# Class 10: Halloween Mini-Project

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## 1. Importing candy data

```
candy_file <- "candy-data.csv"

candy = read.csv(candy_file, 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. How many different candy types are in this dataset?

```
dim(candy)
```

```
[1] 85 12
```

There are 85 rows so 85 candy types

Q2. How many fruity candy types are in the dataset?

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

```
[1] 38
```

38 are fruity candy types

## 2. What is your favorite candy?

Q3. What is your favorite candy in the dataset and what is it's winpercent value?

```
rownames(candy)
```

```
 [1] "100 Grand"                   "3 Musketeers"
 [3] "One dime"                    "One quarter"
 [5] "Air Heads"                   "Almond Joy"
 [7] "Baby Ruth"                   "Boston Baked Beans"
 [9] "Candy Corn"                  "Caramel Apple Pops"
[11] "Charleston Chew"             "Chewey Lemonhead Fruit Mix"
[13] "Chiclets"                    "Dots"
[15] "Dum Dums"                    "Fruit Chews"
[17] "Fun Dip"                     "Gobstopper"
[19] "Haribo Gold Bears"           "Haribo Happy Cola"
[21] "Haribo Sour Bears"           "Haribo Twin Snakes"
[23] "Hershey's Kisses"            "Hershey's Krackel"
[25] "Hershey's Milk Chocolate"    "Hershey's Special Dark"
[27] "Jawbusters"                  "Junior Mints"
[29] "Kit Kat"                     "Laffy Taffy"
[31] "Lemonhead"                   "Lifesavers big ring gummies"
[33] "Peanut butter M&M's"         "M&M's"
[35] "Mike & Ike"                  "Milk Duds"
[37] "Milky Way"                   "Milky Way Midnight"
[39] "Milky Way Simply Caramel"    "Mounds"
[41] "Mr Good Bar"                 "Nerds"
[43] "Nestle Butterfinger"         "Nestle Crunch"
[45] "Nik L Nip"                   "Now & Later"
[47] "Payday"                      "Peanut M&Ms"
[49] "Pixie Sticks"                "Pop Rocks"
```

```
[51] "Red vines"                   "Reese's Miniatures"
[53] "Reese's Peanut Butter cup"   "Reese's pieces"
[55] "Reese's stuffed with pieces" "Ring pop"
[57] "Rolo"                        "Root Beer Barrels"
[59] "Runts"                       "Sixlets"
[61] "Skittles original"           "Skittles wildberry"
[63] "Nestle Smarties"             "Smarties candy"
[65] "Snickers"                    "Snickers Crisper"
[67] "Sour Patch Kids"             "Sour Patch Tricksters"
[69] "Starburst"                   "Strawberry bon bons"
[71] "Sugar Babies"                "Sugar Daddy"
[73] "Super Bubble"                "Swedish Fish"
[75] "Tootsie Pop"                 "Tootsie Roll Juniors"
[77] "Tootsie Roll Midgies"        "Tootsie Roll Snack Bars"
[79] "Trolli Sour Bites"           "Twix"
[81] "Twizzlers"                   "Warheads"
[83] "Welch's Fruit Snacks"        "Werther's Original Caramel"
[85] "Whoppers"
```

```
candy["M&M's", ]$winpercent
```

```
[1] 66.57458
```

My favorite candy is M&Ms and their winpercent is 66%

> Q4. What is the winpercent value for “Kit Kat”?

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

```
[1] 76.7686
```

76 percent

> Q5. What is the winpercent value for “Tootsie Roll Snack Bars”?

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

```
[1] 49.6535
```

49 percent

```
library("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 | |
| 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. Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset?

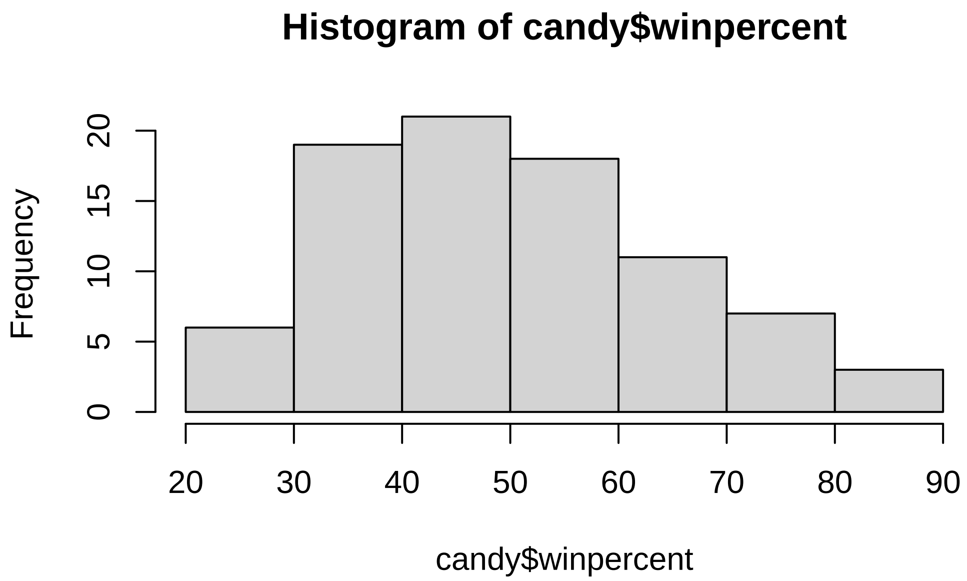
The variables sugarpercent, pricepercent, and winpercent have different scales as the majority of other columns are categorical (i.e. 0s and 1s)

> Q7. What do you think a zero and one represent for the candy$chocolate column?

A zero would mean the candy types does not contain chocolate and a one would mean it does

> Q8. Plot a histogram of winpercent values

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



> Q9. Is the distribution of winpercent values symmetrical?

It is slightly skewed to the right

> Q10. Is the center of the distribution above or below 50%?

The center is below 50%

> Q11. On average is chocolate candy higher or lower ranked than fruit candy?

```r
choco <- candy$winpercent[as.logical(candy$chocolate)]
fruity <- candy$winpercent[as.logical(candy$fruity)]

mean(choco) > mean(fruity)
```

```
[1] TRUE
```

Chocolate candies are ranked higher

> Q12. Is this difference statistically significant?

```r
t.test(choco, fruity)
```

```

	Welch Two Sample t-test

data:  choco and fruity
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 
```

This difference is statistically significant as the p-value is lower than 0.05

## 3. Overall Candy Rankings

> Q13. What are the five least liked candy types in this set?

```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
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
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
```

I prefer the dplyr as it is easier to understand

Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, and Jawbusters

> Q14. What are the top 5 all time favorite candy types out of this set?

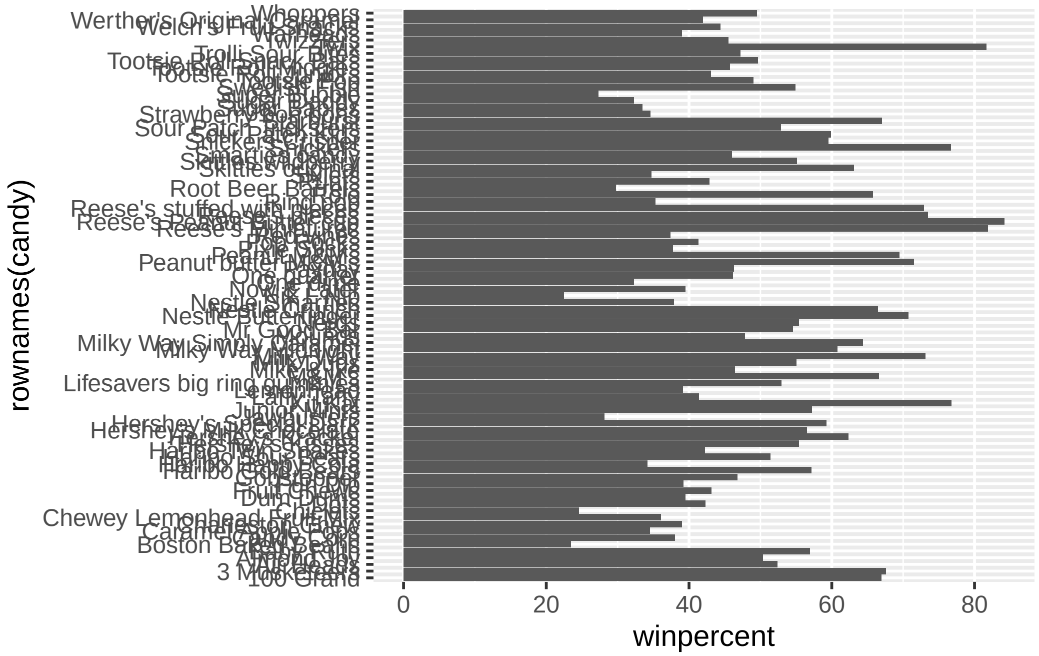
```r
candy %>% arrange(winpercent) %>% tail(5)
```

```
                          chocolate fruity caramel peanutyalmondy nougat
Snickers                          1      0       1              1      1
Kit Kat                           1      0       0              0      0
Twix                              1      0       1              0      0
Reese's Miniatures                1      0       0              1      0
Reese's 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
Reese's Miniatures                       0    0   0        0        0.034
Reese's 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
Reese's Miniatures               0.279   81.86626
Reese's Peanut Butter cup        0.651   84.18029
```

Snickers, Kit Kat, Twix, Reese's Miniatures, and Reese's Peanut Butter cup

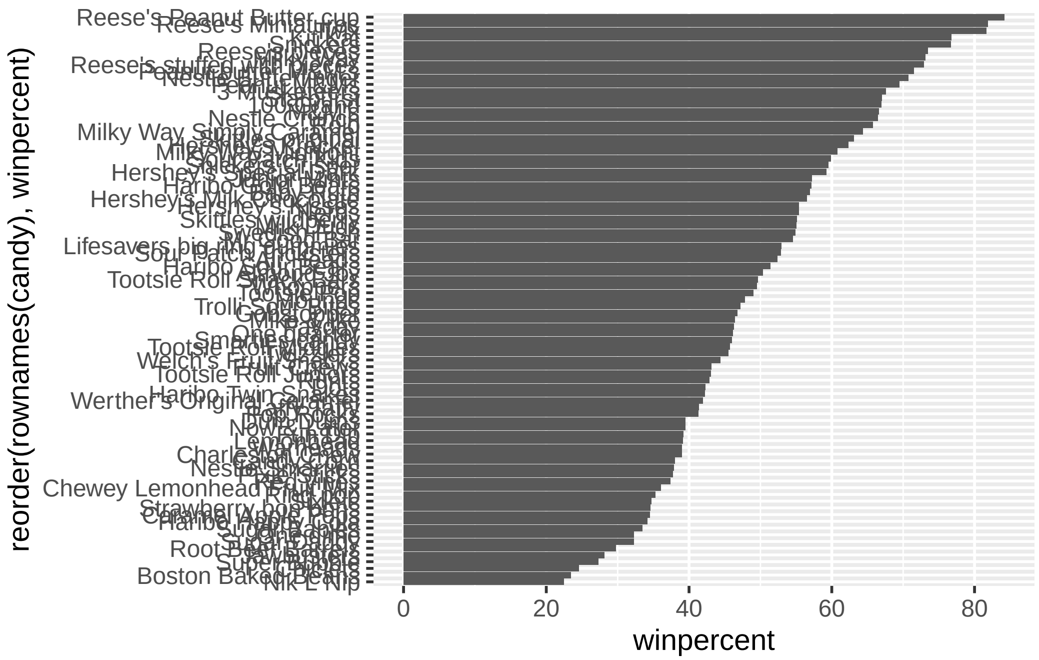
> Q15. Make a first barplot of candy ranking based on winpercent values.

```r
library(ggplot2)

ggplot(candy) +
  aes(winpercent, rownames(candy)) +
  geom_col()
```



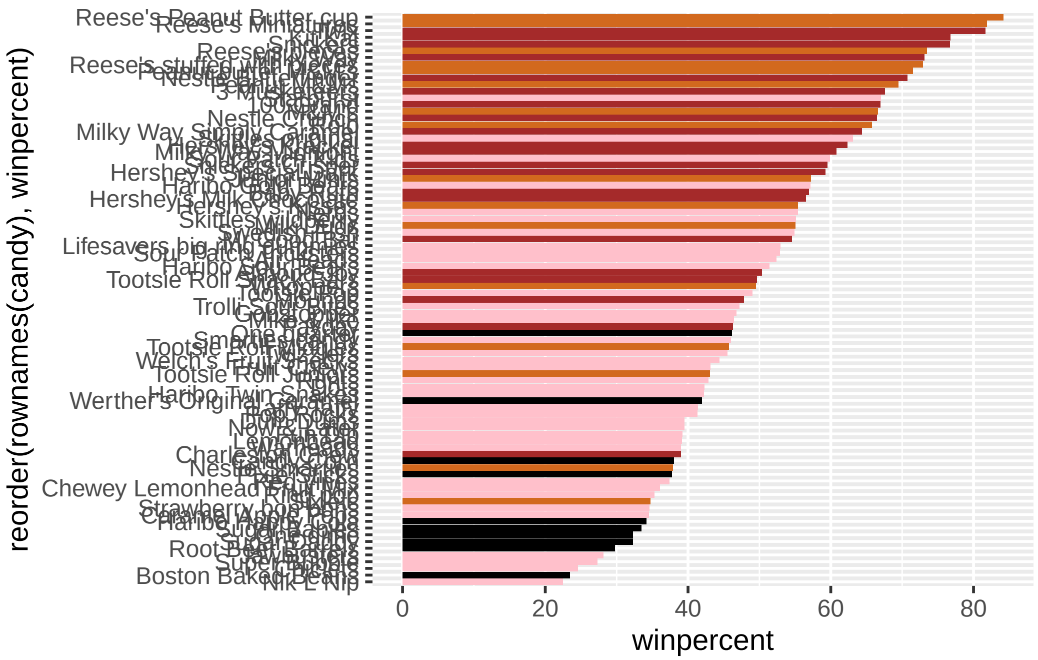
Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_col()
```



```
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)
```



Q17. What is the worst ranked chocolate candy?

Sixlets

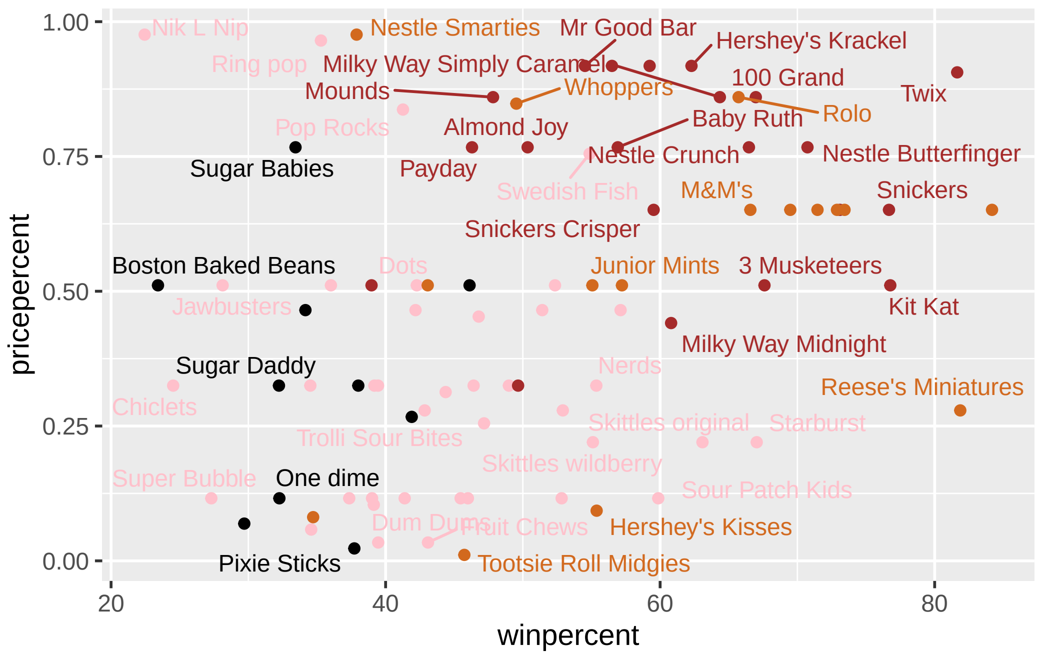
Q18. What is the best ranked fruity candy?

Starburst

## 4. Taking a look at pricepercent

```
library(ggrepel)

# How about a plot of price vs win
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, size=3.3, max.overlaps = 10)
```

```
Warning: ggrepel: 40 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



> Q19. Which candy type is the highest ranked in terms of winpercent for the least money - i.e. offers the most bang for your buck?

Tootsie Roll Midgies

> Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular?

```r
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
Hershey's Krackel               0.918   62.28448
Hershey's Milk Chocolate        0.918   56.49050
```

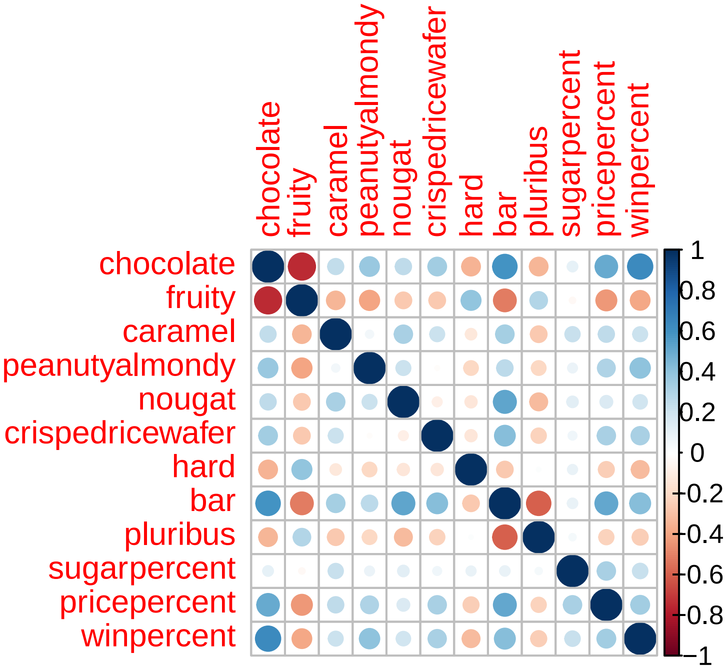
The top 5 are Nik L Nip, Nestle Smarties, Ring pop, Hershey's Krackel, and Hershey's Milk Chocolate. Nik L Nip is the least popular

## 5. Exploring the correlation structure

```
library(corrplot)
```

```
corrplot 0.92 loaded
```

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



> Q22. Examining this plot, what two variables are anti-correlated (i.e. have minus values)?

fruity and chocolate

> Q23. Similarly, what two variables are most positively correlated?

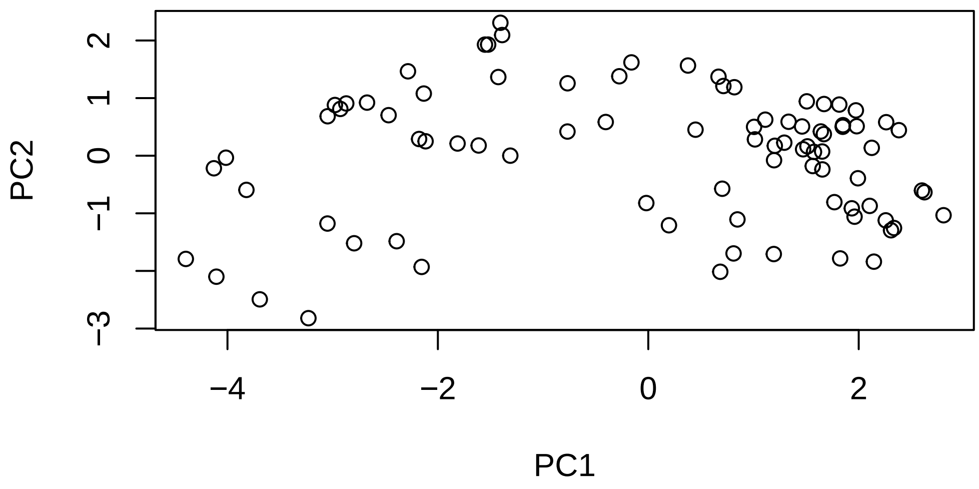
winpercent and chocolate, as well as chocolate and bar

## 6. Principal Component Analysis

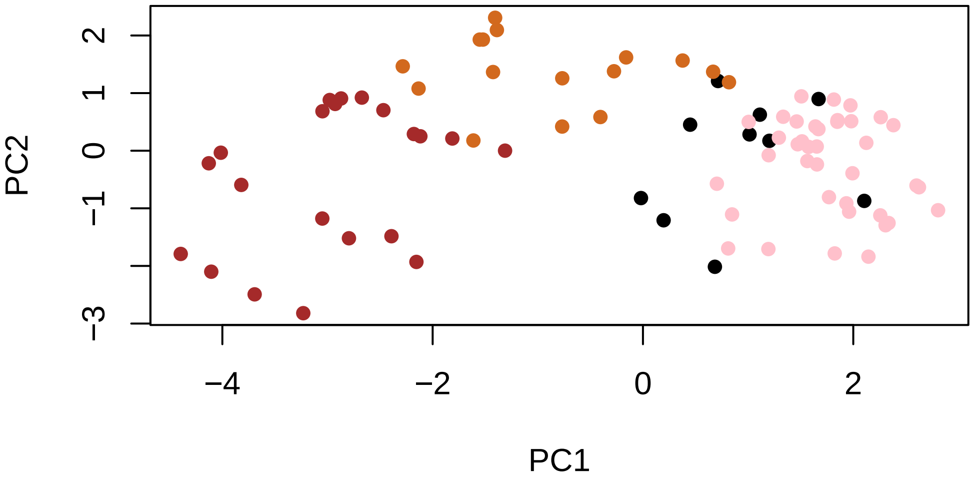
```
pca <- prcomp(candy, scale=TRUE)
summary(pca)
```

```
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$x[,1], pca$x[,2], xlab="PC1", ylab="PC2")
```

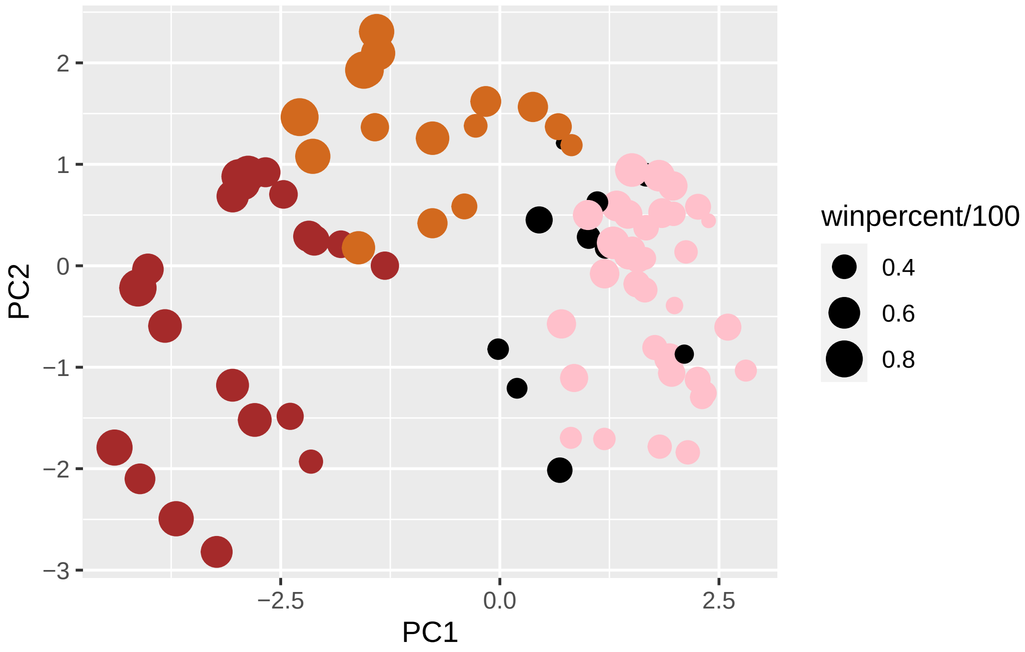


```
plot(pca$x[,1:2], col=my_cols, pch=16)
```



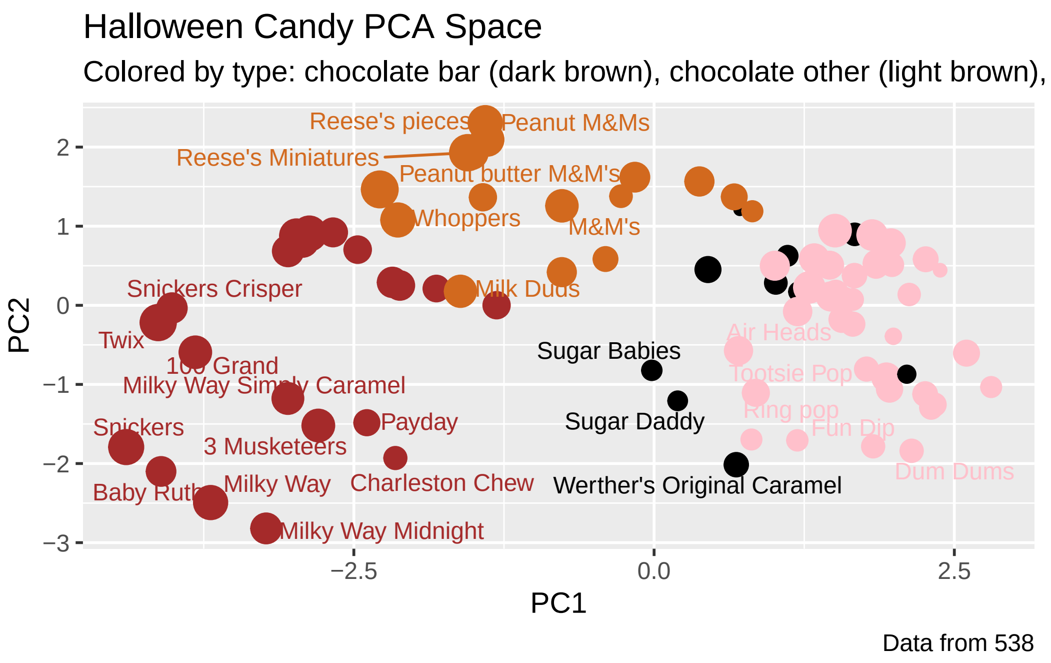
```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])
```

```
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 = 7)  +
  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")
```

```
Warning: ggrepel: 59 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```

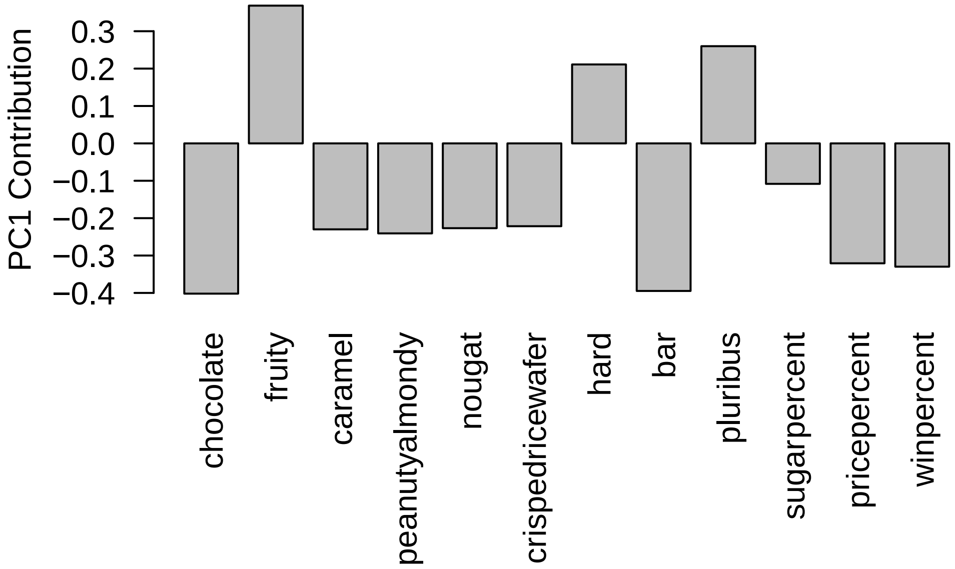


```
library(plotly)
```

```
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. What original variables are picked up strongly by PC1 in the positive direction? Do these make sense to you?

fruity, hard, and pluribus. This does make sense as fruity candies usually do not contain chocolate, caramel etc, most other candies in the dataset are not hard and come in individual packages.