Class 10

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Background

Part 1

In this mini-project we will examine 538 Halloween Candy data. What is your favorite candy? What is nougat anyway? And how do you say it in American?

First step is to read the data…

```
candy <- read.csv("candy-data.csv", row.names=1)
head(candy)
```

```
             chocolate fruity caramel peanutyalmondy nougat crispedricewafer
100 Grand            1      0       1              0      0                1
3 Musketeers         1      0       0              0      1                0
One dime             0      0       0              0      0                0
One quarter          0      0       0              0      0                0
Air Heads            0      1       0              0      0                0
Almond Joy           1      0       0              1      0                0
             hard bar pluribus sugarpercent pricepercent winpercent
100 Grand       0   1        0        0.732        0.860   66.97173
3 Musketeers    0   1        0        0.604        0.511   67.60294
One dime        0   0        0        0.011        0.116   32.26109
One quarter     0   0        0        0.011        0.511   46.11650
Air Heads       0   0        0        0.906        0.511   52.34146
Almond Joy      0   1        0        0.465        0.767   50.34755
```

Q1:

There are 85 different candy types in this data set.

```
dim(candy)
```

```
[1] 85 12
```

```
nrow(candy)
```

```
[1] 85
```

Q2:

There are 38 candies categorized as “fruity”.

```
sum(candy$fruity)
```

```
[1] 38
```

```
table(candy$fruity)
```

```

 0  1 
47 38 
```

Part 2

Q3:

My favorite candy is Sour Patch Kids and its win percent is 59.864%.

```
candy["Sour Patch Kids",]$winpercent
```

```
[1] 59.864
```

Q4:

The win percent value for Kit Kat is 76.7686%.

```
candy["Kit Kat",]$winpercent
```

```
[1] 76.7686
```

Q5:

The win percent for Tootsie Roll Snack Bars is 49.6535%.

```
candy["Tootsie Roll Snack Bars",]$winpercent
```

```
[1] 49.6535
```

```
skimr::skim(candy)
```

Table 1: Data summary

Name	candy
Number of rows	85
Number of columns	12
Column type frequency:	
numeric	12
Group variables	None

Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
chocolate	0	1	0.44	0.50	0.00	0.00	0.00	1.00	1.00	
fruity	0	1	0.45	0.50	0.00	0.00	0.00	1.00	1.00	
caramel	0	1	0.16	0.37	0.00	0.00	0.00	0.00	1.00	
peanutyalmondy	0	1	0.16	0.37	0.00	0.00	0.00	0.00	1.00	
nougat	0	1	0.08	0.28	0.00	0.00	0.00	0.00	1.00	
crispedricewafer	0	1	0.08	0.28	0.00	0.00	0.00	0.00	1.00	
hard	0	1	0.18	0.38	0.00	0.00	0.00	0.00	1.00	
bar	0	1	0.25	0.43	0.00	0.00	0.00	0.00	1.00	
pluribus	0	1	0.52	0.50	0.00	0.00	1.00	1.00	1.00	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
sugarpercent	0	1	0.48	0.28	0.01	0.22	0.47	0.73	0.99	
pricepercent	0	1	0.47	0.29	0.01	0.26	0.47	0.65	0.98	
winpercent	0	1	50.32	14.71	22.45	39.14	47.83	59.86	84.18	

Q6:

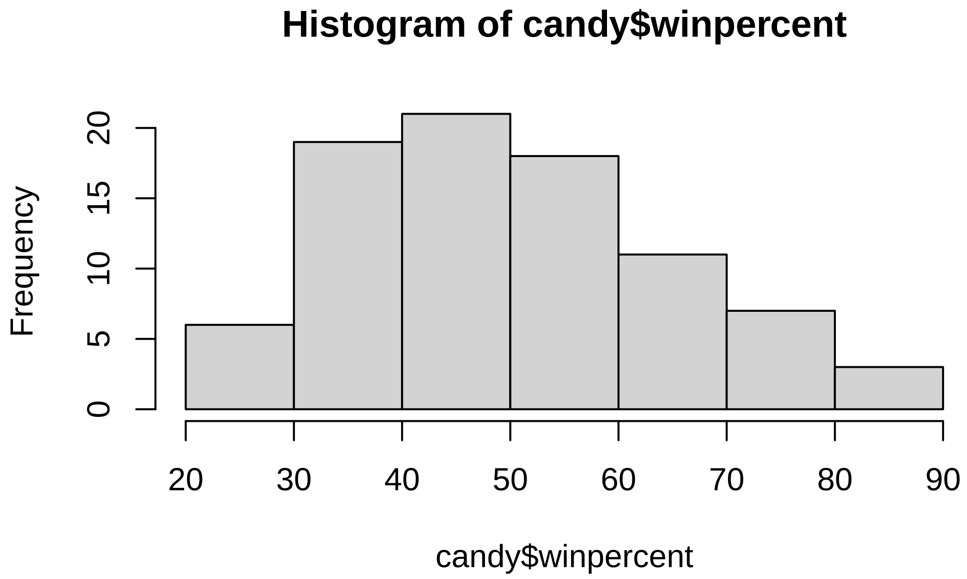
The win percent variable looks to be on a different scale to the majority of the others in the dataset

Q7:

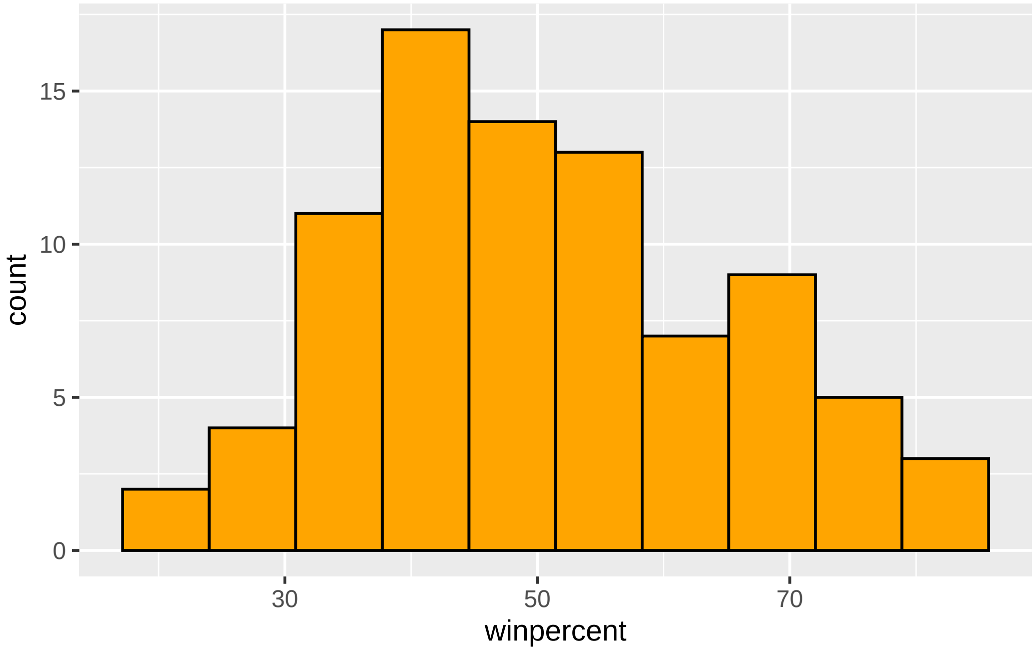
For candy$chocolate, the 0 and 1 means that it either is or is not a chocolate candy. 0 means it isn't, 1 means it is.

Q8:

```r
hist(candy$winpercent)
```



```r
library(ggplot2)

ggplot(candy, aes(winpercent,)) +
  geom_histogram(bins=10, col="black", fill="orange")
```



Q9:

The distribution is not totally symmestrical.

Q10:

The center of the distribution is below 50%

Q11:

Chocolate candy does rank better than fruity candy on average.

```r
as.logical(candy$chocolate)
```

```
 [1]  TRUE  TRUE FALSE FALSE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE
[13] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE
[25]  TRUE  TRUE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE  TRUE FALSE  TRUE
[37]  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE
[49] FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE FALSE  TRUE
[61] FALSE FALSE  TRUE FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
[73] FALSE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE FALSE FALSE FALSE
[85]  TRUE
```

```r
choc_stats <- candy$winpercent[as.logical(candy$chocolate)]
choc_win <- mean(candy$winpercent[as.logical(candy$chocolate)])
choc_win
```

```
[1] 60.92153
```

```r
fruit_stats <- candy$winpercent[as.logical(candy$fruity)]
fruit_win <- mean(candy$winpercent[as.logical(candy$fruity)])
fruit_win
```

```
[1] 44.11974
```

```r
choc_win > fruit_win
```

```
[1] TRUE
```

```r
fruit_win > choc_win
```

```
[1] FALSE
```

Q12:

Yes, it is statistically different, the p value is lower than 0.5.

```r
t.test(choc_stats, fruit_stats)
```

```
	Welch Two Sample t-test

data:  choc_stats and fruit_stats
t = 6.2582, df = 68.882, p-value = 2.871e-08
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 11.44563 22.15795
sample estimates:
mean of x mean of y 
 60.92153  44.11974 
```

Part 3

The base R `sort()` and `order()` functions are very useful!

Q13:

The least 5 liked candies are: Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, and Jawbusters.

```
head(sort(candy$winpercent), n=5)
```

```
[1] 22.44534 23.41782 24.52499 27.30386 28.12744
```

```
head(candy[order(candy$winpercent),], n=5)
```

```
                   chocolate fruity caramel peanutyalmondy nougat
Nik L Nip                  0      1       0              0      0
Boston Baked Beans         0      0       0              1      0
Chiclets                   0      1       0              0      0
Super Bubble               0      1       0              0      0
Jawbusters                 0      1       0              0      0
                   crispedricewafer hard bar pluribus sugarpercent pricepercent
Nik L Nip                         0    0   0        1        0.197        0.976
Boston Baked Beans                0    0   0        1        0.313        0.511
Chiclets                          0    0   0        1        0.046        0.325
Super Bubble                      0    0   0        0        0.162        0.116
Jawbusters                        0    1   0        1        0.093        0.511
```

```
                   winpercent
Nik L Nip            22.44534
Boston Baked Beans   23.41782
Chiclets             24.52499
Super Bubble         27.30386
Jawbusters           28.12744
```

```r
library(dplyr)
```

```

Attaching package: 'dplyr'

The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```r
candy %>%
  arrange(winpercent) %>%
  head(5)
```

```
                   chocolate fruity caramel peanutyalmondy nougat
Nik L Nip                  0      1       0              0      0
Boston Baked Beans         0      0       0              1      0
Chiclets                   0      1       0              0      0
Super Bubble               0      1       0              0      0
Jawbusters                 0      1       0              0      0
                   crispedricewafer hard bar pluribus sugarpercent pricepercent
Nik L Nip                         0    0   0        1        0.197        0.976
Boston Baked Beans                0    0   0        1        0.313        0.511
Chiclets                          0    0   0        1        0.046        0.325
Super Bubble                      0    0   0        0        0.162        0.116
Jawbusters                        0    1   0        1        0.093        0.511
                   winpercent
Nik L Nip            22.44534
Boston Baked Beans   23.41782
Chiclets             24.52499
Super Bubble         27.30386
Jawbusters           28.12744
```

Q14:

The most liked candies are Reese’s Peanut Butter Cup, Reese’s Miniatures, Twix, Kit Kat, Snickers.

```
tail(candy[order(candy$winpercent),], n=5)
```

```
                          chocolate fruity caramel peanutyalmondy nougat
Snickers                          1      0       1              1      1
Kit Kat                           1      0       0              0      0
Twix                              1      0       1              0      0
ReeseÕs Miniatures                1      0       0              1      0
ReeseÕs Peanut Butter cup         1      0       0              1      0
                          crispedricewafer hard bar pluribus sugarpercent
Snickers                                 0    0   1        0        0.546
Kit Kat                                  1    0   1        0        0.313
Twix                                     1    0   1        0        0.546
ReeseÕs Miniatures                       0    0   0        0        0.034
ReeseÕs Peanut Butter cup                0    0   0        0        0.720
                          pricepercent winpercent
Snickers                         0.651   76.67378
Kit Kat                          0.511   76.76860
Twix                             0.906   81.64291
ReeseÕs Miniatures               0.279   81.86626
ReeseÕs Peanut Butter cup        0.651   84.18029
```

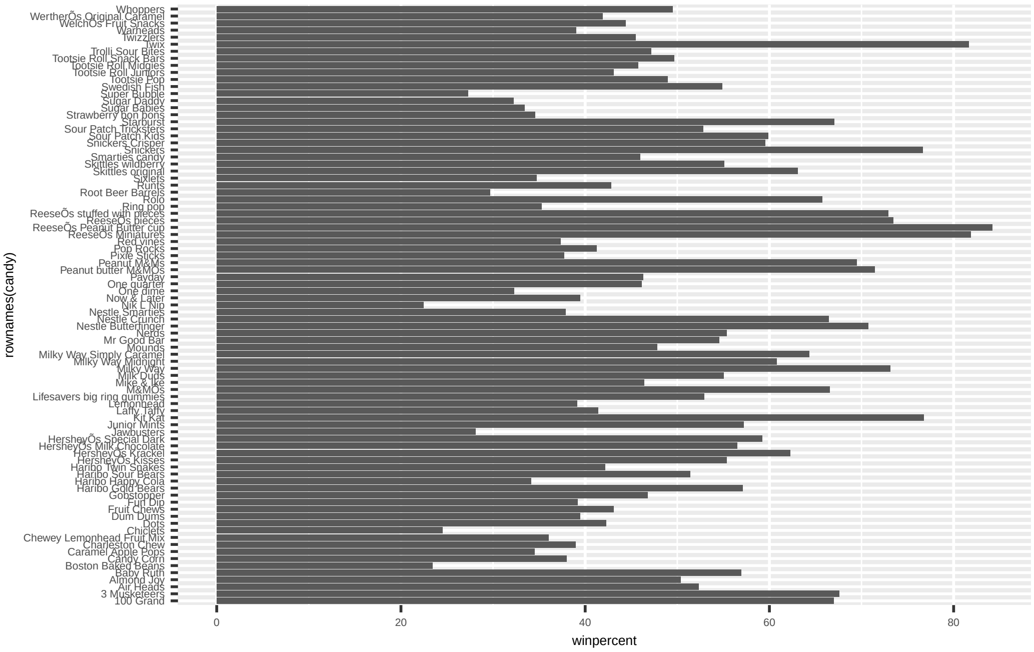
```
candy %>%
  arrange(winpercent) %>%
  tail(5)
```

```
                          chocolate fruity caramel peanutyalmondy nougat
Snickers                          1      0       1              1      1
Kit Kat                           1      0       0              0      0
Twix                              1      0       1              0      0
ReeseÕs Miniatures                1      0       0              1      0
ReeseÕs Peanut Butter cup         1      0       0              1      0
                          crispedricewafer hard bar pluribus sugarpercent
Snickers                                 0    0   1        0        0.546
Kit Kat                                  1    0   1        0        0.313
Twix                                     1    0   1        0        0.546
```

```
ReeseÕs Miniatures                       0    0   0         0         0.034
ReeseÕs Peanut Butter cup                0    0   0         0         0.720
                          pricepercent winpercent
Snickers                         0.651   76.67378
Kit Kat                          0.511   76.76860
Twix                             0.906   81.64291
ReeseÕs Miniatures               0.279   81.86626
ReeseÕs Peanut Butter cup        0.651   84.18029
```

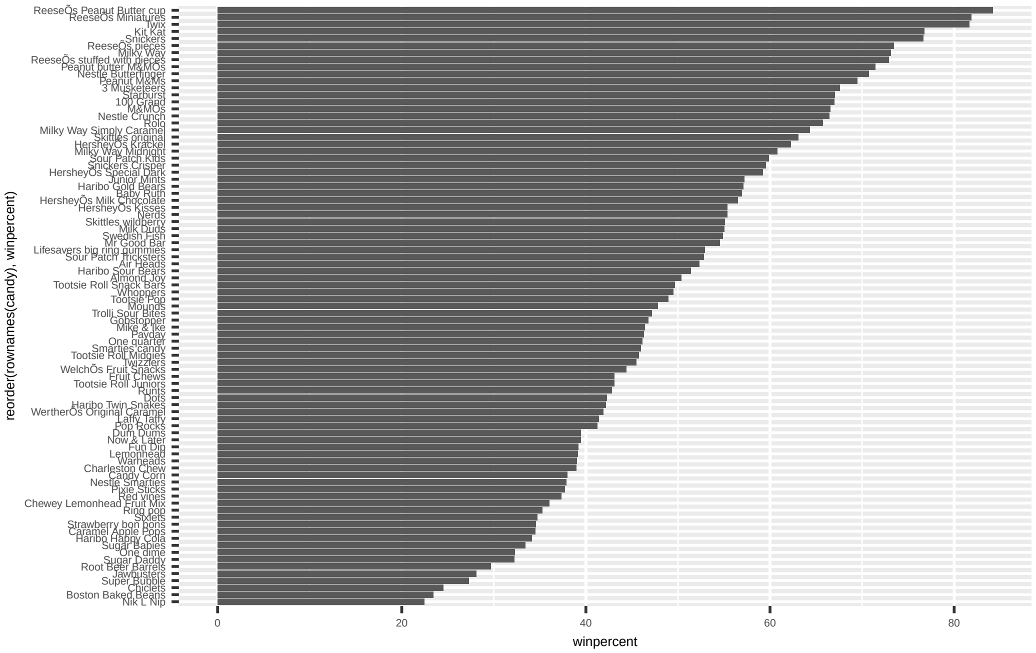
Q15:

```
library(ggplot2)

ggplot(candy, aes(winpercent, rownames(candy))) +
  geom_col() +
  theme(text = element_text(size=5))
```



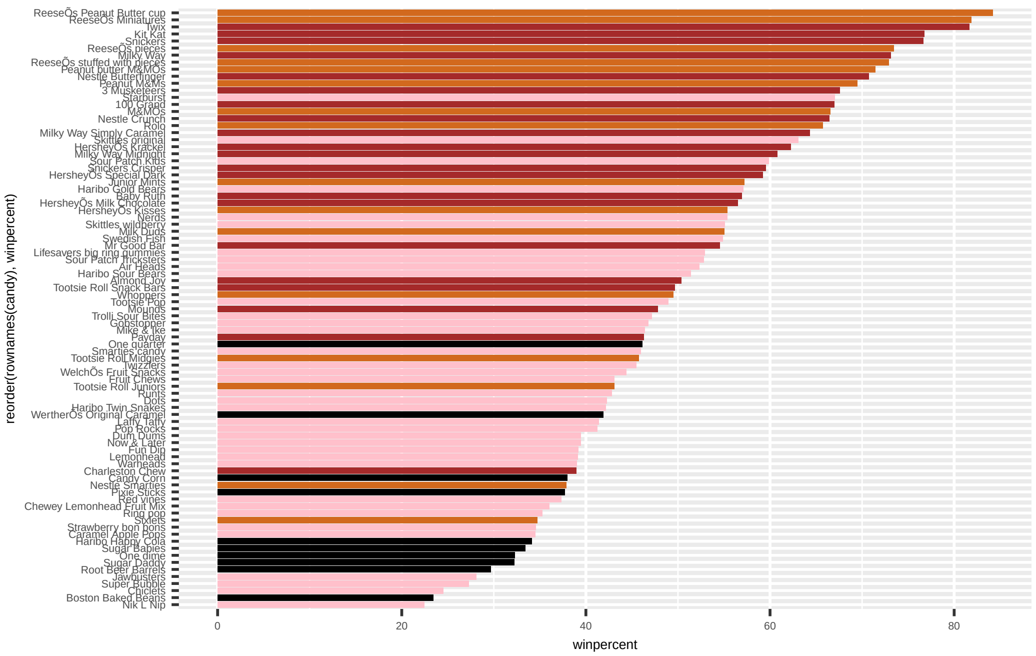
Q16:

```
ggplot(candy) + aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col() +
  theme(text = element_text(size=5))
```



```
my_cols=rep("black", nrow(candy))
my_cols[as.logical(candy$chocolate)] = "chocolate"
my_cols[as.logical(candy$bar)] = "brown"
my_cols[as.logical(candy$fruity)] = "pink"
```

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_col(fill=my_cols) +
  theme(text = element_text(size=5))
```



```r
ggsave("mybarplot.png")
```

```
Saving 5.5 x 3.5 in image
```

Q17:

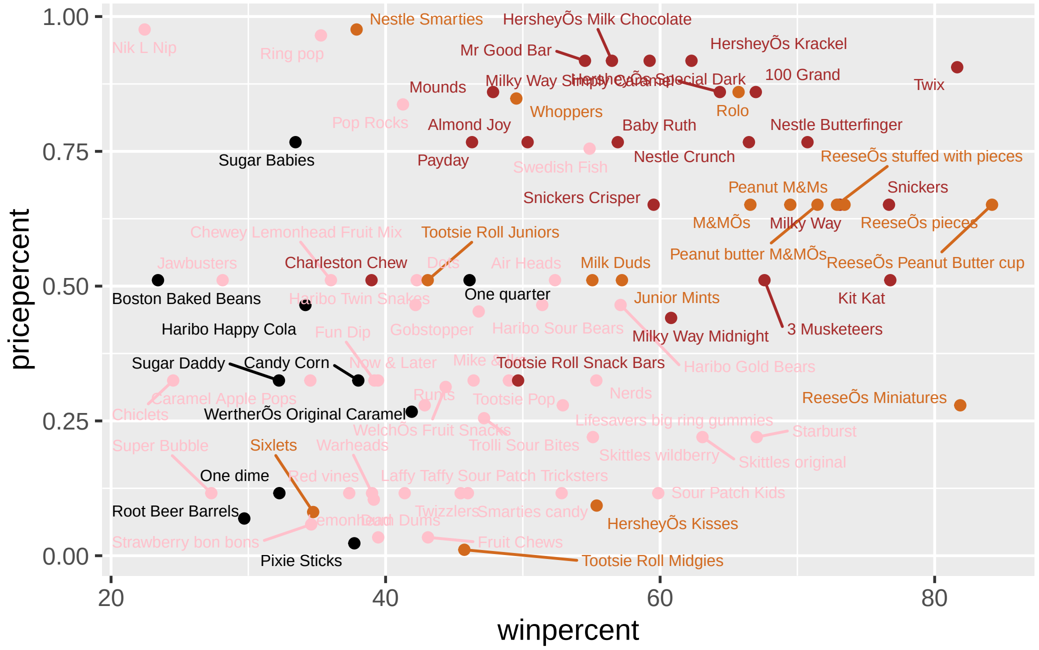
The worst ranked chocolate candy is Sixlets.

Q18:

The best ranked fruity candy is Starburst.

Part 4

```r
library(ggrepel)

ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, size=2, max.overlaps = 100)
```



Q19:

Reese’s Miniatures has a high win percent ranking but is pretty low price percentage.

Q20:

The 5 most expensive candy types are Hershey’s Special Dark, Mr Goof Bar, Ring pop, Nik L Nip, and Nestle Smarties. Nik L Nip is the lowest ranked at the highest price.

```
most_money <- candy %>%
  arrange(pricepercent) %>%
  tail(5)

most_money
```

```
                      chocolate fruity caramel peanutyalmondy nougat
HersheyÕs Special Dark         1      0       0              0      0
```

```
Mr Good Bar                    1      0       0              1      0
Ring pop                       0      1       0              0      0
Nik L Nip                      0      1       0              0      0
Nestle Smarties                1      0       0              0      0
                       crispedricewafer hard bar pluribus sugarpercent
HersheyÕs Special Dark                0    0   1        0        0.430
Mr Good Bar                           0    0   1        0        0.313
Ring pop                              0    1   0        0        0.732
Nik L Nip                             0    0   0        1        0.197
Nestle Smarties                       0    0   0        1        0.267
                       pricepercent winpercent
HersheyÕs Special Dark        0.918   59.23612
Mr Good Bar                   0.918   54.52645
Ring pop                      0.965   35.29076
Nik L Nip                     0.976   22.44534
Nestle Smarties               0.976   37.88719
```

```
#candy[order$winpercent,]
```

```
most_money[order(most_money$winpercent),]
```

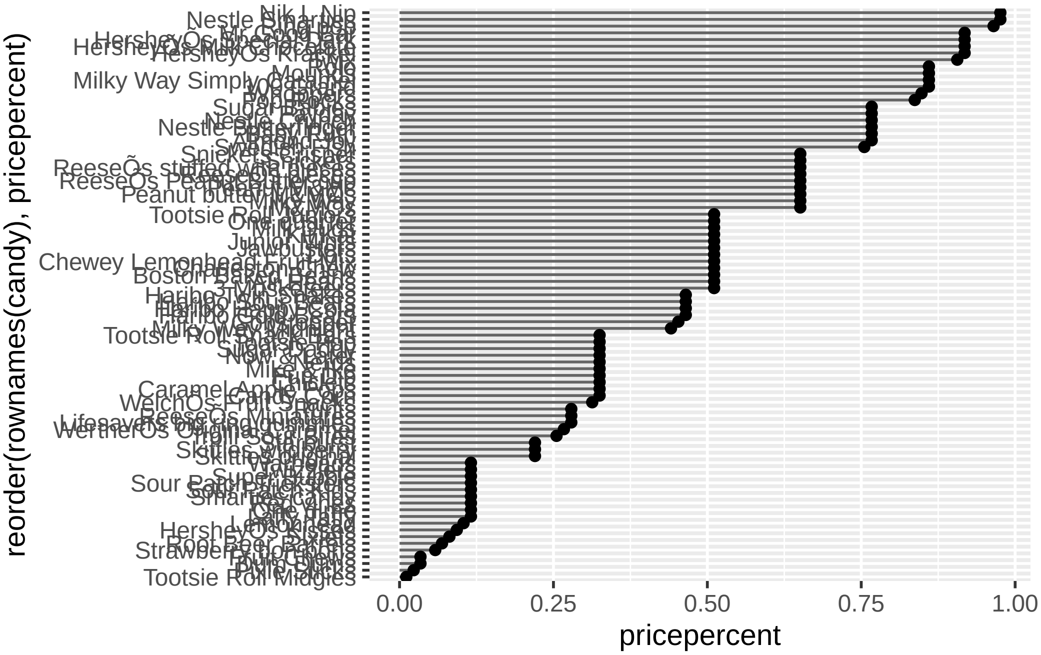
```
                       chocolate fruity caramel peanutyalmondy nougat
Nik L Nip                      0      1       0              0      0
Ring pop                       0      1       0              0      0
Nestle Smarties                1      0       0              0      0
Mr Good Bar                    1      0       0              1      0
HersheyÕs Special Dark         1      0       0              0      0
                       crispedricewafer hard bar pluribus sugarpercent
Nik L Nip                             0    0   0        1        0.197
Ring pop                              0    1   0        0        0.732
Nestle Smarties                       0    0   0        1        0.267
Mr Good Bar                           0    0   1        0        0.313
HersheyÕs Special Dark                0    0   1        0        0.430
                       pricepercent winpercent
Nik L Nip                     0.976   22.44534
Ring pop                      0.965   35.29076
Nestle Smarties               0.976   37.88719
Mr Good Bar                   0.918   54.52645
HersheyÕs Special Dark        0.918   59.23612
```

```
ord <- order(candy$pricepercent, decreasing = TRUE)
head( candy[ord,c(11,12)], n=5 )
```

```
                         pricepercent winpercent
Nik L Nip                       0.976   22.44534
Nestle Smarties                 0.976   37.88719
Ring pop                        0.965   35.29076
HersheyÕs Krackel               0.918   62.28448
HersheyÕs Milk Chocolate        0.918   56.49050
```

Q21:

```
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_segment(aes(yend = reorder(rownames(candy), pricepercent),
                   xend = 0), col="gray40") +
    geom_point()
```

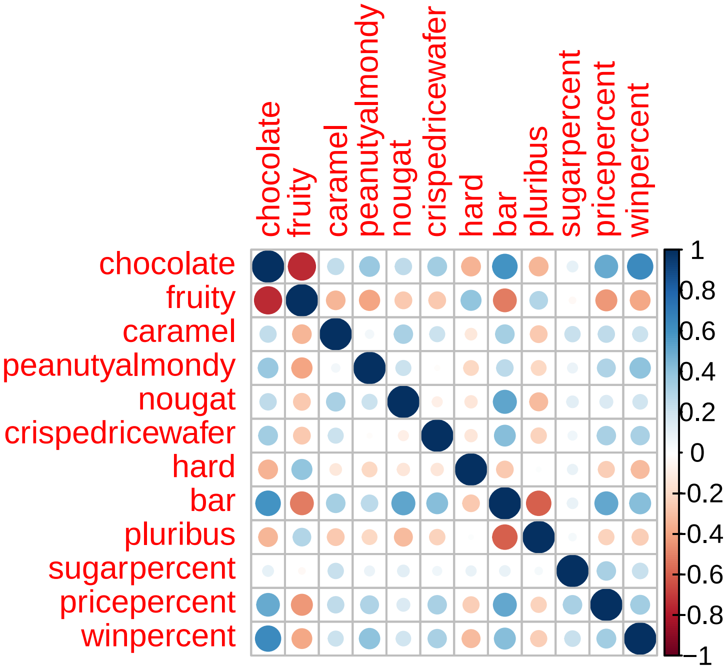


Part 5

```
library(corrplot)
```

```
corrplot 0.92 loaded
```

```
cij <- cor(candy)
corrplot(cij)
```



Q22:

Fruity and chocolate are anti-correlated.

Q23:

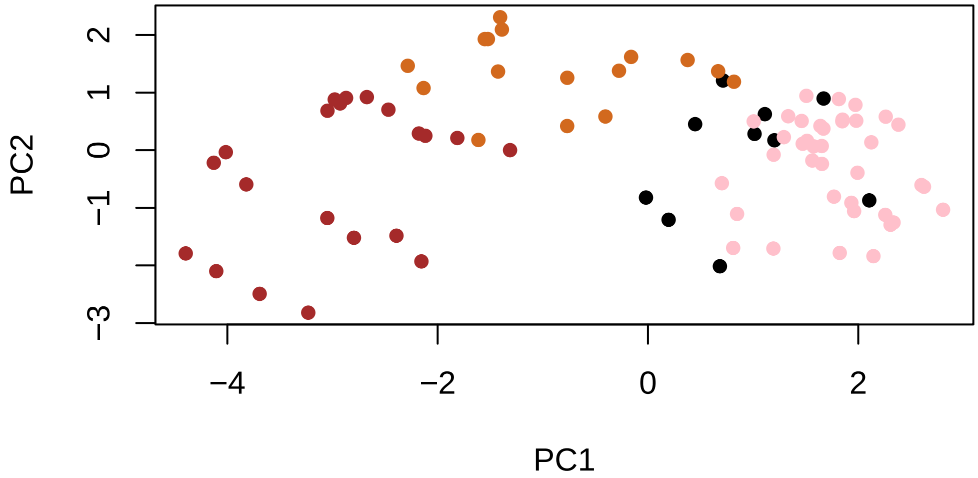
Chocolate with win percent and bar are most positively correlated.

Part 6

```
pca <- prcomp(candy, scale=T)
summary(pca)
```

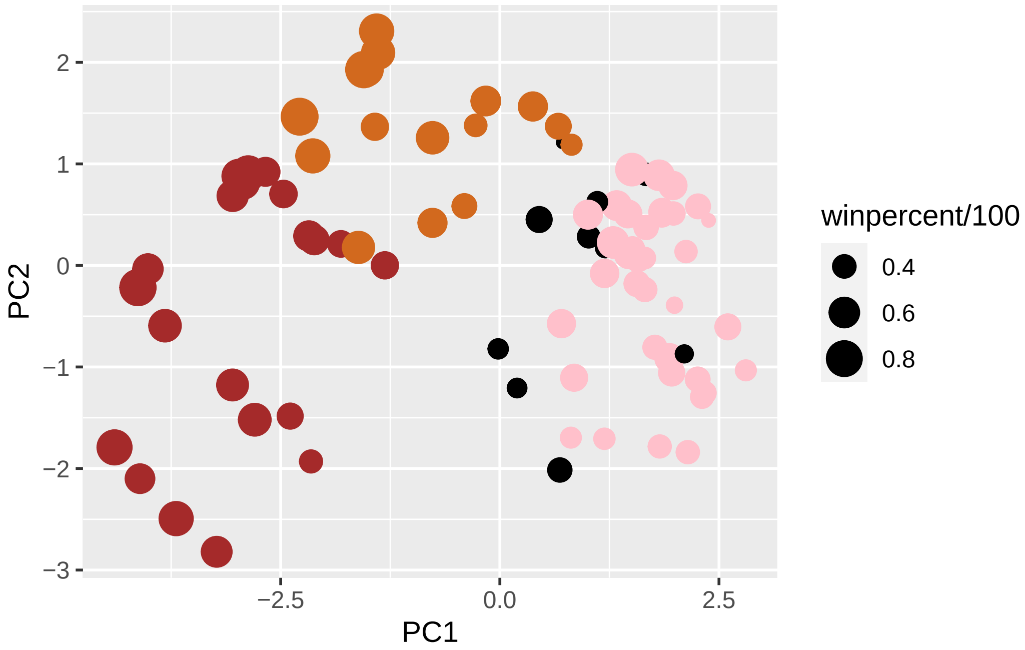
```
Importance of components:
                          PC1    PC2    PC3     PC4    PC5     PC6     PC7
Standard deviation     2.0788 1.1378 1.1092 1.07533 0.9518 0.81923 0.81530
Proportion of Variance 0.3601 0.1079 0.1025 0.09636 0.0755 0.05593 0.05539
Cumulative Proportion  0.3601 0.4680 0.5705 0.66688 0.7424 0.79830 0.85369
                           PC8     PC9    PC10    PC11    PC12
Standard deviation     0.74530 0.67824 0.62349 0.43974 0.39760
Proportion of Variance 0.04629 0.03833 0.03239 0.01611 0.01317
Cumulative Proportion  0.89998 0.93832 0.97071 0.98683 1.00000
```

```
plot(pca$x[,1:2], col=my_cols, pch=16)
```

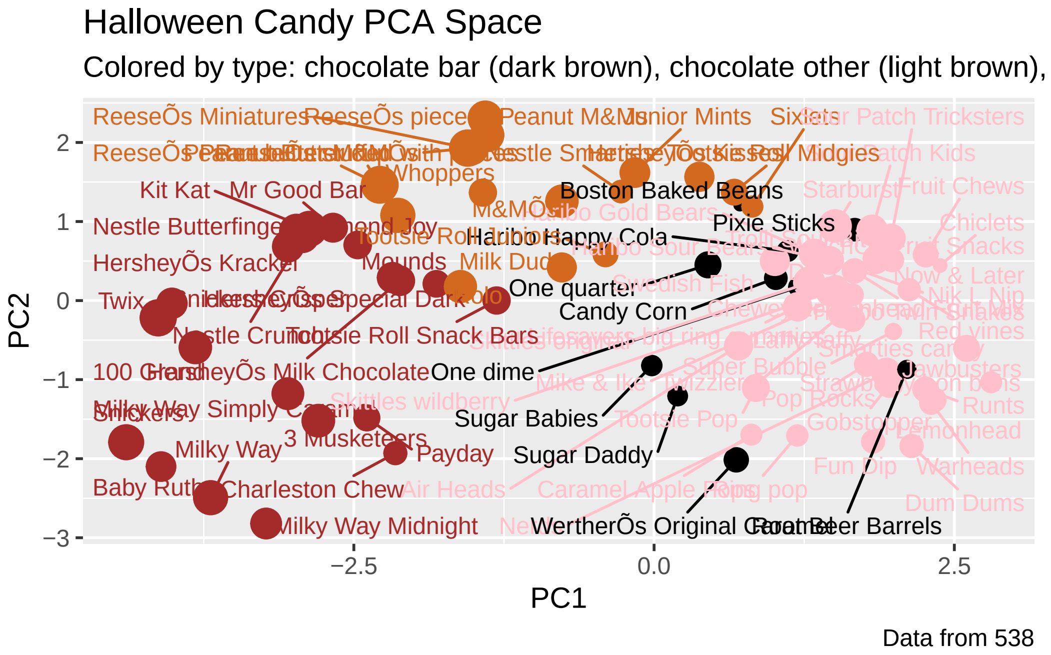


```
my_data <- cbind(candy, pca$x[,1:3])
```

```
p <- ggplot(my_data) +
      aes(x=PC1, y=PC2,
        size=winpercent/100,
        text=rownames(my_data),
        label=rownames(my_data)) +
      geom_point(col=my_cols)

p
```



```
library(ggrepel)

p + geom_text_repel(size=3.3, col=my_cols, max.overlaps = 100)  +
  theme(legend.position = "none") +
  labs(title="Halloween Candy PCA Space",
       subtitle="Colored by type: chocolate bar (dark brown), chocolate other (light brown
       caption="Data from 538")
```


Halloween Candy PCA Space

Colored by type: chocolate bar (dark brown), chocolate other (light brown),

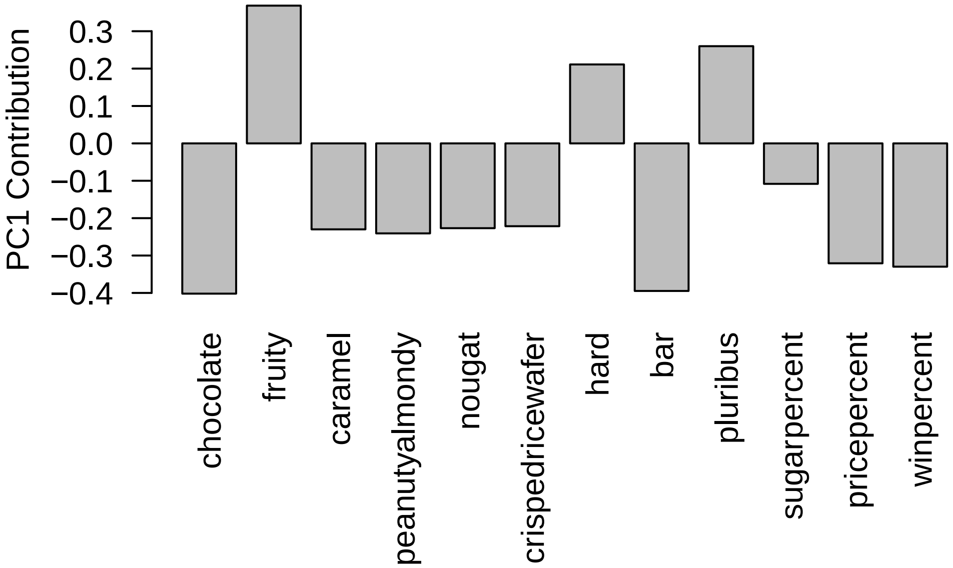
Data from 538

```
library(plotly)
```

```
Attaching package: 'plotly'

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

    last_plot

The following object is masked from 'package:stats':

    filter

The following object is masked from 'package:graphics':

    layout
```

```
#ggplotly(p)
```

```
par(mar=c(8,4,2,2))
barplot(pca$rotation[,1], las=2, ylab="PC1 Contribution")
```



Q24:

Fruity, hard, and pluribus are picked up strongly by PC1 in the positive direction. This makes sense because fruity candies are usually hard and pluribus, these variables are positively correlated in the correlation plot. Also considering that fruity and chocolate were very negatively correlated in the correlation plot (and fruity is high here, while chocolate is low). Additionally, chocolate was a bit negatively correlated with hard and pluribus (in the correlation plot).