# class10: Halloween Mini-Project

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# 1. Importing candy data

```
#candy_file <- "candy-data.csv"
#head(candy_file)
candy = read.csv("https://raw.githubusercontent.com/fivethirtyeight/data
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
```

Answer: There are 85 different candy types in this dataset.

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

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

```
[1] 38
```

Answer: There are 38 fruity candy types in the dataset.

# 2. What is your favorate candy?

```
candy["Twix", ]$winpercent
```

```
[1] 81.64291
```

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

```
candy["Dum Dums", ]$winpercent
```

```
[1] 39.46056
```

Answer: My favorite candy in the dataset is "Dum Dums" and it's winpercent value is 39.46056.

## Q4. What is the winpercent value for "Kit Kat"?

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

```
[1] 76.7686
```

The winpercent value for “Kit Kat” is 76.7686.

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

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

```
[1] 49.6535
```

Answer: The winpercent value for “Tootsie Roll Snack Bars” is 49.6535.

```
#install.packages("skimr")
library("skimr")
skim(candy)
```

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 | p7 |
|---|---|---|---|---|---|---|---|---|
| chocolate | 0 | 1 | 0.44 | 0.50 | 0.00 | 0.00 | 0.00 | 1.0 |
| fruity | 0 | 1 | 0.45 | 0.50 | 0.00 | 0.00 | 0.00 | 1.0 |

| skim_variable | n_missing | complete_rate | mean | sd | p0 | p25 | p50 | p7 |
|---|---|---|---|---|---|---|---|---|
| fruity | 0 | 1 | 0.45 | 0.50 | 0.00 | 0.00 | 0.00 | 1.0 |
| caramel | 0 | 1 | 0.16 | 0.37 | 0.00 | 0.00 | 0.00 | 0.0 |
| peanutyalmondy | 0 | 1 | 0.16 | 0.37 | 0.00 | 0.00 | 0.00 | 0.0 |
| nougat | 0 | 1 | 0.08 | 0.28 | 0.00 | 0.00 | 0.00 | 0.0 |
| crispedricewafer | 0 | 1 | 0.08 | 0.28 | 0.00 | 0.00 | 0.00 | 0.0 |
| hard | 0 | 1 | 0.18 | 0.38 | 0.00 | 0.00 | 0.00 | 0.0 |
| bar | 0 | 1 | 0.25 | 0.43 | 0.00 | 0.00 | 0.00 | 0.0 |
| pluribus | 0 | 1 | 0.52 | 0.50 | 0.00 | 0.00 | 1.00 | 1.0 |
| sugarpercent | 0 | 1 | 0.48 | 0.28 | 0.01 | 0.22 | 0.47 | 0.7 |
| pricepercent | 0 | 1 | 0.47 | 0.29 | 0.01 | 0.26 | 0.47 | 0.6 |
| winpercent | 0 | 1 | 50.32 | 14.71 | 22.45 | 39.14 | 47.83 | 59.8 |

## Q6. Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset?

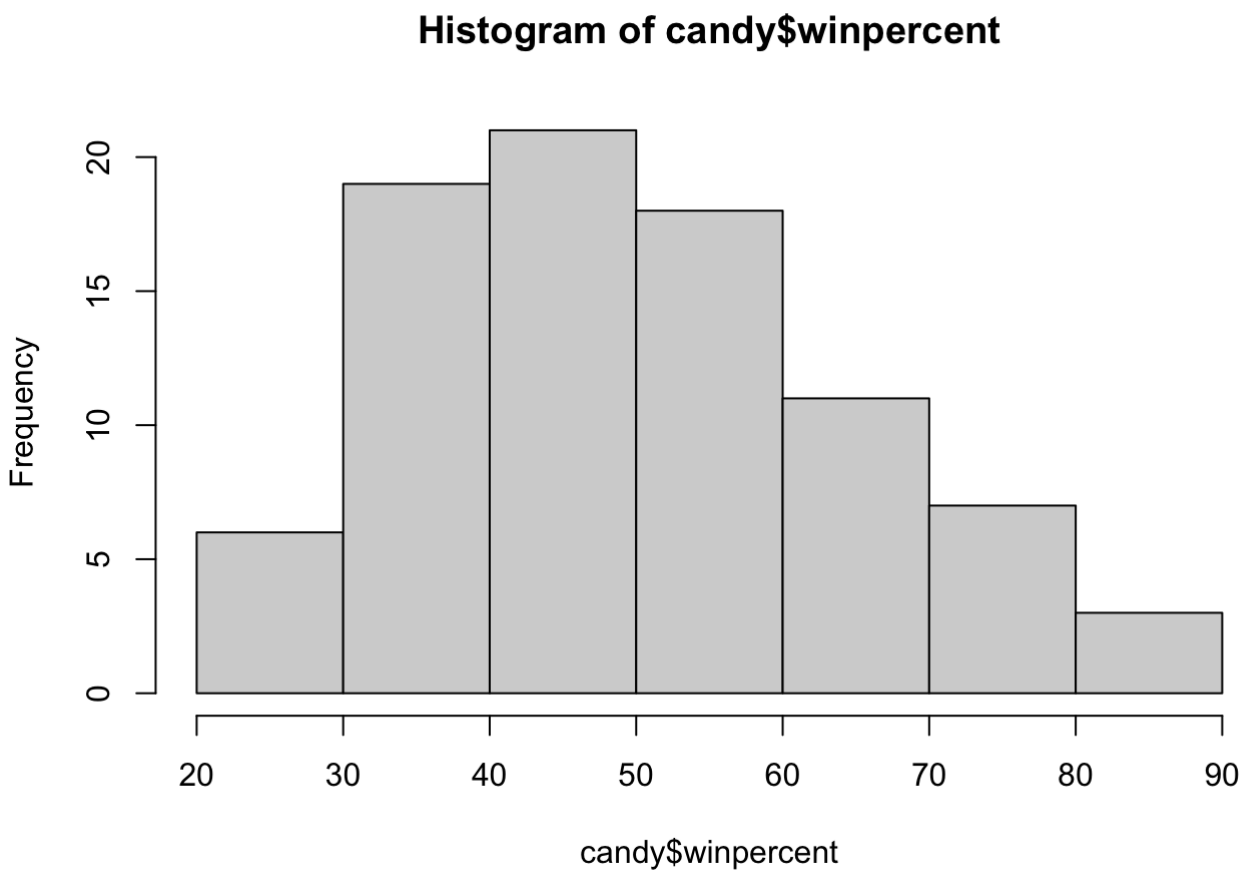
Answer: The winpercent variable looks to be on a different scale to the majority of the other variables in the dataset.

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

Answer: For the candy$chocolate column, the zero and one represent whether the candy contains chocolate (1) or does not have chocolate (0).

## Q8. Plot a histogram of winpercent values.

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




## Q9. Is the distribution of winpercent values symmetrical?

Answer: No, the distribution of winpercent values is not symmetrical - the distribution is right-skewed.

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

Answer: The center of the distribution is below 50%.

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

```
chocolate_avg <- mean(candy$winpercent[as.logical(candy$chocolate)])
chocolate_avg
```

```
[1] 60.92153
```

```
fruity_avg <- mean(candy$winpercent[as.logical(candy$fruity)])
fruity_avg
```

```
[1] 44.11974
```

Answer: On average, chocolate candy is higher ranked than fruit candy.

## Q12. Is this difference statistically significant?

```
t.test(candy$winpercent[as.logical(candy$chocolate)], candy$winpercent[
```

```
    Welch Two Sample t-test

data:  candy$winpercent[as.logical(candy$chocolate)] and
candy$winpercent[as.logical(candy$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
```

Answer: The p-value of 2.871e-08 is less than the significance level of 0.05; this difference is statistically different.

# 3. Overall Candy Rankings

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

```
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
```

Answer: The five least liked candy types in this set are 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?

```
#approach 1
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
```

```
#approach 2
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
```

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

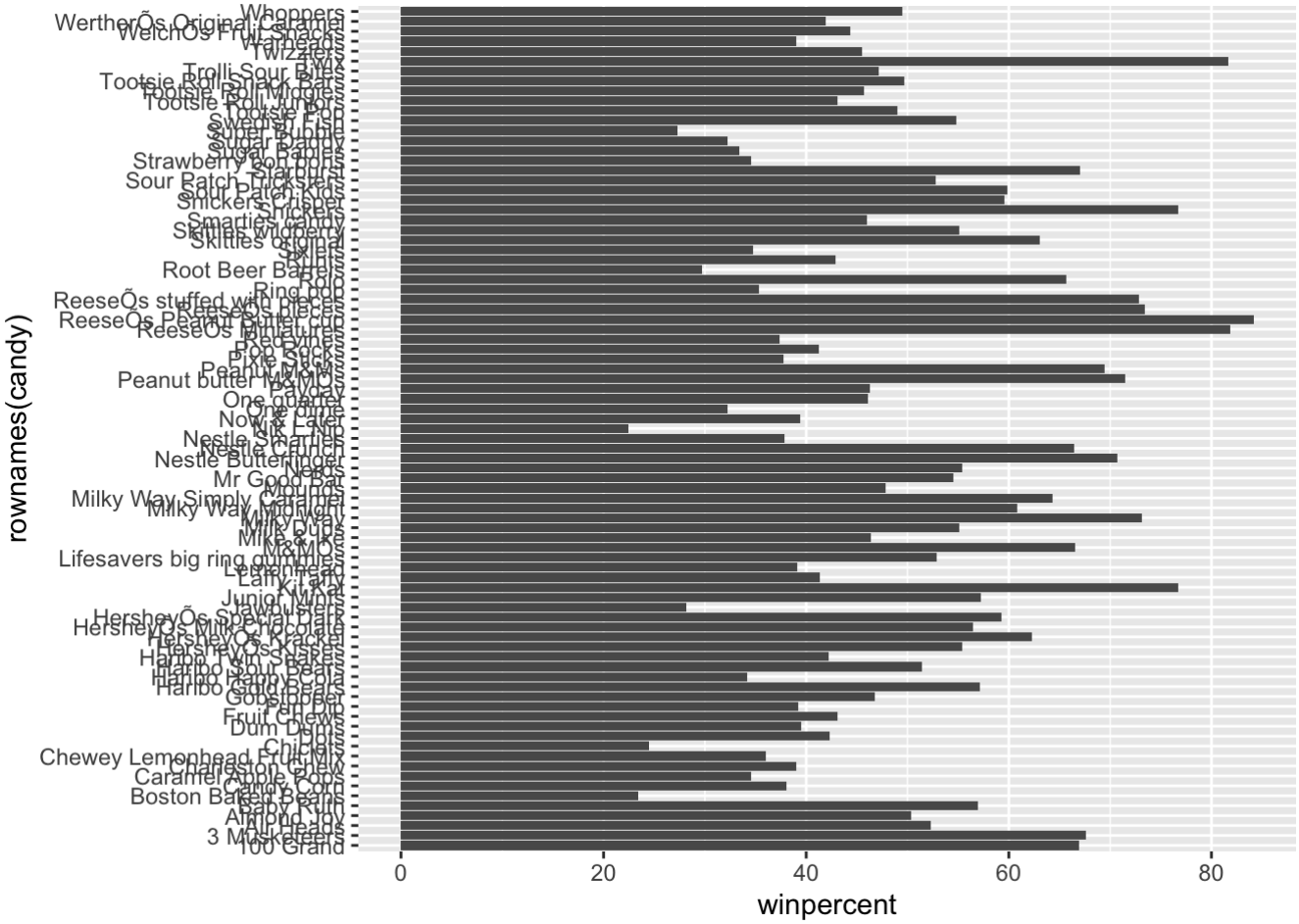
```
                        chocolate fruity caramel peanutyalmondy
nougat
Snickers                        1      0       1              1
1
Kit Kat                         1      0       0              0
0
Twix                            1      0       1              0
0
ReeseÕs Miniatures              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
```

```
# I prefer approach 1 because it's much simpler as it uses base R funct
```

Answer: The top 5 all time favorite candy types out of this set are Snickers, Kit Kat, Twix, Reese's Miniatures, and Reese's Peanut Butter cup.

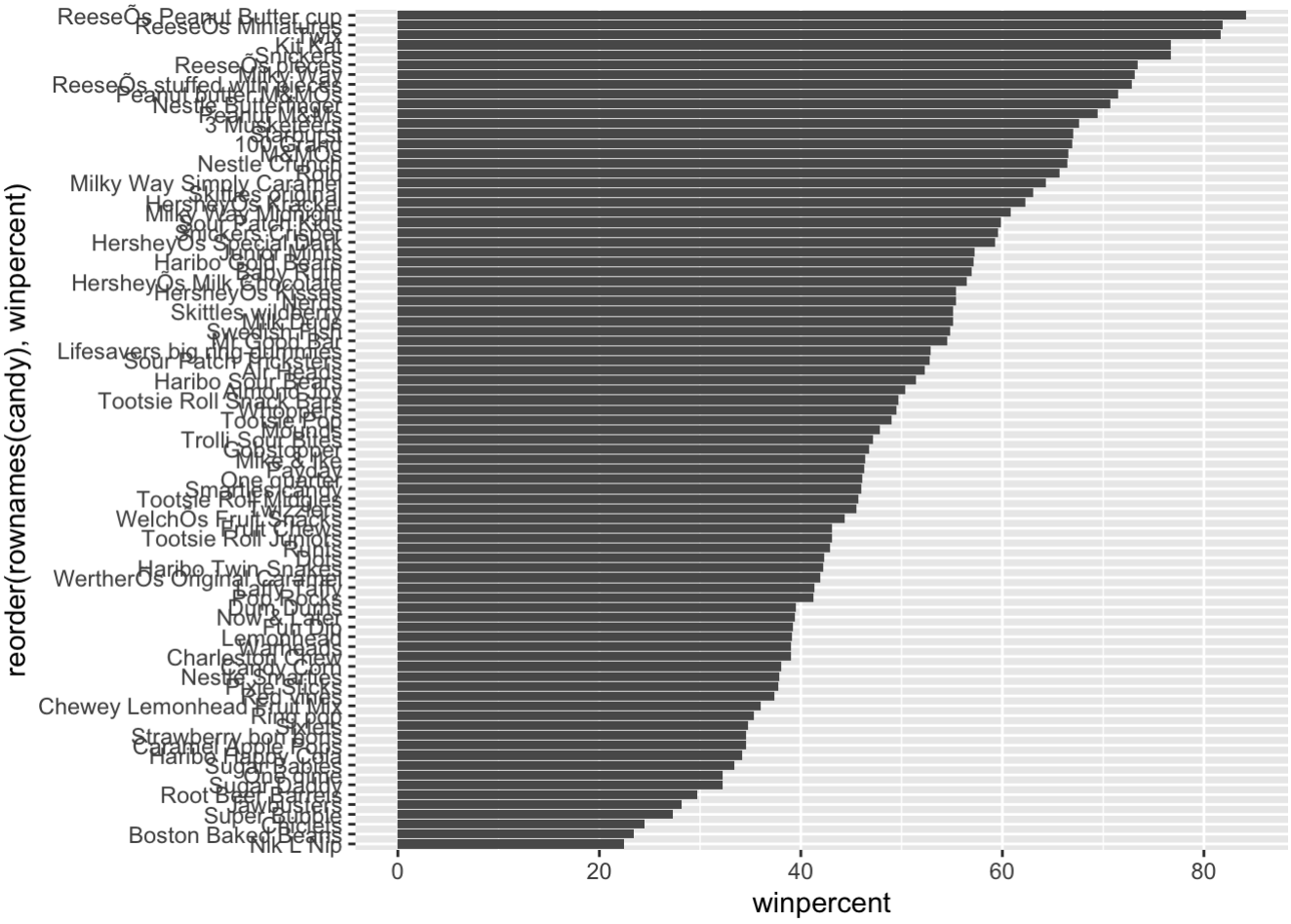
## Q15. Make a first barplot of candy ranking based on winpercent values.

```
library(ggplot2)

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



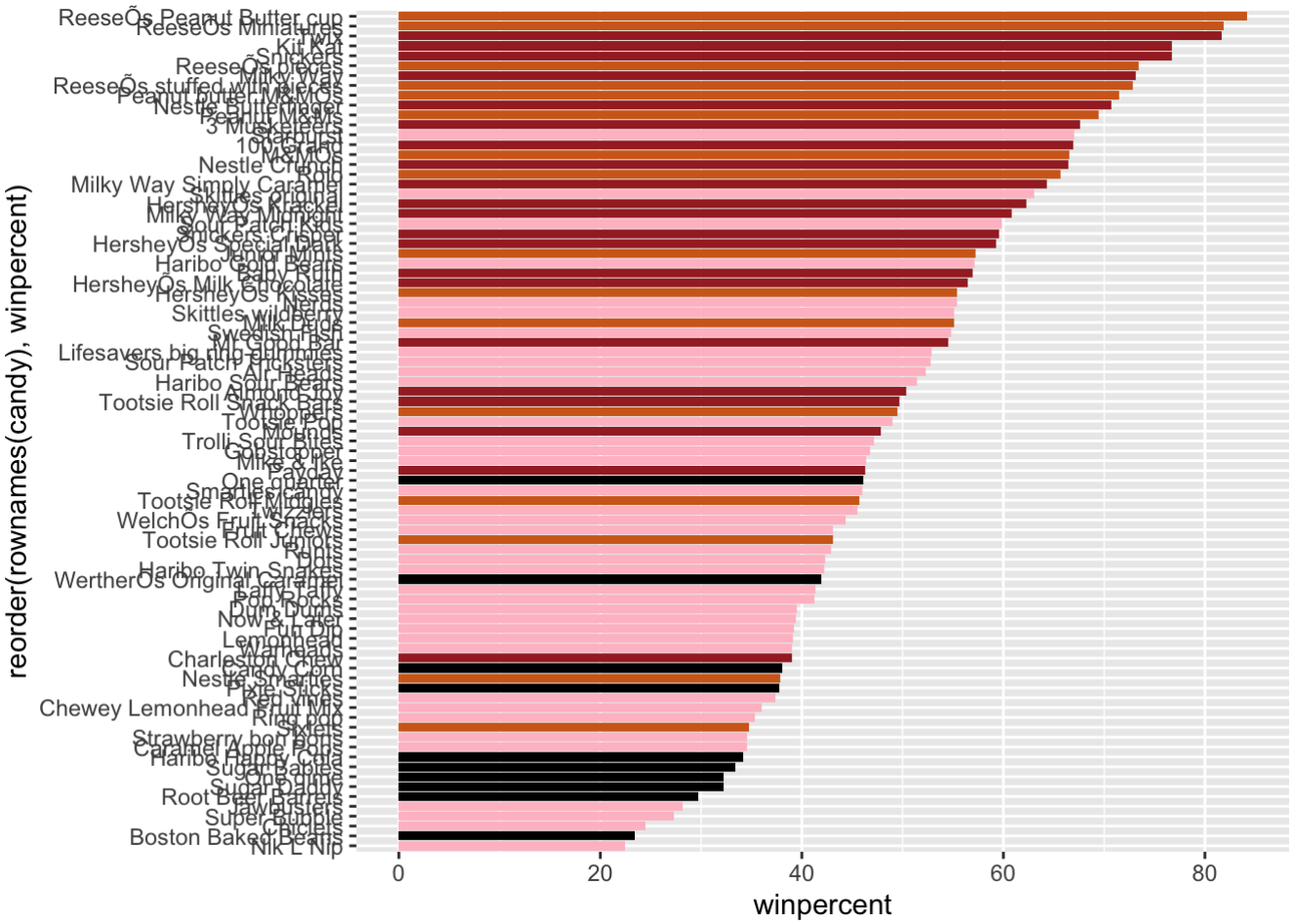
# Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

```
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?

Answer: Sixlets is the worst ranked chocolate candy.

## Q18. What is the best ranked fruity candy?

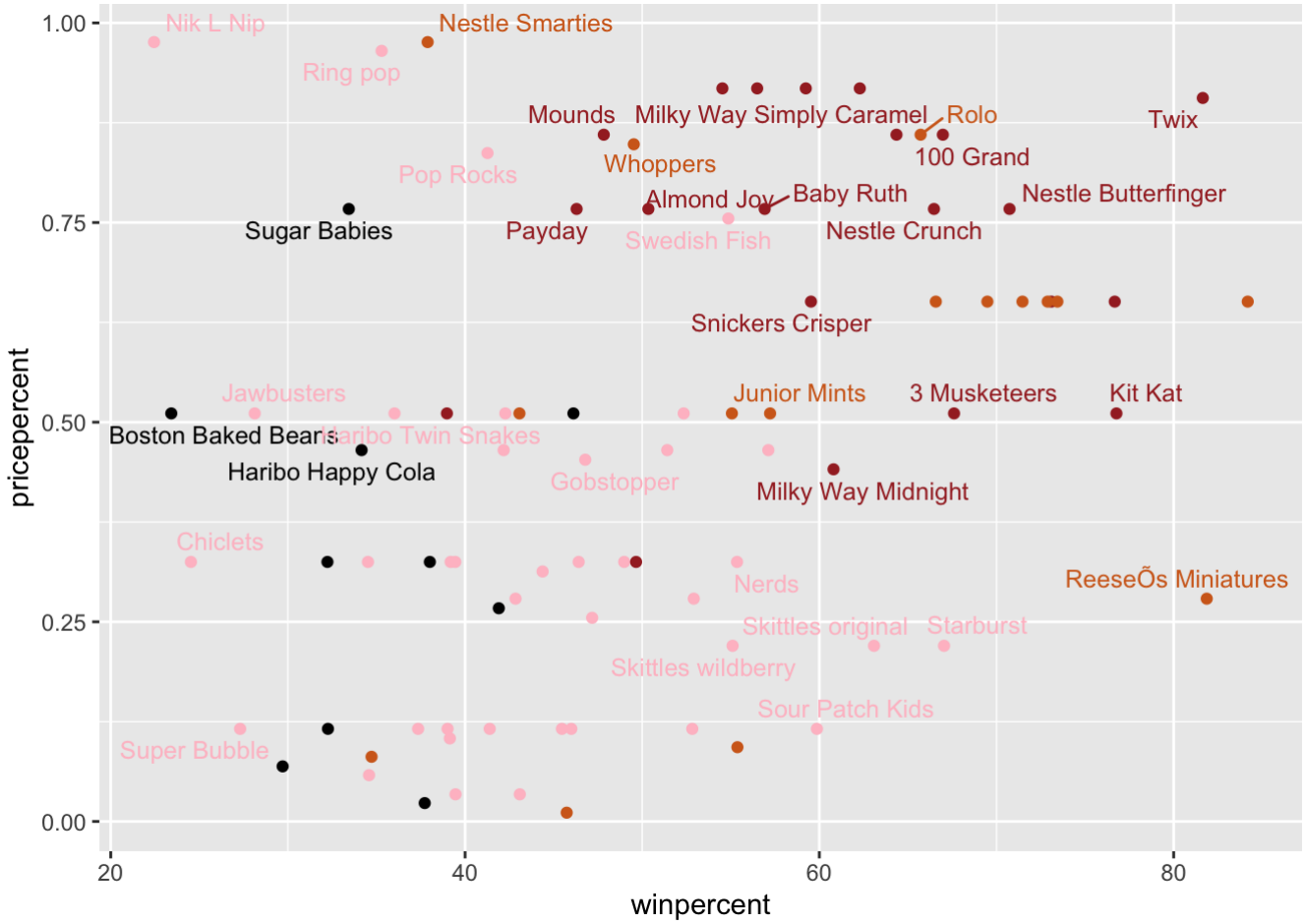
Answer: Starburst is the best ranked fruity candy.

# 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 = 5)
```

```
Warning: ggrepel: 50 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?

Answer: Reese's Miniatures is the highest ranked in terms of winpercent for the least money.

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

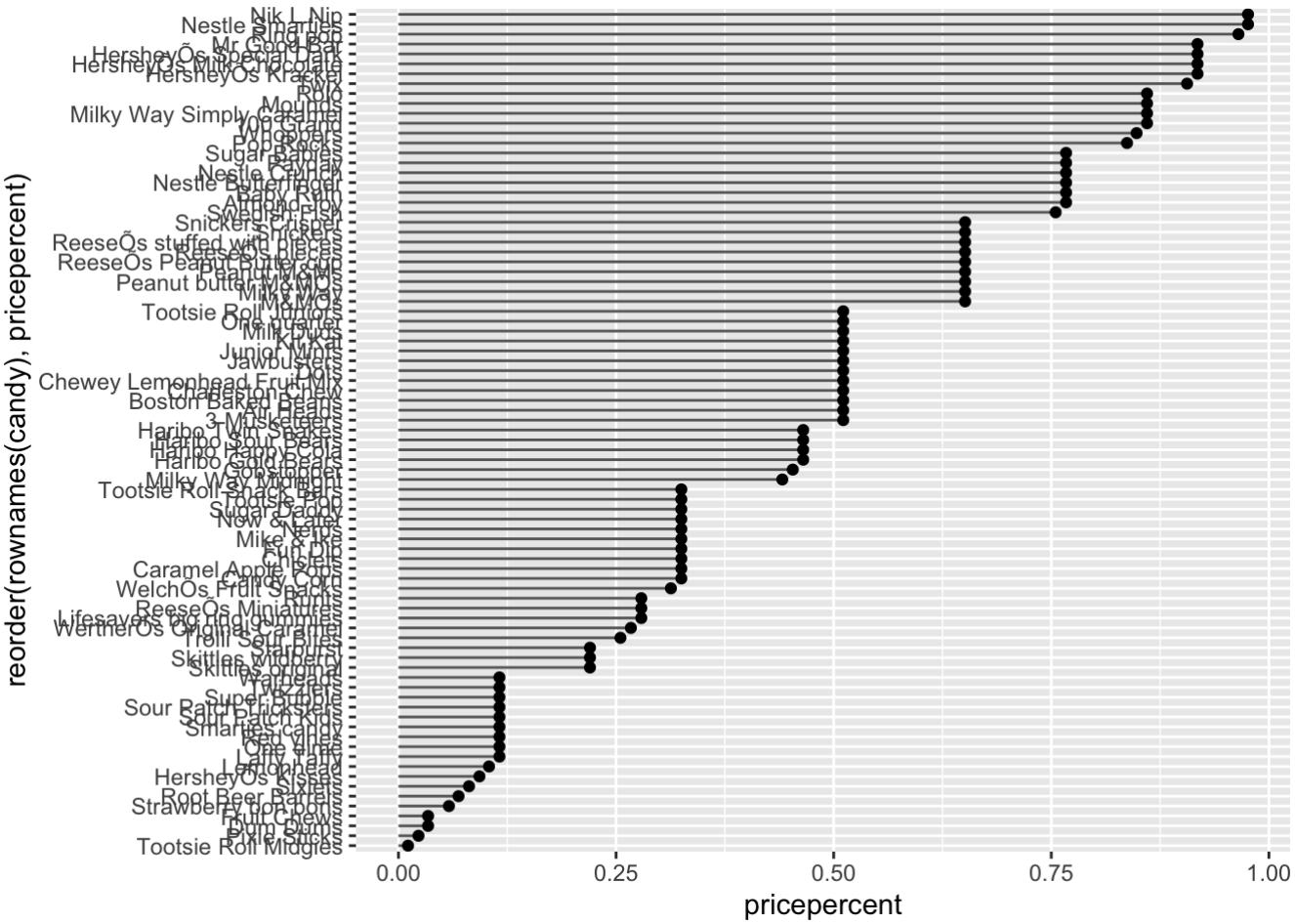
```
ord <- order(candy$pricepercent, decreasing = TRUE)
head( candy[ord,c(11,12)], n=5 )
```

| | 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 |

Answer: The top 5 most expensive candy types in the dataset are Nik L Nip, Nestle Smarties, Ring pop, Hershey's Krackel, and Hershey's Milk Chocolate. Of these, Nik L Nip is the least popular.

## Q21. Make a barplot again with geom_col() this time using pricepercent and then improve this step by step, first ordering the x-axis by value and finally making a so called "dot chat" or "lollipop" chart by swapping geom_col() for geom_point() + geom_segment().

```
# Make a lollipop chart of pricepercent
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_segment(aes(yend = reorder(rownames(candy), pricepercent),
                   xend = 0), col="gray40") +
    geom_point()
```

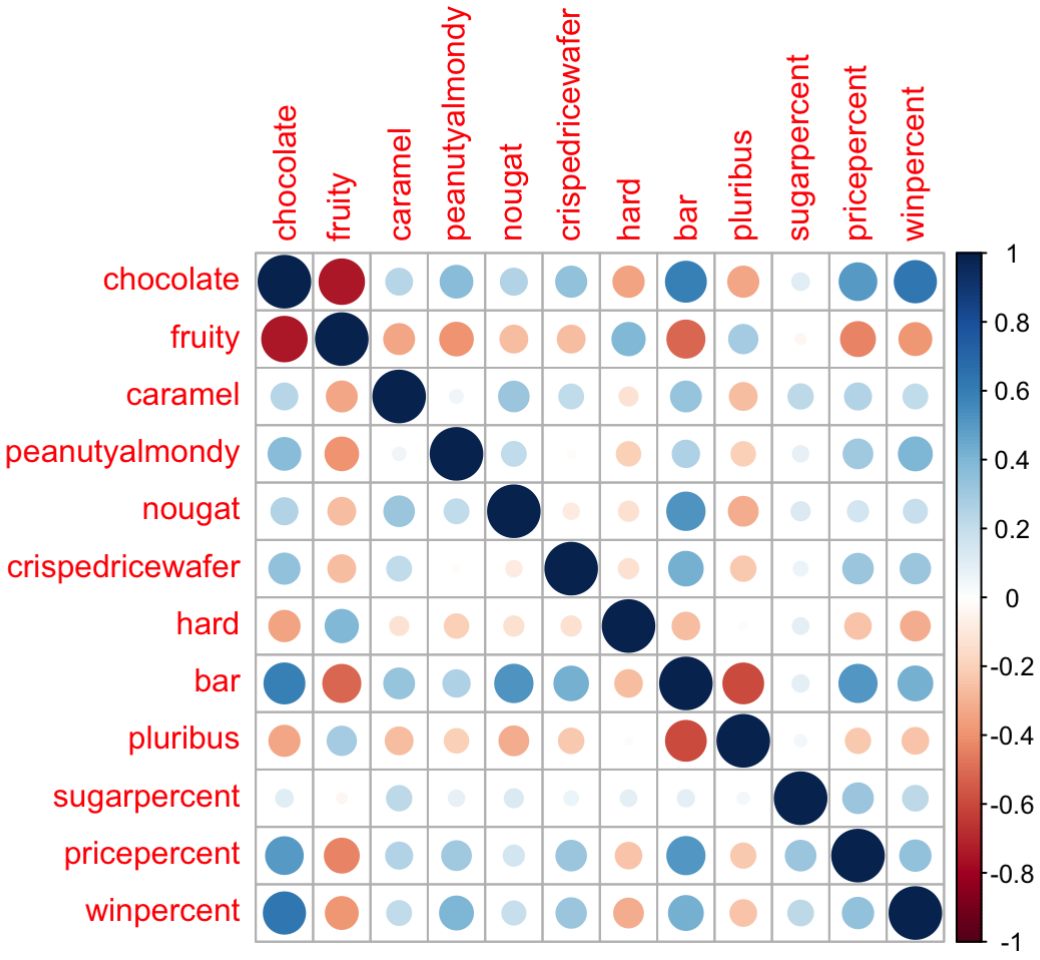



# 5. Exploring the correlation structure

```
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)?

Answer: Chocolate and fruity are the two variables in this plot that are anti-correlated.

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

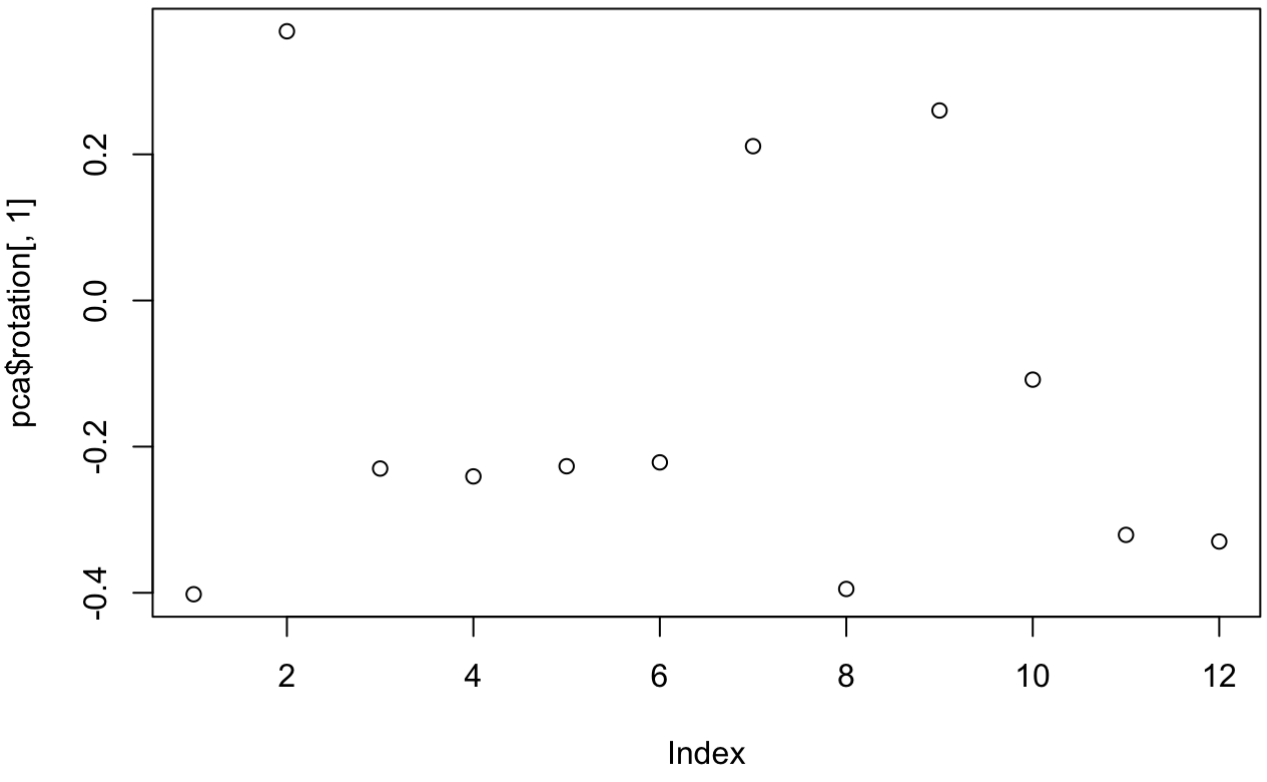
Answer: Chocolate and bar are the two variables in this plot that are most positively correlated.

# 6. Principal Component Analysis

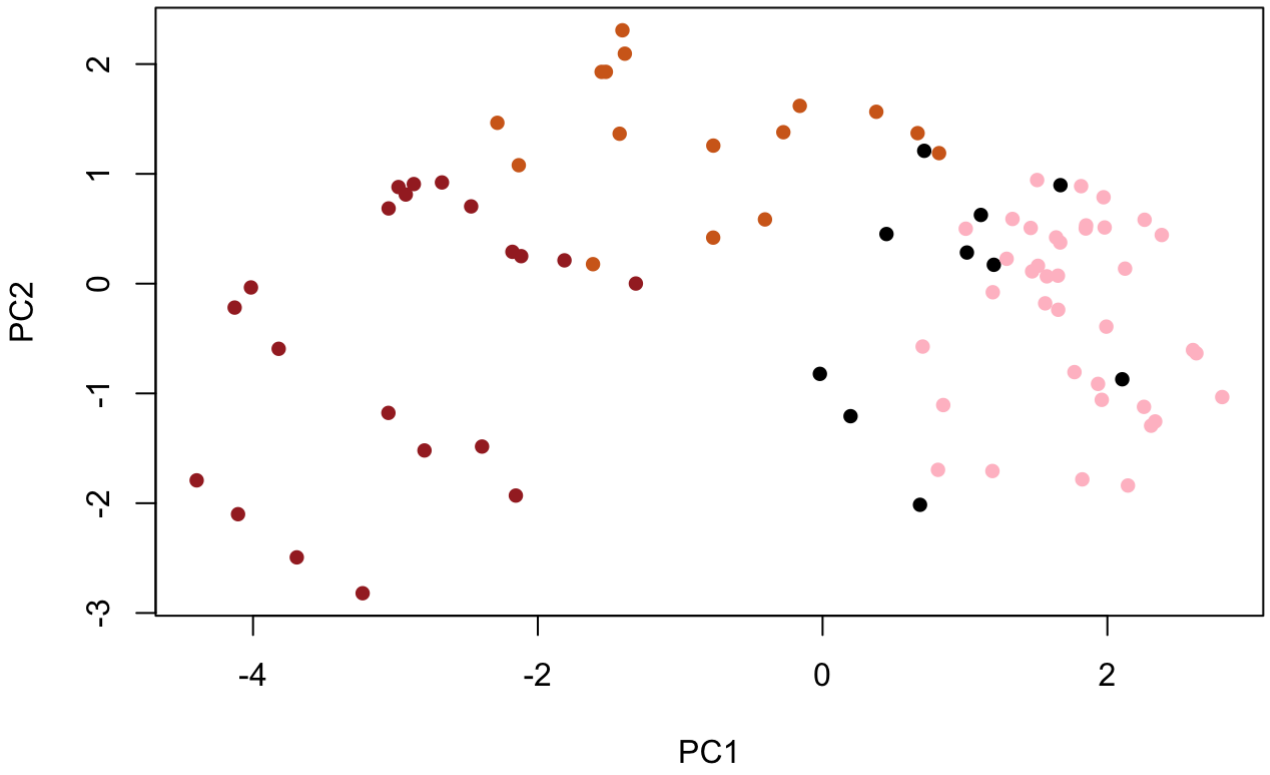
```
pca <- prcomp(candy, scale=TRUE)
summary(pca)
```

```
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$rotation[,1])
```

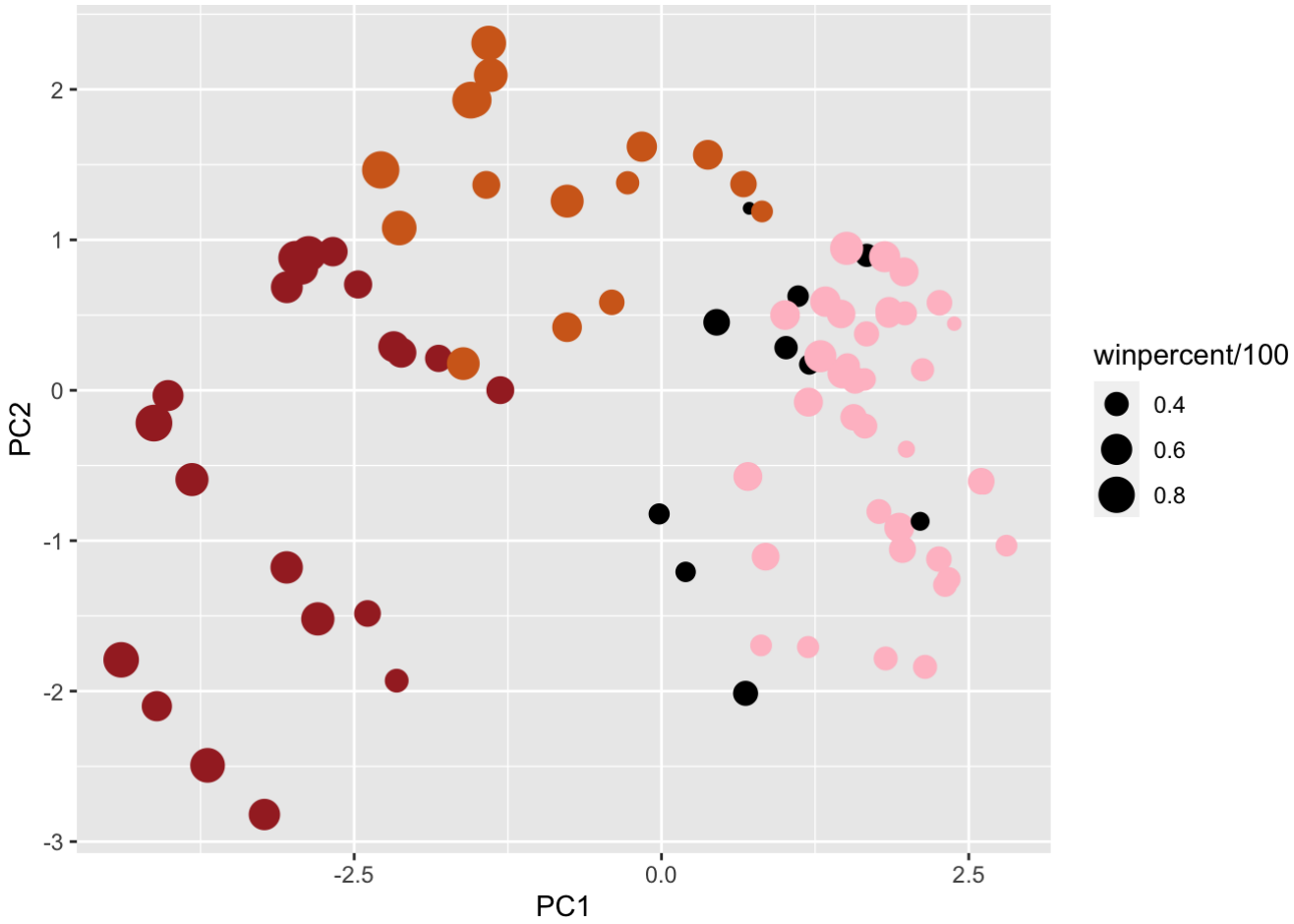


```
plot(pca$x[,1:2], col=my_cols, pch=16)
```



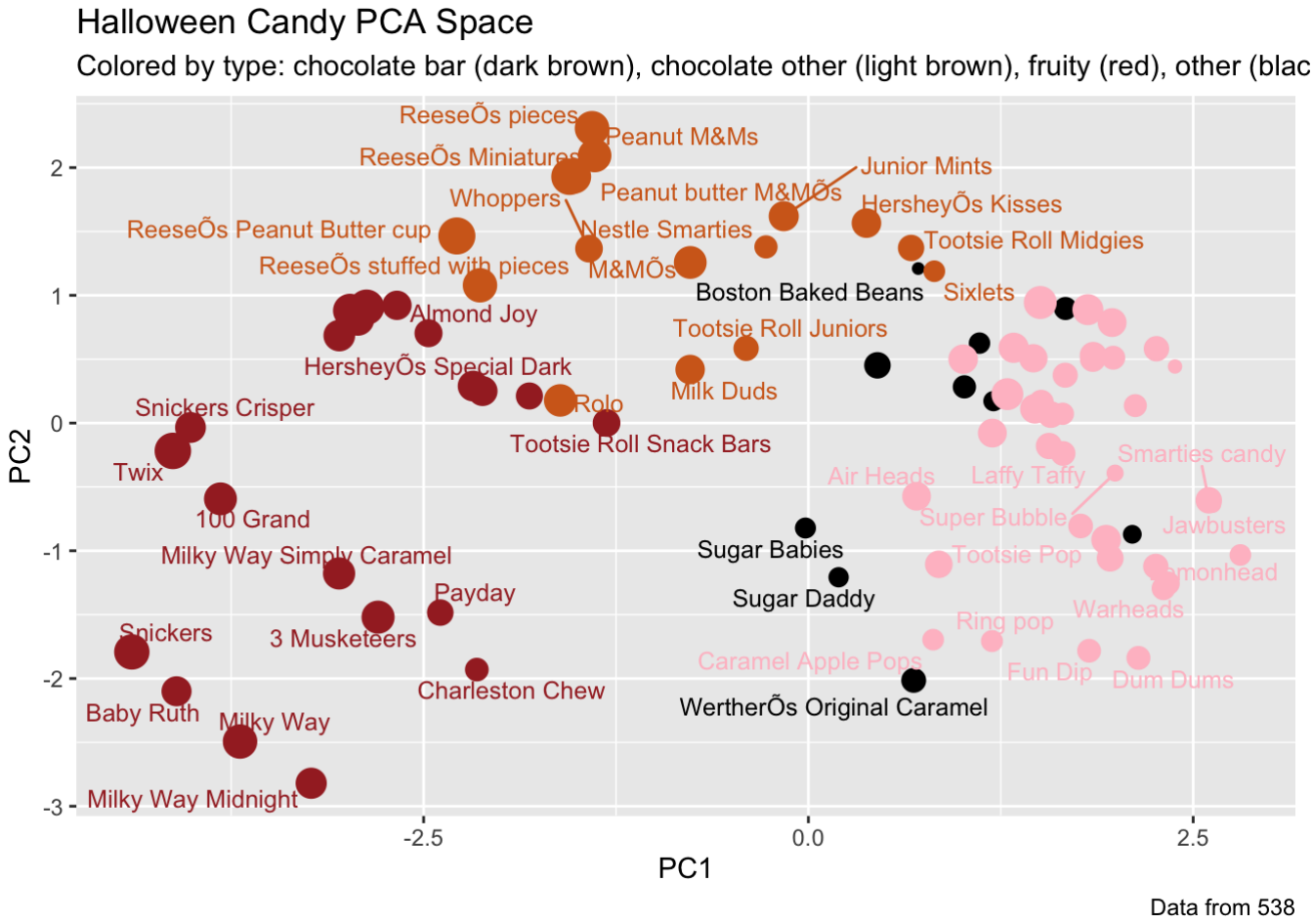

```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])
```

```
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
       caption="Data from 538")
```

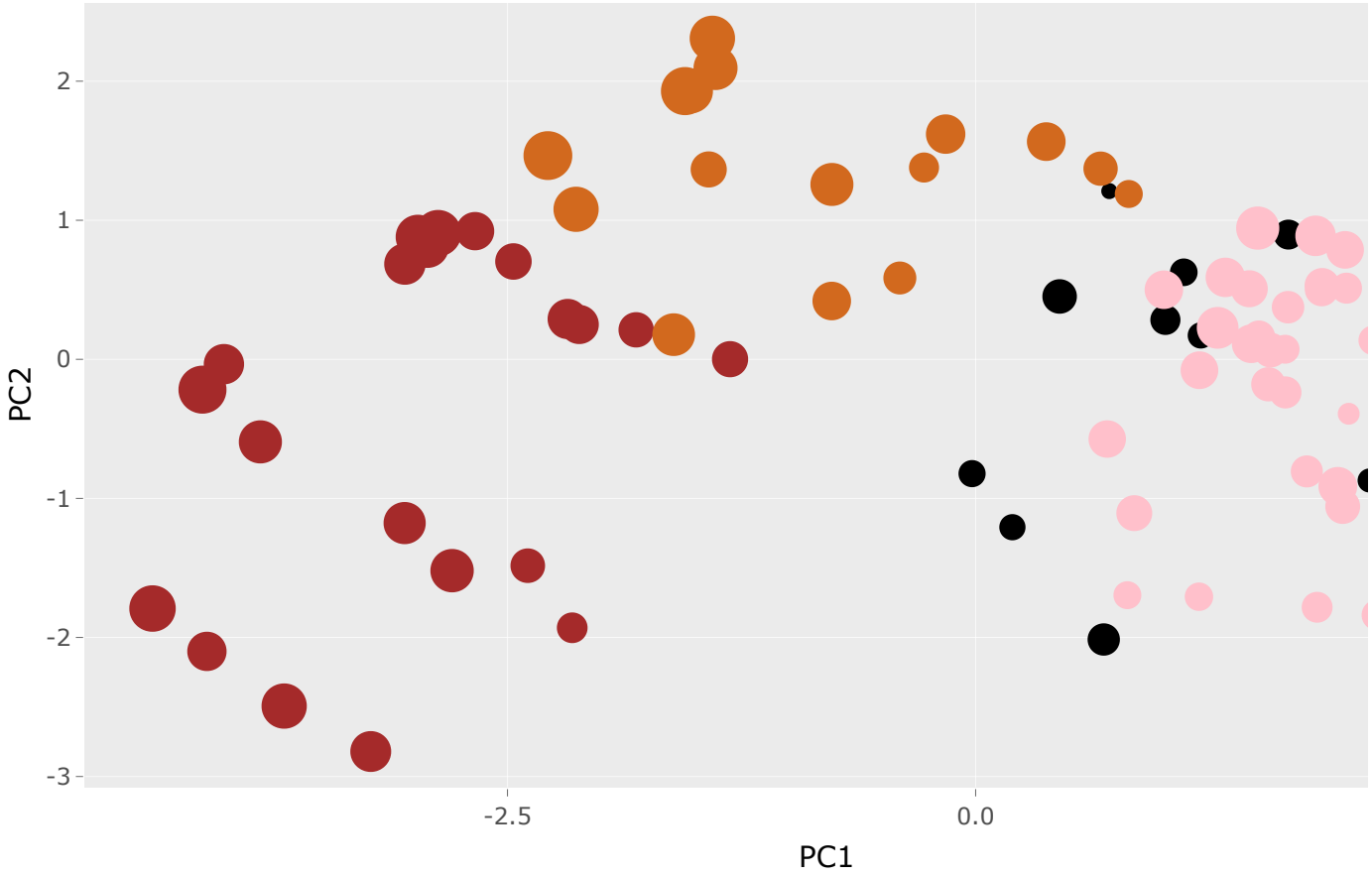
```
Warning: ggrepel: 39 unlabeled data points (too many overlaps).
Consider
increasing max.overlaps
```



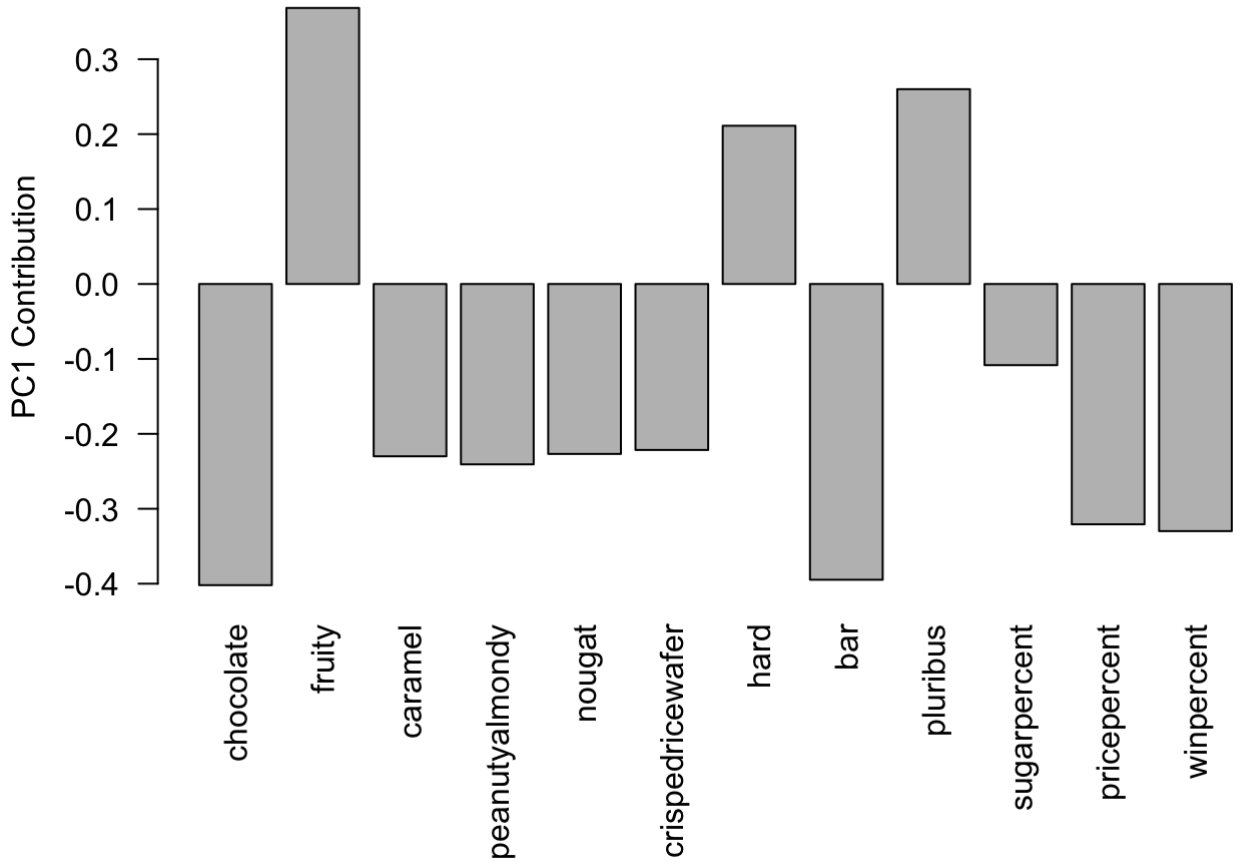

```
library(plotly)
```

```
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?

Answer: Original variables “fruity”, “hard”, and “pluribus” are picked up strongly by PC1 in the positive direction. These make sense because many people enjoy fruit-flavored candies, prefer that their candy is not melted, and like to buy candy in bulk.