class10

10/28/22

In this mini-project we will examine 538 Halloween Candy data.

```
candy_file <- "https://raw.githubusercontent.com/fivethirtyeight/data/master/candy-power-r
```

```
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 differeny candy types are in this dataset?

```
nrow(candy)
```

```
[1] 85
```

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

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

```
[1] 38
```

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

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

```
[1] 76.7686
```

The winpercent for Kit Kat is 76.7686

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

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

```
[1] 76.7686
```

The winpercent 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
```

```
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

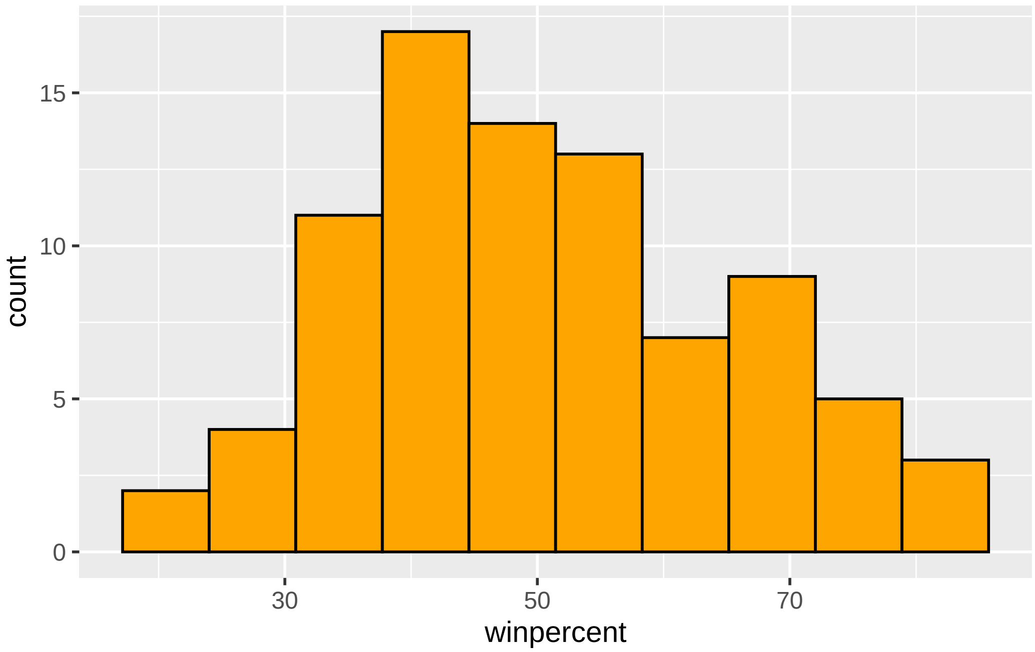
skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
chocolate	0	1	0.44	0.50	0.00	0.00	0.00	1.00	1.00	
fruity	0	1	0.45	0.50	0.00	0.00	0.00	1.00	1.00	
caramel	0	1	0.16	0.37	0.00	0.00	0.00	0.00	1.00	
peanutyalmondy	0	1	0.16	0.37	0.00	0.00	0.00	0.00	1.00	
nougat	0	1	0.08	0.28	0.00	0.00	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?

The winpercent variable seems to be on a different scale than the rest. The rest of the values are functions

Q8. Plot a histogram of winpercent values

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



Q9. Is the distribution of winpercent values symmetrical? No it's not

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

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

Let's look at chocolate

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

```
[1] 60.92153
```

Now let's look at fruit candy..

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

```
[1] 44.11974
```

On average, chocolate is ranked higher than fruit candy.

Q12. Is this difference statistically significant?

```
t.test(chocolate_win, fruity_win)
```

```

	Welch Two Sample t-test

data:  chocolate_win and fruity_win
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 
```

According to the results of the t-test, the difference is statistically different

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

```
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)%>%
  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
```

The five least liked candy types 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?

```
library(dplyr)

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

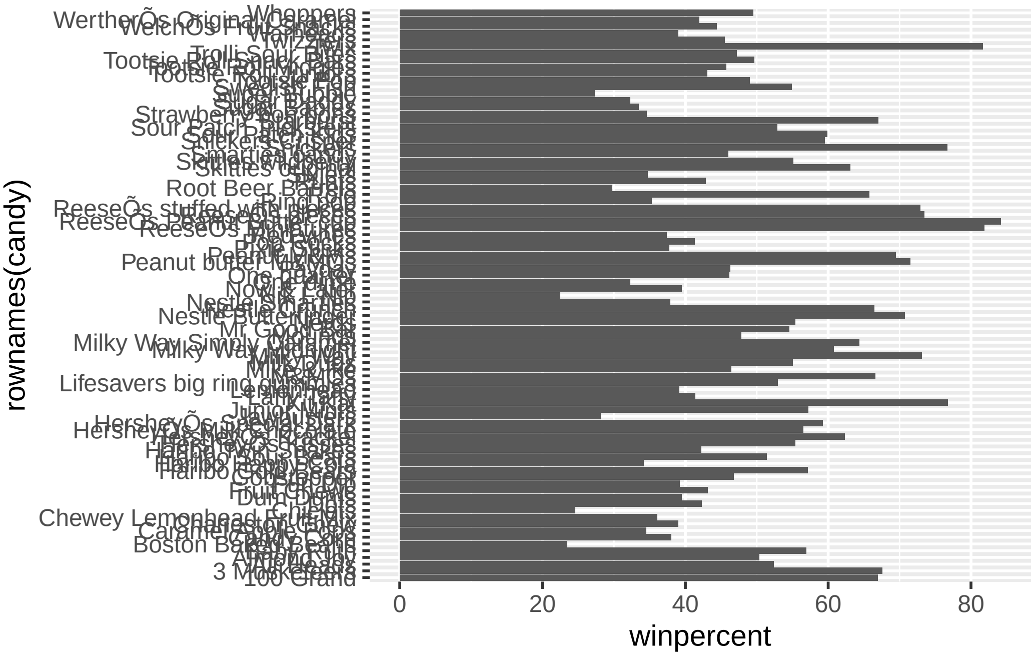
```
                          chocolate fruity caramel peanutyalmondy nougat
Snickers                          1      0       1              1      1
Kit Kat                           1      0       0              0      0
Twix                              1      0       1              0      0
ReeseÕs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

The top 5 favorite candies are Snickers, Kit Kat, Twix, ReeseÕs Miniatures, and ReeseÕs Peanut Butter cup

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

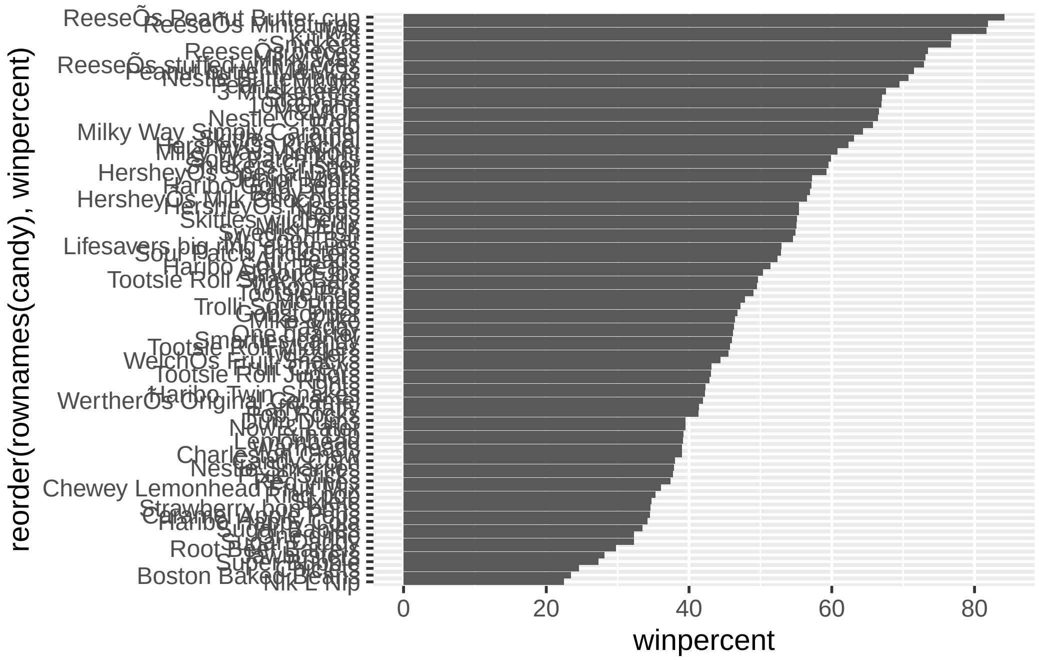
```r
library(ggplot2)

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



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

```r
library(ggplot2)
```

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



```
ggsave("myrplot.png", height=15)
```

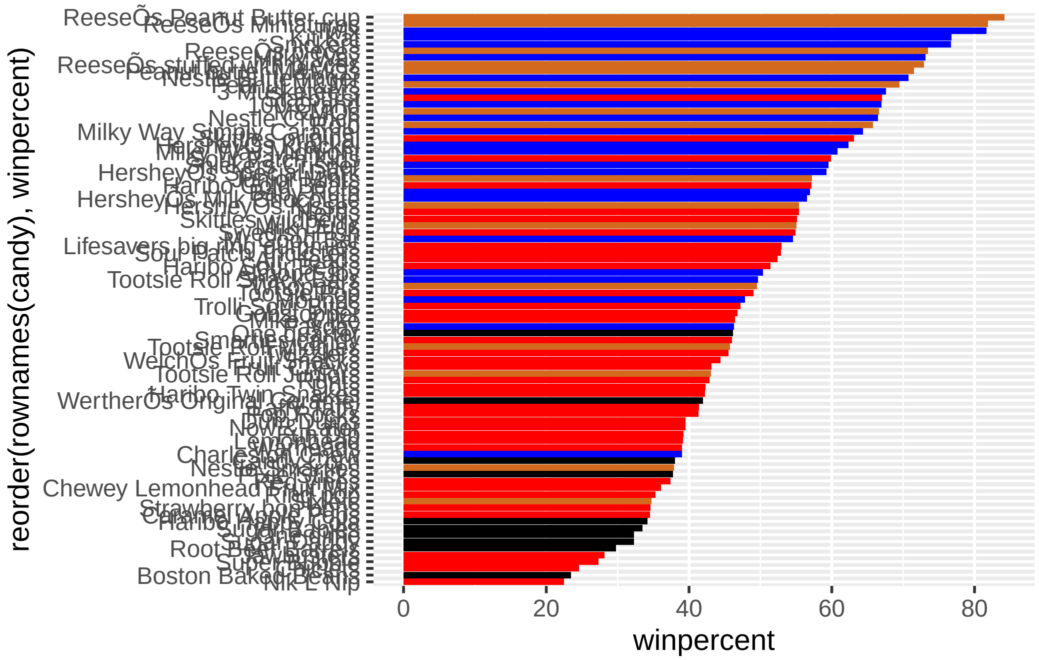
```
Saving 5.5 x 15 in image
```

Adding color vectors

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

Add it to the graph

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



Q17. What is the worst ranked chocolate candy?

Sixlets it the worst ranked chocolate candy

Q18. What is the best ranked fruity candy?

Starburst

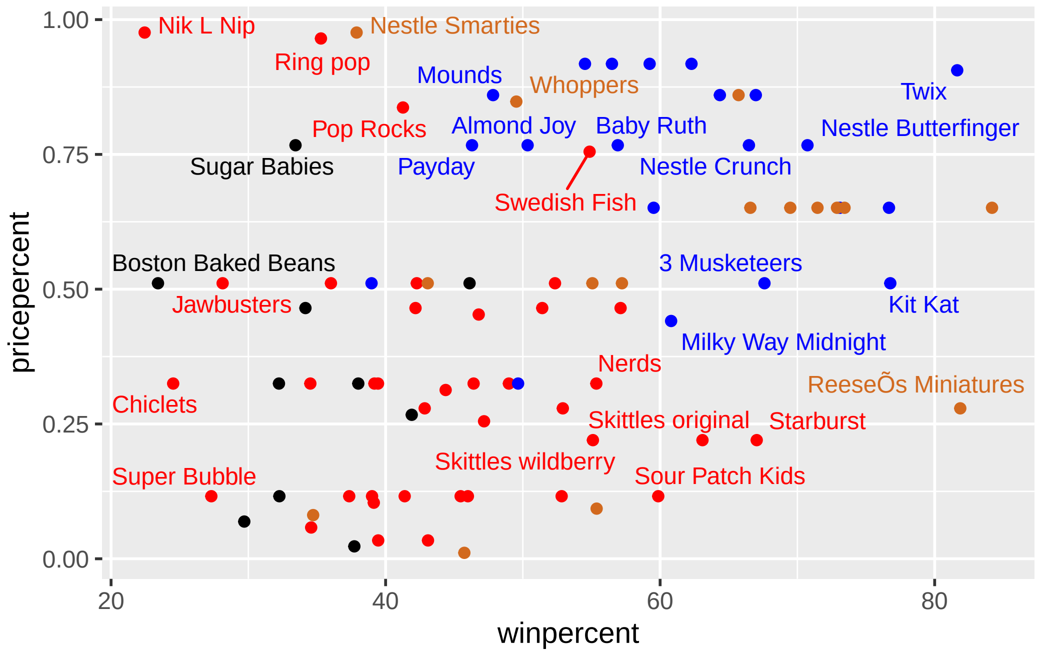
Looking at pricepercent

What about value for money? What is the best candy for the least money?

One way to get at this would be to make a plot of `winpercent` vs `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 = 7)
```

```
Warning: ggrepel: 58 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?

The candy that is the highest ranked for the least money is Reeses Miniatures

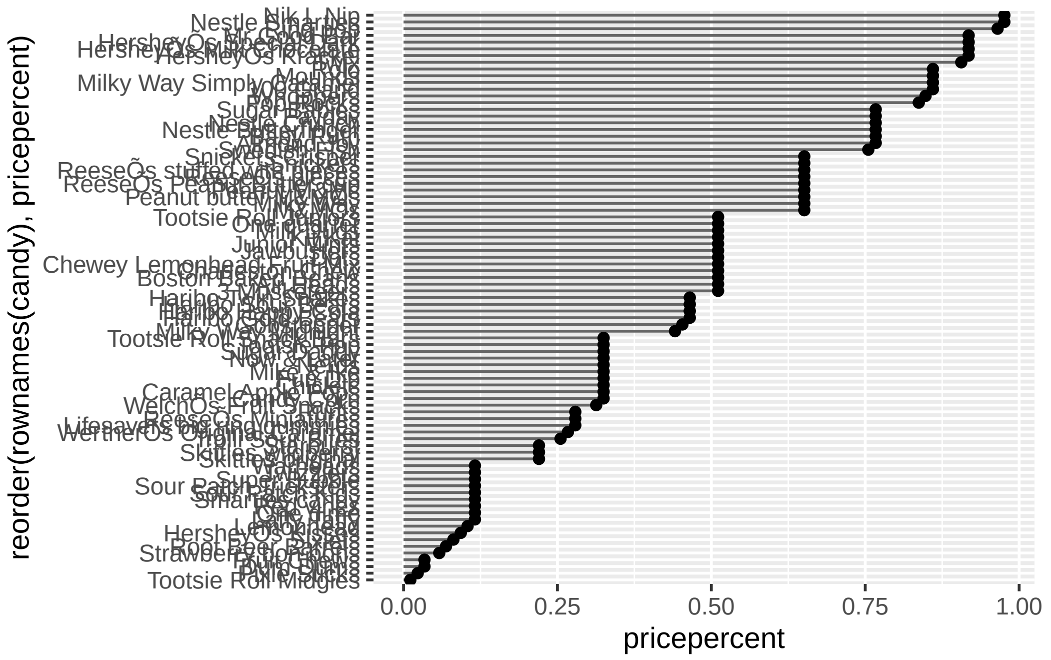
Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular?

```
library(dplyr)
candy%>%
  arrange(pricepercent)%>%
  tail(5)
```

```
                             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
```

```
# 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()
```

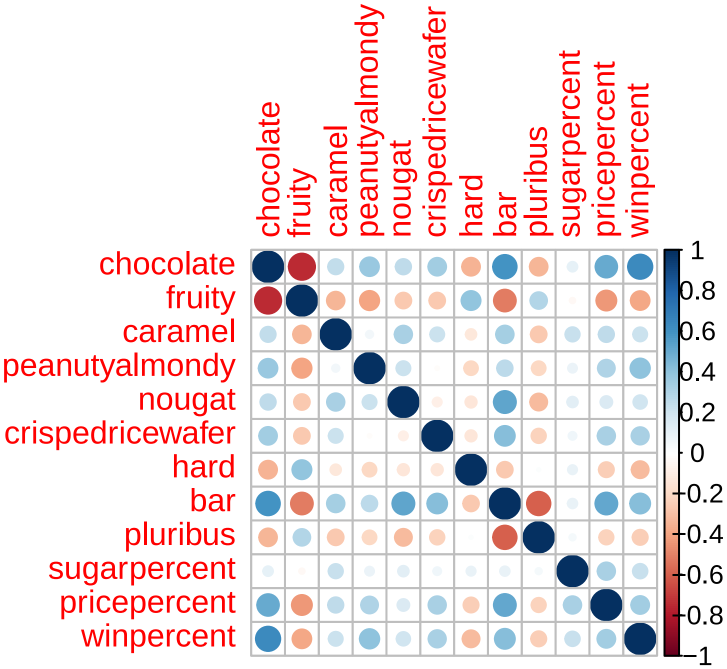


Exploring Correlation

```r
library(corrplot)
```

```
corrplot 0.92 loaded
```

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



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

Fruity and chocolate are anti-correlated

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

bar and chocolate are most positively correlated

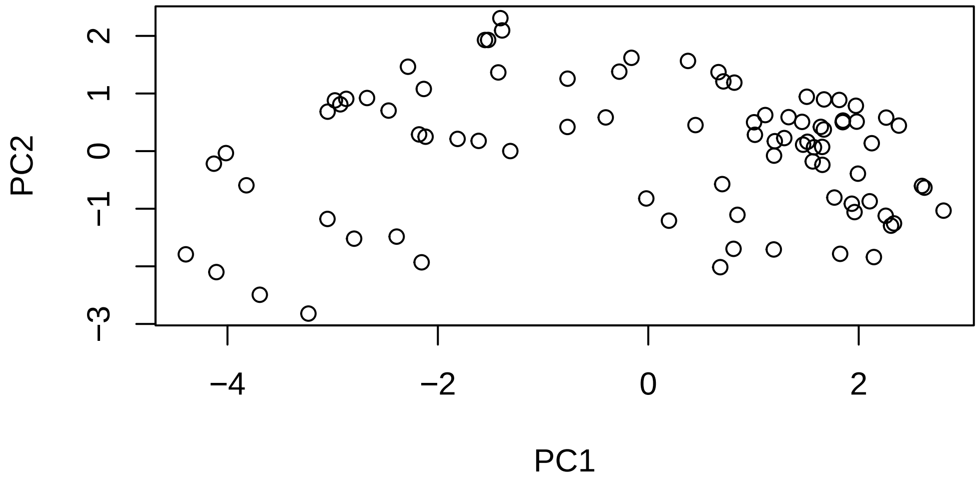
Principal Component Analysis

```
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
```

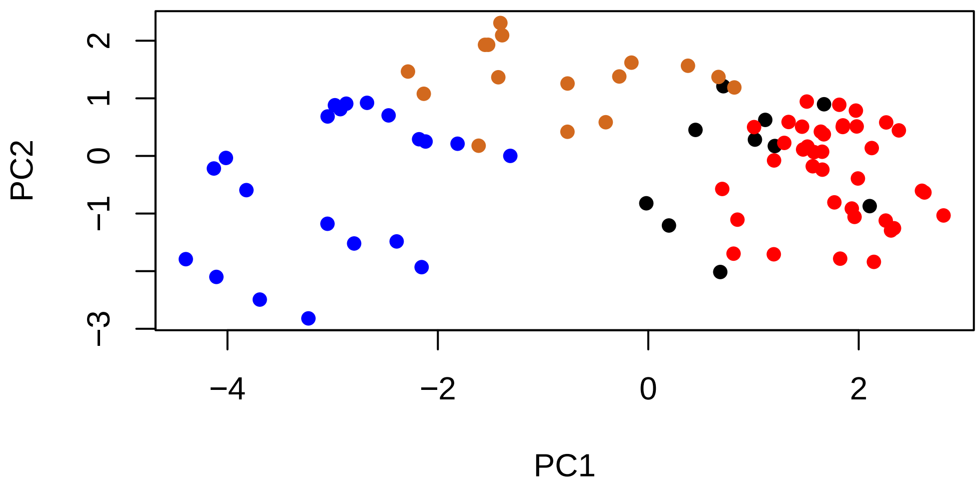
Let's plot results from PCA analysis

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



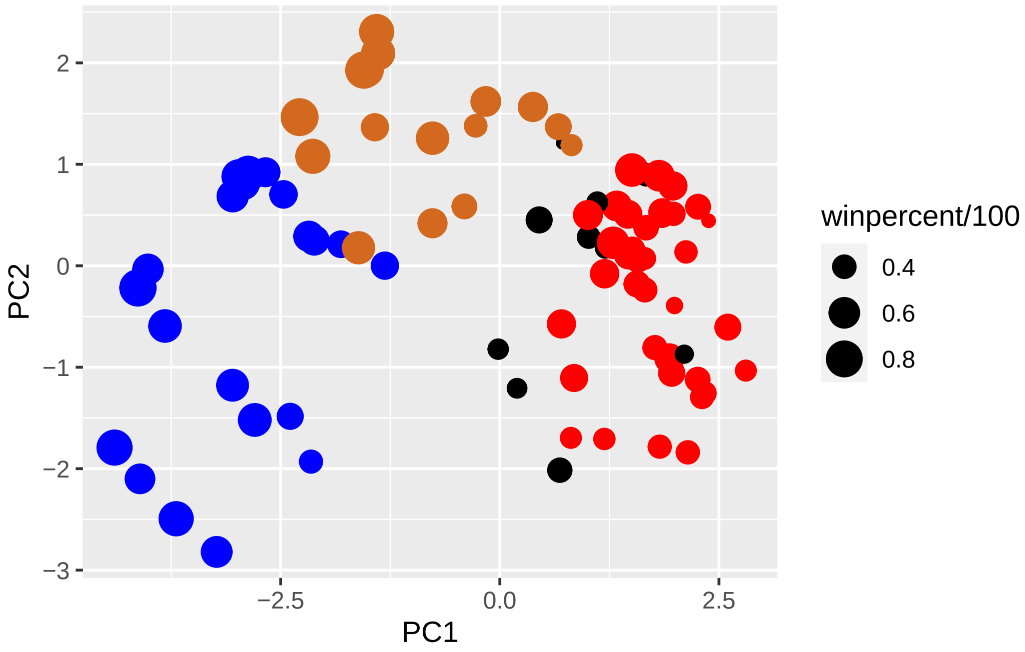
Adding color we originally defined

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



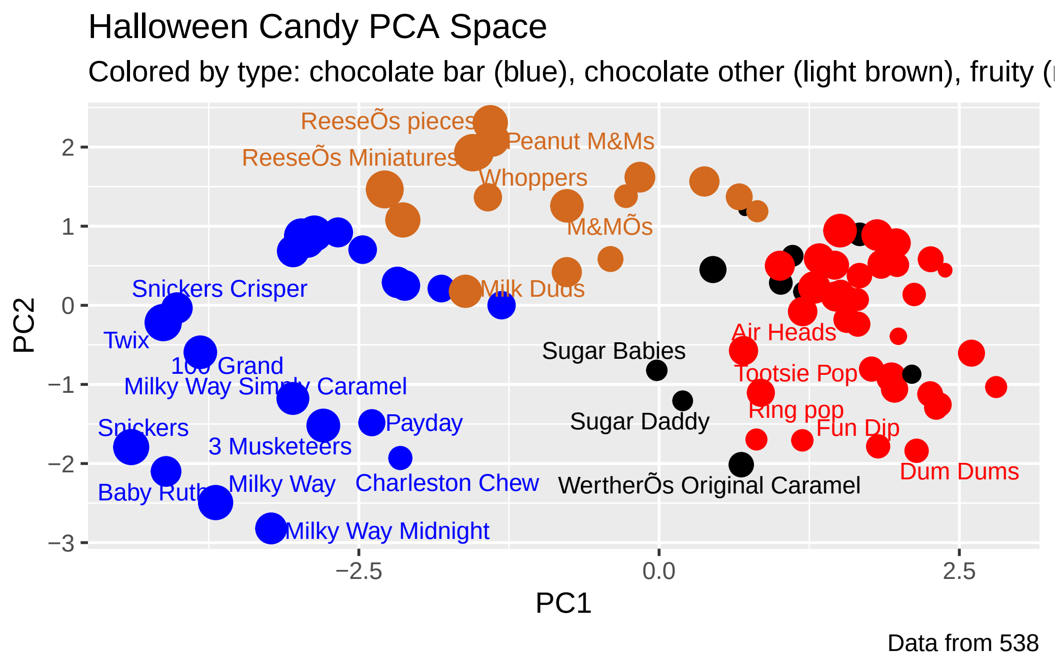
```
my_data <- cbind(candy, pca$x[,1:3])
```

```
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 = 7)  +
  theme(legend.position = "none") +
  labs(title="Halloween Candy PCA Space",
       subtitle="Colored by type: chocolate bar (blue), chocolate other (light brown), fru
       caption="Data from 538")
```

```
Warning: ggrepel: 60 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Halloween Candy PCA Space

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

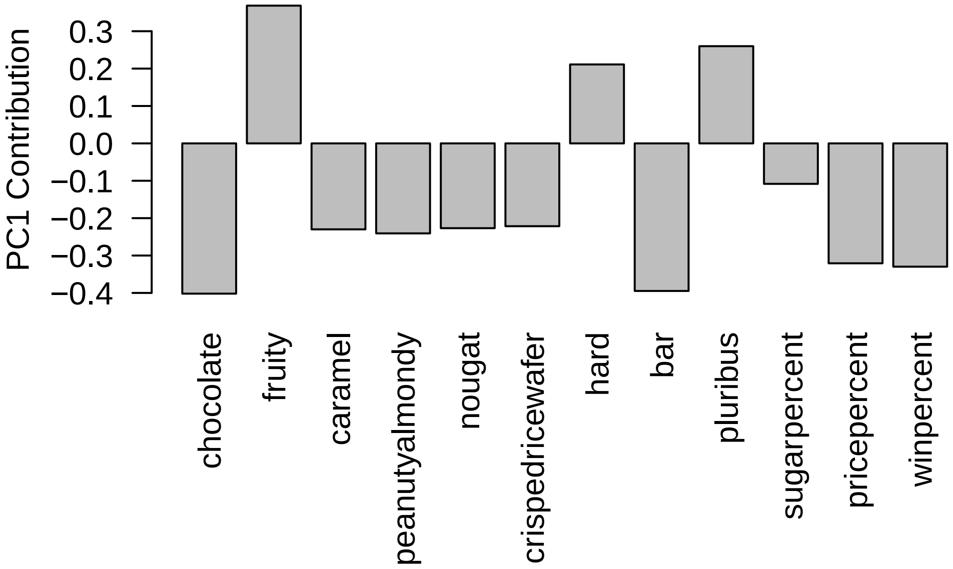
Data from 538

```r
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
```

```r
# ggplotly(p)
```

```r
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?

The original variable that are picked up most strongly by PC1 in the positive direction are fruity, hard, and pluribus

These do make sense because the candies that are furthest to the right on PC1 are fruity, hard, and a lot of them do come in multiples in a packet