Class 10: Halloween Mini-Project

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```
url <- "https://raw.githubusercontent.com/fivethirtyeight/data/master/candy-power-ranking/
candy <- read.csv(url, 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?

```
nrow(candy)
```

```
[1] 85
```

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

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

```
[1] 38
```

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

My favorite candy is Milky Way

```
#rownames(candy)
candy["Milky Way",]$winpercent
```

```
[1] 73.09956
```

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

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

```
[1] 76.7686
```

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

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

```
[1] 49.6535
```

```
#install.packages("skimr")
```

```
#library("skimr")
#Instead of using library() to load the whole package, can use this function instead for j

skimr::skim(candy)
```

Table 1: Data summary

Name	candy
Number of rows	85
Number of columns	12
Column type frequency:	
numeric	12

Table 1: Data summary

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?

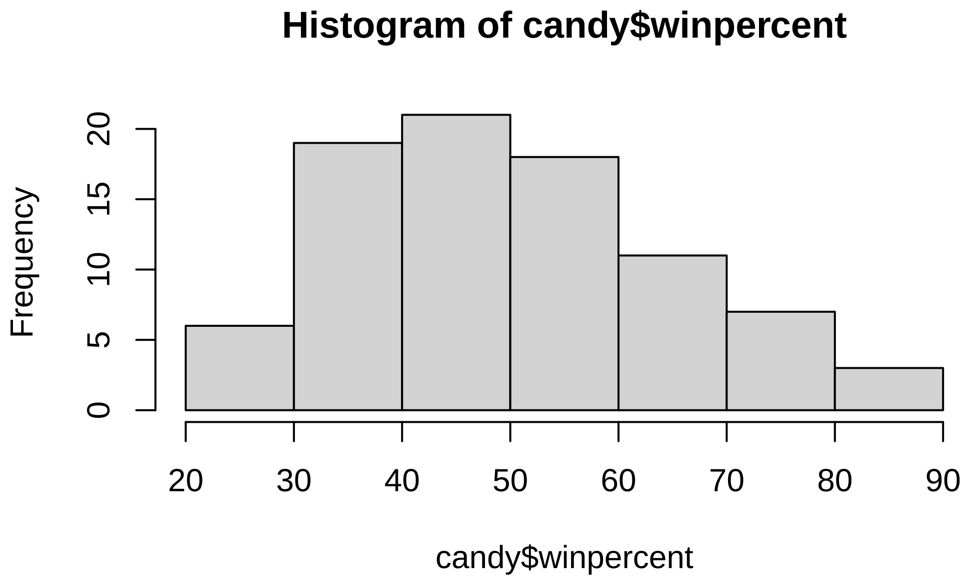
Yes, winpercent is the only column that looks different from other other columns as its values are much higher than 0.

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

If contains chocolate or not (1=yes, 0=no)

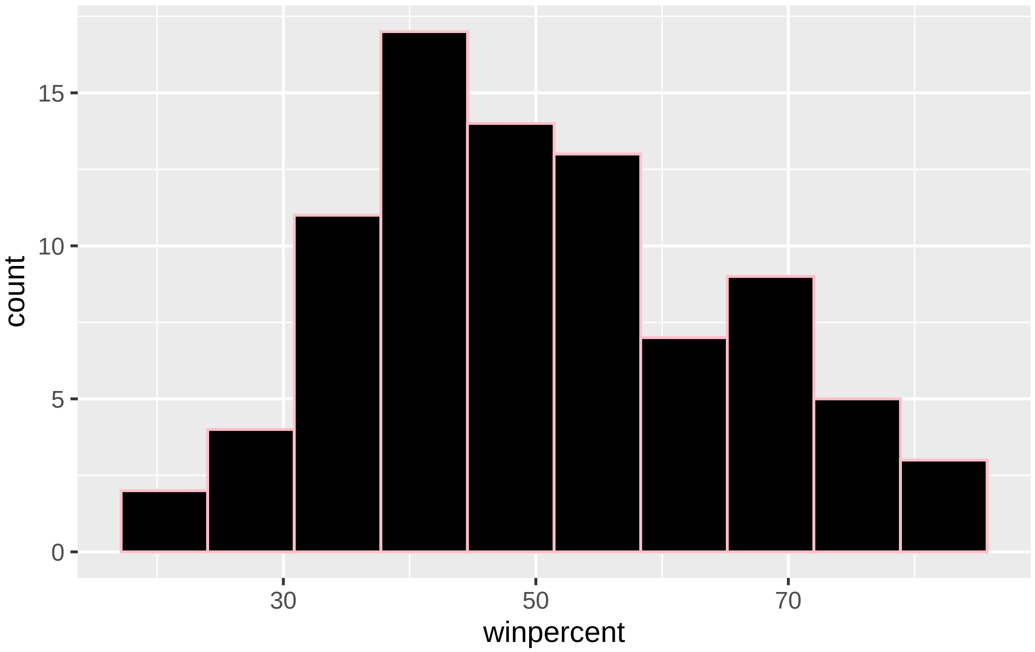
> Q8. Plot a histogram of winpercent values

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



```
#install.packages("ggplot2")
```

```
library(ggplot2)
ggplot(candy) +
  aes(winpercent) +
  geom_histogram(bins=10, fill="black", col="pink")
```



Q9. Is the distribution of winpercent values symmetrical?

No the distribution is not symmetrical. It is slightly skewed to the left.

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

```
median(candy$winpercent)
```

```
[1] 47.82975
```

It is below 50%

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

```
chocolate.inds <- as.logical(candy$chocolate)
chocolate.wins <- candy[chocolate.inds,]$winpercent
mean(chocolate.wins)
```

```
[1] 60.92153
```

```r
fruity.inds <- as.logical(candy$fruity)
fruity.wins <- candy[fruity.inds,]$winpercent
mean(fruity.wins)
```

```
[1] 44.11974
```

```r
t.test(chocolate.wins, fruity.wins)
```

```

	Welch Two Sample t-test

data:  chocolate.wins and fruity.wins
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 
```

Chocolate candy is higher ranked than fruit candy

> Q12. Is this difference statistically significant?

Yes, this difference is statistically significant

3. Overall Candy Rankings

> 13. What are the five least liked candy types in this set?

```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
```

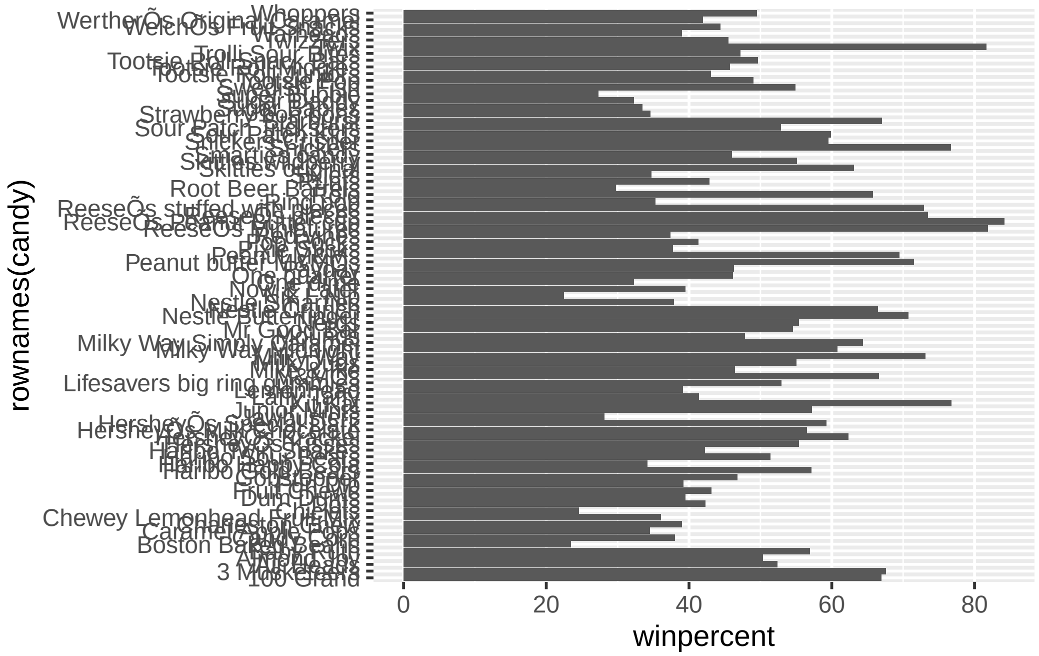
Q14. What are the top 5 all time favorite candy types out of this set?

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

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

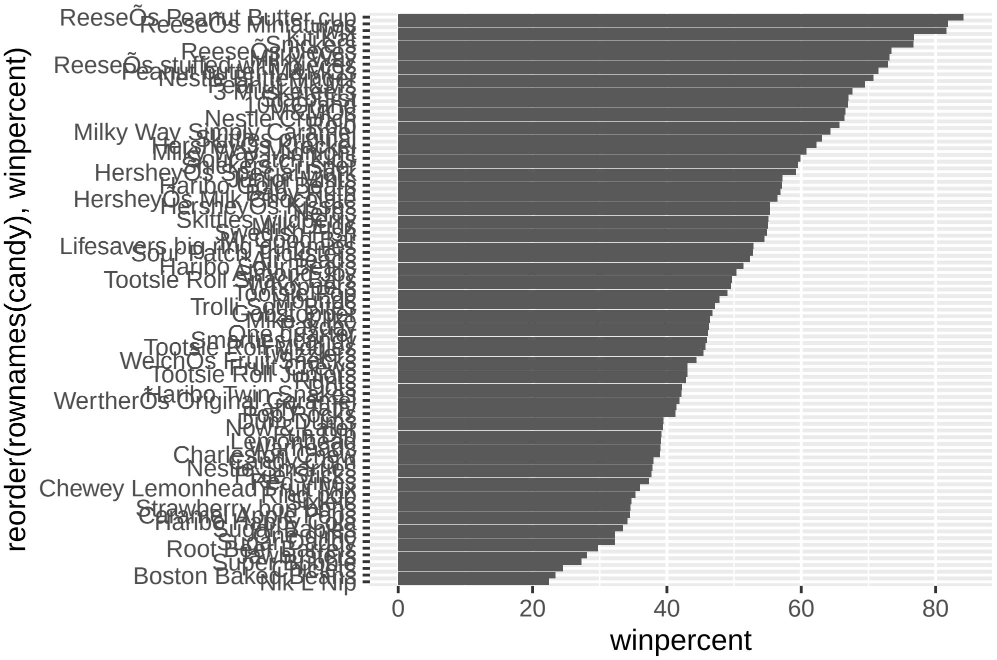
Q15. Make a first barplot of candy ranking based on winpercent values.

```
library(ggplot2)
ggplot(candy) +
  aes(winpercent, rownames(candy)) +
  geom_col()
```



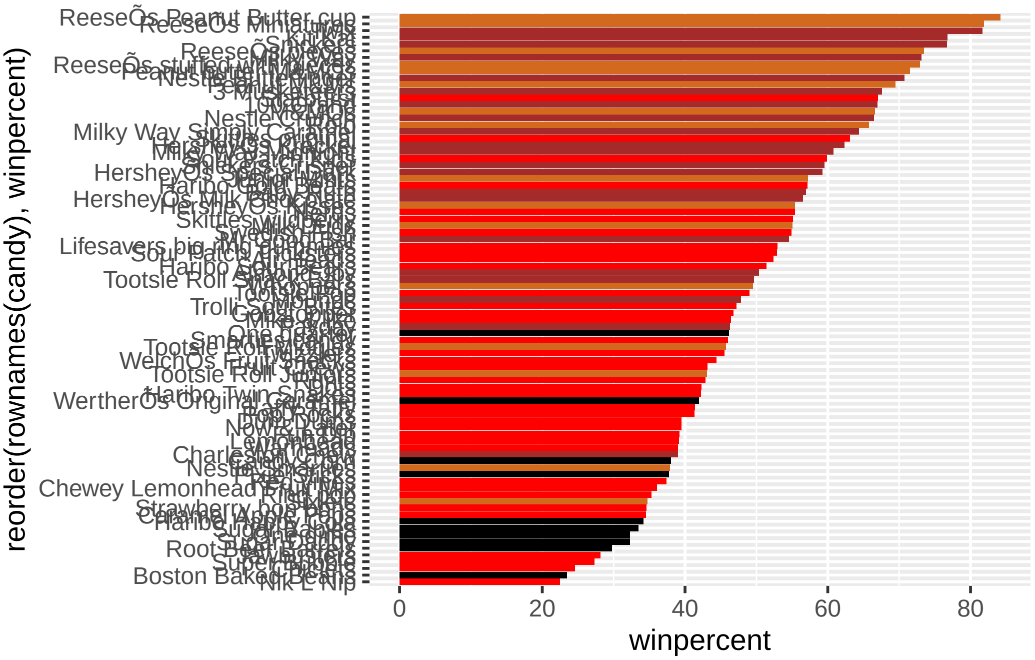
Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

```
library(ggplot2)
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col() +
  coord_fixed()
```



```
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)]="red"
```

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



```
#Save the last ggplot as image
ggsave("tmp.png")
```

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

> Q17. What is the worst ranked chocolate candy?

Sixlets

> Q18. What is the best ranked fruity candy?

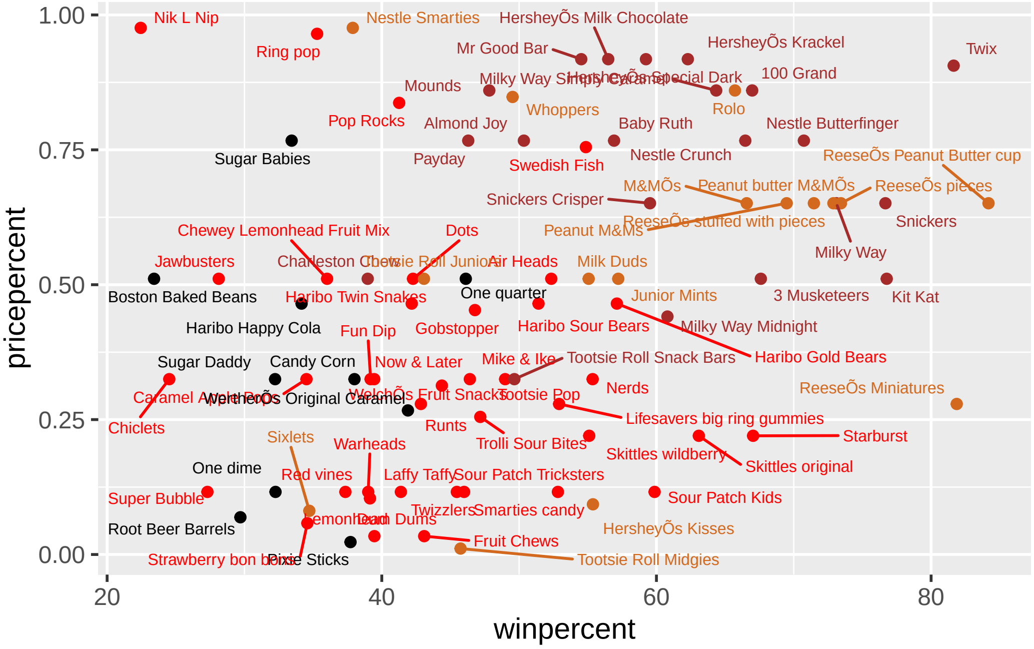
Starburst

4. Taking a look at pricepercent

```
#install.packages("ggrepel")
library(ggrepel)

ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
```

```r
geom_text_repel(col=my_cols, size=2, max.overlaps=23)
```



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?

```r
max <- which.max((candy[, "winpercent"] / candy[, "pricepercent"]))
candy[max,]
```

```
                     chocolate fruity caramel peanutyalmondy nougat
Tootsie Roll Midgies         1      0       0              0      0
                     crispedricewafer hard bar pluribus sugarpercent
Tootsie Roll Midgies                0    0   0        1        0.174
                     pricepercent winpercent
Tootsie Roll Midgies        0.011   45.73675
```

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
HersheyÕs Krackel               0.918   62.28448
HersheyÕs Milk Chocolate        0.918   56.49050
```

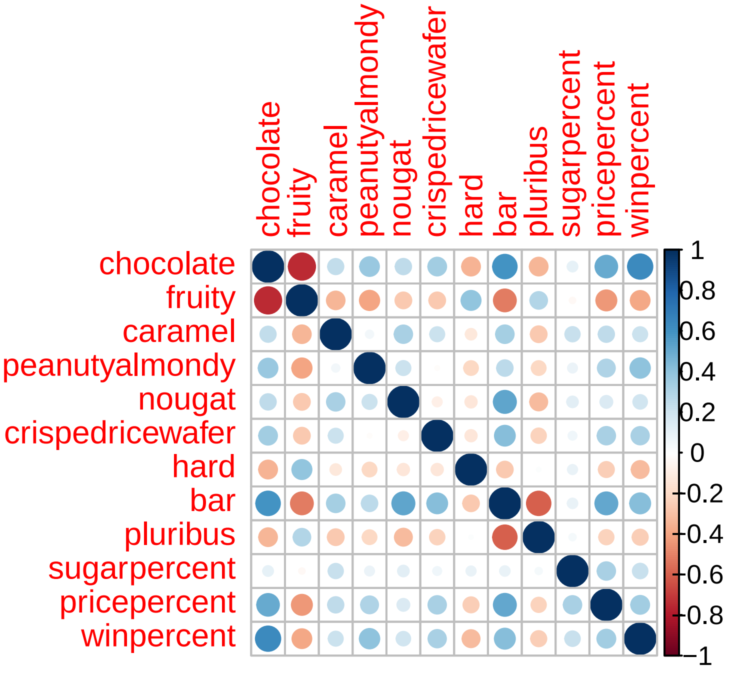
Among the top 5 most expensive candy types, the least popular is Nik L Nip

5. Exploring the correlation structure

```
#install.packages("corrplot")
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)?

chocolate and fruity

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

chocolate and winpercent

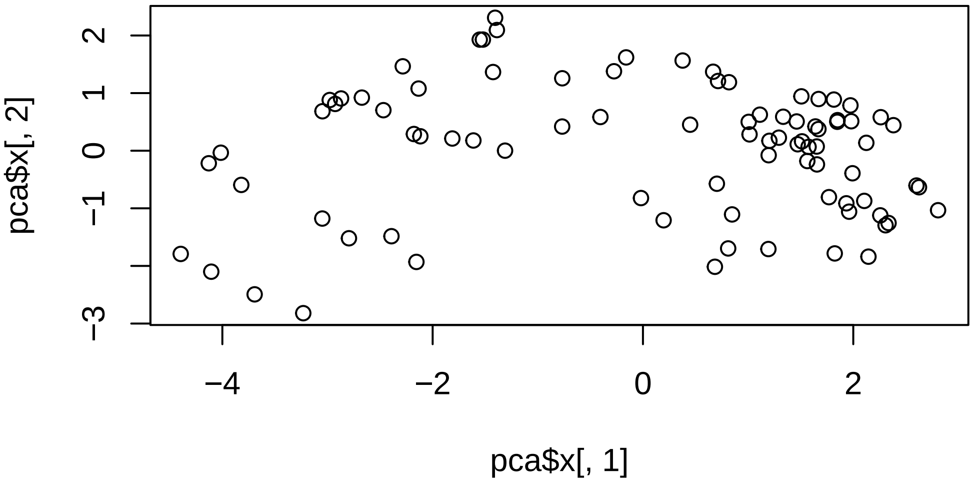
6. Principal Component Analysis

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

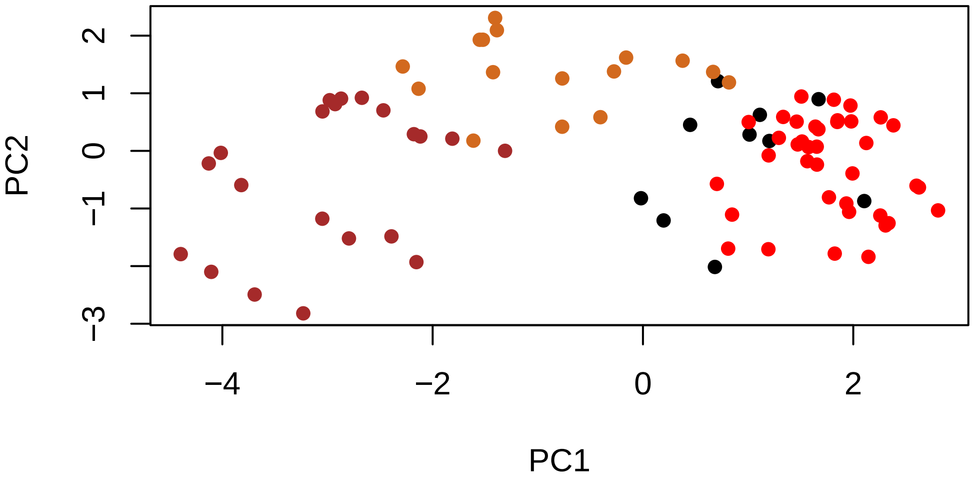
```
Importance of components:
                          PC1    PC2    PC3     PC4    PC5     PC6     PC7
Standard deviation     2.0788 1.1378 1.1092 1.07533 0.9518 0.81923 0.81530
Proportion of Variance 0.3601 0.1079 0.1025 0.09636 0.0755 0.05593 0.05539
Cumulative Proportion  0.3601 0.4680 0.5705 0.66688 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
```

```r
#pca$rotation[]
```

```r
plot(pca$x[,1], pca$x[,2])
```



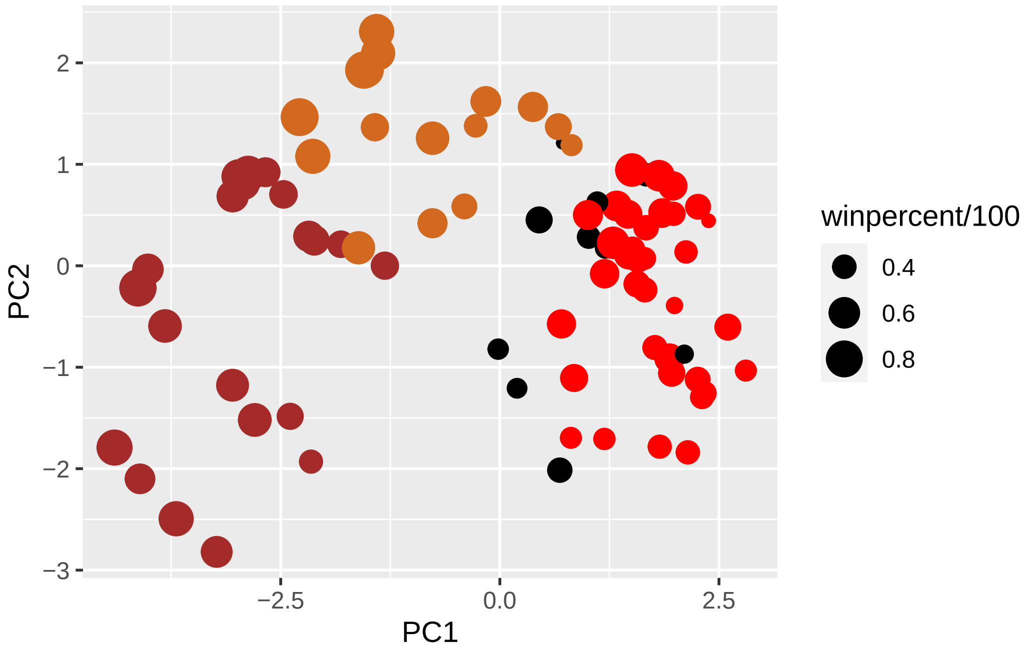
```
plot(pca$x[,1], pca$x[,2], col=my_cols, xlab="PC1", ylab="PC2", pch=16)
```



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

```
             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        PC1
100 Grand       0   1        0        0.732        0.860   66.97173 -3.8198617
3 Musketeers    0   1        0        0.604        0.511   67.60294 -2.7960236
One dime        0   0        0        0.011        0.116   32.26109  1.2025836
One quarter     0   0        0        0.011        0.511   46.11650  0.4486538
Air Heads       0   0        0        0.906        0.511   52.34146  0.7028992
Almond Joy      0   1        0        0.465        0.767   50.34755 -2.4683383
                    PC2        PC3
100 Grand    -0.5935788  2.1863087
3 Musketeers -1.5196062 -1.4121986
One dime      0.1718121 -2.0607712
One quarter   0.4519736 -1.4764928
Air Heads    -0.5731343  0.9293893
Almond Joy    0.7035501 -0.8581089
```

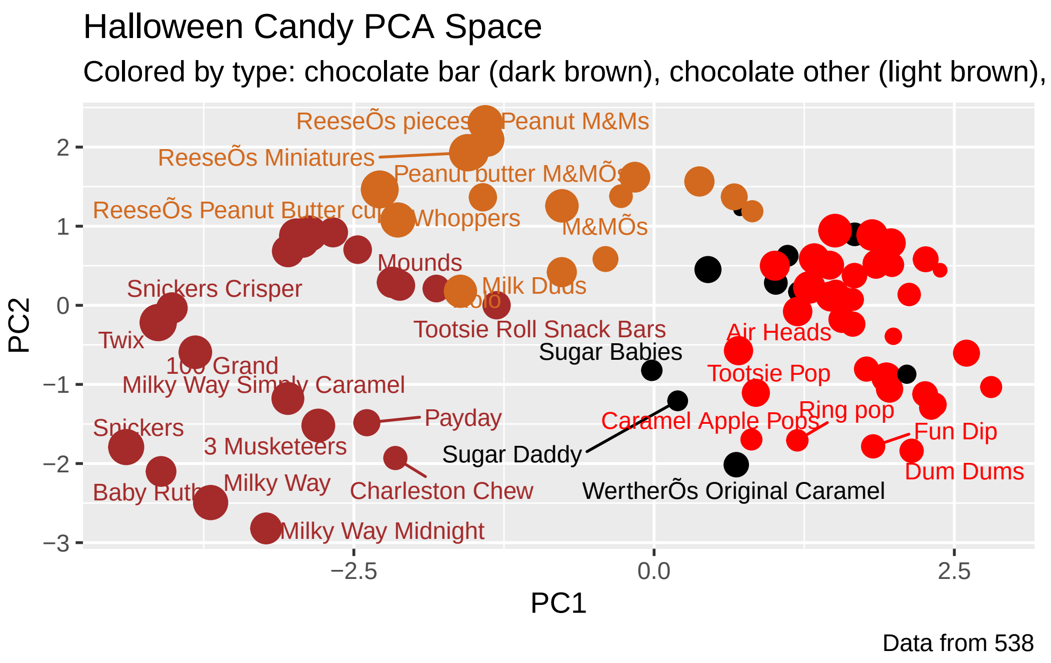
```r
p <- ggplot(my_data) +
  aes(x=PC1, y=PC2,
      size=winpercent/100,
      text=rownames(my_data),
      label=rownames(my_data)) +
  geom_point(col=my_cols)
p
```



```
library(ggrepel)

p + geom_text_repel(size=3.3, col=my_cols, max.overlaps = 10)  +
  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: 54 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



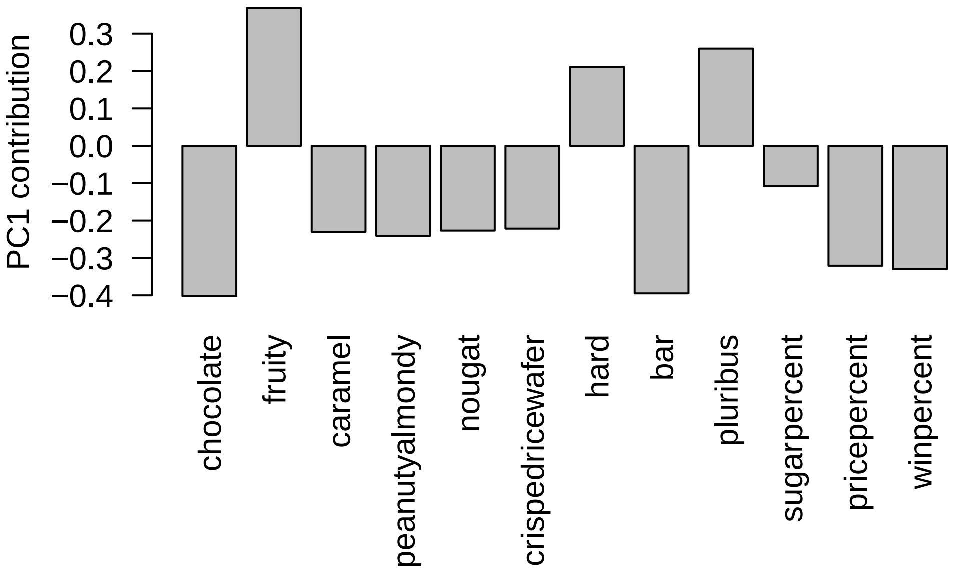
Halloween Candy PCA Space

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

Data from 538

```
#install.packages("plotly")
#library(plotly)
#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. Yes, they make sense because these types of candy usually go together (fruity candies are hard and pluribus) so it makes sense that they are all positive values.