yogurt} 0.019623793 0.2088745 0.093950178 1
## [701] {yogurt} => {sausage} 0.019623793 0.1406706 0.139501779 1
## [702] {sausage} => {rolls/buns} 0.030604982 0.3257576 0.093950178 1
## [703] {rolls/buns} => {sausage} 0.030604982 0.1663903 0.183934926 1
## [704] {sausage} => {other vegetables} 0.026944586 0.2867965 0.093950178 1
## [705] {other vegetables} => {sausage} 0.026944586 0.1392538 0.193492628 1
## [706] {sausage} => {whole milk} 0.029893238 0.3181818 0.093950178 1
## [707] {whole milk} => {sausage} 0.029893238 0.1169916 0.255516014 1
## [708] {bottled water} => {tropical fruit} 0.018505338 0.1674333 0.110523640 1
## [709] {tropical fruit} => {bottled water} 0.018505338 0.1763566 0.104931368 1
## [710] {bottled water} => {root vegetables} 0.015658363 0.1416743 0.110523640 1
## [711] {root vegetables} => {bottled water} 0.015658363 0.1436567 0.108998475 1
## [712] {bottled water} => {soda} 0.028978139 0.2621895 0.110523640 1
## [713] {soda} => {bottled water} 0.028978139 0.1661808 0.174377224 1
## [714] {bottled water} => {yogurt} 0.022979156 0.2079117 0.110523640 1
## [715] {yogurt} => {bottled water} 0.022979156 0.1647230 0.139501779 1
## [716] {bottled water} => {rolls/buns} 0.024199288 0.2189512 0.110523640 1
## [717] {rolls/buns} => {bottled water} 0.024199288 0.1315644 0.183934926 1
## [718] {bottled water} => {other vegetables} 0.024809354 0.2244710 0.110523640 1
## [719] {other vegetables} => {bottled water} 0.024809354 0.1282186 0.193492628 1
## [720] {bottled water} => {whole milk} 0.034367056 0.3109476 0.110523640 1
## [721] {whole milk} => {bottled water} 0.034367056 0.1345006 0.255516014 1
## [722] {tropical fruit} => {root vegetables} 0.021047280 0.2005814 0.104931368 1
## [723] {root vegetables} => {tropical fruit} 0.021047280 0.1930970 0.108998475 1
## [724] {tropical fruit} => {soda} 0.020843925 0.1986434 0.104931368 1
## [725] {soda} => {tropical fruit} 0.020843925 0.1195335 0.174377224 1
## [726] {tropical fruit} => {yogurt} 0.029283172 0.2790698 0.104931368 2
## [727] {yogurt} => {tropical fruit} 0.029283172 0.2099125 0.139501779 2
## [728] {tropical fruit} => {rolls/buns} 0.024605999 0.2344961 0.104931368 1
## [729] {rolls/buns} => {tropical fruit} 0.024605999 0.1337756 0.183934926 1
## [730] {tropical fruit} => {other vegetables} 0.035892222 0.3420543 0.104931368 1
## [731] {other vegetables} => {tropical fruit} 0.035892222 0.1854966 0.193492628 1
## [732] {tropical fruit} => {whole milk} 0.042297916 0.4031008 0.104931368 1
## [733] {whole milk} => {tropical fruit} 0.042297916 0.1655392 0.255516014 1
## [734] {root vegetables} => {soda} 0.018607016 0.1707090 0.108998475 0
## [735] {soda} => {root vegetables} 0.018607016 0.1067055 0.174377224 0
## [736] {root vegetables} => {yogurt} 0.025826131 0.2369403 0.108998475 1
## [737] {yogurt} => {root vegetables} 0.025826131 0.1851312 0.139501779 1
## [738] {root vegetables} => {rolls/buns} 0.024300966 0.2229478 0.108998475 1
## [739] {rolls/buns} => {root vegetables} 0.024300966 0.1321172 0.183934926 1
## [740] {root vegetables} => {other vegetables} 0.047381800 0.4347015 0.108998475 2
## [741] {other vegetables} => {root vegetables} 0.047381800 0.2448765 0.193492628 2
## [742] {root vegetables} => {whole milk} 0.048906965 0.4486940 0.108998475 1
## [743] {whole milk} => {root vegetables} 0.048906965 0.1914047 0.255516014 1
## [744] {soda} => {yogurt} 0.027351296 0.1568513 0.174377224 1
## [745] {yogurt} => {soda} 0.027351296 0.1960641 0.139501779 1
## [746] {soda} => {rolls/buns} 0.038332486 0.2198251 0.174377224 1
## [747] {rolls/buns} => {soda} 0.038332486 0.2084024 0.183934926 1
## [748] {soda} => {other vegetables} 0.032740214 0.1877551 0.174377224 0
## [749] {other vegetables} => {soda} 0.032740214 0.1692065 0.193492628 0
## [750] {soda} => {whole milk} 0.040061007 0.2297376 0.174377224 0

```

```

## [751] {whole milk}          => {soda}           0.040061007 0.1567847 0.255516014 0
## [752] {yogurt}             => {rolls/buns}    0.034367056 0.2463557 0.139501779 1
## [753] {rolls/buns}         => {yogurt}          0.034367056 0.1868436 0.183934926 1
## [754] {yogurt}              => {other vegetables} 0.043416370 0.3112245 0.139501779 1
## [755] {other vegetables}   => {yogurt}          0.043416370 0.2243826 0.193492628 1
## [756] {yogurt}              => {whole milk}      0.056024403 0.4016035 0.139501779 1
## [757] {whole milk}          => {yogurt}          0.056024403 0.2192598 0.255516014 1
## [758] {rolls/buns}          => {other vegetables} 0.042602949 0.2316197 0.183934926 1
## [759] {other vegetables}   => {rolls/buns}      0.042602949 0.2201787 0.193492628 1
## [760] {rolls/buns}          => {whole milk}      0.056634469 0.3079049 0.183934926 1
## [761] {whole milk}           => {rolls/buns}      0.056634469 0.2216474 0.255516014 1
## [762] {other vegetables}   => {whole milk}      0.074834774 0.3867578 0.193492628 1
## [763] {whole milk}           => {other vegetables} 0.074834774 0.2928770 0.255516014 1
## [764] {oil,                  => {whole milk}      0.005083884 0.5102041 0.009964413 1
##       other vegetables}    => {other vegetables} 0.005083884 0.4504505 0.011286223 2
## [765] {oil,                  => {other vegetables} 0.005693950 0.6021505 0.009456024 3
##       whole milk}            => {other vegetables} 0.005693950 0.4000000 0.014234875 3
## [766] {onions,               => {other vegetables} 0.005693950 0.1201717 0.047381800 3
##       root vegetables}     => {root vegetables} 0.006609049 0.4642857 0.014234875 1
## [767] {onions,               => {root vegetables} 0.006609049 0.5462185 0.012099644 2
##       other vegetables}    => {onions}          0.006304016 0.4558824 0.013828165 1
## [768] {other vegetables,    => {whole milk}      0.006304016 0.4275862 0.014743264 2
##       root vegetables}     => {other vegetables} 0.005185562 0.5425532 0.009557702 2
## [769] {onions,               => {whole milk}      0.005185562 0.4047619 0.012811388 2
##       other vegetables}    => {whole milk}      0.006304016 0.5849057 0.010777834 2
## [770] {onions,               => {other vegetables} 0.006304016 0.4189189 0.015048297 2
##       whole milk}            => {long life bakery product, 0.005693950 0.5333333 0.010676157 2
## [771] {hamburger meat,      => {whole milk}      0.005693950 0.4210526 0.013523132 2
##       other vegetables}    => {other vegetables} 0.005287239 0.4262295 0.012404677 2
## [772] {hamburger meat,      => {whole milk}      0.005287239 0.3851852 0.013726487 2
##       whole milk}             => {other vegetables} 0.005287239 0.1217799 0.043416370 3
## [773] {hygiene articles,   => {other vegetables} 0.006609049 0.5327869 0.012404677 2
##       other vegetables}    => {cream cheese, 0.006609049 0.4012346 0.016471784 2
## [774] {hygiene articles,   => {yogurt}          0.006609049 0.5327869 0.012404677 2
##       whole milk}             => {other vegetables} 0.005287239 0.1217799 0.043416370 3
## [775] {other vegetables,   => {whole milk}      0.005287239 0.4262295 0.012404677 2
##       sugar}                 => {other vegetables} 0.005287239 0.3851852 0.013726487 2
## [776] {sugar,                => {whole milk}      0.005287239 0.1217799 0.043416370 3
##       whole milk}             => {long life bakery product, 0.005693950 0.5333333 0.010676157 2
## [777] {long life bakery product,  => {whole milk}      0.005693950 0.4210526 0.013523132 2
##       other vegetables}    => {other vegetables} 0.005287239 0.4262295 0.012404677 2
## [778] {long life bakery product,  => {whole milk}      0.005287239 0.3851852 0.013726487 2
##       whole milk}             => {other vegetables} 0.005287239 0.1217799 0.043416370 3
## [779] {cream cheese,        => {other vegetables} 0.005287239 0.4262295 0.012404677 2
##       yogurt}                 => {yogurt}          0.005287239 0.3851852 0.013726487 2
## [780] {cream cheese,        => {yogurt}          0.005287239 0.1217799 0.043416370 3
##       other vegetables}     => {cream cheese, 0.006609049 0.5327869 0.012404677 2
## [781] {other vegetables,   => {yogurt}          0.006609049 0.4012346 0.016471784 2
##       yogurt}                 => {cream cheese} 0.006609049 0.5327869 0.012404677 2
## [782] {cream cheese,        => {whole milk}      0.006609049 0.4012346 0.016471784 2
##       yogurt}                 => {yogurt}          0.006609049 0.5327869 0.012404677 2
## [783] {cream cheese,        => {yogurt}          0.006609049 0.4012346 0.016471784 2
##       whole milk}              => {yogurt}          0.006609049 0.5327869 0.012404677 2
## [784] {whole milk,           => {whole milk}      0.006609049 0.4012346 0.016471784 2
##       whole milk}             => {other vegetables} 0.006609049 0.5327869 0.012404677 2

```

| | | | | | | |
|----------|---------------------|-----------------------|-------------|-----------|-------------|---|
| ## | yogurt} | => {cream cheese} | 0.006609049 | 0.1179673 | 0.056024403 | 2 |
| ## [785] | {cream cheese, | => {whole milk} | 0.006710727 | 0.4888889 | 0.013726487 | 1 |
| ## | other vegetables} | => {other vegetables} | 0.006710727 | 0.4074074 | 0.016471784 | 2 |
| ## [786] | {cream cheese, | => {other vegetables} | 0.005693950 | 0.5233645 | 0.010879512 | 2 |
| ## | whole milk} | => {other vegetables} | 0.005693950 | 0.3181818 | 0.017895272 | 2 |
| ## [787] | {chicken, | => {other vegetables} | 0.005693950 | 0.1201717 | 0.047381800 | 2 |
| ## | root vegetables} | => {root vegetables} | 0.005998983 | 0.5514019 | 0.010879512 | 2 |
| ## [788] | {chicken, | => {chicken} | 0.005998983 | 0.3410405 | 0.017590239 | 3 |
| ## | other vegetables} | => {whole milk} | 0.005998983 | 0.1226611 | 0.048906965 | 2 |
| ## [789] | {other vegetables, | => {root vegetables} | 0.005287239 | 0.5473684 | 0.009659380 | 2 |
| ## | root vegetables} | => {chicken} | 0.005287239 | 0.3005780 | 0.017590239 | 1 |
| ## [790] | {chicken, | => {whole milk} | 0.008439248 | 0.4715909 | 0.017895272 | 1 |
| ## | root vegetables} | => {other vegetables} | 0.008439248 | 0.4797688 | 0.017590239 | 2 |
| ## [791] | {chicken, | => {chicken} | 0.008439248 | 0.1127717 | 0.074834774 | 2 |
| ## | whole milk} | => {whole milk} | 0.005897306 | 0.4296296 | 0.013726487 | 1 |
| ## [792] | {root vegetables, | => {other vegetables} | 0.005897306 | 0.3452381 | 0.017081851 | 1 |
| ## | whole milk} | => {chicken} | 0.005083884 | 0.3759398 | 0.013523132 | 1 |
| ## [793] | {chicken, | => {whole milk} | 0.005083884 | 0.3048780 | 0.016675140 | 1 |
| ## | rolls/buns} | => {rolls/buns} | 0.005083884 | 0.1269036 | 0.040061007 | 2 |
| ## [794] | {chicken, | => {whole milk} | 0.005490595 | 0.4320000 | 0.012709710 | 1 |
| ## | whole milk} | => {other vegetables} | 0.005490595 | 0.3292683 | 0.016675140 | 1 |
| ## [795] | {chicken, | => {whole milk} | 0.005083884 | 0.5208333 | 0.009761057 | 2 |
| ## | other vegetables} | => {chocolate} | 0.005083884 | 0.2717391 | 0.018708693 | 1 |
| ## [796] | {chicken, | => {whole milk} | 0.006405694 | 0.4772727 | 0.013421454 | 1 |
| ## | whole milk} | => {soda} | 0.006405694 | 0.3423913 | 0.018708693 | 1 |
| ## [797] | {other vegetables, | => {whole milk} | 0.006100661 | 0.5263158 | 0.011591256 | 2 |
| ## | whole milk} | => {other vegetables} | 0.006100661 | 0.3428571 | 0.017793594 | 3 |
| ## [798] | {other vegetables, | => {chicken} | | | | |
| ## | white bread} | => {whole milk} | | | | |
| ## [799] | {white bread, | => {other vegetables} | | | | |
| ## | whole milk} | => {whole milk} | | | | |
| ## [800] | {chocolate, | => {whole milk} | | | | |
| ## | soda} | => {whole milk} | | | | |
| ## [801] | {chocolate, | => {soda} | | | | |
| ## | whole milk} | => {chocolate} | | | | |
| ## [802] | {soda, | => {whole milk} | | | | |
| ## | whole milk} | => {other vegetables} | | | | |
| ## [803] | {chocolate, | => {whole milk} | | | | |
| ## | other vegetables} | => {chocolate} | | | | |
| ## [804] | {chocolate, | => {whole milk} | | | | |
| ## | whole milk} | => {other vegetables} | | | | |
| ## [805] | {coffee, | => {whole milk} | | | | |
| ## | yogurt} | => {whole milk} | | | | |
| ## [806] | {coffee, | => {yogurt} | | | | |
| ## | whole milk} | => {yogurt} | | | | |
| ## [807] | {coffee, | => {whole milk} | | | | |
| ## | other vegetables} | => {whole milk} | | | | |
| ## [808] | {coffee, | => {other vegetables} | | | | |
| ## | whole milk} | => {other vegetables} | | | | |
| ## [809] | {frozen vegetables, | => {other vegetables} | | | | |
| ## | root vegetables} | => {other vegetables} | | | | |
| ## [810] | {frozen vegetables, | => {root vegetables} | | | | |
| ## | other vegetables} | => {root vegetables} | | | | |
| ## [811] | {other vegetables, | | | | | |

```

##      root vegetables}          => {frozen vegetables}          0.006100661  0.1287554 0.047381800 2
## [812] {frozen vegetables,     => {whole milk}                 0.006202339  0.5350877 0.011591256 2
##      root vegetables}          => {root vegetables}           0.006202339  0.3034826 0.020437214 2
## [813] {frozen vegetables,     => {frozen vegetables}           0.006202339  0.1268191 0.048906965 2
##      whole milk}                => {other vegetables}         0.005287239  0.4262295 0.012404677 2
## [814] {root vegetables,       => {yogurt}                   0.005287239  0.2971429 0.017793594 2
##      whole milk}                => {frozen vegetables}         0.005287239  0.1217799 0.043416370 2
## [815] {frozen vegetables,     => {whole milk}                 0.006100661  0.4918033 0.012404677 1
##      yogurt}                   => {yogurt}                  0.006100661  0.2985075 0.020437214 2
## [816] {frozen vegetables,     => {frozen vegetables}           0.006100661  0.1088929 0.056024403 2
##      other vegetables}          => {whole milk}                 0.005083884  0.5000000 0.010167768 1
## [817] {other vegetables,     => {rolls/buns}                 0.005083884  0.2487562 0.020437214 1
##      yogurt}                   => {whole milk}                 0.009659380  0.5428571 0.017793594 2
## [818] {frozen vegetables,     => {other vegetables}           0.009659380  0.4726368 0.020437214 2
##      yogurt}                   => {frozen vegetables}         0.009659380  0.1290761 0.074834774 2
## [819] {frozen vegetables,     => {other vegetables}           0.007930859  0.4561404 0.017386884 2
##      whole milk}                => {root vegetables}          0.007930859  0.4020619 0.019725470 3
## [820] {whole milk,            => {beef}                      0.007930859  0.1673820 0.047381800 3
##      yogurt}                   => {other vegetables}         0.008032537  0.4619883 0.017386884 1
## [821] {frozen vegetables,     => {root vegetables}           0.008032537  0.3779904 0.021250635 3
##      rolls/buns}                => {beef}                      0.008032537  0.1642412 0.048906965 3
## [822] {frozen vegetables,     => {other vegetables}           0.005185562  0.4434783 0.011692933 2
##      whole milk}                => {yogurt}                   0.005185562  0.2628866 0.019725470 1
## [823] {frozen vegetables,     => {beef}                      0.005185562  0.1194379 0.043416370 2
##      other vegetables}          => {frozen vegetables}         0.006100661  0.5217391 0.011692933 2
## [824] {frozen vegetables,     => {whole milk}                 0.006100661  0.2870813 0.021250635 2
##      whole milk}                => {yogurt}                   0.006100661  0.1088929 0.056024403 2
## [825] {other vegetables,      => {beef}                      0.006100661  0.4918033 0.012404677 1
##      whole milk}                => {frozen vegetables}         0.005083884  0.5000000 0.010167768 1
## [826] {beef,                   => {other vegetables}           0.007930859  0.4561404 0.017386884 2
##      root vegetables}          => {root vegetables}          0.007930859  0.4020619 0.019725470 3
## [827] {beef,                   => {beef}                      0.007930859  0.1673820 0.047381800 3
##      other vegetables}          => {whole milk}                 0.008032537  0.4619883 0.017386884 1
## [828] {other vegetables,     => {root vegetables}           0.008032537  0.3779904 0.021250635 3
##      root vegetables}          => {beef}                      0.008032537  0.1642412 0.048906965 3
## [829] {beef,                   => {other vegetables}           0.005185562  0.4434783 0.011692933 2
##      root vegetables}          => {yogurt}                   0.005185562  0.2628866 0.019725470 1
## [830] {beef,                   => {beef}                      0.005185562  0.1194379 0.043416370 2
##      whole milk}                => {frozen vegetables}         0.006100661  0.5217391 0.011692933 2
## [831] {root vegetables,       => {beef}                      0.006100661  0.2870813 0.021250635 2
##      whole milk}                => {whole milk}                 0.006100661  0.1088929 0.056024403 2
## [832] {beef,                   => {other vegetables}           0.005185562  0.4434783 0.011692933 2
##      yogurt}                   => {yogurt}                   0.005185562  0.2628866 0.019725470 1
## [833] {beef,                   => {beef}                      0.005185562  0.1194379 0.043416370 2
##      other vegetables}          => {frozen vegetables}         0.006100661  0.5217391 0.011692933 2
## [834] {other vegetables,     => {whole milk}                 0.006100661  0.2870813 0.021250635 2
##      yogurt}                   => {yogurt}                   0.006100661  0.1088929 0.056024403 2
## [835] {beef,                   => {beef}                      0.006100661  0.4918033 0.012404677 1
##      yogurt}                   => {whole milk}                 0.005083884  0.5000000 0.010167768 1
## [836] {beef,                   => {yogurt}                   0.005083884  0.2487562 0.020437214 1
##      whole milk}                => {beef}                      0.006100661  0.1673820 0.047381800 3
## [837] {whole milk,             => {yogurt}                   0.006100661  0.1088929 0.056024403 2
##      yogurt}                   => {beef}                      0.006100661  0.4918033 0.012404677 1
## [838] {beef,

```

| | | | | | | |
|----------|----------------------|-----------------------|-------------|-------------|-------------|-------------|
| ## | rolls/buns} | => {other vegetables} | 0.005795628 | 0.4253731 | 0.013624809 | 2 |
| ## [839] | {beef, | => {rolls/buns} | 0.005795628 | 0.2938144 | 0.019725470 | 1 |
| ## | other vegetables} | => {beef} | 0.005795628 | 0.1360382 | 0.042602949 | 2 |
| ## [840] | {other vegetables, | => {whole milk} | 0.006812405 | 0.5000000 | 0.013624809 | 1 |
| ## | rolls/buns} | => {rolls/buns} | 0.006812405 | 0.3205742 | 0.021250635 | 1 |
| ## [841] | {beef, | => {beef} | 0.006812405 | 0.1202873 | 0.056634469 | 2 |
| ## | rolls/buns} | => {whole milk} | 0.009252669 | 0.4690722 | 0.019725470 | 1 |
| ## [842] | {beef, | => {other vegetables} | 0.009252669 | 0.4354067 | 0.021250635 | 2 |
| ## | whole milk} | => {beef} | 0.009252669 | 0.1236413 | 0.074834774 | 2 |
| ## [843] | {rolls/buns, | => {whole milk} | 0.005897306 | 0.5631068 | 0.010472801 | 2 |
| ## | whole milk} | => {other vegetables} | 0.005897306 | 0.2256809 | 0.026131164 | 3 |
| ## [844] | {beef, | => {beef} | 0.005897306 | 0.1829653 | 0.032231825 | 3 |
| ## | other vegetables} | => {whole milk} | 0.005897306 | 0.5148515 | 0.010269446 | 3 |
| ## [845] | {beef, | => {curd} | 0.005897306 | 0.3058824 | 0.017285206 | 2 |
| ## | whole milk} | => {yogurt} | 0.005897306 | 0.1805556 | 0.029283172 | 3 |
| ## [846] | {other vegetables, | => {tropical fruit} | 0.005897306 | 0.5148515 | 0.010269446 | 2 |
| ## | whole milk} | => {curd} | 0.005897306 | 0.3076923 | 0.017183528 | 2 |
| ## [847] | {curd, | => {other vegetables} | 0.005897306 | 0.1473088 | 0.035892222 | 2 |
| ## | whipped/sour cream} | => {tropical fruit} | 0.005897306 | 0.006507372 | 0.6336634 | 0.010269446 |
| ## [848] | {curd, | => {curd} | 0.005897306 | 0.006507372 | 0.2490272 | 0.026131164 |
| ## | whole milk} | => {whole milk} | 0.005897306 | 0.006507372 | 0.1538462 | 0.042297916 |
| ## [849] | {whipped/sour cream, | => {tropical fruit} | 0.005897306 | 0.006507372 | 0.1158798 | 0.047381800 |
| ## | whole milk} | => {curd} | 0.005897306 | 0.006202339 | 0.5700935 | 0.010879512 |
| ## [850] | {curd, | => {other vegetables} | 0.005897306 | 0.006202339 | 0.2373541 | 0.026131164 |
| ## | tropical fruit} | => {tropical fruit} | 0.005897306 | 0.006202339 | 0.1268191 | 0.048906965 |
| ## [851] | {curd, | => {yogurt} | 0.005897306 | 0.005287239 | 0.5148515 | 0.010269446 |
| ## | yogurt} | => {curd} | 0.005897306 | 0.005287239 | 0.3058824 | 0.017285206 |
| ## [852] | {tropical fruit, | => {curd} | 0.005897306 | 0.005287239 | 0.1805556 | 0.029283172 |
| ## | yogurt} | => {other vegetables} | 0.005897306 | 0.005287239 | 0.5148515 | 0.010269446 |
| ## [853] | {curd, | => {tropical fruit} | 0.005897306 | 0.005287239 | 0.3076923 | 0.017183528 |
| ## | tropical fruit} | => {curd} | 0.005897306 | 0.005287239 | 0.1473088 | 0.035892222 |
| ## [854] | {curd, | => {whole milk} | 0.005897306 | 0.005287239 | 0.006507372 | 0.6336634 |
| ## | other vegetables} | => {tropical fruit} | 0.005897306 | 0.005287239 | 0.006507372 | 0.2490272 |
| ## [855] | {other vegetables, | => {curd} | 0.005897306 | 0.005287239 | 0.006507372 | 0.1538462 |
| ## | tropical fruit} | => {whole milk} | 0.005897306 | 0.005287239 | 0.006507372 | 0.1158798 |
| ## [856] | {curd, | => {tropical fruit} | 0.005897306 | 0.005287239 | 0.006507372 | 0.042297916 |
| ## | tropical fruit} | => {curd} | 0.005897306 | 0.005287239 | 0.006507372 | 0.1805556 |
| ## [857] | {curd, | => {whole milk} | 0.005897306 | 0.005287239 | 0.006507372 | 0.1473088 |
| ## | whole milk} | => {tropical fruit} | 0.005897306 | 0.005287239 | 0.006507372 | 0.3058824 |
| ## [858] | {tropical fruit, | => {curd} | 0.005897306 | 0.005287239 | 0.006507372 | 0.1805556 |
| ## | whole milk} | => {other vegetables} | 0.005897306 | 0.005287239 | 0.006507372 | 0.5148515 |
| ## [859] | {curd, | => {tropical fruit} | 0.005897306 | 0.005287239 | 0.006507372 | 0.3076923 |
| ## | root vegetables} | => {curd} | 0.005897306 | 0.005287239 | 0.006507372 | 0.1473088 |
| ## [860] | {curd, | => {other vegetables} | 0.005897306 | 0.005287239 | 0.006507372 | 0.005490595 |
| ## | other vegetables} | => {root vegetables} | 0.005897306 | 0.005287239 | 0.006507372 | 0.3195266 |
| ## [861] | {other vegetables, | => {curd} | 0.005897306 | 0.005287239 | 0.006507372 | 0.005490595 |
| ## | root vegetables} | => {whole milk} | 0.005897306 | 0.005287239 | 0.006507372 | 0.1158798 |
| ## [862] | {curd, | => {root vegetables} | 0.005897306 | 0.005287239 | 0.006507372 | 0.047381800 |
| ## | root vegetables} | => {curd} | 0.005897306 | 0.005287239 | 0.006507372 | 0.5700935 |
| ## [863] | {curd, | => {whole milk} | 0.005897306 | 0.005287239 | 0.006507372 | 0.2373541 |
| ## | whole milk} | => {root vegetables} | 0.005897306 | 0.005287239 | 0.006507372 | 0.1268191 |
| ## [864] | {root vegetables, | => {curd} | 0.005897306 | 0.005287239 | 0.006507372 | 0.048906965 |
| ## | whole milk} | => {other vegetables} | 0.005897306 | 0.005287239 | 0.006507372 | 0.5148515 |
| ## [865] | {curd, | => {curd} | 0.005897306 | 0.005287239 | 0.006507372 | 0.3076923 |

| | | | | | | |
|----------|--------------------|-----------------------|-------------|-----------|-------------|---|
| ## | yogurt} | => {other vegetables} | 0.006100661 | 0.3529412 | 0.017285206 | 1 |
| ## [866] | {curd, | => {yogurt} | 0.006100661 | 0.3550296 | 0.017183528 | 2 |
| ## [867] | other vegetables} | => {curd} | 0.006100661 | 0.1405152 | 0.043416370 | 2 |
| ## [868] | {other vegetables, | => {whole milk} | 0.010066090 | 0.5823529 | 0.017285206 | 2 |
| ## [869] | yogurt} | => {yogurt} | 0.010066090 | 0.3852140 | 0.026131164 | 2 |
| ## [870] | {curd, | => {curd} | 0.010066090 | 0.1796733 | 0.056024403 | 3 |
| ## [871] | whole milk} | => {whole milk} | 0.005897306 | 0.5858586 | 0.010066090 | 2 |
| ## [872] | {whole milk, | => {rolls/buns} | 0.005897306 | 0.2256809 | 0.026131164 | 1 |
| ## [873] | yogurt} | => {whole milk} | 0.005897306 | 0.1041293 | 0.056634469 | 1 |
| ## [874] | {curd, | => {curd} | 0.009862735 | 0.5739645 | 0.017183528 | 2 |
| ## [875] | other vegetables} | => {whole milk} | 0.009862735 | 0.3774319 | 0.026131164 | 1 |
| ## [876] | {curd, | => {other vegetables} | 0.009862735 | 0.1317935 | 0.074834774 | 2 |
| ## [877] | whole milk} | => {curd} | 0.006100661 | 0.4958678 | 0.012302999 | 1 |
| ## [878] | {napkins, | => {whole milk} | 0.006100661 | 0.3092784 | 0.019725470 | 2 |
| ## [879] | yogurt} | => {yogurt} | 0.006100661 | 0.1088929 | 0.056024403 | 2 |
| ## [880] | {napkins, | => {napkins} | 0.005287239 | 0.4521739 | 0.011692933 | 1 |
| ## [881] | whole milk} | => {whole milk} | 0.005287239 | 0.2680412 | 0.019725470 | 1 |
| ## [882] | {napkins, | => {rolls/buns} | 0.006812405 | 0.4718310 | 0.014438231 | 1 |
| ## [883] | other vegetables} | => {whole milk} | 0.006812405 | 0.3453608 | 0.019725470 | 1 |
| ## [884] | {napkins, | => {other vegetables} | 0.007015760 | 0.5149254 | 0.013624809 | 2 |
| ## [885] | whole milk} | => {other vegetables} | 0.007015760 | 0.3239437 | 0.021657346 | 2 |
| ## [886] | {pork, | => {root vegetables} | 0.007015760 | 0.1480687 | 0.047381800 | 2 |
| ## [887] | root vegetables} | => {pork} | 0.006812405 | 0.5000000 | 0.013624809 | 1 |
| ## [888] | {other vegetables, | => {whole milk} | 0.006812405 | 0.3073394 | 0.022165735 | 2 |
| ## [889] | pork} | => {root vegetables} | 0.006812405 | 0.1392931 | 0.048906965 | 2 |
| ## [890] | {other vegetables, | => {pork} | 0.005592272 | 0.4954955 | 0.011286223 | 2 |
| ## [891] | root vegetables, | => {other vegetables} | 0.005592272 | 0.2582160 | 0.021657346 | 1 |
| ## [892] | pork} | => {rolls/buns} | | | | |
| ## [893] | {other vegetables, | | | | | |

```

##      rolls/buns}          => {pork}          0.005592272 0.1312649 0.042602949 2
## [893]  {pork,           => {whole milk}    0.006202339 0.5495495 0.011286223 2
##      rolls/buns}          => {rolls/buns}   0.006202339 0.2798165 0.022165735 1
## [894]  {pork,           => {pork}          0.006202339 0.1095153 0.056634469 1
##      whole milk}          => {whole milk}    0.010167768 0.4694836 0.021657346 1
## [895]  {rolls/buns,       => {pork}          0.010167768 0.4587156 0.022165735 2
##      whole milk}          => {other vegetables} 0.010167768 0.1358696 0.074834774 2
## [896]  {other vegetables,=> {whole milk}    0.005185562 0.5483871 0.009456024 2
##      pork}                => {pork}          0.005185562 0.2524752 0.020538892 2
## [897]  {pork,           => {tropical fruit} 0.005185562 0.1225962 0.042297916 2
##      whole milk}          => {frankfurter}   0.005083884 0.5000000 0.010167768 1
## [898]  {other vegetables,=> {whole milk}    0.005083884 0.2475248 0.020538892 2
##      whole milk}          => {tropical fruit} 0.005083884 0.1039501 0.048906965 1
## [899]  {frankfurter,       => {frankfurter}   0.006202339 0.5545455 0.011184545 2
##      tropical fruit}      => {whole milk}    0.006202339 0.3019802 0.020538892 2
## [900]  {frankfurter,       => {frankfurter}   0.006202339 0.1107078 0.056024403 1
##      whole milk}          => {root vegetables} 0.005592272 0.2910053 0.019217082 1
## [901]  {tropical fruit,   => {whole milk}    0.005592272 0.3395062 0.016471784 1
##      whole milk}          => {frankfurter}   0.005592272 0.1312649 0.042602949 2
## [902]  {frankfurter,       => {whole milk}    0.005998983 0.3121693 0.019217082 1
##      root vegetables}     => {frankfurter}   0.005998983 0.2920792 0.020538892 1
## [903]  {frankfurter,       => {whole milk}    0.005998983 0.1059246 0.056634469 1
##      whole milk}          => {other vegetables} 0.007625826 0.4629630 0.016471784 1
## [904]  {root vegetables,   => {whole milk}    0.007625826 0.3712871 0.020538892 1
##      whole milk}          => {frankfurter}   0.007625826 0.1019022 0.074834774 1
## [905]  {frankfurter,       => {yogurt}        0.005083884 0.3225806 0.015760041 1
##      yogurt}              => {frankfurter}   0.005083884 0.2994012 0.016980173 2
## [906]  {frankfurter,       => {whole milk}    0.005083884 0.1059246 0.056634469 1
##      whole milk}          => {frankfurter}   0.005083884 0.2994012 0.016980173 2
## [907]  {whole milk,         => {frankfurter}   0.005083884 0.1059246 0.056634469 1
##      yogurt}              => {whole milk}    0.005592272 0.2910053 0.019217082 1
## [908]  {frankfurter,       => {rolls/buns}   0.005592272 0.3395062 0.016471784 1
##      rolls/buns}          => {other vegetables} 0.005592272 0.2910053 0.019217082 1
## [909]  {frankfurter,       => {rolls/buns}   0.005592272 0.3395062 0.016471784 1
##      other vegetables}    => {frankfurter}   0.005592272 0.1312649 0.042602949 2
## [910]  {other vegetables, => {rolls/buns}   0.005592272 0.1312649 0.042602949 2
##      rolls/buns}          => {frankfurter}   0.005592272 0.1312649 0.042602949 2
## [911]  {frankfurter,       => {whole milk}    0.005998983 0.3121693 0.019217082 1
##      rolls/buns}          => {whole milk}    0.005998983 0.2920792 0.020538892 1
## [912]  {frankfurter,       => {whole milk}    0.005998983 0.1059246 0.056634469 1
##      whole milk}          => {rolls/buns}   0.005998983 0.1059246 0.056634469 1
## [913]  {rolls/buns,         => {frankfurter}   0.005998983 0.1059246 0.056634469 1
##      whole milk}          => {frankfurter}   0.005998983 0.1059246 0.056634469 1
## [914]  {frankfurter,       => {whole milk}    0.007625826 0.4629630 0.016471784 1
##      other vegetables}    => {whole milk}    0.007625826 0.3712871 0.020538892 1
## [915]  {frankfurter,       => {other vegetables} 0.007625826 0.3712871 0.020538892 1
##      whole milk}          => {other vegetables} 0.007625826 0.3712871 0.020538892 1
## [916]  {other vegetables,  => {frankfurter}   0.007625826 0.1019022 0.074834774 1
##      whole milk}          => {frankfurter}   0.007625826 0.1019022 0.074834774 1
## [917]  {bottled beer,       => {soda}          0.005083884 0.3225806 0.015760041 1
##      bottled water}        => {bottled water} 0.005083884 0.2994012 0.016980173 2
## [918]  {bottled beer,       => {bottled water} 0.005083884 0.2994012 0.016980173 2
##      soda}                => {bottled water} 0.005083884 0.2994012 0.016980173 2
## [919]  {bottled water,

```

| | | | | | | |
|----------|--------------------|-----------------------|-------------|-----------|-------------|---|
| ## | soda} | => {bottled beer} | 0.005083884 | 0.1754386 | 0.028978139 | 2 |
| ## [920] | {bottled beer, | => {whole milk} | 0.006100661 | 0.3870968 | 0.015760041 | 1 |
| ## | bottled water} | => {bottled water} | 0.006100661 | 0.2985075 | 0.020437214 | 2 |
| ## [921] | {bottled beer, | => {bottled beer} | 0.006100661 | 0.1775148 | 0.034367056 | 2 |
| ## | whole milk} | => {whole milk} | 0.005185562 | 0.5604396 | 0.009252669 | 2 |
| ## [922] | {bottled water, | => {whole milk} | 0.005185562 | 0.2537313 | 0.020437214 | 1 |
| ## | whole milk} | => {yogurt} | 0.005388917 | 0.3955224 | 0.013624809 | 1 |
| ## [923] | {bottled beer, | => {whole milk} | 0.005388917 | 0.2636816 | 0.020437214 | 1 |
| ## | yogurt} | => {rolls/buns} | 0.007625826 | 0.4716981 | 0.016166751 | 1 |
| ## [924] | {bottled beer, | => {whole milk} | 0.007625826 | 0.3731343 | 0.020437214 | 1 |
| ## | whole milk} | => {other vegetables} | 0.007625826 | 0.1019022 | 0.074834774 | 1 |
| ## [925] | {bottled beer, | => {bottled beer} | 0.005693950 | 0.5333333 | 0.010676157 | 2 |
| ## | rolls/buns} | => {whole milk} | 0.005693950 | 0.2258065 | 0.025216065 | 2 |
| ## [926] | {bottled beer, | => {rolls/buns} | 0.005693950 | 0.1346154 | 0.042297916 | 2 |
| ## | whole milk} | => {whole milk} | 0.005693950 | 0.5600000 | 0.010167768 | 2 |
| ## [927] | {bottled beer, | => {tropical fruit} | 0.005693950 | 0.2258065 | 0.025216065 | 2 |
| ## | other vegetables} | => {brown bread} | 0.005693950 | 0.1164241 | 0.048906965 | 1 |
| ## [928] | {bottled beer, | => {whole milk} | 0.005083884 | 0.4032258 | 0.012608033 | 1 |
| ## | whole milk} | => {root vegetables} | 0.005083884 | 0.2016129 | 0.025216065 | 1 |
| ## [929] | {other vegetables, | => {brown bread} | 0.005083884 | 0.1269036 | 0.040061007 | 1 |
| ## | whole milk} | => {whole milk} | 0.005083884 | 0.3566434 | 0.014539908 | 1 |
| ## [930] | {brown bread, | => {root vegetables} | 0.005185562 | 0.2771739 | 0.018708693 | 1 |
| ## | tropical fruit} | => {brown bread} | 0.005185562 | 0.1194379 | 0.043416370 | 1 |
| ## [931] | {brown bread, | => {whole milk} | 0.005185562 | 0.4895105 | 0.014539908 | 1 |
| ## | whole milk} | => {yogurt} | 0.007117438 | 0.2822581 | 0.025216065 | 2 |
| ## [932] | {tropical fruit, | => {brown bread} | 0.007117438 | 0.1270417 | 0.056024403 | 1 |
| ## | whole milk} | => {whole milk} | 0.005693950 | 0.1164241 | 0.048906965 | 1 |
| ## [933] | {brown bread, | => {root vegetables} | 0.005693950 | 0.1269036 | 0.040061007 | 1 |
| ## | root vegetables} | => {brown bread} | 0.005693950 | 0.3566434 | 0.014539908 | 1 |
| ## [934] | {brown bread, | => {whole milk} | 0.005693950 | 0.2771739 | 0.018708693 | 1 |
| ## | whole milk} | => {soda} | 0.005083884 | 0.1194379 | 0.043416370 | 1 |
| ## [935] | {root vegetables, | => {brown bread} | 0.005083884 | 0.4895105 | 0.014539908 | 1 |
| ## | whole milk} | => {whole milk} | 0.005083884 | 0.2822581 | 0.025216065 | 2 |
| ## [936] | {brown bread, | => {soda} | 0.005185562 | 0.1270417 | 0.056024403 | 1 |
| ## | soda} | => {whole milk} | 0.005185562 | 0.1194379 | 0.043416370 | 1 |
| ## [937] | {brown bread, | => {soda} | 0.005185562 | 0.4895105 | 0.014539908 | 1 |
| ## | whole milk} | => {brown bread} | 0.007117438 | 0.2822581 | 0.025216065 | 2 |
| ## [938] | {soda, | => {brown bread} | 0.007117438 | 0.1270417 | 0.056024403 | 1 |
| ## | whole milk} | => {whole milk} | 0.005083884 | 0.1194379 | 0.043416370 | 1 |
| ## [939] | {brown bread, | => {other vegetables} | 0.005083884 | 0.4895105 | 0.014539908 | 1 |
| ## | yogurt} | => {yogurt} | 0.005185562 | 0.2822581 | 0.025216065 | 2 |
| ## [940] | {brown bread, | => {brown bread} | 0.005185562 | 0.1270417 | 0.056024403 | 1 |
| ## | other vegetables} | => {whole milk} | 0.007117438 | 0.1194379 | 0.043416370 | 1 |
| ## [941] | {other vegetables, | => {yogurt} | 0.007117438 | 0.4895105 | 0.014539908 | 1 |
| ## | yogurt} | => {brown bread} | 0.005185562 | 0.2822581 | 0.025216065 | 2 |
| ## [942] | {brown bread, | => {whole milk} | 0.005185562 | 0.1270417 | 0.056024403 | 1 |
| ## | yogurt} | => {yogurt} | 0.007117438 | 0.1194379 | 0.043416370 | 1 |
| ## [943] | {brown bread, | => {yogurt} | 0.007117438 | 0.4895105 | 0.014539908 | 1 |
| ## | whole milk} | => {brown bread} | 0.005185562 | 0.2822581 | 0.025216065 | 2 |
| ## [944] | {whole milk, | => {brown bread} | 0.007117438 | 0.1270417 | 0.056024403 | 1 |
| ## | yogurt} | => {whole milk} | 0.005287239 | 0.4193548 | 0.012608033 | 1 |
| ## [945] | {brown bread, | => {whole milk} | 0.005287239 | 0.1194379 | 0.043416370 | 1 |
| ## | rolls/buns} | => {brown bread} | 0.005287239 | 0.4895105 | 0.014539908 | 1 |
| ## [946] | {brown bread, | => {whole milk} | 0.005287239 | 0.2822581 | 0.025216065 | 2 |

| | | | | | | |
|----------|--------------------|-----------------------|-------------|-------------|-------------|-------------|
| ## | whole milk} | => {rolls/buns} | 0.005287239 | 0.2096774 | 0.025216065 | 1 |
| ## [947] | {brown bread, | => {whole milk} | 0.009354347 | 0.5000000 | 0.018708693 | 1 |
| ## | other vegetables} | => {other vegetables} | 0.009354347 | 0.3709677 | 0.025216065 | 1 |
| ## [948] | {brown bread, | => {brown bread} | 0.009354347 | 0.1250000 | 0.074834774 | 1 |
| ## | whole milk} | => {whole milk} | 0.005185562 | 0.6219512 | 0.008337570 | 2 |
| ## [949] | {other vegetables, | => {domestic eggs} | 0.005185562 | 0.2142857 | 0.024199288 | 3 |
| ## | whole milk} | => {margarine} | 0.005185562 | 0.1728814 | 0.029994916 | 2 |
| ## [950] | {domestic eggs, | => {whole milk} | 0.005897306 | 0.5321101 | 0.011082867 | 2 |
| ## | margarine} | => {domestic eggs, | 0.005897306 | 0.2989691 | 0.019725470 | 2 |
| ## [951] | {margarine, | => {margarine} | 0.005897306 | 0.1244635 | 0.047381800 | 2 |
| ## | whole milk} | => {root vegetables} | 0.005693950 | 0.4000000 | 0.014234875 | 2 |
| ## [952] | {domestic eggs, | => {root vegetables} | 0.005693950 | 0.2886598 | 0.019725470 | 2 |
| ## | whole milk} | => {margarine} | 0.005693950 | 0.1311475 | 0.043416370 | 2 |
| ## [953] | {margarine, | => {other vegetables} | 0.005693950 | 0.005185562 | 0.014743264 | 1 |
| ## | root vegetables} | => {yogurt} | 0.005693950 | 0.4928571 | 0.014234875 | 1 |
| ## [954] | {margarine, | => {other vegetables} | 0.005693950 | 0.005185562 | 0.2899160 | 0.024199288 |
| ## | other vegetables} | => {margarine} | 0.005693950 | 0.005185562 | 0.1252269 | 0.056024403 |
| ## [955] | {other vegetables, | => {whole milk} | 0.005693950 | 0.005693950 | 0.007015760 | 0.019725470 |
| ## | root vegetables} | => {yogurt} | 0.005693950 | 0.005693950 | 0.007015760 | 0.014234875 |
| ## [956] | {margarine, | => {margarine} | 0.005693950 | 0.005693950 | 0.007015760 | 0.1311475 |
| ## | yogurt} | => {other vegetables} | 0.005693950 | 0.005693950 | 0.007015760 | 0.043416370 |
| ## [957] | {margarine, | => {yogurt} | 0.005693950 | 0.005693950 | 0.007015760 | 0.2886598 |
| ## | other vegetables} | => {margarine} | 0.005693950 | 0.005693950 | 0.007015760 | 0.1311475 |
| ## [958] | {other vegetables, | => {whole milk} | 0.005693950 | 0.005693950 | 0.007015760 | 0.043416370 |
| ## | yogurt} | => {yogurt} | 0.005693950 | 0.005693950 | 0.007015760 | 0.1252269 |
| ## [959] | {margarine, | => {margarine} | 0.005693950 | 0.005693950 | 0.007015760 | 0.056024403 |
| ## | yogurt} | => {whole milk} | 0.005693950 | 0.005693950 | 0.007015760 | 0.4928571 |
| ## [960] | {margarine, | => {yogurt} | 0.005693950 | 0.005693950 | 0.007015760 | 0.2899160 |
| ## | whole milk} | => {margarine} | 0.005693950 | 0.005693950 | 0.007015760 | 0.1252269 |
| ## [961] | {whole milk, | => {rolls/buns} | 0.005693950 | 0.005693950 | 0.007015760 | 0.056024403 |
| ## | yogurt} | => {other vegetables} | 0.005693950 | 0.005693950 | 0.007015760 | 0.3517241 |
| ## [962] | {margarine, | => {rolls/buns} | 0.005693950 | 0.005693950 | 0.007015760 | 0.2628866 |
| ## | rolls/buns} | => {margarine} | 0.005693950 | 0.005693950 | 0.007015760 | 0.1217184 |
| ## [963] | {margarine, | => {whole milk} | 0.005693950 | 0.005693950 | 0.007930859 | 0.042602949 |
| ## | other vegetables} | => {rolls/buns} | 0.005693950 | 0.005693950 | 0.007930859 | 0.5379310 |
| ## [964] | {other vegetables, | => {margarine} | 0.005693950 | 0.005693950 | 0.007930859 | 0.14743264 |
| ## | rolls/buns} | => {other vegetables} | 0.005693950 | 0.005693950 | 0.007930859 | 0.3277311 |
| ## [965] | {margarine, | => {whole milk} | 0.005693950 | 0.005693950 | 0.007930859 | 0.024199288 |
| ## | rolls/buns} | => {rolls/buns} | 0.005693950 | 0.005693950 | 0.007930859 | 0.1400359 |
| ## [966] | {margarine, | => {margarine} | 0.005693950 | 0.005693950 | 0.009252669 | 0.056634469 |
| ## | whole milk} | => {whole milk} | 0.005693950 | 0.005693950 | 0.009252669 | 0.4690722 |
| ## [967] | {rolls/buns, | => {rolls/buns} | 0.005693950 | 0.005693950 | 0.009252669 | 0.019725470 |
| ## | whole milk} | => {margarine} | 0.005693950 | 0.005693950 | 0.009252669 | 0.1236413 |
| ## [968] | {margarine, | => {whole milk} | 0.005693950 | 0.005693950 | 0.009252669 | 0.074834774 |
| ## | other vegetables} | => {margarine} | 0.005693950 | 0.005693950 | 0.009252669 | 0.6210526 |
| ## [969] | {margarine, | => {other vegetables} | 0.005693950 | 0.005693950 | 0.009252669 | 0.3823529 |
| ## | whole milk} | => {margarine} | 0.005693950 | 0.005693950 | 0.009252669 | 0.024199288 |
| ## [970] | {other vegetables, | => {whole milk} | 0.005693950 | 0.005693950 | 0.009252669 | 0.1400359 |
| ## | whole milk} | => {margarine} | 0.005693950 | 0.005693950 | 0.009252669 | 0.056634469 |
| ## [971] | {butter, | => {whole milk} | 0.005693950 | 0.005693950 | 0.009252669 | 0.2177122 |
| ## | domestic eggs} | => {margarine} | 0.005693950 | 0.005693950 | 0.009252669 | 0.027554652 |
| ## [972] | {butter, | => {whole milk} | 0.005693950 | 0.005693950 | 0.009252669 | 0.009659380 |
| ## | whole milk} | => {domestic eggs} | 0.005693950 | 0.005693950 | 0.009252669 | 0.2177122 |
| ## [973] | {domestic eggs, | => {domestic eggs} | 0.005693950 | 0.005693950 | 0.009252669 | 0.027554652 |

| | | | | | | |
|-----------|----------------------|-------------------------|-------------|-----------|-------------|---|
| ## | whole milk} | => {butter} | 0.005998983 | 0.2000000 | 0.029994916 | 3 |
| ## [974] | {butter, | => {other vegetables} | 0.005795628 | 0.5700000 | 0.010167768 | 2 |
| ## [975] | whipped/sour cream} | => {whipped/sour cream} | 0.005795628 | 0.2893401 | 0.020030503 | 4 |
| ## [976] | {butter, | => {butter} | 0.005795628 | 0.2007042 | 0.028876462 | 3 |
| ## [977] | other vegetables} | => {whole milk} | 0.006710727 | 0.6600000 | 0.010167768 | 2 |
| ## [978] | {butter, | => {whipped/sour cream} | 0.006710727 | 0.2435424 | 0.027554652 | 3 |
| ## [979] | whole milk} | => {butter} | 0.006710727 | 0.2082019 | 0.032231825 | 3 |
| ## [980] | {whipped/sour cream, | => {whole milk} | 0.005083884 | 0.5555556 | 0.009150991 | 2 |
| ## [981] | whole milk} | => {citrus fruit} | 0.005083884 | 0.1845018 | 0.027554652 | 2 |
| ## [982] | {citrus fruit, | => {butter} | 0.005083884 | 0.1666667 | 0.030503305 | 3 |
| ## [983] | whole milk} | => {whole milk} | 0.005388917 | 0.6022727 | 0.008947636 | 2 |
| ## [984] | {bottled water, | => {bottled water} | 0.005388917 | 0.1955720 | 0.027554652 | 1 |
| ## [985] | butter} | => {butter} | 0.005388917 | 0.1568047 | 0.034367056 | 2 |
| ## [986] | {butter, | => {other vegetables} | 0.005490595 | 0.5510204 | 0.009964413 | 2 |
| ## [987] | tropical fruit} | => {tropical fruit} | 0.005490595 | 0.2741117 | 0.020030503 | 2 |
| ## [988] | {butter, | => {butter} | 0.005490595 | 0.1529745 | 0.035892222 | 2 |
| ## [989] | other vegetables} | => {whole milk} | 0.006202339 | 0.6224490 | 0.009964413 | 2 |
| ## [990] | {tropical fruit, | => {tropical fruit} | 0.006202339 | 0.2250923 | 0.027554652 | 2 |
| ## [991] | whole milk} | => {butter} | 0.006202339 | 0.1466346 | 0.042297916 | 2 |
| ## [992] | {butter, | => {other vegetables} | 0.006609049 | 0.5118110 | 0.012913066 | 2 |
| ## [993] | root vegetables} | => {butter} | 0.006609049 | 0.3299492 | 0.020030503 | 3 |
| ## [994] | {butter, | => {root vegetables} | 0.006609049 | 0.1394850 | 0.047381800 | 2 |
| ## [995] | other vegetables} | => {butter} | 0.008235892 | 0.6377953 | 0.012913066 | 2 |
| ## [996] | {other vegetables, | => {whole milk} | 0.008235892 | 0.2988930 | 0.027554652 | 2 |
| ## [997] | root vegetables} | => {root vegetables} | 0.008235892 | 0.1683992 | 0.048906965 | 3 |
| ## [998] | {butter, | => {butter} | 0.006405694 | 0.4375000 | 0.014641586 | 2 |
| ## [999] | yogurt} | => {other vegetables} | 0.006405694 | 0.3197970 | 0.020030503 | 2 |
| ## [1000] | {butter, | => {yogurt} | 0.006405694 | | | |
| ## [1001] | other vegetables} | | | | | |
| ## [1002] | {other vegetables, | | | | | |

```

##      yogurt}          => {butter}          0.006405694  0.1475410  0.043416370  2
## [1001] {butter,        => {whole milk}       0.009354347  0.6388889  0.014641586  2
##      yogurt}          => {yogurt}          0.009354347  0.3394834  0.027554652  2
## [1002] {butter,        => {butter}          0.009354347  0.1669691  0.056024403  3
##      whole milk}       => {other vegetables} 0.005693950  0.4242424  0.013421454  2
## [1003] {whole milk,    => {rolls/buns}       0.005693950  0.2842640  0.020030503  1
##      yogurt}          => {butter}          0.005693950  0.1336516  0.042602949  2
## [1004] {butter,        => {other vegetables} 0.005693950  0.4924242  0.013421454  1
##      rolls/buns}       => {rolls/buns}       0.005693950  0.2398524  0.027554652  1
## [1005] {butter,        => {butter}          0.005693950  0.1166966  0.056634469  2
##      other vegetables}=> {whole milk}       0.011489578  0.5736041  0.020030503  2
## [1006] {other vegetables,=> {rolls/buns}       0.011489578  0.4169742  0.027554652  2
##      rolls/buns}       => {butter}          0.011489578  0.1535326  0.074834774  2
## [1007] {butter,        => {other vegetables} 0.005083884  0.4310345  0.011794611  1
##      rolls/buns}       => {whole milk}       0.005083884  0.1858736  0.027351296  1
## [1008] {butter,        => {butter}          0.005083884  0.1201923  0.042297916  1
##      whole milk}       => {other vegetables} 0.005998983  0.5221239  0.011489578  2
## [1009] {rolls/buns,    => {newspapers}       0.005998983  0.3105263  0.019318760  2
##      whole milk}       => {tropical fruit}   0.005998983  0.1266094  0.047381800  1
## [1010] {butter,        => {newspapers}       0.005795628  0.5044248  0.011489578  1
##      other vegetables}=> {whole milk}       0.005795628  0.2118959  0.027351296  1
## [1011] {butter,        => {root vegetables} 0.005795628  0.1185031  0.048906965  1
##      whole milk}       => {newspapers}       0.005083884  0.3311258  0.015353330  1
## [1012] {other vegetables,=> {newspapers}       0.005083884  0.2577320  0.019725470  1
##      whole milk}       => {rolls/buns}       0.005083884  0.1479290  0.034367056  1
## [1013] {newspapers,    => {yogurt}          0.005083884  0.3642384  0.015353330  1
##      tropical fruit}   => {newspapers}       0.005592272  0.2894737  0.019318760  2
## [1014] {newspapers,    => {other vegetables} 0.005592272  0.1166966  0.056634469  2
##      whole milk}       => {butter}          0.005592272  0.005083884  0.4169742  0.027554652
## [1015] {tropical fruit,=> {whole milk}       0.005592272  0.005083884  0.1858736  0.027351296
##      whole milk}       => {newspapers}       0.005592272  0.005083884  0.1266094  0.047381800
## [1016] {newspapers,    => {root vegetables} 0.005592272  0.005083884  0.1201923  0.042297916
##      root vegetables}=> {newspapers}       0.005592272  0.005083884  0.05998983  0.5221239
## [1017] {newspapers,    => {other vegetables} 0.005592272  0.005083884  0.05998983  0.3105263
##      other vegetables}=> {root vegetables} 0.005592272  0.005083884  0.05998983  0.1185031
## [1018] {other vegetables,=> {newspapers}       0.005592272  0.005083884  0.05998983  0.048906965
##      root vegetables}=> {whole milk}       0.005592272  0.005083884  0.05795628  0.5044248
## [1019] {newspapers,    => {root vegetables} 0.005592272  0.005083884  0.05795628  0.2118959
##      root vegetables}=> {newspapers}       0.005592272  0.005083884  0.05795628  0.1185031
## [1020] {newspapers,    => {newspapers}        0.005592272  0.005083884  0.05795628  0.048906965
##      whole milk}       => {root vegetables} 0.005592272  0.005083884  0.05592272  0.3311258
## [1021] {root vegetables,=> {newspapers}       0.005592272  0.005083884  0.05592272  0.2577320
##      whole milk}       => {yogurt}          0.005592272  0.005083884  0.05592272  0.1479290
## [1022] {newspapers,    => {rolls/buns}       0.005592272  0.005083884  0.05592272  0.3642384
##      yogurt}          => {yogurt}          0.005592272  0.005083884  0.05592272  0.2894737
## [1023] {newspapers,    => {newspapers}        0.005592272  0.005083884  0.05592272  0.1166966
##      rolls/buns}       => {other vegetables} 0.005592272  0.005083884  0.05592272  0.056634469
## [1024] {rolls/buns,    => {yogurt}          0.005592272  0.005083884  0.05592272  0.05592272
##      yogurt}          => {newspapers}       0.005592272  0.005083884  0.05592272  0.048906965
## [1025] {newspapers,    => {other vegetables} 0.005592272  0.005083884  0.05592272  0.048906965
##      yogurt}          => {yogurt}          0.005592272  0.005083884  0.05592272  0.047381800
## [1026] {newspapers,    => {yogurt}          0.005592272  0.005083884  0.05592272  0.047381800
##      other vegetables}=> {newspapers}       0.005592272  0.005083884  0.05592272  0.042297916
## [1027] {other vegetables,=> {other vegetables} 0.005592272  0.005083884  0.05592272  0.042297916
##      yogurt}          => {yogurt}          0.005592272  0.005083884  0.05592272  0.042297916

```

| | | | | | |
|--|-------------------------|-------------|-----------|-------------|---|
| ## yogurt} | => {newspapers} | 0.005592272 | 0.1288056 | 0.043416370 | 1 |
| ## [1028] {newspapers, ## yogurt} | => {whole milk} | 0.006609049 | 0.4304636 | 0.015353330 | 1 |
| ## [1029] {newspapers, ## whole milk} | => {yogurt} | 0.006609049 | 0.2416357 | 0.027351296 | 1 |
| ## [1030] {whole milk, ## yogurt} | => {newspapers} | 0.006609049 | 0.1179673 | 0.056024403 | 1 |
| ## [1031] {newspapers, ## rolls/buns} | => {other vegetables} | 0.005490595 | 0.2783505 | 0.019725470 | 1 |
| ## [1032] {newspapers, ## other vegetables} | => {rolls/buns} | 0.005490595 | 0.2842105 | 0.019318760 | 1 |
| ## [1033] {other vegetables, ## rolls/buns} | => {newspapers} | 0.005490595 | 0.1288783 | 0.042602949 | 1 |
| ## [1034] {newspapers, ## rolls/buns} | => {whole milk} | 0.007625826 | 0.3865979 | 0.019725470 | 1 |
| ## [1035] {newspapers, ## whole milk} | => {rolls/buns} | 0.007625826 | 0.2788104 | 0.027351296 | 1 |
| ## [1036] {rolls/buns, ## whole milk} | => {newspapers} | 0.007625826 | 0.1346499 | 0.056634469 | 1 |
| ## [1037] {newspapers, ## other vegetables} | => {whole milk} | 0.008337570 | 0.4315789 | 0.019318760 | 1 |
| ## [1038] {newspapers, ## whole milk} | => {other vegetables} | 0.008337570 | 0.3048327 | 0.027351296 | 1 |
| ## [1039] {other vegetables, ## whole milk} | => {newspapers} | 0.008337570 | 0.1114130 | 0.074834774 | 1 |
| ## [1040] {domestic eggs, ## whipped/sour cream} | => {other vegetables} | 0.005083884 | 0.5102041 | 0.009964413 | 2 |
| ## [1041] {domestic eggs, ## other vegetables} | => {whipped/sour cream} | 0.005083884 | 0.2283105 | 0.022267412 | 3 |
| ## [1042] {other vegetables, ## whipped/sour cream} | => {domestic eggs} | 0.005083884 | 0.1760563 | 0.028876462 | 2 |
| ## [1043] {domestic eggs, ## whipped/sour cream} | => {whole milk} | 0.005693950 | 0.5714286 | 0.009964413 | 2 |
| ## [1044] {domestic eggs, ## whole milk} | => {whipped/sour cream} | 0.005693950 | 0.1898305 | 0.029994916 | 2 |
| ## [1045] {whipped/sour cream, ## whole milk} | => {domestic eggs} | 0.005693950 | 0.1766562 | 0.032231825 | 2 |
| ## [1046] {domestic eggs, ## pip fruit} | => {whole milk} | 0.005388917 | 0.6235294 | 0.008642603 | 2 |
| ## [1047] {domestic eggs, ## whole milk} | => {pip fruit} | 0.005388917 | 0.1796610 | 0.029994916 | 2 |
| ## [1048] {pip fruit, ## whole milk} | => {domestic eggs} | 0.005388917 | 0.1790541 | 0.030096594 | 2 |
| ## [1049] {citrus fruit, ## domestic eggs} | => {whole milk} | 0.005693950 | 0.5490196 | 0.010371124 | 2 |
| ## [1050] {domestic eggs, ## whole milk} | => {citrus fruit} | 0.005693950 | 0.1898305 | 0.029994916 | 2 |
| ## [1051] {citrus fruit, ## whole milk} | => {domestic eggs} | 0.005693950 | 0.1866667 | 0.030503305 | 2 |
| ## [1052] {domestic eggs, ## tropical fruit} | => {whole milk} | 0.006914082 | 0.6071429 | 0.011387900 | 2 |
| ## [1053] {domestic eggs, ## whole milk} | => {tropical fruit} | 0.006914082 | 0.2305085 | 0.029994916 | 2 |
| ## [1054] {tropical fruit, | | | | | |

```

##      whole milk}          => {domestic eggs}          0.006914082 0.1634615 0.042297916 2
## [1055] {domestic eggs,    => {other vegetables}    0.007320793 0.5106383 0.014336553 2
##           root vegetables}=> {root vegetables}    0.007320793 0.3287671 0.022267412 3
## [1056] {domestic eggs,    => {domestic eggs}          0.007320793 0.1545064 0.047381800 2
##           other vegetables}=> {whole milk}            0.008540925 0.5957447 0.014336553 2
## [1057] {other vegetables,=> {root vegetables}    0.008540925 0.2847458 0.029994916 2
##           root vegetables}=> {domestic eggs}          0.008540925 0.1746362 0.048906965 2
## [1058] {domestic eggs,    => {whole milk}            0.008540925 0.4098361 0.012404677 2
##           root vegetables}=> {root vegetables}    0.008540925 0.2283105 0.022267412 1
## [1059] {domestic eggs,    => {domestic eggs}          0.008540925 0.1552795 0.032740214 2
##           whole milk}        => {other vegetables}    0.005083884 0.4098361 0.012404677 2
## [1060] {root vegetables,  => {soda}                  0.005083884 0.4180328 0.012404677 1
##           whole milk}        => {domestic eggs}          0.005083884 0.1728814 0.029994916 0
## [1061] {domestic eggs,    => {whole milk}            0.005083884 0.1294416 0.040061007 2
##           soda}              => {soda}                  0.005083884 0.2602740 0.022267412 1
## [1062] {domestic eggs,    => {domestic eggs}          0.005083884 0.1334895 0.043416370 2
##           other vegetables}=> {other vegetables}    0.005795628 0.4042553 0.014336553 2
## [1063] {other vegetables,=> {yogurt}                0.005795628 0.005795628 0.22267412 1
##           soda}              => {domestic eggs}          0.005795628 0.1379310 0.056024403 2
## [1064] {domestic eggs,    => {whole milk}            0.005795628 0.2576271 0.029994916 1
##           soda}              => {yogurt}                0.005795628 0.005795628 0.1379310 0.056024403 2
## [1065] {domestic eggs,    => {whole milk}            0.005185562 0.5390071 0.014336553 2
##           whole milk}         => {yogurt}                0.005185562 0.2648402 0.022267412 1
## [1066] {soda,              => {domestic eggs}          0.005185562 0.1384248 0.042602949 2
##           whole milk}         => {other vegetables}    0.005897306 0.3766234 0.015658363 1
## [1067] {domestic eggs,    => {rolls/buns}            0.005897306 0.005897306 0.2203390 0.029994916 1
##           yogurt}             => {domestic eggs}          0.005897306 0.4220779 0.015658363 1
## [1068] {domestic eggs,    => {whole milk}            0.005897306 0.1166966 0.056634469 1
##           other vegetables}=> {rolls/buns}            0.006609049 0.2203390 0.029994916 1
## [1069] {other vegetables,=> {domestic eggs}          0.006609049 0.5525114 0.022267412 2
##           yogurt}             => {whole milk}            0.012302999 0.4101695 0.029994916 2
## [1070] {domestic eggs,    => {other vegetables}    0.012302999 0.1166966 0.056634469 1
##           yogurt}             => {whole milk}            0.006609049 0.2203390 0.029994916 1
## [1071] {domestic eggs,    => {rolls/buns}            0.006609049 0.5525114 0.022267412 2
##           whole milk}         => {domestic eggs}          0.006609049 0.1166966 0.056634469 1
## [1072] {whole milk,       => {yogurt}                0.006609049 0.2203390 0.029994916 1
##           yogurt}             => {domestic eggs}          0.007727504 0.4220779 0.015658363 1
## [1073] {domestic eggs,    => {domestic eggs}          0.007727504 0.1384248 0.042602949 2
##           rolls/buns}          => {other vegetables}    0.007727504 0.2648402 0.022267412 1
## [1074] {domestic eggs,    => {rolls/buns}            0.007727504 0.1379310 0.056024403 2
##           other vegetables}=> {domestic eggs}          0.007727504 0.2203390 0.029994916 1
## [1075] {other vegetables,=> {domestic eggs}          0.007727504 0.5525114 0.022267412 2
##           rolls/buns}          => {whole milk}            0.006609049 0.4101695 0.029994916 2
## [1076] {domestic eggs,    => {whole milk}            0.006609049 0.1166966 0.056634469 1
##           rolls/buns}          => {rolls/buns}            0.006609049 0.2203390 0.029994916 1
## [1077] {domestic eggs,    => {domestic eggs}          0.006609049 0.5525114 0.022267412 2
##           whole milk}         => {rolls/buns}            0.006609049 0.1166966 0.056634469 1
## [1078] {rolls/buns,       => {domestic eggs}          0.006609049 0.2203390 0.029994916 1
##           whole milk}          => {whole milk}            0.012302999 0.4101695 0.029994916 2
## [1079] {domestic eggs,    => {other vegetables}    0.012302999 0.1166966 0.056634469 1
##           other vegetables}=> {whole milk}            0.012302999 0.2203390 0.029994916 1
## [1080] {domestic eggs,    => {other vegetables}    0.012302999 0.5525114 0.022267412 2
##           whole milk}          => {other vegetables}  0.012302999 0.1166966 0.056634469 1
## [1081] {other vegetables,

```

```

##      whole milk}          => {domestic eggs}          0.012302999  0.1644022  0.074834774 2
## [1082] {bottled water,    => {soda}                  0.005185562  0.3642857  0.014234875 2
##           fruit/vegetable juice}=> {bottled water}          0.005185562  0.2817680  0.018403660 2
## [1083] {fruit/vegetable juice,=> {fruit/vegetable juice}  0.005185562  0.1789474  0.028978139 2
##           soda}              => {whole milk}            0.005795628  0.4071429  0.014234875 1
## [1084] {bottled water,    => {bottled water}          0.005795628  0.2175573  0.026639553 1
##           soda}              => {fruit/vegetable juice} 0.005795628  0.1686391  0.034367056 2
## [1085] {bottled water,    => {other vegetables}       0.006609049  0.4814815  0.013726487 2
##           fruit/vegetable juice}=> {tropical fruit}        0.006609049  0.3140097  0.021047280 2
## [1086] {fruit/vegetable juice,=> {fruit/vegetable juice}  0.006609049  0.1841360  0.035892222 2
##           whole milk}         => {whole milk}            0.005998983  0.4370370  0.013726487 1
## [1087] {bottled water,    => {tropical fruit}          0.005998983  0.2251908  0.026639553 2
##           whole milk}         => {fruit/vegetable juice} 0.005998983  0.1418269  0.042297916 1
## [1088] {fruit/vegetable juice,=> {other vegetables}       0.006609049  0.5508475  0.011997966 2
##           tropical fruit}     => {root vegetables}        0.006609049  0.3140097  0.021047280 2
## [1089] {fruit/vegetable juice,=> {fruit/vegetable juice}  0.006609049  0.1394850  0.047381800 1
##           other vegetables}   => {whole milk}            0.006507372  0.5423729  0.011997966 2
## [1090] {other vegetables,=> {root vegetables}          0.006507372  0.2442748  0.026639553 2
##           tropical fruit}     => {fruit/vegetable juice} 0.006507372  0.1330561  0.048906965 1
## [1091] {fruit/vegetable juice,=> {yogurt}                0.005083884  0.2762431  0.018403660 1
##           tropical fruit}     => {soda}                  0.005083884  0.2717391  0.018708693 1
## [1092] {fruit/vegetable juice,=> {fruit/vegetable juice}  0.005083884  0.1858736  0.027351296 2
##           whole milk}         => {whole milk}            0.006100661  0.3314917  0.018403660 1
## [1093] {tropical fruit,    => {soda}                  0.006100661  0.2290076  0.026639553 1
##           whole milk}         => {fruit/vegetable juice} 0.006100661  0.1522843  0.040061007 2
## [1094] {fruit/vegetable juice,=> {other vegetables}       0.008235892  0.4402174  0.018708693 2
##           root vegetables}   => {other vegetables}       0.008235892  0.3913043  0.021047280 2
## [1095] {fruit/vegetable juice,=> {yogurt}                0.008235892  0.3913043  0.021047280 2
##           other vegetables}  => {whole milk}            0.006507372  0.2442748  0.026639553 2
## [1096] {other vegetables,=> {root vegetables}          0.006507372  0.2442748  0.026639553 2
##           root vegetables}   => {fruit/vegetable juice} 0.006507372  0.1330561  0.048906965 1
## [1097] {fruit/vegetable juice,=> {whole milk}            0.006507372  0.5423729  0.011997966 2
##           root vegetables}   => {root vegetables}          0.006507372  0.2442748  0.026639553 2
## [1098] {fruit/vegetable juice,=> {fruit/vegetable juice}  0.006507372  0.1330561  0.048906965 1
##           whole milk}         => {root vegetables}          0.006507372  0.2442748  0.026639553 2
## [1099] {root vegetables,  => {fruit/vegetable juice}  0.006507372  0.1330561  0.048906965 1
##           whole milk}         => {yogurt}                0.005083884  0.2762431  0.018403660 1
## [1100] {fruit/vegetable juice,=> {soda}                  0.005083884  0.2717391  0.018708693 1
##           soda}               => {whole milk}            0.006100661  0.3314917  0.018403660 1
## [1101] {fruit/vegetable juice,=> {yogurt}                0.005083884  0.2762431  0.018403660 1
##           yogurt}             => {soda}                  0.005083884  0.2717391  0.018708693 1
## [1102] {soda,               => {fruit/vegetable juice} 0.005083884  0.1858736  0.027351296 2
##           yogurt}             => {whole milk}            0.006100661  0.3314917  0.018403660 1
## [1103] {fruit/vegetable juice,=> {whole milk}            0.006100661  0.3314917  0.018403660 1
##           soda}               => {soda}                  0.006100661  0.2290076  0.026639553 1
## [1104] {fruit/vegetable juice,=> {soda}                  0.006100661  0.2290076  0.026639553 1
##           whole milk}          => {fruit/vegetable juice} 0.006100661  0.1522843  0.040061007 2
## [1105] {soda,               => {fruit/vegetable juice} 0.006100661  0.1522843  0.040061007 2
##           whole milk}          => {whole milk}            0.006100661  0.3314917  0.018403660 1
## [1106] {fruit/vegetable juice,=> {yogurt}                0.008235892  0.4402174  0.018708693 2
##           yogurt}              => {other vegetables}       0.008235892  0.3913043  0.021047280 2
## [1107] {fruit/vegetable juice,=> {yogurt}                0.008235892  0.3913043  0.021047280 2
##           other vegetables}   => {whole milk}            0.006100661  0.3314917  0.018403660 1
## [1108] {other vegetables,

```

```

##      yogurt} => {fruit/vegetable juice} 0.008235892 0.1896956 0.043416370 2
## [1109] {fruit/vegetable juice, => {whole milk} 0.009456024 0.5054348 0.018708693 1
##      yogurt} => {yogurt} 0.009456024 0.3549618 0.026639553 2
## [1110] {fruit/vegetable juice, => {fruit/vegetable juice} 0.009456024 0.1687840 0.056024403 2
##      whole milk} => {whole milk} 0.005592272 0.3846154 0.014539908 1
## [1111] {whole milk, => {rolls/buns} 0.005592272 0.2099237 0.026639553 1
##      yogurt} => {fruit/vegetable juice} 0.009456024 0.1687840 0.056024403 2
## [1112] {fruit/vegetable juice, => {whole milk} 0.005592272 0.3846154 0.014539908 1
##      rolls/buns} => {whole milk} 0.005592272 0.2099237 0.026639553 1
## [1113] {fruit/vegetable juice, => {whole milk} 0.010472801 0.4975845 0.021047280 1
##      whole milk} => {other vegetables} 0.010472801 0.3931298 0.026639553 2
## [1114] {fruit/vegetable juice, => {whole milk} 0.010472801 0.1399457 0.074834774 1
##      other vegetables} => {other vegetables} 0.005592272 0.6043956 0.009252669 3
## [1115] {fruit/vegetable juice, => {whole milk} 0.010472801 0.4975845 0.021047280 1
##      whole milk} => {other vegetables} 0.010472801 0.3931298 0.026639553 2
## [1116] {other vegetables, => {fruit/vegetable juice} 0.010472801 0.1399457 0.074834774 1
##      whole milk} => {other vegetables} 0.005592272 0.6043956 0.009252669 3
## [1117] {pip fruit, => {whole milk} 0.005592272 0.6483516 0.009252669 2
##      whipped/sour cream} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1118] {other vegetables, => {whole milk} 0.005592272 0.2140078 0.026131164 2
##      whipped/sour cream} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1119] {other vegetables, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      pip fruit} => {whipped/sour cream} 0.005592272 0.1936620 0.028876462 2
## [1120] {pip fruit, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whipped/sour cream} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1121] {whipped/sour cream, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whole milk} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1122] {pip fruit, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whole milk} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1123] {citrus fruit, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whipped/sour cream} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1124] {other vegetables, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whipped/sour cream} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1125] {citrus fruit, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      other vegetables} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1126] {citrus fruit, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whipped/sour cream} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1127] {whipped/sour cream, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whole milk} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1128] {citrus fruit, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whole milk} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1129] {sausage, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whipped/sour cream} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1130] {whipped/sour cream, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whole milk} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1131] {sausage, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whole milk} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1132] {tropical fruit, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      whipped/sour cream} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1133] {whipped/sour cream, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      yogurt} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1134] {tropical fruit, => {whole milk} 0.005592272 0.1936620 0.028876462 2
##      yogurt} => {whole milk} 0.005592272 0.1936620 0.028876462 2
## [1135] {tropical fruit,

```

| | | | | | | |
|-----------|----------------------|-------------------------|-------------|-----------|-------------|---|
| ## | whipped/sour cream} | => {other vegetables} | 0.007829181 | 0.5661765 | 0.013828165 | 2 |
| ## [1136] | {other vegetables, | => {tropical fruit} | 0.007829181 | 0.2711268 | 0.028876462 | 2 |
| ## | whipped/sour cream} | => {whipped/sour cream} | 0.007829181 | 0.2181303 | 0.035892222 | 3 |
| ## [1137] | {other vegetables, | => {whole milk} | 0.007930859 | 0.5735294 | 0.013828165 | 2 |
| ## | tropical fruit} | => {tropical fruit} | 0.007930859 | 0.2460568 | 0.032231825 | 2 |
| ## [1138] | {tropical fruit, | => {whipped/sour cream} | 0.007930859 | 0.1875000 | 0.042297916 | 2 |
| ## | whipped/sour cream} | => {yogurt} | 0.006405694 | 0.3750000 | 0.017081851 | 2 |
| ## [1139] | {whipped/sour cream, | => {root vegetables} | 0.006405694 | 0.3088235 | 0.020742247 | 2 |
| ## | whole milk} | => {whipped/sour cream} | 0.006405694 | 0.2480315 | 0.025826131 | 3 |
| ## [1140] | {tropical fruit, | => {other vegetables} | 0.008540925 | 0.5000000 | 0.017081851 | 2 |
| ## | whole milk} | => {root vegetables} | 0.008540925 | 0.2957746 | 0.028876462 | 2 |
| ## [1141] | {root vegetables, | => {whipped/sour cream} | 0.008540925 | 0.1802575 | 0.047381800 | 2 |
| ## | whipped/sour cream} | => {whole milk} | 0.009456024 | 0.5535714 | 0.017081851 | 2 |
| ## [1142] | {whipped/sour cream, | => {root vegetables} | 0.009456024 | 0.2933754 | 0.032231825 | 2 |
| ## | yogurt} | => {whipped/sour cream} | 0.009456024 | 0.1933472 | 0.048906965 | 2 |
| ## [1143] | {root vegetables, | => {whole milk} | 0.005490595 | 0.4736842 | 0.011591256 | 1 |
| ## | yogurt} | => {soda} | 0.005490595 | 0.1703470 | 0.032231825 | 0 |
| ## [1144] | {root vegetables, | => {whipped/sour cream} | 0.005490595 | 0.1370558 | 0.040061007 | 1 |
| ## | whipped/sour cream} | => {other vegetables} | 0.010167768 | 0.4901961 | 0.020742247 | 2 |
| ## [1145] | {other vegetables, | => {yogurt} | 0.010167768 | 0.3521127 | 0.028876462 | 2 |
| ## | whipped/sour cream} | => {whipped/sour cream} | 0.010167768 | 0.2341920 | 0.043416370 | 3 |
| ## [1146] | {other vegetables, | => {whole milk} | 0.010879512 | 0.5245098 | 0.020742247 | 2 |
| ## | root vegetables} | => {yogurt} | 0.010879512 | 0.3375394 | 0.032231825 | 2 |
| ## [1147] | {root vegetables, | => {whipped/sour cream} | 0.010879512 | 0.1941924 | 0.056024403 | 2 |
| ## | whipped/sour cream} | => {other vegetables} | 0.006710727 | 0.4583333 | 0.014641586 | 2 |
| ## [1148] | {whipped/sour cream, | => {rolls/buns} | 0.006710727 | 0.2323944 | 0.028876462 | 1 |
| ## | whole milk} | => {whipped/sour cream} | 0.006710727 | 0.1575179 | 0.042602949 | 2 |
| ## [1149] | {root vegetables, | | | | | |
| ## | whole milk} | | | | | |
| ## [1150] | {soda, | | | | | |
| ## | whipped/sour cream} | | | | | |
| ## [1151] | {whipped/sour cream, | | | | | |
| ## | whole milk} | | | | | |
| ## [1152] | {soda, | | | | | |
| ## | whole milk} | | | | | |
| ## [1153] | {whipped/sour cream, | | | | | |
| ## | yogurt} | | | | | |
| ## [1154] | {other vegetables, | | | | | |
| ## | whipped/sour cream} | | | | | |
| ## [1155] | {other vegetables, | | | | | |
| ## | yogurt} | | | | | |
| ## [1156] | {whipped/sour cream, | | | | | |
| ## | yogurt} | | | | | |
| ## [1157] | {whipped/sour cream, | | | | | |
| ## | whole milk} | | | | | |
| ## [1158] | {whole milk, | | | | | |
| ## | yogurt} | | | | | |
| ## [1159] | {rolls/buns, | | | | | |
| ## | whipped/sour cream} | | | | | |
| ## [1160] | {other vegetables, | | | | | |
| ## | whipped/sour cream} | | | | | |
| ## [1161] | {other vegetables, | | | | | |
| ## | rolls/buns} | | | | | |
| ## [1162] | {rolls/buns, | | | | | |

| | | | | | | |
|-----------|----------------------|-------------------------|-------------|-----------|-------------|---|
| ## | whipped/sour cream} | => {whole milk} | 0.007829181 | 0.5347222 | 0.014641586 | 2 |
| ## [1163] | {whipped/sour cream, | => {rolls/buns} | 0.007829181 | 0.2429022 | 0.032231825 | 1 |
| ## | whole milk} | => {whipped/sour cream} | 0.007829181 | 0.1382406 | 0.056634469 | 1 |
| ## [1164] | {rolls/buns, | => {whole milk} | 0.014641586 | 0.5070423 | 0.028876462 | 1 |
| ## | whole milk} | => {other vegetables} | 0.014641586 | 0.4542587 | 0.032231825 | 2 |
| ## [1165] | {other vegetables, | => {whipped/sour cream} | 0.014641586 | 0.1956522 | 0.074834774 | 2 |
| ## | whipped/sour cream} | => {whole milk} | 0.005083884 | 0.4761905 | 0.010676157 | 1 |
| ## [1166] | {whipped/sour cream, | => {other vegetables} | 0.005083884 | 0.1689189 | 0.030096594 | 1 |
| ## | whole milk} | => {whipped/sour cream} | 0.005083884 | 0.1529052 | 0.033248602 | 2 |
| ## [1167] | {other vegetables, | => {pastry} | 0.005083884 | 0.2736318 | 0.020437214 | 3 |
| ## | whole milk} | => {pip fruit} | 0.005592272 | 0.4044118 | 0.013828165 | 3 |
| ## [1168] | {pastry, | => {tropical fruit} | 0.005592272 | 0.2806122 | 0.019928826 | 3 |
| ## | pip fruit} | => {citrus fruit} | 0.005592272 | 0.2042254 | 0.028876462 | 2 |
| ## [1169] | {pip fruit, | => {whole milk} | 0.005185562 | 0.3750000 | 0.013828165 | 1 |
| ## | whole milk} | => {citrus fruit} | 0.005185562 | 0.1722973 | 0.030096594 | 2 |
| ## [1170] | {pastry, | => {pip fruit} | 0.005185562 | 0.1700000 | 0.030503305 | 2 |
| ## | whole milk} | => {whole milk} | 0.005592272 | 0.5188679 | 0.010777834 | 2 |
| ## [1171] | {citrus fruit, | => {sausage} | 0.005592272 | 0.1858108 | 0.030096594 | 1 |
| ## | pip fruit} | => {whole milk} | 0.005592272 | 0.1870748 | 0.029893238 | 2 |
| ## [1172] | {pip fruit, | => {root vegetables} | 0.005287239 | 0.2587065 | 0.020437214 | 2 |
| ## | tropical fruit} | => {tropical fruit} | 0.005287239 | 0.3398693 | 0.015556685 | 3 |
| ## [1173] | {citrus fruit, | => {pip fruit} | 0.005287239 | 0.2512077 | 0.021047280 | 3 |
| ## | tropical fruit} | => {yogurt} | 0.006405694 | 0.3134328 | 0.020437214 | 2 |
| ## [1174] | {citrus fruit, | => {tropical fruit} | 0.006405694 | 0.3559322 | 0.017996950 | 3 |
| ## | pip fruit} | => {whole milk} | 0.006405694 | 0.2187500 | 0.029283172 | 2 |
| ## [1175] | {other vegetables, | => {other vegetables} | 0.005897306 | 0.4264706 | 0.013828165 | 2 |
| ## | pip fruit} | => {citrus fruit} | 0.005897306 | 0.2256809 | 0.026131164 | 2 |
| ## [1176] | {citrus fruit, | => {whole milk} | 0.005897306 | 0.2042254 | 0.028876462 | 2 |
| ## | other vegetables} | => {citrus fruit} | 0.005185562 | 0.3750000 | 0.013828165 | 1 |
| ## [1177] | {citrus fruit, | => {whole milk} | 0.005185562 | 0.1722973 | 0.030096594 | 2 |
| ## | pip fruit} | => {citrus fruit} | 0.005185562 | 0.1700000 | 0.030503305 | 2 |
| ## [1178] | {pip fruit, | => {whole milk} | 0.005592272 | 0.5188679 | 0.010777834 | 2 |
| ## | whole milk} | => {whole milk} | 0.005592272 | 0.1858108 | 0.030096594 | 1 |
| ## [1179] | {citrus fruit, | => {sausage} | 0.005592272 | 0.1870748 | 0.029893238 | 2 |
| ## | whole milk} | => {whole milk} | 0.005185562 | 0.1700000 | 0.030503305 | 2 |
| ## [1180] | {pip fruit, | => {root vegetables} | 0.005287239 | 0.2587065 | 0.020437214 | 2 |
| ## | sausage} | => {tropical fruit} | 0.005287239 | 0.3398693 | 0.015556685 | 3 |
| ## [1181] | {pip fruit, | => {pip fruit} | 0.005287239 | 0.2512077 | 0.021047280 | 3 |
| ## | whole milk} | => {whole milk} | 0.005592272 | 0.3134328 | 0.020437214 | 2 |
| ## [1182] | {sausage, | => {whole milk} | 0.005592272 | 0.3559322 | 0.017996950 | 3 |
| ## | whole milk} | => {root vegetables} | 0.005185562 | 0.2587065 | 0.020437214 | 2 |
| ## [1183] | {pip fruit, | => {tropical fruit} | 0.005287239 | 0.3398693 | 0.015556685 | 3 |
| ## | tropical fruit} | => {whole milk} | 0.005592272 | 0.2512077 | 0.021047280 | 3 |
| ## [1184] | {pip fruit, | => {whole milk} | 0.005592272 | 0.3134328 | 0.020437214 | 2 |
| ## | root vegetables} | => {root vegetables} | 0.005287239 | 0.2587065 | 0.020437214 | 2 |
| ## [1185] | {root vegetables, | => {pip fruit} | 0.005287239 | 0.3398693 | 0.015556685 | 3 |
| ## | tropical fruit} | => {whole milk} | 0.005592272 | 0.2512077 | 0.021047280 | 3 |
| ## [1186] | {pip fruit, | => {whole milk} | 0.005592272 | 0.3134328 | 0.020437214 | 2 |
| ## | tropical fruit} | => {yogurt} | 0.006405694 | 0.3559322 | 0.017996950 | 3 |
| ## [1187] | {pip fruit, | => {tropical fruit} | 0.006405694 | 0.2187500 | 0.029283172 | 2 |
| ## | yogurt} | => {whole milk} | 0.006405694 | 0.2042254 | 0.028876462 | 2 |
| ## [1188] | {tropical fruit, | => {whole milk} | 0.006405694 | 0.1870748 | 0.029893238 | 2 |
| ## | yogurt} | => {root vegetables} | 0.005287239 | 0.2587065 | 0.020437214 | 2 |
| ## [1189] | {pip fruit, | => {tropical fruit} | 0.005287239 | 0.3398693 | 0.015556685 | 3 |

```

##      tropical fruit} => {other vegetables} 0.009456024 0.4626866 0.020437214 2
## [1190] {other vegetables,
##          pip fruit} => {tropical fruit} 0.009456024 0.3618677 0.026131164 3
## [1191] {other vegetables,
##          tropical fruit} => {pip fruit} 0.009456024 0.2634561 0.035892222 3
## [1192] {pip fruit,
##          tropical fruit} => {whole milk} 0.008439248 0.4129353 0.020437214 1
## [1193] {pip fruit,
##          whole milk} => {tropical fruit} 0.008439248 0.2804054 0.030096594 2
## [1194] {tropical fruit,
##          whole milk} => {pip fruit} 0.008439248 0.1995192 0.042297916 2
## [1195] {pip fruit,
##          root vegetables} => {yogurt} 0.005287239 0.3398693 0.015556685 2
## [1196] {pip fruit,
##          yogurt} => {root vegetables} 0.005287239 0.2937853 0.017996950 2
## [1197] {root vegetables,
##          yogurt} => {pip fruit} 0.005287239 0.2047244 0.025826131 2
## [1198] {pip fruit,
##          root vegetables} => {other vegetables} 0.008134215 0.5228758 0.015556685 2
## [1199] {other vegetables,
##          pip fruit} => {root vegetables} 0.008134215 0.3112840 0.026131164 2
## [1200] {other vegetables,
##          root vegetables} => {pip fruit} 0.008134215 0.1716738 0.047381800 2
## [1201] {pip fruit,
##          root vegetables} => {whole milk} 0.008947636 0.5751634 0.015556685 2
## [1202] {pip fruit,
##          whole milk} => {root vegetables} 0.008947636 0.2972973 0.030096594 2
## [1203] {root vegetables,
##          whole milk} => {pip fruit} 0.008947636 0.1829522 0.048906965 2
## [1204] {pip fruit,
##          yogurt} => {other vegetables} 0.008134215 0.4519774 0.017996950 2
## [1205] {other vegetables,
##          pip fruit} => {yogurt} 0.008134215 0.3112840 0.026131164 2
## [1206] {other vegetables,
##          yogurt} => {pip fruit} 0.008134215 0.1873536 0.043416370 2
## [1207] {pip fruit,
##          yogurt} => {whole milk} 0.009557702 0.5310734 0.017996950 2
## [1208] {pip fruit,
##          whole milk} => {yogurt} 0.009557702 0.3175676 0.030096594 2
## [1209] {whole milk,
##          yogurt} => {pip fruit} 0.009557702 0.1705989 0.056024403 2
## [1210] {pip fruit,
##          rolls/buns} => {other vegetables} 0.005083884 0.3649635 0.013929842 1
## [1211] {other vegetables,
##          pip fruit} => {rolls/buns} 0.005083884 0.1945525 0.026131164 1
## [1212] {other vegetables,
##          rolls/buns} => {pip fruit} 0.005083884 0.1193317 0.042602949 1
## [1213] {pip fruit,
##          rolls/buns} => {whole milk} 0.006202339 0.4452555 0.013929842 1
## [1214] {pip fruit,
##          whole milk} => {rolls/buns} 0.006202339 0.2060811 0.030096594 1
## [1215] {rolls/buns,
##          whole milk} => {pip fruit} 0.006202339 0.1095153 0.056634469 1
## [1216] {other vegetables,
##          whole milk} => {other vegetables} 0.009456024 0.4626866 0.020437214 2

```

```

##      pip fruit}          => {whole milk}          0.013523132  0.5175097 0.026131164 2
## [1217] {pip fruit,       => {other vegetables} 0.013523132  0.4493243 0.030096594 2
##           whole milk}    => {pip fruit}          0.013523132  0.1807065 0.074834774 2
## [1218] {other vegetables,=> {whole milk}          0.005693950  0.4552846 0.012506355 1
##           whole milk}    => {sausage}           0.005693950  0.1712538 0.033248602 1
## [1219] {pastry,          => {pastry}            0.005693950  0.1904762 0.029893238 2
##           sausage}         => {other vegetables} 0.005083884  0.3846154 0.013218099 1
## [1220] {pastry,          => {tropical fruit}   0.005083884  0.2252252 0.022572445 2
##           whole milk}     => {pastry}           0.005083884  0.1416431 0.035892222 1
## [1221] {sausage,          => {whole milk}          0.006710727  0.5076923 0.013218099 1
##           whole milk}     => {tropical fruit}   0.006710727  0.2018349 0.033248602 1
## [1222] {pastry,          => {pastry}           0.006710727  0.1586538 0.042297916 1
##           tropical fruit} => {other vegetables} 0.005897306  0.5370370 0.010981190 2
## [1223] {other vegetables,=> {root vegetables}  0.005897306  0.2612613 0.022572445 2
##           pastry}         => {pastry}            0.005897306  0.1244635 0.047381800 1
## [1224] {other vegetables,=> {whole milk}          0.005693950  0.5185185 0.010981190 2
##           tropical fruit}=> {pastry}           0.005693950  0.1712538 0.033248602 1
## [1225] {pastry,          => {root vegetables}  0.005693950  0.1164241 0.048906965 1
##           tropical fruit}=> {rolls/buns}        0.005388917  0.2560386 0.021047280 1
## [1226] {pastry,          => {soda}              0.005388917  0.2572816 0.020945602 1
##           whole milk}     => {pastry}           0.005388917  0.1405836 0.038332486 1
## [1227] {tropical fruit,=> {other vegetables}  0.005490595  0.2608696 0.021047280 1
##           whole milk}     => {soda}              0.005490595  0.2432432 0.022572445 1
## [1228] {pastry,          => {pastry}           0.005490595  0.1677019 0.032740214 1
##           root vegetables}=> {whole milk}        0.008235892  0.3913043 0.021047280 1
## [1229] {other vegetables,=> {soda}              0.008235892  0.2477064 0.033248602 1
##           pastry}         => {pastry}           0.008235892  0.2055838 0.040061007 2
## [1230] {other vegetables,=> {pastry}           0.008235892  0.1904762 0.029893238 2
##           root vegetables}=> {whole milk}        0.006710727  0.5076923 0.013218099 1
## [1231] {pastry,          => {root vegetables}  0.006710727  0.1586538 0.042297916 1
##           root vegetables}=> {pastry}           0.005693950  0.5185185 0.010981190 2
## [1232] {pastry,          => {whole milk}          0.005693950  0.1712538 0.033248602 1
##           whole milk}     => {root vegetables}  0.005693950  0.1164241 0.048906965 1
## [1233] {root vegetables,=> {pastry}           0.005693950  0.2560386 0.021047280 1
##           whole milk}     => {rolls/buns}        0.005388917  0.2572816 0.020945602 1
## [1234] {pastry,          => {soda}              0.005388917  0.1405836 0.038332486 1
##           soda}            => {pastry}           0.005388917  0.1244635 0.047381800 1
## [1235] {pastry,          => {rolls/buns}        0.005388917  0.1677019 0.032740214 1
##           rolls/buns}      => {soda}              0.005388917  0.2432432 0.022572445 1
## [1236] {rolls/buns,      => {pastry}           0.005388917  0.2055838 0.040061007 2
##           soda}             => {other vegetables} 0.005490595  0.2608696 0.021047280 1
## [1237] {pastry,          => {soda}              0.005490595  0.2477064 0.033248602 1
##           soda}             => {pastry}           0.005490595  0.1904762 0.029893238 2
## [1238] {other vegetables,=> {pastry}           0.005490595  0.1712538 0.033248602 1
##           pastry}            => {whole milk}        0.008235892  0.3913043 0.021047280 1
## [1239] {other vegetables,=> {soda}              0.008235892  0.2477064 0.033248602 1
##           soda}             => {pastry}           0.005490595  0.1677019 0.032740214 1
## [1240] {pastry,          => {whole milk}        0.008235892  0.2055838 0.040061007 2
##           soda}             => {soda}              0.008235892  0.2560386 0.021047280 1
## [1241] {pastry,          => {soda}              0.008235892  0.2477064 0.033248602 1
##           whole milk}       => {pastry}           0.008235892  0.2055838 0.040061007 2
## [1242] {soda,             => {pastry}           0.008235892  0.2477064 0.033248602 1
##           whole milk}       => {whole milk}        0.008235892  0.3913043 0.021047280 1
## [1243] {pastry,

```

```

##      yogurt} => {rolls/buns} 0.005795628 0.3275862 0.017691917 1
## [1244] {pastry,          => {yogurt} 0.005795628 0.2766990 0.020945602 1
##      rolls/buns}          => {pastry} 0.005795628 0.1686391 0.034367056 1
## [1245] {rolls/buns,      => {other vegetables} 0.006609049 0.3735632 0.017691917 1
##      yogurt}              => {yogurt} 0.006609049 0.2927928 0.022572445 2
## [1246] {pastry,          => {pastry} 0.006609049 0.1522248 0.043416370 1
##      yogurt}              => {whole milk} 0.009150991 0.5172414 0.017691917 2
## [1247] {other vegetables,=> {yogurt} 0.009150991 0.2752294 0.033248602 1
##      pastry}               => {pastry} 0.009150991 0.1633394 0.056024403 1
## [1248] {other vegetables,=> {whole milk} 0.009150991 0.2912621 0.020945602 1
##      yogurt}              => {pastry} 0.006100661 0.2702703 0.022572445 1
## [1249] {pastry,          => {other vegetables} 0.006100661 0.1431981 0.042602949 1
##      yogurt}              => {rolls/buns} 0.006100661 0.008540925 0.4077670 0.020945602 1
## [1250] {pastry,          => {pastry} 0.008540925 0.2568807 0.033248602 1
##      whole milk}           => {whole milk} 0.008540925 0.1508079 0.056634469 1
## [1251] {whole milk,      => {rolls/buns} 0.008540925 0.010574479 0.4684685 0.022572445 1
##      yogurt}              => {pastry} 0.010574479 0.3180428 0.033248602 1
## [1252] {pastry,          => {other vegetables} 0.010574479 0.1413043 0.074834774 1
##      rolls/buns}           => {whole milk} 0.010574479 0.005083884 0.3759398 0.013523132 1
## [1253] {other vegetables,=> {pastry} 0.010574479 0.1760563 0.028876462 1
##      pastry}               => {other vegetables} 0.005083884 0.005083884 0.2049180 0.024809354 2
## [1254] {other vegetables,=> {bottled water} 0.005083884 0.005897306 0.4360902 0.013523132 1
##      rolls/buns}           => {citrus fruit} 0.005083884 0.005897306 0.1933333 0.030503305 1
## [1255] {pastry,          => {whole milk} 0.005083884 0.1715976 0.034367056 2
##      rolls/buns}           => {bottled water} 0.005083884 0.005897306 0.005693950 0.2857143 0.019928826 2
## [1256] {pastry,          => {citrus fruit} 0.005083884 0.005897306 0.005693950 0.3218391 0.017691917 3
##      whole milk}           => {root vegetables} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1257] {rolls/buns,      => {tropical fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      whole milk}           => {citrus fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1258] {other vegetables,=> {citrus fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      pastry}               => {whole milk} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1259] {pastry,          => {other vegetables} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      whole milk}           => {pastry} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1260] {other vegetables,=> {whole milk} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      whole milk}           => {bottled water} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1261] {bottled water,    => {other vegetables} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      citrus fruit}         => {pastry} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1262] {citrus fruit,     => {bottled water} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      other vegetables}     => {citrus fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1263] {bottled water,    => {whole milk} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      other vegetables}     => {bottled water} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1264] {bottled water,    => {citrus fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      citrus fruit}         => {whole milk} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1265] {citrus fruit,     => {bottled water} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      whole milk}           => {citrus fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1266] {bottled water,    => {root vegetables} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      whole milk}           => {tropical fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1267] {citrus fruit,     => {citrus fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      tropical fruit}       => {root vegetables} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1268] {citrus fruit,     => {tropical fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      root vegetables}      => {citrus fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1269] {root vegetables,  => {tropical fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
##      tropical fruit}       => {citrus fruit} 0.005083884 0.005897306 0.005693950 0.2705314 0.021047280 3
## [1270] {citrus fruit,

```

```

##      tropical fruit}          => {yogurt}          0.006304016  0.3163265 0.019928826 2
## [1271] {citrus fruit,        => {tropical fruit} 0.006304016  0.2910798 0.021657346 2
##      yogurt}                 => {citrus fruit}   0.006304016  0.2152778 0.029283172 2
## [1272] {tropical fruit,     => {other vegetables} 0.009049314  0.4540816 0.019928826 2
##      yogurt}                 => {tropical fruit} 0.009049314  0.3133803 0.028876462 2
## [1273] {citrus fruit,       => {citrus fruit}    0.009049314  0.2521246 0.035892222 3
##      tropical fruit}         => {whole milk}     0.009049314  0.4540816 0.019928826 1
## [1274] {citrus fruit,       => {tropical fruit} 0.009049314  0.2966667 0.030503305 2
##      other vegetables}       => {citrus fruit}   0.009049314  0.2139423 0.042297916 2
## [1275] {other vegetables,  => {other vegetables} 0.010371124  0.5862069 0.017691917 3
##      tropical fruit}         => {root vegetables} 0.010371124  0.3591549 0.028876462 3
## [1276] {citrus fruit,       => {root vegetables} 0.010371124  0.2188841 0.047381800 2
##      tropical fruit}         => {whole milk}     0.009150991  0.5172414 0.017691917 2
## [1277] {citrus fruit,       => {root vegetables} 0.009150991  0.3000000 0.030503305 2
##      whole milk}              => {citrus fruit}   0.009150991  0.1871102 0.048906965 2
## [1278] {tropical fruit,     => {rolls/buns}     0.005795628  0.2676056 0.021657346 1
##      whole milk}              => {yogurt}         0.005795628  0.3454545 0.016776817 2
## [1279] {citrus fruit,       => {citrus fruit}    0.005795628  0.1686391 0.034367056 2
##      root vegetables}        => {other vegetables} 0.007625826  0.3521127 0.021657346 1
## [1280] {citrus fruit,       => {yogurt}         0.007625826  0.2640845 0.028876462 1
##      other vegetables}       => {citrus fruit}   0.007625826  0.1756440 0.043416370 2
## [1281] {other vegetables,  => {whole milk}     0.010269446  0.4741784 0.021657346 1
##      root vegetables}        => {rolls/buns}     0.010269446  0.3366667 0.030503305 2
## [1282] {citrus fruit,       => {yogurt}         0.010269446  0.1833031 0.056024403 2
##      root vegetables}        => {citrus fruit}   0.005998983  0.3575758 0.016776817 1
## [1283] {citrus fruit,       => {other vegetables} 0.005998983  0.2077465 0.028876462 1
##      whole milk}              => {rolls/buns}     0.005998983  0.1408115 0.042602949 1
## [1284] {root vegetables,   => {citrus fruit}    0.005998983  0.2910798 0.021657346 2
##      whole milk}              => {whole milk}     0.005998983  0.1686391 0.034367056 2
## [1285] {citrus fruit,       => {rolls/buns}     0.005998983  0.3521127 0.021657346 1
##      yogurt}                 => {yogurt}         0.005998983  0.2640845 0.028876462 1
## [1286] {citrus fruit,       => {citrus fruit}   0.005998983  0.1756440 0.043416370 2
##      rolls/buns}              => {other vegetables} 0.007625826  0.3575758 0.016776817 1
## [1287] {rolls/buns,        => {yogurt}         0.005998983  0.1833031 0.056024403 2
##      yogurt}                 => {citrus fruit}   0.005998983  0.2077465 0.028876462 1
## [1288] {citrus fruit,       => {whole milk}     0.005998983  0.1408115 0.042602949 1
##      yogurt}                 => {rolls/buns}     0.005998983  0.2910798 0.021657346 2
## [1289] {citrus fruit,       => {yogurt}         0.005998983  0.1686391 0.034367056 2
##      other vegetables}       => {citrus fruit}   0.005998983  0.2640845 0.028876462 1
## [1290] {other vegetables,  => {whole milk}     0.005998983  0.1756440 0.043416370 2
##      yogurt}                 => {rolls/buns}     0.005998983  0.3521127 0.021657346 1
## [1291] {citrus fruit,       => {yogurt}         0.005998983  0.1833031 0.056024403 2
##      yogurt}                 => {whole milk}     0.005998983  0.2077465 0.028876462 1
## [1292] {citrus fruit,       => {yogurt}         0.005998983  0.1408115 0.042602949 1
##      whole milk}              => {citrus fruit}   0.005998983  0.2910798 0.021657346 2
## [1293] {whole milk,         => {rolls/buns}     0.005998983  0.3575758 0.016776817 1
##      yogurt}                 => {yogurt}         0.005998983  0.2640845 0.028876462 1
## [1294] {citrus fruit,       => {other vegetables} 0.005998983  0.1833031 0.056024403 2
##      rolls/buns}              => {citrus fruit}   0.005998983  0.2077465 0.028876462 1
## [1295] {citrus fruit,       => {rolls/buns}     0.005998983  0.1408115 0.042602949 1
##      other vegetables}       => {yogurt}         0.005998983  0.2910798 0.021657346 2
## [1296] {other vegetables,  => {rolls/buns}     0.005998983  0.1686391 0.034367056 2
##      rolls/buns}              => {citrus fruit}   0.005998983  0.2640845 0.028876462 1
## [1297] {citrus fruit,

```

```

##      rolls/buns}          => {whole milk}          0.007219115  0.4303030 0.016776817 1
## [1298] {citrus fruit,    => {rolls/buns}          0.007219115  0.2366667 0.030503305 1
##           whole milk}     => {citrus fruit}        0.007219115  0.1274686 0.056634469 1
## [1299] {rolls/buns,     => {whole milk}          0.013014743  0.4507042 0.028876462 1
##           whole milk}     => {other vegetables} 0.013014743  0.4266667 0.030503305 2
## [1300] {citrus fruit,    => {whole milk}          0.013014743  0.1739130 0.074834774 2
##           other vegetables}=> {citrus fruit}        0.005693950  0.3636364 0.015658363 2
## [1301] {citrus fruit,    => {other vegetables} 0.005693950  0.2314050 0.024605999 2
##           whole milk}     => {soda}                0.005693950  0.2343096 0.024300966 2
## [1302] {other vegetables,=> {sausage}             0.005693950  0.3072917 0.019522115 3
##           whole milk}     => {shopping bags}       0.005998983  0.3831169 0.015658363 2
## [1303] {sausage,         => {rolls/buns}          0.005998983  0.3072917 0.019522115 3
##           shopping bags}   => {sausage}              0.005998983  0.1960133 0.030604982 1
## [1304] {shopping bags,   => {shopping bags}       0.005388917  0.3441558 0.015658363 1
##           soda}              => {other vegetables} 0.005388917  0.2324561 0.023182511 2
## [1305] {sausage,         => {sausage}              0.005388917  0.2000000 0.026944586 2
##           soda}              => {shopping bags}       0.006609049  0.5158730 0.012811388 2
## [1306] {sausage,         => {root vegetables}     0.006609049  0.2850877 0.023182511 2
##           shopping bags}   => {root vegetables}     0.006609049  0.1394850 0.047381800 1
## [1307] {rolls/buns,      => {shopping bags}       0.005287239  0.4126984 0.012811388 1
##           shopping bags}   => {whole milk}            0.005287239  0.2157676 0.024504321 1
## [1308] {rolls/buns,      => {root vegetables}     0.005287239  0.1081081 0.048906965 1
##           sausage}             => {shopping bags}       0.006304016  0.2561983 0.024605999 1
## [1309] {sausage,         => {rolls/buns}          0.006304016  0.3229167 0.019522115 1
##           shopping bags}   => {soda}                0.006304016  0.1644562 0.038332486 1
## [1310] {other vegetables,=> {shopping bags}       0.005388917  0.2190083 0.024605999 1
##           shopping bags}   => {other vegetables} 0.005388917  0.2324561 0.023182511 1
## [1311] {other vegetables,=> {sausage}              0.005388917  0.1645963 0.032740214 1
##           sausage}             => {shopping bags}       0.006609049  0.5158730 0.012811388 2
## [1312] {root vegetables,=> {other vegetables} 0.006609049  0.2850877 0.023182511 2
##           shopping bags}   => {root vegetables}     0.006609049  0.1394850 0.047381800 1
## [1313] {other vegetables,=> {shopping bags}       0.005287239  0.4126984 0.012811388 1
##           shopping bags}   => {whole milk}            0.005287239  0.2157676 0.024504321 1
## [1314] {other vegetables,=> {root vegetables}     0.005287239  0.1081081 0.048906965 1
##           root vegetables}  => {shopping bags}       0.006304016  0.2561983 0.024605999 1
## [1315] {root vegetables,=> {root vegetables}     0.006609049  0.3229167 0.019522115 1
##           shopping bags}   => {whole milk}            0.006609049  0.1644562 0.038332486 1
## [1316] {shopping bags,   => {root vegetables}     0.005287239  0.2157676 0.024504321 1
##           whole milk}        => {shopping bags}       0.006304016  0.1081081 0.048906965 1
## [1317] {root vegetables,=> {rolls/buns}          0.005287239  0.2561983 0.024605999 1
##           whole milk}        => {soda}                0.006304016  0.3229167 0.019522115 1
## [1318] {shopping bags,   => {rolls/buns}          0.006304016  0.2324561 0.023182511 1
##           soda}                 => {rolls/buns}          0.006304016  0.1644562 0.038332486 1
## [1319] {rolls/buns,      => {soda}                0.005388917  0.2190083 0.024605999 1
##           shopping bags}   => {other vegetables} 0.005388917  0.2324561 0.023182511 1
## [1320] {rolls/buns,      => {soda}                0.005388917  0.1645963 0.032740214 1
##           soda}                 => {shopping bags}       0.006609049  0.5158730 0.012811388 2
## [1321] {shopping bags,   => {shopping bags}       0.006609049  0.2850877 0.023182511 2
##           soda}                 => {other vegetables} 0.006609049  0.1394850 0.047381800 1
## [1322] {other vegetables,=> {soda}                0.005388917  0.2190083 0.024605999 1
##           shopping bags}   => {soda}                0.005388917  0.2324561 0.023182511 1
## [1323] {other vegetables,=> {soda}                0.005388917  0.1644562 0.038332486 1
##           soda}                 => {shopping bags}       0.006609049  0.5158730 0.012811388 2
## [1324] {shopping bags,   => {shopping bags}       0.006609049  0.2850877 0.023182511 2
##           soda}                 => {shopping bags}       0.006609049  0.1394850 0.047381800 1

```

```

##      soda}          => {whole milk}          0.006812405 0.2768595 0.024605999 1
## [1325] {shopping bags, => {soda}              0.006812405 0.2780083 0.024504321 1
##           whole milk}          => {shopping bags}          0.006812405 0.1700508 0.040061007 1
## [1326] {soda,          => {other vegetables}        0.005388917 0.3533333 0.015251652 1
##           whole milk}          => {yogurt}              0.005388917 0.2324561 0.023182511 1
## [1327] {shopping bags, => {shopping bags}          0.005388917 0.1241218 0.043416370 1
##           yogurt}             => {other vegetables}        0.005388917 0.3466667 0.015251652 1
## [1328] {other vegetables, => {yogurt}              0.005388917 0.2157676 0.024504321 1
##           shopping bags}        => {shopping bags}          0.005287239 0.2708333 0.019522115 1
## [1329] {other vegetables, => {whole milk}            0.005287239 0.2280702 0.023182511 1
##           yogurt}              => {whole milk}            0.005287239 0.1241050 0.042602949 1
## [1330] {shopping bags,    => {yogurt}              0.005287239 0.2708333 0.019522115 1
##           yogurt}              => {other vegetables}        0.005287239 0.3289474 0.023182511 1
## [1331] {shopping bags,    => {rolls/buns}            0.005287239 0.3112033 0.024504321 1
##           whole milk}          => {shopping bags}          0.005287239 0.1019022 0.074834774 1
## [1332] {rolls/buns,       => {whole milk}            0.005287239 0.1886792 0.026944586 1
##           shopping bags}        => {rolls/buns}            0.005083884 0.4237288 0.011997966 2
## [1333] {other vegetables, => {other vegetables}        0.005083884 0.2226415 0.026944586 2
##           shopping bags}        => {tropical fruit}          0.005998983 0.4306569 0.013929842 2
## [1334] {other vegetables, => {sausage}              0.005998983 0.1671388 0.035892222 1
##           whole milk}          => {whole milk}            0.005998983 0.5182482 0.013929842 2
## [1335] {rolls/buns,       => {tropical fruit}          0.005998983 0.2414966 0.029893238 2
##           shopping bags}        => {sausage}              0.007219115 0.1706731 0.042297916 1
## [1336] {shopping bags,    => {yogurt}              0.005185562 0.3469388 0.014946619 2
##           whole milk}          => {root vegetables}        0.005185562 0.2642487 0.019623793 2
## [1337] {other vegetables, => {root vegetables}        0.005185562 0.2642487 0.019623793 2
##           shopping bags}        => {sausage}              0.005185562 0.1019022 0.074834774 1
## [1338] {shopping bags,    => {whole milk}            0.005185562 0.1886792 0.026944586 1
##           whole milk}          => {other vegetables}        0.005185562 0.4237288 0.011997966 2
## [1339] {other vegetables, => {whole milk}            0.005185562 0.2226415 0.026944586 2
##           whole milk}          => {tropical fruit}          0.005185562 0.4306569 0.013929842 2
## [1340] {bottled water,     => {tropical fruit}          0.005185562 0.1671388 0.035892222 1
##           sausage}              => {bottled water}          0.005185562 0.5182482 0.013929842 2
## [1341] {other vegetables, => {sausage}              0.005185562 0.2414966 0.029893238 2
##           sausage}              => {other vegetables}        0.005185562 0.1706731 0.042297916 1
## [1342] {bottled water,     => {whole milk}            0.005185562 0.3469388 0.014946619 2
##           other vegetables}     => {sausage}              0.005185562 0.2642487 0.019623793 2
## [1343] {sausage,          => {whole milk}            0.005185562 0.1019022 0.074834774 1
##           tropical fruit}       => {other vegetables}        0.005185562 0.1886792 0.026944586 1
## [1344] {other vegetables, => {tropical fruit}          0.005185562 0.4237288 0.011997966 2
##           sausage}              => {sausage}              0.005185562 0.2226415 0.026944586 2
## [1345] {other vegetables, => {whole milk}            0.005185562 0.4306569 0.013929842 2
##           tropical fruit}       => {sausage}              0.005185562 0.1671388 0.035892222 1
## [1346] {sausage,          => {whole milk}            0.005185562 0.5182482 0.013929842 2
##           tropical fruit}       => {tropical fruit}          0.005185562 0.2414966 0.029893238 2
## [1347] {sausage,          => {tropical fruit}          0.005185562 0.1706731 0.042297916 1
##           whole milk}          => {sausage}              0.005185562 0.3469388 0.014946619 2
## [1348] {tropical fruit,    => {yogurt}              0.005185562 0.2642487 0.019623793 2
##           whole milk}          => {root vegetables}        0.005185562 0.1019022 0.074834774 1
## [1349] {root vegetables,   => {yogurt}              0.005185562 0.1886792 0.026944586 1
##           sausage}              => {whole milk}            0.005185562 0.4237288 0.011997966 2
## [1350] {sausage,          => {whole milk}            0.005185562 0.2226415 0.026944586 2
##           yogurt}              => {tropical fruit}          0.005185562 0.4306569 0.013929842 2
## [1351] {root vegetables,

```

```

##      yogurt}          => {sausage}          0.005185562  0.2007874  0.025826131 2
## [1352] {root vegetables, => {other vegetables} 0.006812405  0.4557823  0.014946619 2
##           sausage}          => {root vegetables} 0.006812405  0.2528302  0.026944586 2
## [1353] {other vegetables, => {sausage}          0.006812405  0.1437768  0.047381800 1
##           sausage}          => {whole milk}        0.007727504  0.5170068  0.014946619 2
## [1354] {other vegetables, => {root vegetables} 0.007727504  0.2585034  0.029893238 2
##           root vegetables}          => {sausage}          0.007727504  0.1580042  0.048906965 1
## [1355] {root vegetables, => {root vegetables} 0.007727504  0.2301255  0.024300966 1
##           sausage}          => {yogurt}            0.005592272  0.2849741  0.019623793 1
## [1356] {sausage,          => {soda}              0.005592272  0.2044610  0.027351296 2
##           whole milk}          => {sausage}          0.009659380  0.3974895  0.024300966 2
## [1357] {root vegetables, => {rolls/buns}        0.009659380  0.3156146  0.030604982 1
##           whole milk}          => {soda}              0.009659380  0.2519894  0.038332486 2
## [1358] {sausage,          => {sausage}          0.007219115  0.2970711  0.024300966 1
##           soda}              => {other vegetables} 0.007219115  0.2679245  0.026944586 1
## [1359] {sausage,          => {soda}              0.007219115  0.2204969  0.032740214 2
##           yogurt}             => {sausage}          0.006710727  0.2761506  0.024300966 1
## [1360] {soda,              => {whole milk}        0.006710727  0.2244898  0.029893238 1
##           yogurt}             => {soda}              0.006710727  0.1675127  0.040061007 1
## [1361] {sausage,          => {rolls/buns}        0.005998983  0.3056995  0.019623793 1
##           soda}              => {yogurt}            0.005998983  0.1960133  0.030604982 1
## [1362] {rolls/buns,       => {sausage}          0.005998983  0.1745562  0.034367056 1
##           sausage}            => {other vegetables} 0.008134215  0.4145078  0.019623793 2
## [1363] {rolls/buns,       => {yogurt}            0.008134215  0.3018868  0.026944586 2
##           soda}              => {sausage}          0.008134215  0.1873536  0.043416370 1
## [1364] {sausage,          => {whole milk}        0.008744281  0.4455959  0.019623793 1
##           soda}              => {yogurt}            0.008744281  0.2925170  0.029893238 2
## [1365] {other vegetables, => {soda}              0.008744281  0.2007874  0.025826131 2
##           sausage}            => {sausage}          0.007219115  0.2301255  0.024300966 1
## [1366] {other vegetables, => {whole milk}        0.007219115  0.2244898  0.029893238 1
##           soda}              => {soda}              0.007219115  0.1675127  0.040061007 1
## [1367] {sausage,          => {rolls/buns}        0.006710727  0.3056995  0.019623793 1
##           soda}              => {yogurt}            0.006710727  0.1960133  0.030604982 1
## [1368] {sausage,          => {sausage}          0.006710727  0.1745562  0.034367056 1
##           whole milk}         => {other vegetables} 0.008134215  0.4145078  0.019623793 2
## [1369] {soda,              => {whole milk}        0.008134215  0.3018868  0.026944586 2
##           whole milk}         => {soda}              0.008134215  0.1873536  0.043416370 1
## [1370] {sausage,          => {rolls/buns}        0.008134215  0.4455959  0.019623793 1
##           yogurt}             => {yogurt}            0.008134215  0.2925170  0.029893238 2
## [1371] {rolls/buns,       => {sausage}          0.008134215  0.2007874  0.025826131 2
##           sausage}            => {other vegetables} 0.008744281  0.2301255  0.024300966 1
## [1372] {rolls/buns,       => {yogurt}            0.008744281  0.2244898  0.029893238 1
##           yogurt}             => {sausage}          0.008744281  0.1675127  0.040061007 1
## [1373] {sausage,          => {other vegetables} 0.008744281  0.2007874  0.025826131 2
##           yogurt}             => {yogurt}            0.008744281  0.2301255  0.024300966 1
## [1374] {other vegetables, => {sausage}          0.008744281  0.2244898  0.029893238 1
##           sausage}            => {yogurt}            0.008744281  0.1675127  0.040061007 1
## [1375] {other vegetables, => {whole milk}        0.008744281  0.4455959  0.019623793 1
##           yogurt}             => {sausage}          0.008744281  0.2007874  0.025826131 2
## [1376] {sausage,          => {whole milk}        0.008744281  0.2244898  0.029893238 1
##           yogurt}             => {yogurt}            0.008744281  0.1675127  0.040061007 1
## [1377] {sausage,          => {whole milk}        0.008744281  0.2007874  0.025826131 2
##           whole milk}         => {yogurt}            0.008744281  0.2301255  0.024300966 1
## [1378] {whole milk,

```

```

##      yogurt} => {sausage} 0.008744281 0.1560799 0.056024403 1
## [1379] {rolls/buns, => {other vegetables} 0.008845958 0.2890365 0.030604982 1
##          sausage} => {rolls/buns} 0.008845958 0.3283019 0.026944586 1
## [1380] {other vegetables, => {sausage} 0.008845958 0.2076372 0.042602949 2
##          sausage} => {whole milk} 0.009354347 0.3056478 0.030604982 1
## [1381] {other vegetables, => {rolls/buns} 0.009354347 0.3129252 0.029893238 1
##          rolls/buns} => {sausage} 0.009354347 0.1651706 0.056634469 1
## [1382] {rolls/buns, => {whole milk} 0.010167768 0.3773585 0.026944586 1
##          sausage} => {sausage} 0.010167768 0.3401361 0.029893238 1
## [1383] {sausage, => {other vegetables} 0.010167768 0.1358696 0.074834774 1
##          whole milk} => {sausage} 0.005185562 0.2802198 0.018505338 1
## [1384] {rolls/buns, => {whole milk} 0.005185562 0.1789474 0.028978139 1
##          whole milk} => {soda} 0.005185562 0.2487805 0.020843925 2
## [1385] {other vegetables, => {tropical fruit} 0.005185562 0.3846154 0.018505338 2
##          sausage} => {yogurt} 0.007117438 0.3097345 0.022979156 2
## [1386] {sausage, => {tropical fruit} 0.007117438 0.2430556 0.029283172 2
##          whole milk} => {bottled water} 0.005388917 0.2912088 0.018505338 1
## [1387] {other vegetables, => {yogurt} 0.005388917 0.2226891 0.024199288 2
##          whole milk} => {rolls/buns} 0.005388917 0.2190083 0.024605999 1
## [1388] {bottled water, => {tropical fruit} 0.006202339 0.3351648 0.018505338 1
##          tropical fruit} => {bottled water} 0.006202339 0.2500000 0.024809354 2
## [1389] {bottled water, => {other vegetables} 0.006202339 0.1728045 0.035892222 1
##          tropical fruit} => {tropical fruit} 0.008032537 0.4340659 0.018505338 1
## [1390] {soda, => {bottled water} 0.008032537 0.2337278 0.034367056 2
##          tropical fruit} => {rolls/buns} 0.008032537 0.1899038 0.042297916 1
## [1391] {bottled water, => {whole milk} 0.007015760 0.4480519 0.015658363 2
##          tropical fruit} => {tropical fruit} 0.007015760 0.2827869 0.024809354 2
## [1392] {bottled water, => {other vegetables} 0.007015760 0.2912088 0.018505338 1
##          yogurt} => {bottled water} 0.005388917 0.2226891 0.024199288 2
## [1393] {tropical fruit, => {tropical fruit} 0.005388917 0.2190083 0.024605999 1
##          yogurt} => {rolls/buns} 0.005388917 0.2500000 0.024809354 2
## [1394] {bottled water, => {tropical fruit} 0.006202339 0.3351648 0.018505338 1
##          tropical fruit} => {bottled water} 0.006202339 0.1728045 0.035892222 1
## [1395] {bottled water, => {other vegetables} 0.006202339 0.4340659 0.018505338 1
##          rolls/buns} => {tropical fruit} 0.008032537 0.2337278 0.034367056 2
## [1396] {rolls/buns, => {tropical fruit} 0.008032537 0.1899038 0.042297916 1
##          tropical fruit} => {bottled water} 0.005388917 0.2190083 0.024605999 1
## [1397] {bottled water, => {other vegetables} 0.006202339 0.3351648 0.018505338 1
##          tropical fruit} => {tropical fruit} 0.006202339 0.2500000 0.024809354 2
## [1398] {bottled water, => {bottled water} 0.006202339 0.1728045 0.035892222 1
##          other vegetables} => {tropical fruit} 0.008032537 0.4340659 0.018505338 1
## [1399] {other vegetables, => {bottled water} 0.008032537 0.2337278 0.034367056 2
##          tropical fruit} => {whole milk} 0.006202339 0.1899038 0.042297916 1
## [1400] {bottled water, => {tropical fruit} 0.008032537 0.4480519 0.015658363 2
##          tropical fruit} => {bottled water} 0.007015760 0.2827869 0.024809354 2
## [1401] {bottled water, => {whole milk} 0.007015760 0.2190083 0.024605999 1
##          whole milk} => {tropical fruit} 0.008032537 0.2500000 0.024809354 2
## [1402] {tropical fruit, => {bottled water} 0.008032537 0.1728045 0.035892222 1
##          whole milk} => {other vegetables} 0.007015760 0.4340659 0.018505338 1
## [1403] {bottled water, => {root vegetables} 0.007015760 0.2337278 0.034367056 2
##          root vegetables} => {other vegetables} 0.008032537 0.1899038 0.042297916 1
## [1404] {bottled water, => {root vegetables} 0.008032537 0.4480519 0.015658363 2
##          other vegetables} => {root vegetables} 0.007015760 0.2827869 0.024809354 2
## [1405] {other vegetables,

```

```

##      root vegetables} => {bottled water} 0.007015760 0.1480687 0.047381800 1
## [1406] {bottled water, => {whole milk} 0.007320793 0.4675325 0.015658363 1
##      root vegetables} => {root vegetables} 0.007320793 0.2130178 0.034367056 1
## [1407] {bottled water, => {bottled water} 0.007320793 0.1496881 0.048906965 1
##      whole milk} => {yogurt} 0.007422471 0.2561404 0.028978139 1
## [1408] {root vegetables, => {soda} 0.007422471 0.3230088 0.022979156 1
##      whole milk} => {bottled water} 0.007422471 0.2713755 0.027351296 2
## [1409] {bottled water, => {rolls/buns} 0.006812405 0.2350877 0.028978139 1
##      soda} => {soda} 0.006812405 0.2815126 0.024199288 1
## [1410] {bottled water, => {bottled water} 0.006812405 0.1777188 0.038332486 1
##      yogurt} => {other vegetables} 0.005693950 0.1964912 0.028978139 1
## [1411] {soda, => {soda} 0.005693950 0.2295082 0.024809354 1
##      yogurt} => {bottled water} 0.005693950 0.1739130 0.032740214 1
## [1412] {bottled water, => {whole milk} 0.007524148 0.2596491 0.028978139 1
##      soda} => {soda} 0.007524148 0.2189349 0.034367056 1
## [1413] {bottled water, => {bottled water} 0.007524148 0.1878173 0.040061007 1
##      rolls/buns} => {bottled water} 0.007117438 0.3097345 0.022979156 1
## [1414] {rolls/buns, => {rolls/buns} 0.007117438 0.2941176 0.024199288 2
##      soda} => {yogurt} 0.007117438 0.2071006 0.034367056 1
## [1415] {bottled water, => {bottled water} 0.008134215 0.3539823 0.022979156 1
##      soda} => {other vegetables} 0.008134215 0.3278689 0.024809354 2
## [1416] {bottled water, => {yogurt} 0.008134215 0.1873536 0.043416370 1
##      other vegetables} => {bottled water} 0.009659380 0.4203540 0.022979156 1
## [1417] {other vegetables, => {whole milk} 0.009659380 0.2810651 0.034367056 2
##      soda} => {yogurt} 0.009659380 0.1724138 0.056024403 1
## [1418] {bottled water, => {bottled water} 0.007320793 0.3025210 0.024199288 1
##      soda} => {other vegetables} 0.007320793 0.2950820 0.024809354 1
## [1419] {bottled water, => {rolls/buns} 0.007320793 0.2295082 0.024809354 1
##      whole milk} => {soda} 0.007320793 0.1739130 0.032740214 1
## [1420] {soda, => {bottled water} 0.007524148 0.3097345 0.022979156 1
##      whole milk} => {bottled water} 0.007117438 0.2941176 0.024199288 2
## [1421] {bottled water, => {rolls/buns} 0.007117438 0.2071006 0.034367056 1
##      yogurt} => {yogurt} 0.007117438 0.1878173 0.040061007 1
## [1422] {bottled water, => {bottled water} 0.008134215 0.3539823 0.022979156 1
##      rolls/buns} => {bottled water} 0.008134215 0.3278689 0.024809354 2
## [1423] {rolls/buns, => {yogurt} 0.008134215 0.1873536 0.043416370 1
##      yogurt} => {bottled water} 0.009659380 0.4203540 0.022979156 1
## [1424] {bottled water, => {whole milk} 0.009659380 0.2810651 0.034367056 2
##      yogurt} => {bottled water} 0.009659380 0.1724138 0.056024403 1
## [1425] {bottled water, => {yogurt} 0.009659380 0.2295082 0.024809354 1
##      other vegetables} => {bottled water} 0.008134215 0.3097345 0.022979156 1
## [1426] {other vegetables, => {whole milk} 0.008134215 0.2941176 0.024199288 1
##      yogurt} => {bottled water} 0.008134215 0.2071006 0.034367056 1
## [1427] {bottled water, => {whole milk} 0.008134215 0.1873536 0.043416370 1
##      yogurt} => {bottled water} 0.009659380 0.4203540 0.022979156 1
## [1428] {bottled water, => {yogurt} 0.009659380 0.2810651 0.034367056 2
##      whole milk} => {bottled water} 0.009659380 0.1724138 0.056024403 1
## [1429] {whole milk, => {bottled water} 0.007320793 0.3025210 0.024199288 1
##      yogurt} => {other vegetables} 0.007320793 0.2950820 0.024809354 1
## [1430] {bottled water, => {rolls/buns} 0.007320793 0.2295082 0.024809354 1
##      rolls/buns} => {other vegetables} 0.007320793 0.2071006 0.034367056 1
## [1431] {bottled water, => {rolls/buns} 0.007320793 0.1873536 0.043416370 1
##      other vegetables} => {rolls/buns} 0.007320793 0.1724138 0.056024403 1
## [1432] {other vegetables,

```

```

##      rolls/buns}          => {bottled water}          0.007320793 0.1718377 0.042602949 1
## [1433] {bottled water,    => {whole milk}           0.008744281 0.3613445 0.024199288 1
##      rolls/buns}          => {rolls/buns}           0.008744281 0.2544379 0.034367056 1
## [1434] {bottled water,    => {bottled water}          0.008744281 0.1543986 0.056634469 1
##      whole milk}          => {whole milk}           0.010777834 0.4344262 0.024809354 1
## [1435] {rolls/buns,      => {other vegetables}     0.010777834 0.3136095 0.034367056 1
##      whole milk}          => {whole milk}           0.010777834 0.1440217 0.074834774 1
## [1436] {bottled water,    => {bottled water}          0.010777834 0.3864734 0.021047280 2
##      other vegetables}    => {other vegetables}    0.008134215 0.2777778 0.029283172 2
## [1437] {bottled water,    => {root vegetables}       0.008134215 0.3149606 0.025826131 3
##      whole milk}          => {tropical fruit}        0.005897306 0.2801932 0.021047280 1
## [1438] {other vegetables,=> {bottled water}          0.005897306 0.2396694 0.024605999 2
##      whole milk}          => {root vegetables}      0.005897306 0.2426778 0.024300966 2
## [1439] {root vegetables,  => {tropical fruit}        0.012302999 0.5845411 0.021047280 3
##      tropical fruit}       => {rolls/buns}           0.012302999 0.3427762 0.035892222 3
## [1440] {tropical fruit,   => {root vegetables}       0.012302999 0.2596567 0.047381800 2
##      yogurt}              => {tropical fruit}        0.011997966 0.5700483 0.021047280 2
## [1441] {root vegetables,  => {other vegetables}      0.011997966 0.2836538 0.042297916 2
##      yogurt}              => {root vegetables}      0.011997966 0.2453222 0.048906965 2
## [1442] {root vegetables,  => {tropical fruit}        0.006609049 0.3170732 0.020843925 2
##      tropical fruit}       => {whole milk}            0.006609049 0.2256944 0.029283172 1
## [1443] {rolls/buns,       => {soda}                  0.006609049 0.2416357 0.027351296 2
##      tropical fruit}       => {yogurt}                0.005388917 0.2585366 0.020843925 1
## [1444] {rolls/buns,       => {rolls/buns}           0.005388917 0.2190083 0.024605999 1
##      root vegetables}     => {soda}                  0.005388917 0.1405836 0.038332486 1
## [1445] {root vegetables,  => {tropical fruit}        0.007219115 0.3463415 0.020843925 1
##      tropical fruit}       => {other vegetables}     0.007219115 0.2011331 0.035892222 1
## [1446] {other vegetables, => {soda}                  0.007219115 0.1718377 0.042602949 1
##      tropical fruit}       => {tropical fruit}        0.007219115 0.3864734 0.021047280 2
## [1447] {other vegetables, => {tropical fruit}        0.007219115 0.2396694 0.024605999 2
##      root vegetables}     => {whole milk}           0.007219115 0.2426778 0.024300966 2
## [1448] {root vegetables,  => {root vegetables}       0.007219115 0.5845411 0.021047280 3
##      tropical fruit}       => {root vegetables}      0.007219115 0.3427762 0.035892222 3
## [1449] {tropical fruit,   => {tropical fruit}        0.007219115 0.2596567 0.047381800 2
##      whole milk}          => {root vegetables}      0.007219115 0.2836538 0.042297916 2
## [1450] {root vegetables,  => {tropical fruit}        0.007219115 0.2453222 0.048906965 2
##      whole milk}          => {whole milk}            0.007219115 0.2256944 0.029283172 1
## [1451] {soda,              => {yogurt}                0.007219115 0.2416357 0.027351296 2
##      tropical fruit}       => {soda}                  0.005388917 0.2585366 0.020843925 1
## [1452] {tropical fruit,   => {rolls/buns}           0.005388917 0.2190083 0.024605999 1
##      yogurt}              => {soda}                  0.005388917 0.1405836 0.038332486 1
## [1453] {soda,              => {tropical fruit}        0.005388917 0.3463415 0.020843925 1
##      yogurt}              => {rolls/buns}           0.005388917 0.2011331 0.035892222 1
## [1454] {soda,              => {tropical fruit}        0.005388917 0.1718377 0.042602949 1
##      tropical fruit}       => {soda}                  0.005388917 0.3864734 0.021047280 2
## [1455] {rolls/buns,       => {soda}                  0.005388917 0.2396694 0.024605999 2
##      tropical fruit}       => {tropical fruit}        0.005388917 0.2426778 0.024300966 2
## [1456] {rolls/buns,       => {rolls/buns}           0.005388917 0.5845411 0.021047280 3
##      soda}                 => {tropical fruit}        0.005388917 0.3427762 0.035892222 3
## [1457] {soda,              => {tropical fruit}        0.005388917 0.2596567 0.047381800 2
##      tropical fruit}       => {other vegetables}     0.005388917 0.2836538 0.042297916 2
## [1458] {other vegetables, => {soda}                  0.005388917 0.2453222 0.048906965 2
##      tropical fruit}       => {soda}                  0.005388917 0.2256944 0.029283172 1
## [1459] {other vegetables,

```

```

##      soda}          => {tropical fruit} 0.007219115 0.2204969 0.032740214 2
## [1460] {soda,        => {whole milk}    0.007829181 0.3756098 0.020843925 1
##      tropical fruit}=> {soda}           0.007829181 0.1850962 0.042297916 1
## [1461] {tropical fruit,=> {tropical fruit} 0.007829181 0.1954315 0.040061007 1
##      whole milk}     => {rolls/buns}   0.008744281 0.2986111 0.029283172 1
## [1462] {soda,        => {yogurt}         0.008744281 0.3553719 0.024605999 2
##      whole milk}     => {tropical fruit} 0.008744281 0.2544379 0.034367056 2
## [1463] {tropical fruit,=> {other vegetables} 0.012302999 0.4201389 0.029283172 2
##      yogurt}          => {yogurt}         0.012302999 0.3427762 0.035892222 2
## [1464] {rolls/buns,=> {tropical fruit} 0.012302999 0.2833724 0.043416370 2
##      tropical fruit}=> {tropical fruit} 0.015149975 0.5173611 0.029283172 2
## [1465] {rolls/buns,=> {whole milk}    0.015149975 0.3581731 0.042297916 2
##      yogurt}          => {yogurt}         0.015149975 0.2704174 0.056024403 2
## [1466] {tropical fruit,=> {other vegetables} 0.007829181 0.3181818 0.024605999 1
##      yogurt}          => {tropical fruit} 0.007829181 0.2181303 0.035892222 1
## [1467] {other vegetables,=> {rolls/buns}   0.007829181 0.1837709 0.042602949 1
##      tropical fruit}=> {tropical fruit} 0.010981190 0.4462810 0.024605999 1
## [1468] {other vegetables,=> {whole milk}    0.010981190 0.2596154 0.042297916 1
##      yogurt}          => {rolls/buns}   0.010981190 0.1938959 0.056634469 1
## [1469] {tropical fruit,=> {tropical fruit} 0.017081851 0.4759207 0.035892222 1
##      yogurt}          => {whole milk}    0.017081851 0.4038462 0.042297916 2
## [1470] {tropical fruit,=> {other vegetables} 0.008235892 0.4426230 0.018607016 2
##      whole milk}     => {tropical fruit} 0.008235892 0.2282609 0.074834774 2
## [1471] {whole milk,=> {other vegetables} 0.008235892 0.1738197 0.047381800 0
##      yogurt}          => {root vegetables} 0.008235892 0.2515528 0.032740214 2
## [1472] {rolls/buns,=> {soda}            0.008235892 0.108134215 0.4371585 0.018607016 1
##      tropical fruit}=> {whole milk}    0.008235892 0.1663202 0.048906965 0
## [1473] {other vegetables,=> {soda}            0.008235892 0.007219115 0.2204969 0.032740214 2
##      tropical fruit}=> {rolls/buns}   0.008235892 0.007829181 0.3756098 0.020843925 1
## [1474] {other vegetables,=> {tropical fruit} 0.008235892 0.010981190 0.4462810 0.024605999 1
##      rolls/buns}       => {whole milk}    0.008235892 0.010981190 0.2596154 0.042297916 1
## [1475] {rolls/buns,=> {tropical fruit} 0.008235892 0.017081851 0.4038462 0.042297916 2
##      tropical fruit}=> {whole milk}    0.008235892 0.017081851 0.4759207 0.035892222 1
## [1476] {tropical fruit,=> {other vegetables} 0.008235892 0.008235892 0.4426230 0.018607016 2
##      whole milk}     => {rolls/buns}   0.008235892 0.008235892 0.2282609 0.074834774 2
## [1477] {rolls/buns,=> {tropical fruit} 0.008235892 0.008235892 0.1738197 0.047381800 0
##      whole milk}     => {whole milk}    0.008235892 0.008235892 0.2515528 0.032740214 2
## [1478] {other vegetables,=> {root vegetables} 0.008235892 0.008235892 0.108134215 0.4371585 0.018607016 1
##      tropical fruit}=> {soda}            0.008235892 0.008235892 0.1663202 0.048906965 0
## [1479] {tropical fruit,=> {other vegetables} 0.008235892 0.008235892 0.007219115 0.2204969 0.032740214 2
##      whole milk}     => {tropical fruit} 0.008235892 0.008235892 0.007829181 0.3756098 0.020843925 1
## [1480] {other vegetables,=> {whole milk}    0.008235892 0.008235892 0.010981190 0.4462810 0.024605999 1
##      whole milk}     => {rolls/buns}   0.008235892 0.008235892 0.010981190 0.2596154 0.042297916 1
## [1481] {root vegetables,=> {tropical fruit} 0.008235892 0.008235892 0.017081851 0.4038462 0.042297916 2
##      soda}            => {other vegetables} 0.008235892 0.008235892 0.017081851 0.4759207 0.035892222 1
## [1482] {other vegetables,=> {soda}            0.008235892 0.008235892 0.008235892 0.1738197 0.047381800 0
##      root vegetables}=> {root vegetables} 0.008235892 0.008235892 0.008235892 0.2282609 0.074834774 2
## [1483] {other vegetables,=> {soda}            0.008235892 0.008235892 0.008235892 0.108134215 0.4371585 0.018607016 1
##      soda}             => {root vegetables} 0.008235892 0.008235892 0.008235892 0.1663202 0.048906965 0
## [1484] {root vegetables,=> {whole milk}    0.008235892 0.008235892 0.008235892 0.007219115 0.2204969 0.032740214 2
##      soda}             => {whole milk}    0.008235892 0.008235892 0.008235892 0.007829181 0.3756098 0.020843925 1
## [1485] {root vegetables,=> {soda}            0.008235892 0.008235892 0.008235892 0.008235892 0.1738197 0.047381800 0
##      whole milk}     => {soda}           0.008235892 0.008235892 0.008235892 0.008235892 0.2515528 0.032740214 2
## [1486] {soda,

```

```

##      whole milk}          => {root vegetables}          0.008134215  0.2030457  0.040061007  1
## [1487] {root vegetables, => {rolls/buns}              0.007219115  0.2795276  0.025826131  1
##      yogurt}                => {yogurt}                  0.007219115  0.2970711  0.024300966  2
## [1488] {rolls/buns,        => {root vegetables}          0.007219115  0.2100592  0.034367056  1
##      root vegetables}       => {other vegetables}        0.012913066  0.5000000  0.025826131  2
## [1489] {rolls/buns,        => {yogurt}                  0.012913066  0.2725322  0.047381800  1
##      yogurt}                => {root vegetables}          0.012913066  0.2974239  0.043416370  2
## [1490] {root vegetables, => {whole milk}                 0.014539908  0.5629921  0.025826131  2
##      yogurt}                => {yogurt}                  0.014539908  0.2972973  0.048906965  2
## [1491] {other vegetables,=> {root vegetables}          0.014539908  0.2595281  0.056024403  2
##      root vegetables}       => {other vegetables}        0.012201322  0.5020921  0.024300966  2
## [1492] {other vegetables,=> {rolls/buns}                 0.012201322  0.2575107  0.047381800  1
##      yogurt}                => {root vegetables}          0.012201322  0.2863962  0.042602949  2
## [1493] {root vegetables,=> {whole milk}                 0.012709710  0.5230126  0.024300966  2
##      yogurt}                => {rolls/buns}               0.012709710  0.2598753  0.048906965  1
## [1494] {root vegetables,=> {root vegetables}          0.012709710  0.2244165  0.056634469  2
##      whole milk}              => {other vegetables}        0.023182511  0.4892704  0.047381800  1
## [1495] {whole milk,        => {whole milk}                 0.023182511  0.4740125  0.048906965  2
##      yogurt}                => {rolls/buns}               0.023182511  0.3097826  0.074834774  2
## [1496] {rolls/buns,        => {root vegetables}          0.008642603  0.3159851  0.027351296  1
##      root vegetables}       => {yogurt}                  0.008642603  0.2254642  0.038332486  1
## [1497] {other vegetables,=> {soda}                     0.008642603  0.2514793  0.034367056  1
##      root vegetables}       => {other vegetables}        0.008337570  0.3048327  0.027351296  1
## [1498] {other vegetables,=> {yogurt}                   0.008337570  0.2546584  0.032740214  1
##      rolls/buns}              => {soda}                     0.008337570  0.1920375  0.043416370  1
## [1499] {rolls/buns,        => {whole milk}               0.010472801  0.3828996  0.027351296  1
##      root vegetables}       => {yogurt}                  0.010472801  0.2614213  0.040061007  1
## [1500] {root vegetables,=> {whole milk}                 0.014539908  0.5629921  0.025826131  2
##      whole milk}              => {rolls/buns}               0.014539908  0.2598753  0.048906965  1
## [1501] {rolls/buns,        => {root vegetables}          0.014539908  0.2244165  0.056634469  2
##      whole milk}              => {other vegetables}        0.023182511  0.4892704  0.047381800  1
## [1502] {other vegetables,=> {whole milk}                 0.023182511  0.4740125  0.048906965  2
##      root vegetables}       => {rolls/buns}               0.023182511  0.3097826  0.074834774  2
## [1503] {root vegetables,=> {root vegetables}          0.012709710  0.2244165  0.056634469  2
##      whole milk}              => {other vegetables}        0.023182511  0.4740125  0.048906965  2
## [1504] {other vegetables,=> {whole milk}                 0.023182511  0.3097826  0.074834774  2
##      whole milk}              => {rolls/buns}               0.008642603  0.3159851  0.027351296  1
## [1505] {soda,              => {yogurt}                  0.008642603  0.2254642  0.038332486  1
##      yogurt}                => {rolls/buns}               0.008642603  0.2514793  0.034367056  1
## [1506] {rolls/buns,        => {soda}                     0.008642603  0.2514793  0.034367056  1
##      soda}                  => {yogurt}                  0.008642603  0.2254642  0.038332486  1
## [1507] {rolls/buns,        => {soda}                     0.008642603  0.2514793  0.034367056  1
##      yogurt}                => {rolls/buns}               0.008642603  0.3048327  0.027351296  1
## [1508] {soda,              => {yogurt}                  0.008642603  0.2514793  0.034367056  1
##      yogurt}                => {soda}                     0.008642603  0.2254642  0.038332486  1
## [1509] {other vegetables,=> {soda}                     0.008642603  0.2514793  0.034367056  1
##      soda}                  => {yogurt}                  0.008642603  0.2254642  0.038332486  1
## [1510] {other vegetables,=> {yogurt}                   0.008642603  0.2514793  0.034367056  1
##      yogurt}                => {soda}                     0.008642603  0.2254642  0.038332486  1
## [1511] {soda,              => {whole milk}               0.010472801  0.3828996  0.027351296  1
##      yogurt}                => {whole milk}               0.010472801  0.2614213  0.040061007  1
## [1512] {soda,              => {yogurt}                  0.010472801  0.2614213  0.040061007  1
##      yogurt}                => {whole milk}               0.010472801  0.3828996  0.027351296  1
## [1513] {whole milk,        => {yogurt}                  0.010472801  0.2614213  0.040061007  1
##      whole milk}              => {whole milk}               0.010472801  0.3828996  0.027351296  1

```

```

##      yogurt}          => {soda}          0.010472801  0.1869328 0.056024403 1
## [1514] {rolls/buns,    => {other vegetables} 0.009862735  0.2572944 0.038332486 1
##      soda}           => {rolls/buns}      0.009862735  0.3012422 0.032740214 1
## [1515] {other vegetables,   => {soda}          0.009862735  0.2315036 0.042602949 1
##      soda}           => {whole milk}     0.008845958  0.2307692 0.038332486 0
## [1516] {other vegetables,   => {rolls/buns}     0.008845958  0.2208122 0.040061007 1
##      rolls/buns}      => {soda}          0.008845958  0.1561939 0.056634469 0
## [1517] {rolls/buns,      => {whole milk}     0.013929842  0.4254658 0.032740214 1
##      soda}            => {other vegetables} 0.013929842  0.3477157 0.040061007 1
## [1518] {soda,          => {soda}          0.013929842  0.1861413 0.074834774 1
##      whole milk}      => {other vegetables} 0.011489578  0.3343195 0.034367056 1
## [1519] {rolls/buns,    => {rolls/buns}     0.011489578  0.2646370 0.043416370 1
##      whole milk}      => {soda}          0.011489578  0.2696897 0.042602949 1
## [1520] {other vegetables,  => {whole milk}     0.015556685  0.4526627 0.034367056 1
##      soda}            => {other vegetables} 0.015556685  0.2776770 0.056024403 1
## [1521] {soda,          => {whole milk}     0.015556685  0.2746858 0.056634469 1
##      whole milk}      => {other vegetables} 0.022267412  0.5128806 0.043416370 2
## [1522] {other vegetables,  => {rolls/buns}     0.022267412  0.3974592 0.056024403 2
##      whole milk}      => {yogurt}         0.022267412  0.2975543 0.074834774 2
## [1523] {rolls/buns,      => {whole milk}     0.017895272  0.4200477 0.042602949 1
##      yogurt}          => {rolls/buns}     0.017895272  0.3159785 0.056634469 1
## [1524] {other vegetables,  => {yogurt}         0.017895272  0.2391304 0.074834774 1
##      yogurt}          => {whole milk}     0.005083884  0.6172840 0.008235892 2
## [1525] {other vegetables,  => {whole milk}     0.005083884  0.5376344 0.009456024 2
##      rolls/buns}      => {other vegetables} 0.005083884  0.4854369 0.010472801 3
## [1526] {rolls/buns,      => {whole milk}     0.015556685  0.4526627 0.034367056 1
##      yogurt}          => {rolls/buns}     0.015556685  0.2776770 0.056024403 1
## [1527] {whole milk,      => {yogurt}         0.015556685  0.2746858 0.056634469 1
##      yogurt}          => {whole milk}     0.022267412  0.5128806 0.043416370 2
## [1528] {rolls/buns,      => {yogurt}         0.022267412  0.3974592 0.056024403 2
##      whole milk}      => {other vegetables} 0.022267412  0.2975543 0.074834774 2
## [1529] {other vegetables,  => {whole milk}     0.017895272  0.4200477 0.042602949 1
##      yogurt}          => {other vegetables} 0.017895272  0.3159785 0.056634469 1
## [1530] {whole milk,      => {whole milk}     0.017895272  0.2391304 0.074834774 1
##      yogurt}          => {other vegetables} 0.022267412  0.6172840 0.008235892 2
## [1531] {other vegetables,  => {yogurt}         0.022267412  0.4200477 0.042602949 1
##      whole milk}      => {whole milk}     0.017895272  0.3159785 0.056634469 1
## [1532] {other vegetables,  => {whole milk}     0.017895272  0.4200477 0.042602949 1
##      rolls/buns}      => {other vegetables} 0.017895272  0.3159785 0.056634469 1
## [1533] {rolls/buns,      => {other vegetables} 0.017895272  0.2391304 0.074834774 1
##      whole milk}      => {rolls/buns}     0.005083884  0.6172840 0.008235892 2
## [1534] {other vegetables,  => {rolls/buns}     0.005083884  0.5376344 0.009456024 2
##      whole milk}      => {whole milk}     0.005083884  0.4854369 0.010472801 3
## [1535] {fruit/vegetable juice,  => {whole milk}     0.005083884  0.6172840 0.008235892 2
##      other vegetables,  => {other vegetables} 0.005083884  0.5376344 0.009456024 2
##      yogurt}          => {whole milk}     0.005083884  0.4854369 0.010472801 3
## [1536] {fruit/vegetable juice,  => {other vegetables} 0.005083884  0.5376344 0.009456024 2
##      whole milk,       => {yogurt}         0.005083884  0.4854369 0.010472801 3
##      yogurt}          => {other vegetables} 0.005083884  0.5376344 0.009456024 2
## [1537] {fruit/vegetable juice,  => {yogurt}         0.005083884  0.4854369 0.010472801 3
##      other vegetables,  => {whole milk}     0.005083884  0.6172840 0.008235892 2
##      whole milk}      => {other vegetables} 0.005083884  0.5376344 0.009456024 2
## [1538] {other vegetables,      => {yogurt}         0.005083884  0.4854369 0.010472801 3
##      whole milk,       => {whole milk}     0.005083884  0.6172840 0.008235892 2

```

```

##      yogurt}          => {fruit/vegetable juice}  0.005083884  0.2283105  0.022267412 3
## [1539] {other vegetables,          => {whole milk}          0.005185562  0.6071429  0.008540925 2
##      root vegetables,
##      whipped/sour cream}
## [1540] {root vegetables,          => {other vegetables}  0.005185562  0.5483871  0.009456024 2
##      whipped/sour cream,
##      whole milk}
## [1541] {other vegetables,          => {root vegetables}  0.005185562  0.3541667  0.014641586 3
##      whipped/sour cream,
##      whole milk}
## [1542] {other vegetables,          => {whipped/sour cream} 0.005185562  0.2236842  0.023182511 3
##      root vegetables,
##      whole milk}
## [1543] {other vegetables,          => {whole milk}          0.005592272  0.5500000  0.010167768 2
##      whipped/sour cream,
##      yogurt}
## [1544] {whipped/sour cream,          => {other vegetables}  0.005592272  0.5140187  0.010879512 2
##      whole milk,
##      yogurt}
## [1545] {other vegetables,          => {yogurt}              0.005592272  0.3819444  0.014641586 2
##      whipped/sour cream,
##      whole milk}
## [1546] {other vegetables,          => {whipped/sour cream} 0.005592272  0.2511416  0.022267412 3
##      whole milk,
##      yogurt}
## [1547] {other vegetables,          => {whole milk}          0.005490595  0.6750000  0.008134215 2
##      pip fruit,
##      root vegetables}
## [1548] {pip fruit,                => {other vegetables}  0.005490595  0.6136364  0.008947636 3
##      root vegetables,
##      whole milk}
## [1549] {other vegetables,          => {root vegetables}  0.005490595  0.4060150  0.013523132 3
##      pip fruit,
##      whole milk}
## [1550] {other vegetables,          => {pip fruit}            0.005490595  0.2368421  0.023182511 3
##      root vegetables,
##      whole milk}
## [1551] {other vegetables,          => {whole milk}          0.005083884  0.6250000  0.008134215 2
##      pip fruit,
##      yogurt}
## [1552] {pip fruit,                => {other vegetables}  0.005083884  0.5319149  0.009557702 2
##      whole milk,
##      yogurt}
## [1553] {other vegetables,          => {yogurt}              0.005083884  0.3759398  0.013523132 2
##      pip fruit,
##      whole milk}
## [1554] {other vegetables,          => {pip fruit}            0.005083884  0.2283105  0.022267412 3
##      whole milk,
##      yogurt}
## [1555] {citrus fruit,              => {whole milk}          0.005795628  0.5588235  0.010371124 2
##      other vegetables,
##      root vegetables}
## [1556] {citrus fruit,              => {root vegetables},
##      root vegetables,

```

| | | | | | |
|------------------------------|-----------------------|-------------|-----------|-------------|---|
| ## whole milk} | => {other vegetables} | 0.005795628 | 0.6333333 | 0.009150991 | 3 |
| ## [1557] {citrus fruit, | | | | | |
| ## other vegetables, | | | | | |
| ## whole milk} | => {root vegetables} | 0.005795628 | 0.4453125 | 0.013014743 | 4 |
| ## [1558] {other vegetables, | | | | | |
| ## root vegetables, | | | | | |
| ## whole milk} | => {citrus fruit} | 0.005795628 | 0.2500000 | 0.023182511 | 3 |
| ## [1559] {root vegetables, | | | | | |
| ## tropical fruit, | | | | | |
| ## yogurt} | => {whole milk} | 0.005693950 | 0.7000000 | 0.008134215 | 2 |
| ## [1560] {root vegetables, | | | | | |
| ## tropical fruit, | | | | | |
| ## whole milk} | => {yogurt} | 0.005693950 | 0.4745763 | 0.011997966 | 3 |
| ## [1561] {tropical fruit, | | | | | |
| ## whole milk, | | | | | |
| ## yogurt} | => {root vegetables} | 0.005693950 | 0.3758389 | 0.015149975 | 3 |
| ## [1562] {root vegetables, | | | | | |
| ## whole milk, | | | | | |
| ## yogurt} | => {tropical fruit} | 0.005693950 | 0.3916084 | 0.014539908 | 3 |
| ## [1563] {other vegetables, | | | | | |
| ## root vegetables, | | | | | |
| ## tropical fruit} | => {whole milk} | 0.007015760 | 0.5702479 | 0.012302999 | 2 |
| ## [1564] {root vegetables, | | | | | |
| ## tropical fruit, | | | | | |
| ## whole milk} | => {other vegetables} | 0.007015760 | 0.5847458 | 0.011997966 | 3 |
| ## [1565] {other vegetables, | | | | | |
| ## tropical fruit, | | | | | |
| ## whole milk} | => {root vegetables} | 0.007015760 | 0.4107143 | 0.017081851 | 3 |
| ## [1566] {other vegetables, | | | | | |
| ## root vegetables, | | | | | |
| ## whole milk} | => {tropical fruit} | 0.007015760 | 0.3026316 | 0.023182511 | 2 |
| ## [1567] {other vegetables, | | | | | |
| ## tropical fruit, | | | | | |
| ## yogurt} | => {whole milk} | 0.007625826 | 0.6198347 | 0.012302999 | 2 |
| ## [1568] {tropical fruit, | | | | | |
| ## whole milk, | | | | | |
| ## yogurt} | => {other vegetables} | 0.007625826 | 0.5033557 | 0.015149975 | 2 |
| ## [1569] {other vegetables, | | | | | |
| ## tropical fruit, | | | | | |
| ## whole milk} | => {yogurt} | 0.007625826 | 0.4464286 | 0.017081851 | 3 |
| ## [1570] {other vegetables, | | | | | |
| ## whole milk, | | | | | |
| ## yogurt} | => {tropical fruit} | 0.007625826 | 0.3424658 | 0.022267412 | 3 |
| ## [1571] {other vegetables, | | | | | |
| ## root vegetables, | | | | | |
| ## yogurt} | => {whole milk} | 0.007829181 | 0.6062992 | 0.012913066 | 2 |
| ## [1572] {root vegetables, | | | | | |
| ## whole milk, | | | | | |
| ## yogurt} | => {other vegetables} | 0.007829181 | 0.5384615 | 0.014539908 | 2 |
| ## [1573] {other vegetables, | | | | | |
| ## root vegetables, | | | | | |
| ## whole milk} | => {yogurt} | 0.007829181 | 0.3377193 | 0.023182511 | 2 |
| ## [1574] {other vegetables, | | | | | |
| ## whole milk, | | | | | |

```

##      yogurt}          => {root vegetables}      0.007829181  0.3515982 0.022267412 3
## [1575] {other vegetables,
##           rolls/buns,
##           root vegetables}      => {whole milk}          0.006202339  0.5083333 0.012201322 1
## [1576] {rolls/buns,
##           root vegetables,
##           whole milk}          => {other vegetables}      0.006202339  0.4880000 0.012709710 2
## [1577] {other vegetables,
##           root vegetables,
##           whole milk}          => {rolls/buns}          0.006202339  0.2675439 0.023182511 1
## [1578] {other vegetables,
##           rolls/buns,
##           whole milk}          => {root vegetables}      0.006202339  0.3465909 0.017895272 3
## [1579] {other vegetables,
##           rolls/buns,
##           yogurt}              => {whole milk}          0.005998983  0.5221239 0.011489578 2
## [1580] {rolls/buns,
##           whole milk,
##           yogurt}              => {other vegetables}      0.005998983  0.3856209 0.015556685 1
## [1581] {other vegetables,
##           whole milk,
##           yogurt}              => {rolls/buns}          0.005998983  0.2694064 0.022267412 1
## [1582] {other vegetables,
##           rolls/buns,
##           whole milk}          => {yogurt}            0.005998983  0.3352273 0.017895272 2
## NULL

```

Since there are too many rules, we chose lift threshold as 1 and confidence threshold as 0.5. The below table shows the Left Hand Side (antecedent) and Right Hand Side (consequent), support, confidence, lift and etc...

```
inspect(subset(itemrules, subset=lift > 1 & confidence > 0.5))[1:5, ]
```

| | lhs | rhs | support | confidence | coverage | lift | co |
|---------|----------------------------|-----------------------|-------------|------------|-------------|----------|----|
| ## [1] | {baking powder} | => {whole milk} | 0.009252669 | 0.5229885 | 0.017691917 | 2.046793 | |
| ## [2] | {oil, | => {whole milk} | 0.005083884 | 0.5102041 | 0.009964413 | 1.996760 | |
| ## [3] | {onions, | => {other vegetables} | 0.005693950 | 0.6021505 | 0.009456024 | 3.112008 | |
| ## [4] | {onions, | => {other vegetables} | 0.006609049 | 0.5462185 | 0.012099644 | 2.822942 | |
| ## [5] | {hygiene articles, | => {whole milk} | 0.005185562 | 0.5425532 | 0.009557702 | 2.123363 | |
| ## [6] | {other vegetables, | => {whole milk} | 0.006304016 | 0.5849057 | 0.010777834 | 2.289115 | |
| ## [7] | {long life bakery product, | => {whole milk} | 0.005693950 | 0.5333333 | 0.010676157 | 2.087279 | |
| ## [8] | {cream cheese, | => {whole milk} | 0.006609049 | 0.5327869 | 0.012404677 | 2.085141 | |
| ## [9] | {yogurt} | => {whole milk} | | | | | |
| ## [10] | {chicken, | => {other vegetables} | 0.005693950 | 0.5233645 | 0.010879512 | 2.704829 | |
| ## [11] | {root vegetables} | => {whole milk} | 0.005998983 | 0.5514019 | 0.010879512 | 2.157993 | |
| ## [12] | {rolls/buns} | => {whole milk} | 0.005287239 | 0.5473684 | 0.009659380 | 2.142208 | |

```

##      yogurt}          => {whole milk}      0.005083884 0.5208333 0.009761057 2.038359
## [13] {frozen vegetables, => {other vegetables} 0.006100661 0.5263158 0.011591256 2.720082
##      root vegetables} => {whole milk}      0.006202339 0.5350877 0.011591256 2.094146
## [14] {frozen vegetables, => {whole milk}      0.009659380 0.5428571 0.017793594 2.124552
##      root vegetables} => {whole milk}      0.006100661 0.5217391 0.011692933 2.041904
## [15] {frozen vegetables, => {whole milk}      0.005897306 0.5631068 0.010472801 2.203802
##      other vegetables} => {whole milk}      0.005287239 0.5148515 0.010269446 3.690645
## [16] {beef,           => {whole milk}      0.006507372 0.6336634 0.010269446 2.479936
##      yogurt}          => {yogurt}         0.005287239 0.5148515 0.010269446 2.660833
## [17] {curd,           => {other vegetables} 0.005287239 0.5148515 0.010269446 2.660833
##      whipped/sour cream} => {whole milk}      0.006202339 0.5700935 0.010879512 2.231146
## [18] {curd,           => {whole milk}      0.009862735 0.5739645 0.017183528 2.246296
##      curd,            => {other vegetables} 0.007015760 0.5149254 0.013624809 2.661214
## [19] {curd,           => {whole milk}      0.006202339 0.5495495 0.011286223 2.150744
##      tropical fruit}  => {whole milk}      0.005185562 0.5483871 0.009456024 2.146195
## [20] {curd,           => {whole milk}      0.005185562 0.5545455 0.011184545 2.170296
##      tropical fruit}  => {whole milk}      0.006202339 0.5604396 0.009252669 2.193364
## [21] {curd,           => {other vegetables} 0.005693950 0.5333333 0.010676157 2.087279
##      root vegetables} => {whole milk}      0.005693950 0.5600000 0.010167768 2.191643
## [22] {curd,           => {whole milk}      0.005185562 0.6219512 0.008337570 2.434099
##      root vegetables} => {other vegetables} 0.005897306 0.5321101 0.011082867 2.750028
## [23] {curd,           => {whole milk}      0.007930859 0.5379310 0.014743264 2.105273
##      yogurt}          => {whole milk}      0.005998983 0.6210526 0.009659380 2.430582
## [24] {curd,           => {other vegetables} 0.005795628 0.5700000 0.010167768 2.945849
##      rolls/buns}       => {whole milk}      0.006710727 0.6600000 0.010167768 2.583008
## [25] {curd,           => {whole milk}      0.006202339 0.6600000 0.010167768 2.583008
##      other vegetables} => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
## [26] {pork,            => {other vegetables} 0.007015760 0.6600000 0.010167768 2.583008
##      root vegetables} => {whole milk}      0.006202339 0.6600000 0.010167768 2.583008
## [27] {pork,            => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
##      rolls/buns}       => {whole milk}      0.006202339 0.6600000 0.010167768 2.583008
## [28] {frankfurter,    => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
##      tropical fruit}  => {whole milk}      0.006202339 0.6600000 0.010167768 2.583008
## [29] {frankfurter,    => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
##      yogurt}          => {whole milk}      0.006202339 0.6600000 0.010167768 2.583008
## [30] {bottled beer,   => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
##      yogurt}          => {whole milk}      0.006202339 0.6600000 0.010167768 2.583008
## [31] {brown bread,    => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
##      tropical fruit}  => {whole milk}      0.005693950 0.6600000 0.010167768 2.583008
## [32] {brown bread,    => {whole milk}      0.005693950 0.6600000 0.010167768 2.583008
##      root vegetables} => {whole milk}      0.005693950 0.6600000 0.010167768 2.583008
## [33] {domestic eggs,  => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
##      margarine}        => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
## [34] {margarine,      => {other vegetables} 0.005897306 0.6600000 0.010167768 2.583008
##      root vegetables} => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
## [35] {margarine,      => {whole milk}      0.007930859 0.6600000 0.010167768 2.583008
##      rolls/buns}       => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
## [36] {butter,          => {whole milk}      0.005998983 0.6600000 0.010167768 2.583008
##      domestic eggs}   => {whole milk}      0.005185562 0.6600000 0.010167768 2.583008
## [37] {butter,          => {other vegetables} 0.005795628 0.6600000 0.010167768 2.583008
##      whipped/sour cream}=> {whole milk}      0.006710727 0.6600000 0.010167768 2.583008
## [38] {butter,          => {whole milk}      0.006710727 0.6600000 0.010167768 2.583008
##      whipped/sour cream}=> {whole milk}      0.006710727 0.6600000 0.010167768 2.583008
## [39] {butter,          => {whole milk}      0.006710727 0.6600000 0.010167768 2.583008

```

```

##      citrus fruit}          => {whole milk}          0.005083884 0.5555556 0.009150991 2.174249
## [40] {bottled water,       => {whole milk}          0.005388917 0.6022727 0.008947636 2.357084
##      butter}               => {other vegetables} 0.005490595 0.5510204 0.009964413 2.847759
## [41] {butter,              => {whole milk}          0.006202339 0.6224490 0.009964413 2.436047
##      tropical fruit}       => {other vegetables} 0.006609049 0.5118110 0.012913066 2.645119
## [42] {butter,              => {whole milk}          0.008235892 0.6377953 0.012913066 2.496107
##      tropical fruit}       => {other vegetables} 0.009354347 0.6388889 0.014641586 2.500387
## [43] {butter,              => {whole milk}          0.011489578 0.5736041 0.020030503 2.244885
##      root vegetables}     => {other vegetables} 0.005998983 0.5221239 0.011489578 2.698417
## [44] {butter,              => {whole milk}          0.005795628 0.5044248 0.011489578 1.974142
##      root vegetables}     => {other vegetables} 0.005083884 0.5102041 0.009964413 2.636814
## [45] {butter,              => {whole milk}          0.005693950 0.5714286 0.009964413 2.236371
##      yogurt}               => {whole milk}          0.005388917 0.6235294 0.008642603 2.440275
## [46] {butter,              => {whole milk}          0.005693950 0.5490196 0.010371124 2.148670
##      other vegetables}    => {whole milk}          0.006914082 0.6071429 0.011387900 2.376144
## [47] {newspapers,          => {other vegetables} 0.007320793 0.5106383 0.014336553 2.639058
##      root vegetables}     => {whole milk}          0.008540925 0.5957447 0.014336553 2.331536
## [48] {newspapers,          => {whole milk}          0.006507372 0.5423729 0.011997966 2.122657
##      root vegetables}     => {other vegetables} 0.005693950 0.5233645 0.010879512 2.704829
## [49] {domestic eggs,        => {whole milk}          0.009456024 0.5054348 0.018708693 1.978094
##      whipped/sour cream}   => {other vegetables} 0.005592272 0.6043956 0.009252669 3.123610
## [50] {domestic eggs,        => {whole milk}          0.005998983 0.6483516 0.009252669 2.537421
##      whipped/sour cream}   => {other vegetables} 0.006609049 0.5508475 0.011997966 2.846865
## [51] {domestic eggs,        => {whole milk}          0.006507372 0.5423729 0.011997966 2.122657
##      pip fruit}             => {whole milk}          0.009456024 0.5054348 0.018708693 1.978094
## [52] {citrus fruit,         => {whole milk}          0.006507372 0.5423729 0.011997966 2.122657
##      domestic eggs}         => {other vegetables} 0.005693950 0.5490196 0.010371124 2.148670
## [53] {domestic eggs,         => {whole milk}          0.006914082 0.6071429 0.011387900 2.376144
##      tropical fruit}        => {other vegetables} 0.007320793 0.5106383 0.014336553 2.639058
## [54] {domestic eggs,         => {whole milk}          0.008540925 0.5957447 0.014336553 2.331536
##      root vegetables}       => {other vegetables} 0.006609049 0.5508475 0.011997966 2.846865
## [55] {domestic eggs,         => {whole milk}          0.006507372 0.5423729 0.011997966 2.122657
##      root vegetables}       => {other vegetables} 0.005693950 0.5233645 0.010879512 2.704829
## [56] {domestic eggs,         => {whole milk}          0.009456024 0.5054348 0.018708693 1.978094
##      yogurt}                => {other vegetables} 0.005592272 0.6043956 0.009252669 3.123610
## [57] {domestic eggs,         => {whole milk}          0.005998983 0.6483516 0.009252669 2.537421
##      other vegetables}      => {other vegetables} 0.006609049 0.5508475 0.011997966 2.846865
## [58] {fruit/vegetable juice, => {whole milk}          0.006507372 0.5423729 0.011997966 2.122657
##      root vegetables}       => {other vegetables} 0.005693950 0.5233645 0.010879512 2.704829
## [59] {fruit/vegetable juice, => {whole milk}          0.009456024 0.5054348 0.018708693 1.978094
##      root vegetables}       => {other vegetables} 0.005592272 0.6043956 0.009252669 3.123610
## [60] {fruit/vegetable juice, => {whole milk}          0.005998983 0.6483516 0.009252669 2.537421
##      yogurt}                 => {other vegetables} 0.006609049 0.5508475 0.011997966 2.846865
## [61] {pip fruit,             => {whole milk}          0.006507372 0.5423729 0.011997966 2.122657
##      whipped/sour cream}    => {other vegetables} 0.005693950 0.5233645 0.010879512 2.704829
## [62] {pip fruit,             => {whole milk}          0.009456024 0.5054348 0.018708693 1.978094
##      whipped/sour cream}    => {other vegetables} 0.005592272 0.6043956 0.009252669 3.123610
## [63] {citrus fruit,           => {whole milk}          0.005998983 0.6483516 0.009252669 2.537421
##      whipped/sour cream}    => {other vegetables} 0.006609049 0.5508475 0.011997966 2.846865
## [64] {citrus fruit,           => {whole milk}          0.009456024 0.5054348 0.018708693 1.978094
##      whipped/sour cream}    => {other vegetables} 0.005592272 0.6043956 0.009252669 3.123610
## [65] {sausage,                => {whole milk}          0.006304016 0.5794393 0.010879512 2.267722
##      whipped/sour cream}    => {other vegetables} 0.005083884 0.5617978 0.009049314 2.198679
## [66] {tropical fruit,          => {whole milk}          0.005998983 0.6483516 0.009252669 2.537421

```

```

##      whipped/sour cream} => {other vegetables} 0.007829181 0.5661765 0.013828165 2.926088
## [67]  {tropical fruit, => {whole milk} 0.007930859 0.5735294 0.013828165 2.244593
##      whipped/sour cream} => {whole milk} 0.009456024 0.5535714 0.017081851 2.166484
## [68]  {root vegetables, => {whole milk} 0.010879512 0.5245098 0.020742247 2.052747
##      whipped/sour cream} => {whole milk} 0.007829181 0.5347222 0.014641586 2.092715
## [69]  {whipped/sour cream, => {whole milk} 0.014641586 0.5070423 0.028876462 1.984385
##      yogurt} => {whole milk} 0.005592272 0.5188679 0.010777834 2.030667
## [70]  {rolls/buns, => {whole milk} 0.008134215 0.5228758 0.015556685 2.702304
##      whipped/sour cream} => {whole milk} 0.008947636 0.5751634 0.015556685 2.250988
## [71]  {other vegetables, => {whole milk} 0.009557702 0.5310734 0.017996950 2.078435
##      whipped/sour cream} => {whole milk} 0.013523132 0.5175097 0.026131164 2.025351
## [72]  {pip fruit, => {whole milk} 0.006710727 0.5076923 0.013218099 1.986930
##      sausage} => {whole milk} 0.005897306 0.5370370 0.010981190 2.775491
## [73]  {pip fruit, => {whole milk} 0.005693950 0.5185185 0.010981190 2.029299
##      root vegetables} => {whole milk} 0.009150991 0.5172414 0.017691917 2.024301
## [74]  {pip fruit, => {whole milk} 0.010371124 0.5862069 0.017691917 3.029608
##      root vegetables} => {whole milk} 0.009150991 0.5172414 0.017691917 2.024301
## [75]  {pip fruit, => {whole milk} 0.006609049 0.5158730 0.012811388 2.666112
##      yogurt} => {whole milk} 0.007219115 0.5182482 0.013929842 2.028241
## [76]  {other vegetables, => {whole milk} 0.007727504 0.5170068 0.014946619 2.023383
##      pip fruit} => {whole milk} 0.011997966 0.5700483 0.021047280 2.230969
## [77]  {pastry, => {whole milk} 0.012302999 0.5845411 0.021047280 3.020999
##      tropical fruit} => {whole milk} 0.015149975 0.5173611 0.029283172 2.024770
## [78]  {pastry, => {whole milk} 0.014539908 0.5629921 0.025826131 2.203354
##      root vegetables} => {whole milk} 0.012201322 0.5020921 0.024300966 2.594890
## [79]  {pastry, => {whole milk} 0.012709710 0.5230126 0.024300966 2.046888
##      root vegetables} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [80]  {pastry, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      yogurt} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [81]  {citrus fruit, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      root vegetables} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [82]  {citrus fruit, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      root vegetables} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [83]  {root vegetables, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      shopping bags} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [84]  {sausage, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      tropical fruit} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [85]  {root vegetables, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      sausage} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [86]  {root vegetables, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      tropical fruit} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [87]  {root vegetables, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      tropical fruit} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [88]  {tropical fruit, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      yogurt} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [89]  {root vegetables, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      yogurt} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [90]  {rolls/buns, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      root vegetables} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [91]  {rolls/buns, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      root vegetables} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [92]  {other vegetables, => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
##      yogurt} => {whole milk} 0.022267412 0.5128806 0.043416370 2.007235
## [93]  {fruit/vegetable juice,

```

```

##      other vegetables,
##      yogurt}          => {whole milk}      0.005083884  0.6172840  0.008235892 2.415833
## [94] {fruit/vegetable juice,
##      whole milk,
##      yogurt}          => {other vegetables} 0.005083884  0.5376344  0.009456024 2.778578
## [95] {other vegetables,
##      root vegetables,
##      whipped/sour cream}=> {whole milk}      0.005185562  0.6071429  0.008540925 2.376144
## [96] {root vegetables,
##      whipped/sour cream,
##      whole milk}       => {other vegetables} 0.005185562  0.5483871  0.009456024 2.834150
## [97] {other vegetables,
##      whipped/sour cream,
##      yogurt}          => {whole milk}      0.005592272  0.5500000  0.010167768 2.152507
## [98] {whipped/sour cream,
##      whole milk,
##      yogurt}          => {other vegetables} 0.005592272  0.5140187  0.010879512 2.656529
## [99] {other vegetables,
##      pip fruit,
##      root vegetables}=> {whole milk}      0.005490595  0.6750000  0.008134215 2.641713
## [100] {pip fruit,
##      root vegetables,
##      whole milk}       => {other vegetables} 0.005490595  0.6136364  0.008947636 3.171368
## [101] {other vegetables,
##      pip fruit,
##      yogurt}          => {whole milk}      0.005083884  0.5319149  0.009557702 2.749019
## [102] {pip fruit,
##      whole milk,
##      yogurt}          => {other vegetables} 0.005083884  0.6250000  0.008134215 2.446031
## [103] {citrus fruit,
##      other vegetables,
##      root vegetables}=> {whole milk}      0.005795628  0.5588235  0.010371124 2.187039
## [104] {citrus fruit,
##      root vegetables,
##      whole milk}       => {other vegetables} 0.005795628  0.6333333  0.009150991 3.273165
## [105] {root vegetables,
##      tropical fruit,
##      yogurt}          => {whole milk}      0.005693950  0.7000000  0.008134215 2.739554
## [106] {other vegetables,
##      root vegetables,
##      tropical fruit}=> {whole milk}      0.007015760  0.5702479  0.012302999 2.231750
## [107] {root vegetables,
##      tropical fruit,
##      whole milk}       => {other vegetables} 0.007015760  0.5847458  0.011997966 3.022057
## [108] {other vegetables,
##      tropical fruit,
##      yogurt}          => {whole milk}      0.007625826  0.6198347  0.012302999 2.425816
## [109] {tropical fruit,
##      whole milk,
##      yogurt}          => {other vegetables} 0.007625826  0.5033557  0.015149975 2.601421
## [110] {other vegetables,
##      root vegetables,
##      yogurt}          => {whole milk}      0.007829181  0.6062992  0.012913066 2.372842
## [111] {root vegetables,

```

```

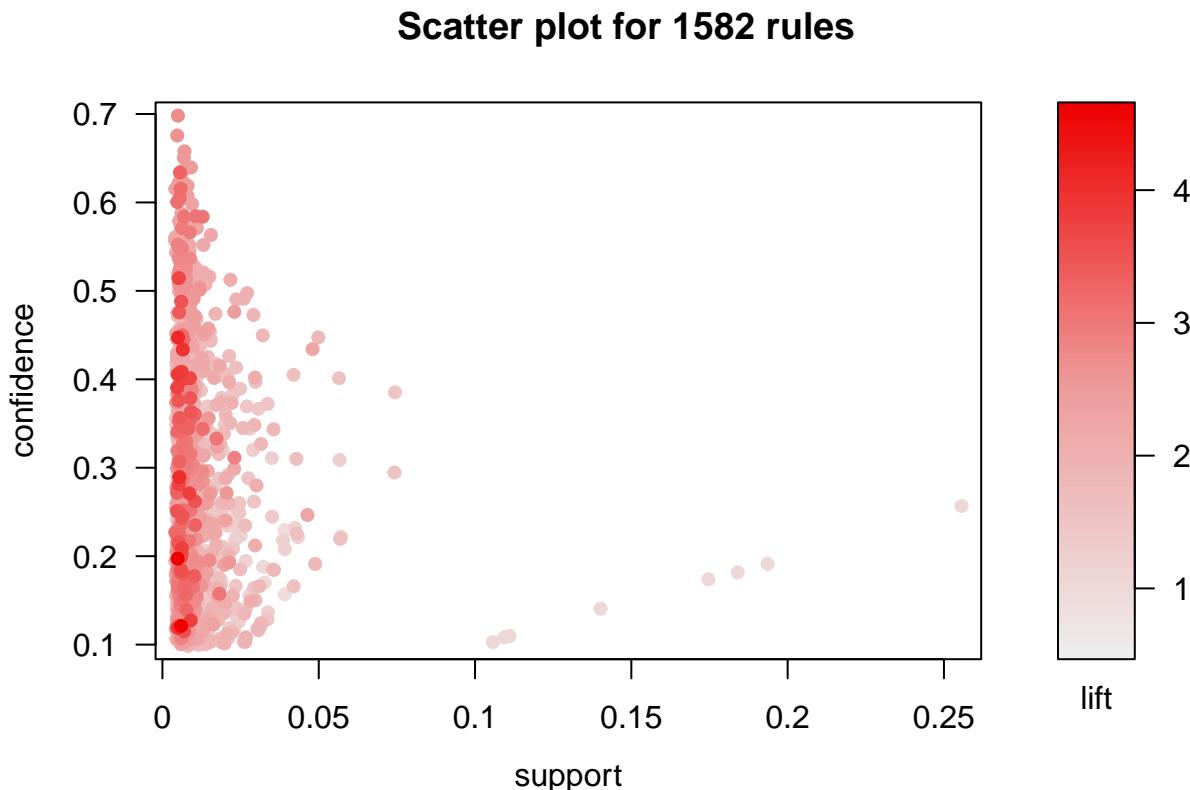
##      whole milk,
##      yogurt}          => {other vegetables} 0.007829181 0.5384615 0.014539908 2.782853
## [112] {other vegetables,
##      rolls/buns,
##      root vegetables} => {whole milk}        0.006202339 0.5083333 0.012201322 1.989438
## [113] {other vegetables,
##      rolls/buns,
##      yogurt}           => {whole milk}        0.005998983 0.5221239 0.011489578 2.043410
## NULL

```

The graph below plots the rules of our items data with 3 variables: x-axis as support, y-axis as confidence, and depth of each scatter point as lift.

```
plot(itemrules)
```

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

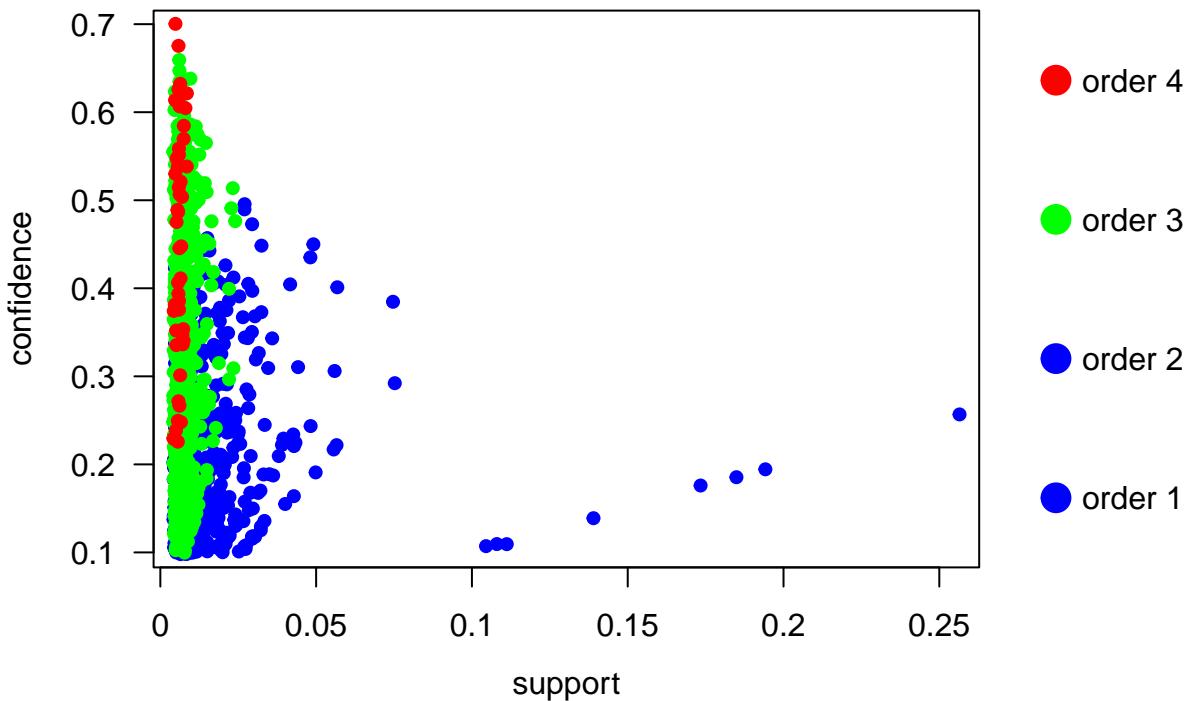


Here, we utilized two-key plot which colors the scatter plot by its order(size).

```
plot(itemrules, method='two-key plot')
```

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

Two-key plot

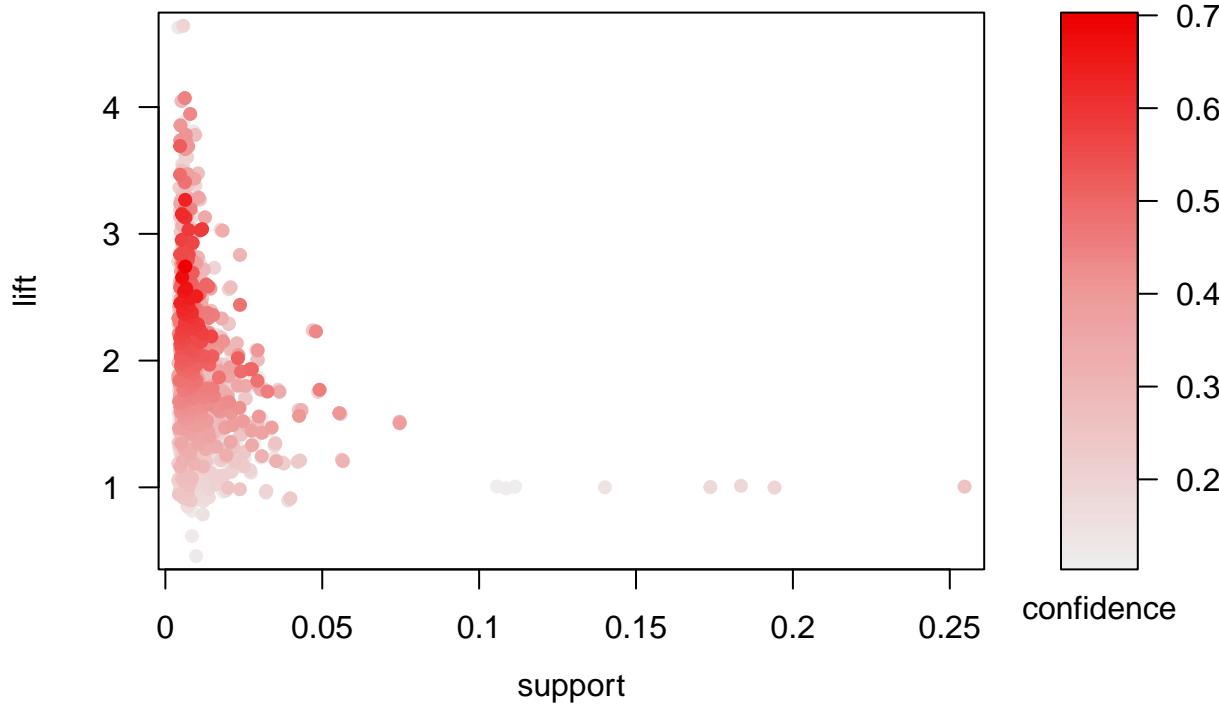


Here, we swapped lift and confidence so that the confidence is now the depth and lift is y-axis.

```
# can swap the axes and color scales
plot(itemrules, measure = c("support", "lift"), shading = "confidence")
```

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

Scatter plot for 1582 rules



By observing the plots above, we could test out different subsets of the rule. Here, we tried to find the case where LHS and RHS have strong relationship between them. Through the graph right above, we could estimate our threshold of lift (2) and confidence (0.45). Below table shows the items that have strong relationship between them. Most of them are quite obvious which indicates that our model is working fine.

```
inspect(subset(itemrules, lift > 2 & confidence > 0.45))[1:5, ]
```

| ## | lhs | rhs | support | confidence | coverage | lift | co |
|---------|----------------------------|-----------------------|-------------|------------|-------------|----------|----|
| ## [1] | {herbs} | => {other vegetables} | 0.007727504 | 0.4750000 | 0.016268429 | 2.454874 | |
| ## [2] | {baking powder} | => {whole milk} | 0.009252669 | 0.5229885 | 0.017691917 | 2.046793 | |
| ## [3] | {onions} | => {other vegetables} | 0.014234875 | 0.4590164 | 0.031011693 | 2.372268 | |
| ## [4] | {oil, | => {other vegetables} | 0.005083884 | 0.4504505 | 0.011286223 | 2.327998 | |
| ## [5] | whole milk} | => {other vegetables} | 0.005693950 | 0.6021505 | 0.009456024 | 3.112008 | |
| ## [6] | {onions, | => {other vegetables} | 0.006609049 | 0.5462185 | 0.012099644 | 2.822942 | |
| ## [7] | root vegetables} | => {other vegetables} | 0.005185562 | 0.5425532 | 0.009557702 | 2.123363 | |
| ## [8] | {onions, | => {other vegetables} | 0.006304016 | 0.5849057 | 0.010777834 | 2.289115 | |
| ## [9] | whole milk} | => {whole milk} | 0.005693950 | 0.5333333 | 0.010676157 | 2.087279 | |
| ## [10] | {long life bakery product, | => {whole milk} | 0.006609049 | 0.5327869 | 0.012404677 | 2.085141 | |
| ## [11] | other vegetables} | => {whole milk} | 0.005693950 | 0.5233645 | 0.010879512 | 2.704829 | |

```

## [12] {chicken,
##       root vegetables} => {whole milk}      0.005998983 0.5514019 0.010879512 2.157993
## [13] {chicken,
##       rolls/buns}      => {whole milk}      0.005287239 0.5473684 0.009659380 2.142208
## [14] {chicken,
##       whole milk}      => {other vegetables} 0.008439248 0.4797688 0.017590239 2.479520
## [15] {coffee,
##       yogurt}          => {whole milk}      0.005083884 0.5208333 0.009761057 2.038359
## [16] {frozen vegetables,
##       root vegetables} => {other vegetables} 0.006100661 0.5263158 0.011591256 2.720082
## [17] {frozen vegetables,
##       root vegetables} => {whole milk}      0.006202339 0.5350877 0.011591256 2.094146
## [18] {frozen vegetables,
##       other vegetables} => {whole milk}      0.009659380 0.5428571 0.017793594 2.124552
## [19] {frozen vegetables,
##       whole milk}        => {other vegetables} 0.009659380 0.4726368 0.020437214 2.442661
## [20] {beef,
##       root vegetables}  => {other vegetables} 0.007930859 0.4561404 0.017386884 2.357404
## [21] {beef,
##       yogurt}           => {whole milk}      0.006100661 0.5217391 0.011692933 2.041904
## [22] {curd,
##       whipped/sour cream}=> {whole milk}      0.005897306 0.5631068 0.010472801 2.203802
## [23] {curd,
##       tropical fruit}   => {yogurt}         0.005287239 0.5148515 0.010269446 3.690645
## [24] {curd,
##       tropical fruit}   => {other vegetables} 0.005287239 0.5148515 0.010269446 2.660833
## [25] {curd,
##       tropical fruit}   => {whole milk}      0.006507372 0.6336634 0.010269446 2.479936
## [26] {curd,
##       root vegetables}  => {other vegetables} 0.005490595 0.5046729 0.010879512 2.608228
## [27] {curd,
##       root vegetables}  => {whole milk}      0.006202339 0.5700935 0.010879512 2.231146
## [28] {curd,
##       yogurt}           => {whole milk}      0.010066090 0.5823529 0.017285206 2.279125
## [29] {curd,
##       rolls/buns}        => {whole milk}      0.005897306 0.5858586 0.010066090 2.292845
## [30] {curd,
##       other vegetables} => {whole milk}      0.009862735 0.5739645 0.017183528 2.246296
## [31] {pork,
##       root vegetables}  => {other vegetables} 0.007015760 0.5149254 0.013624809 2.661214
## [32] {pork,
##       rolls/buns}        => {other vegetables} 0.005592272 0.4954955 0.011286223 2.560798
## [33] {pork,
##       rolls/buns}        => {whole milk}      0.006202339 0.5495495 0.011286223 2.150744
## [34] {pork,
##       whole milk}         => {other vegetables} 0.010167768 0.4587156 0.022165735 2.370714
## [35] {frankfurter,
##       tropical fruit}   => {whole milk}      0.005185562 0.5483871 0.009456024 2.146195
## [36] {frankfurter,
##       yogurt}            => {whole milk}      0.006202339 0.5545455 0.011184545 2.170296
## [37] {bottled beer,
##       yogurt}            => {whole milk}      0.005185562 0.5604396 0.009252669 2.193364
## [38] {brown bread,
##       tropical fruit}   => {whole milk}      0.005693950 0.5333333 0.010676157 2.087279

```

```

## [39] {brown bread,
##       root vegetables} => {whole milk}      0.005693950 0.5600000 0.010167768 2.191643
## [40] {domestic eggs,
##       margarine}        => {whole milk}      0.005185562 0.6219512 0.008337570 2.434099
## [41] {margarine,
##       root vegetables} => {other vegetables} 0.005897306 0.5321101 0.011082867 2.750028
## [42] {margarine,
##       rolls/buns}       => {whole milk}      0.007930859 0.5379310 0.014743264 2.105273
## [43] {butter,
##       domestic eggs}    => {whole milk}      0.005998983 0.6210526 0.009659380 2.430582
## [44] {butter,
##       whipped/sour cream}=> {other vegetables} 0.005795628 0.5700000 0.010167768 2.945849
## [45] {butter,
##       whipped/sour cream}=> {whole milk}      0.006710727 0.6600000 0.010167768 2.583008
## [46] {butter,
##       citrus fruit}     => {whole milk}      0.005083884 0.5555556 0.009150991 2.174249
## [47] {bottled water,
##       butter}           => {whole milk}      0.005388917 0.6022727 0.008947636 2.357084
## [48] {butter,
##       tropical fruit}   => {other vegetables} 0.005490595 0.5510204 0.009964413 2.847759
## [49] {butter,
##       tropical fruit}   => {whole milk}      0.006202339 0.6224490 0.009964413 2.436047
## [50] {butter,
##       root vegetables}  => {other vegetables} 0.006609049 0.5118110 0.012913066 2.645119
## [51] {butter,
##       root vegetables}  => {whole milk}      0.008235892 0.6377953 0.012913066 2.496107
## [52] {butter,
##       yogurt}           => {whole milk}      0.009354347 0.6388889 0.014641586 2.500387
## [53] {butter,
##       other vegetables} => {whole milk}      0.011489578 0.5736041 0.020030503 2.244885
## [54] {newspapers,
##       root vegetables}  => {other vegetables} 0.005998983 0.5221239 0.011489578 2.698417
## [55] {domestic eggs,
##       whipped/sour cream}=> {other vegetables} 0.005083884 0.5102041 0.009964413 2.636814
## [56] {domestic eggs,
##       whipped/sour cream}=> {whole milk}      0.005693950 0.5714286 0.009964413 2.236371
## [57] {domestic eggs,
##       pip fruit}         => {whole milk}      0.005388917 0.6235294 0.008642603 2.440275
## [58] {citrus fruit,
##       domestic eggs}     => {whole milk}      0.005693950 0.5490196 0.010371124 2.148670
## [59] {domestic eggs,
##       tropical fruit}   => {whole milk}      0.006914082 0.6071429 0.011387900 2.376144
## [60] {domestic eggs,
##       root vegetables}  => {other vegetables} 0.007320793 0.5106383 0.014336553 2.639058
## [61] {domestic eggs,
##       root vegetables}  => {whole milk}      0.008540925 0.5957447 0.014336553 2.331536
## [62] {domestic eggs,
##       yogurt}            => {whole milk}      0.007727504 0.5390071 0.014336553 2.109485
## [63] {domestic eggs,
##       other vegetables}  => {whole milk}      0.012302999 0.5525114 0.022267412 2.162336
## [64] {fruit/vegetable juice,
##       tropical fruit}   => {other vegetables} 0.006609049 0.4814815 0.013726487 2.488371
## [65] {fruit/vegetable juice,
##       root vegetables}  => {other vegetables} 0.006609049 0.5508475 0.011997966 2.846865

```

```

## [66] {fruit/vegetable juice,
##       root vegetables} => {whole milk}      0.006507372 0.5423729 0.011997966 2.122657
## [67] {pip fruit,
##       whipped/sour cream} => {other vegetables} 0.005592272 0.6043956 0.009252669 3.123610
## [68] {pip fruit,
##       whipped/sour cream} => {whole milk}      0.005998983 0.6483516 0.009252669 2.537421
## [69] {citrus fruit,
##       whipped/sour cream} => {other vegetables} 0.005693950 0.5233645 0.010879512 2.704829
## [70] {citrus fruit,
##       whipped/sour cream} => {whole milk}      0.006304016 0.5794393 0.010879512 2.267722
## [71] {sausage,
##       whipped/sour cream} => {whole milk}      0.005083884 0.5617978 0.009049314 2.198679
## [72] {tropical fruit,
##       whipped/sour cream} => {other vegetables} 0.007829181 0.5661765 0.013828165 2.926088
## [73] {tropical fruit,
##       whipped/sour cream} => {whole milk}      0.007930859 0.5735294 0.013828165 2.244593
## [74] {root vegetables,
##       whipped/sour cream} => {other vegetables} 0.008540925 0.5000000 0.017081851 2.584078
## [75] {root vegetables,
##       whipped/sour cream} => {whole milk}      0.009456024 0.5535714 0.017081851 2.166484
## [76] {whipped/sour cream,
##       yogurt} => {other vegetables} 0.010167768 0.4901961 0.020742247 2.533410
## [77] {whipped/sour cream,
##       yogurt} => {whole milk}      0.010879512 0.5245098 0.020742247 2.052747
## [78] {rolls/buns,
##       whipped/sour cream} => {other vegetables} 0.006710727 0.4583333 0.014641586 2.368738
## [79] {rolls/buns,
##       whipped/sour cream} => {whole milk}      0.007829181 0.5347222 0.014641586 2.092715
## [80] {whipped/sour cream,
##       whole milk} => {other vegetables} 0.014641586 0.4542587 0.032231825 2.347679
## [81] {pip fruit,
##       sausage} => {whole milk}      0.005592272 0.5188679 0.010777834 2.030667
## [82] {pip fruit,
##       tropical fruit} => {other vegetables} 0.009456024 0.4626866 0.020437214 2.391236
## [83] {pip fruit,
##       root vegetables} => {other vegetables} 0.008134215 0.5228758 0.015556685 2.702304
## [84] {pip fruit,
##       root vegetables} => {whole milk}      0.008947636 0.5751634 0.015556685 2.250988
## [85] {pip fruit,
##       yogurt} => {other vegetables} 0.008134215 0.4519774 0.017996950 2.335890
## [86] {pip fruit,
##       yogurt} => {whole milk}      0.009557702 0.5310734 0.017996950 2.078435
## [87] {other vegetables,
##       pip fruit} => {whole milk}      0.013523132 0.5175097 0.026131164 2.025351
## [88] {pastry,
##       root vegetables} => {other vegetables} 0.005897306 0.5370370 0.010981190 2.775491
## [89] {pastry,
##       root vegetables} => {whole milk}      0.005693950 0.5185185 0.010981190 2.029299
## [90] {pastry,
##       yogurt} => {whole milk}      0.009150991 0.5172414 0.017691917 2.024301
## [91] {citrus fruit,
##       tropical fruit} => {other vegetables} 0.009049314 0.4540816 0.019928826 2.346765
## [92] {citrus fruit,
##       root vegetables} => {other vegetables} 0.010371124 0.5862069 0.017691917 3.029608

```

```

## [93] {citrus fruit,
##       root vegetables} => {whole milk}      0.009150991  0.5172414 0.017691917 2.024301
## [94] {root vegetables,
##       shopping bags}   => {other vegetables} 0.006609049  0.5158730 0.012811388 2.666112
## [95] {sausage,
##       tropical fruit} => {whole milk}      0.007219115  0.5182482 0.013929842 2.028241
## [96] {root vegetables,
##       sausage}        => {other vegetables} 0.006812405  0.4557823 0.014946619 2.355554
## [97] {root vegetables,
##       sausage}        => {whole milk}      0.007727504  0.5170068 0.014946619 2.023383
## [98] {root vegetables,
##       tropical fruit} => {other vegetables} 0.012302999  0.5845411 0.021047280 3.020999
## [99] {root vegetables,
##       tropical fruit} => {whole milk}      0.011997966  0.5700483 0.021047280 2.230969
## [100] {tropical fruit,
##        yogurt}         => {whole milk}      0.015149975  0.5173611 0.029283172 2.024770
## [101] {root vegetables,
##        yogurt}         => {other vegetables} 0.012913066  0.5000000 0.025826131 2.584078
## [102] {root vegetables,
##        yogurt}         => {whole milk}      0.014539908  0.5629921 0.025826131 2.203354
## [103] {rolls/buns,
##       root vegetables} => {other vegetables} 0.012201322  0.5020921 0.024300966 2.594890
## [104] {rolls/buns,
##       root vegetables} => {whole milk}      0.012709710  0.5230126 0.024300966 2.046888
## [105] {root vegetables,
##       whole milk}      => {other vegetables} 0.023182511  0.4740125 0.048906965 2.449770
## [106] {other vegetables,
##       yogurt}         => {whole milk}      0.022267412  0.5128806 0.043416370 2.007235
## [107] {fruit/vegetable juice,
##       other vegetables,
##       yogurt}         => {whole milk}      0.005083884  0.6172840 0.008235892 2.415833
## [108] {fruit/vegetable juice,
##       whole milk,
##       yogurt}         => {other vegetables} 0.005083884  0.5376344 0.009456024 2.778578
## [109] {fruit/vegetable juice,
##       other vegetables,
##       whole milk}     => {yogurt}          0.005083884  0.4854369 0.010472801 3.479790
## [110] {other vegetables,
##       root vegetables,
##       whipped/sour cream}=> {whole milk}      0.005185562  0.6071429 0.008540925 2.376144
## [111] {root vegetables,
##       whipped/sour cream,
##       whole milk}     => {other vegetables} 0.005185562  0.5483871 0.009456024 2.834150
## [112] {other vegetables,
##       whipped/sour cream,
##       yogurt}         => {whole milk}      0.005592272  0.5500000 0.010167768 2.152507
## [113] {whipped/sour cream,
##       whole milk,
##       yogurt}         => {other vegetables} 0.005592272  0.5140187 0.010879512 2.656529
## [114] {other vegetables,
##       pip fruit,
##       root vegetables}=> {whole milk}      0.005490595  0.6750000 0.008134215 2.641713
## [115] {pip fruit,
##       root vegetables,

```

```

##      whole milk}          => {other vegetables} 0.005490595  0.6136364 0.008947636 3.171368
## [116] {other vegetables,
##        pip fruit,
##        yogurt}           => {whole milk}       0.005083884  0.6250000 0.008134215 2.446031
## [117] {pip fruit,
##        whole milk,
##        yogurt}           => {other vegetables} 0.005083884  0.5319149 0.009557702 2.749019
## [118] {citrus fruit,
##        other vegetables,
##        root vegetables} => {whole milk}       0.005795628  0.5588235 0.010371124 2.187039
## [119] {citrus fruit,
##        root vegetables,
##        whole milk}         => {other vegetables} 0.005795628  0.6333333 0.009150991 3.273165
## [120] {root vegetables,
##        tropical fruit,
##        yogurt}             => {whole milk}       0.005693950  0.7000000 0.008134215 2.739554
## [121] {root vegetables,
##        tropical fruit,
##        whole milk}          => {yogurt}          0.005693950  0.4745763 0.011997966 3.401937
## [122] {other vegetables,
##        root vegetables,
##        tropical fruit}     => {whole milk}       0.007015760  0.5702479 0.012302999 2.231750
## [123] {root vegetables,
##        tropical fruit,
##        whole milk}          => {other vegetables} 0.007015760  0.5847458 0.011997966 3.022057
## [124] {other vegetables,
##        tropical fruit,
##        yogurt}              => {whole milk}       0.007625826  0.6198347 0.012302999 2.425816
## [125] {tropical fruit,
##        whole milk,
##        yogurt}              => {other vegetables} 0.007625826  0.5033557 0.015149975 2.601421
## [126] {other vegetables,
##        root vegetables,
##        yogurt}              => {whole milk}       0.007829181  0.6062992 0.012913066 2.372842
## [127] {root vegetables,
##        whole milk,
##        yogurt}              => {other vegetables} 0.007829181  0.5384615 0.014539908 2.782853
## [128] {rolls/buns,
##        root vegetables,
##        whole milk}          => {other vegetables} 0.006202339  0.4880000 0.012709710 2.522060
## [129] {other vegetables,
##        rolls/buns,
##        yogurt}              => {whole milk}       0.005998983  0.5221239 0.011489578 2.043410
## NULL

```

The graph below shows graph for 100 rules. The transparent circles represent support, and the circle's color represents lift (more red = high lift).

```

sub1 = subset(itemrules, subset=confidence > 0.5 & support > 0.005)
summary(sub1)

```

```

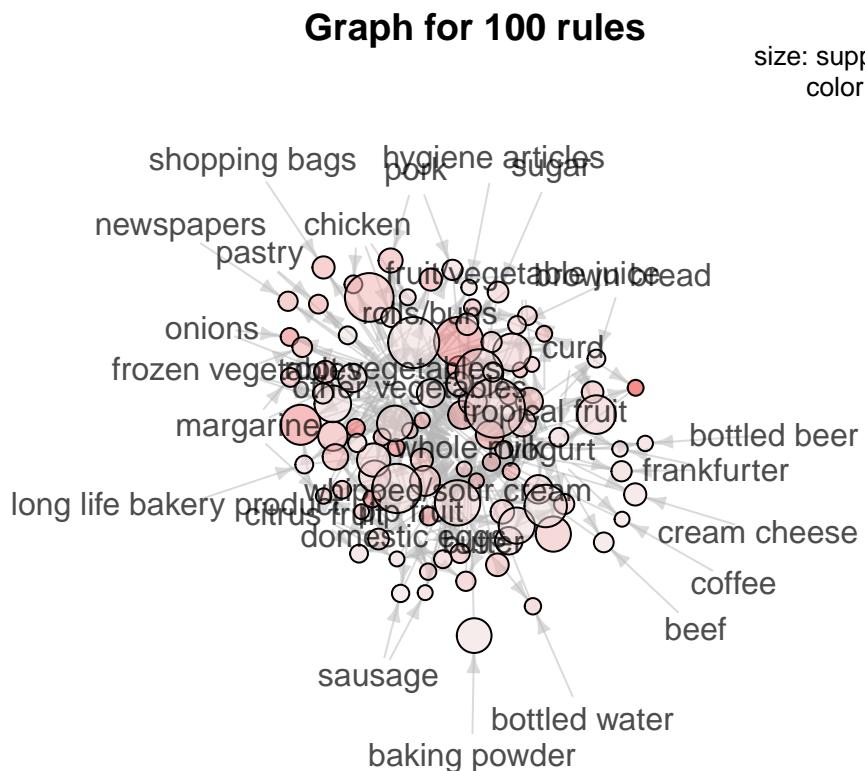
## set of 113 rules
##
## rule length distribution (lhs + rhs):sizes
##  2  3  4

```

```

##  1 91 21
##
##      Min. 1st Qu. Median     Mean 3rd Qu.    Max.
##    2.000  3.000 3.000   3.177  3.000   4.000
##
## summary of quality measures:
##      support       confidence       coverage       lift
##  Min. :0.005084  Min. :0.5021  Min. :0.008134  Min. :1.974
##  1st Qu.:0.005694 1st Qu.:0.5221 1st Qu.:0.009964 1st Qu.:2.109
##  Median :0.006202 Median :0.5484 Median :0.011388 Median :2.268
##  Mean   :0.007315 Mean   :0.5570 Mean   :0.013268 Mean   :2.394
##  3rd Qu.:0.007931 3rd Qu.:0.5824 3rd Qu.:0.014642 3rd Qu.:2.657
##  Max.   :0.022267  Max.   :0.7000  Max.   :0.043416  Max.   :3.691
##
##      count
##  Min.   : 50.00
##  1st Qu.: 56.00
##  Median : 61.00
##  Mean   : 71.95
##  3rd Qu.: 78.00
##  Max.   :219.00
##
## mining info:
##      data ntransactions support confidence
##  transactions         9835     0.005        0.1
plot(head(sub1, 100, by='lift')), method='graph')

```



```
saveAsGraph(head(itemrules, n = 1000, by = "lift"), file = "itemrules.graphml")
```

Below graphs are exported from the visualization program “Gephi”. The first graph is a result from the layout called “Fruchterman Reingold” which represents the whœl association rules in a circular way (heavier as close to the center) and the second one is the result from the layout called “Label Layout” which spreads out the rules by the frequency of items (heavier as far away from the center).

