Class 10: Halloween Mini-Project

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#Background

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 America?

First step is to read the data…

```
candy <- read.csv("candy-data.txt", 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
```

How many candies there is?

```
nrow(candy)
```

```
[1] 85
```

how many fruity candy types are in th data base?

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

```
[1] 38
```

```r
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] "HersheyÕs Kisses"            "HersheyÕs Krackel"
[25] "HersheyÕs Milk Chocolate"    "HersheyÕs Special Dark"
[27] "Jawbusters"                  "Junior Mints"
[29] "Kit Kat"                     "Laffy Taffy"
[31] "Lemonhead"                   "Lifesavers big ring gummies"
[33] "Peanut butter M&MÕs"         "M&MÕs"
[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"                   "ReeseÕs Miniatures"
[53] "ReeseÕs Peanut Butter cup"   "ReeseÕs pieces"
[55] "ReeseÕs 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] "WelchÕs Fruit Snacks"        "WertherÕs Original Caramel"
[85] "Whoppers"
```

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

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

```
[1] 59.864
```

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["Toosie Roll Snack Bars",]$winpercent
```

```
[1] NA
```

```
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	

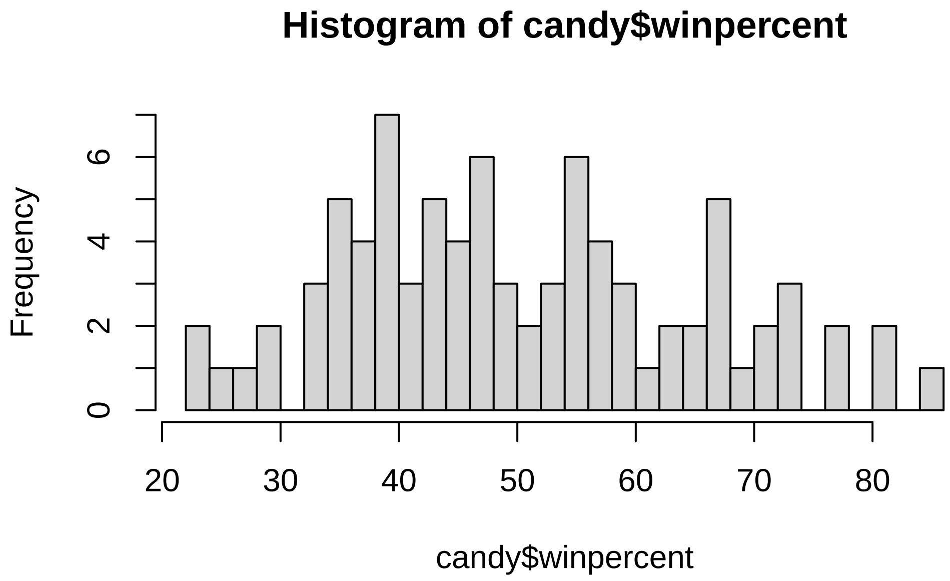
Q6. Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset?

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

```
candy$chocolate
```

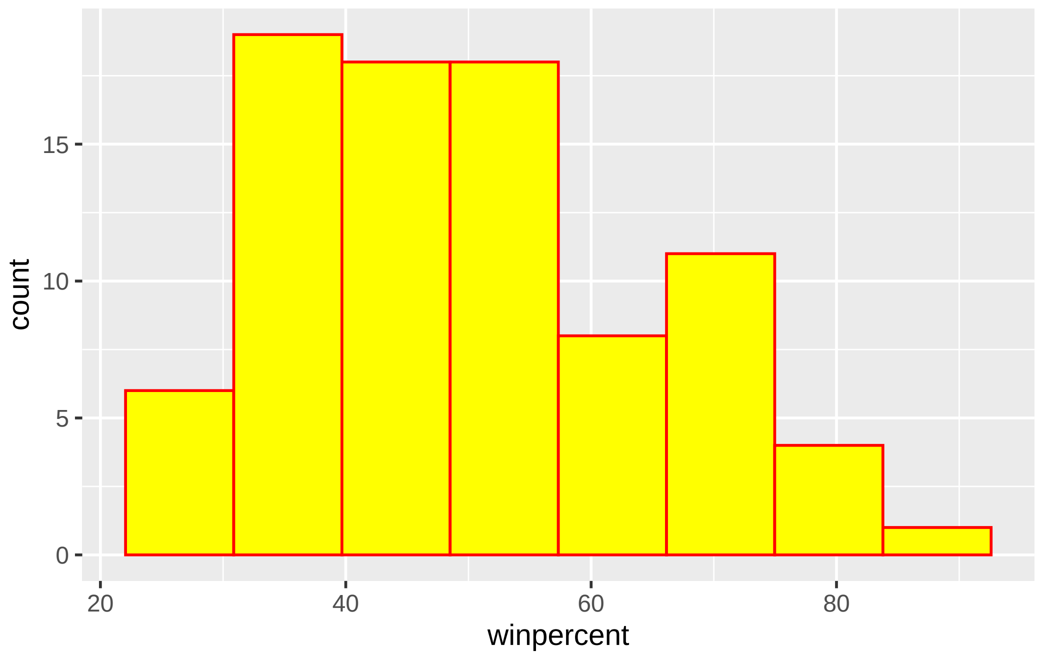
```
 [1] 1 1 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 0 1 1 0 0 0 1 1 0 1 1 1
[39] 1 1 1 0 1 1 0 0 0 1 0 0 0 1 1 1 1 0 1 0 0 1 0 0 1 0 1 1 0 0 0 0 0 0 0 0 1 1
[77] 1 1 0 1 0 0 0 0 1
```

```
hist(candy$winpercent,breaks=30)
```



```
library("ggplot2")

ggplot(candy) +
  aes(winpercent)+
  geom_histogram(bins=8, col="red", fill="yellow")
```



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

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

```
[1] 60.92153
```

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

```
[1] 44.11974
```

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
```

#3 Overall Candy Rankings

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

```r
x <- c(5,1,2,6)
sort(x)
```

```
[1] 1 2 5 6
```

```r
x[order(x)]
```

```
[1] 1 2 5 6
```

```r
y <- c("barry","alice","chandra")
y
```

```
[1] "barry"   "alice"   "chandra"
```

```r
sort(y)
```

```
[1] "alice"   "barry"   "chandra"
```

```r
order(y)
```

```
[1] 2 1 3
```

First I want to order/arrange the whole database by winpercent values

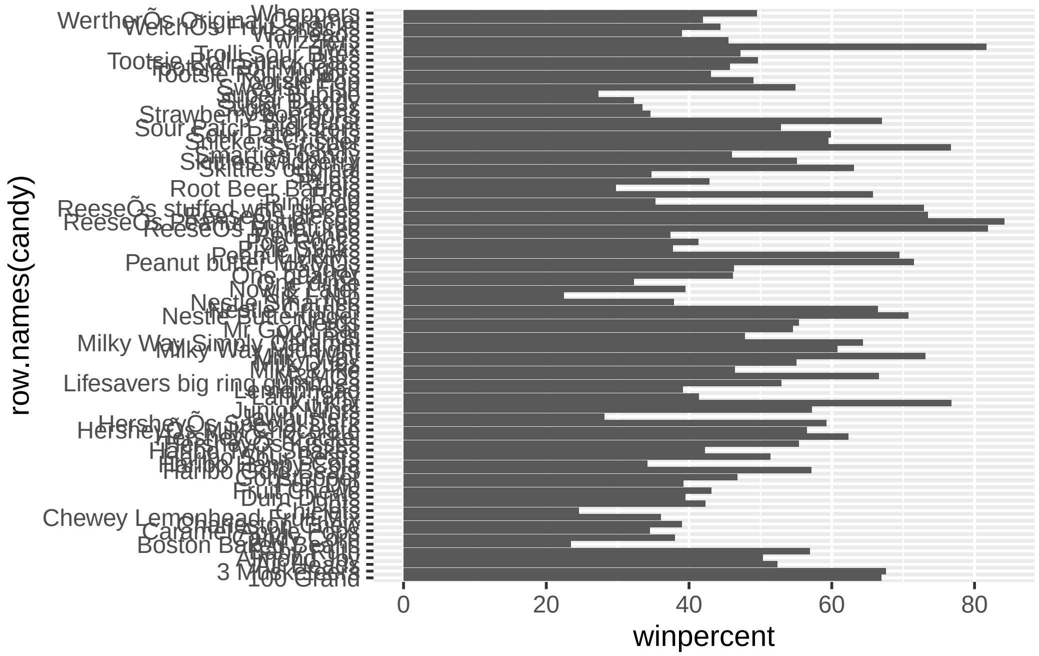
```r
inds <- order(candy$winpercent)
head(candy[inds,],n=5)
```

```
                   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
```

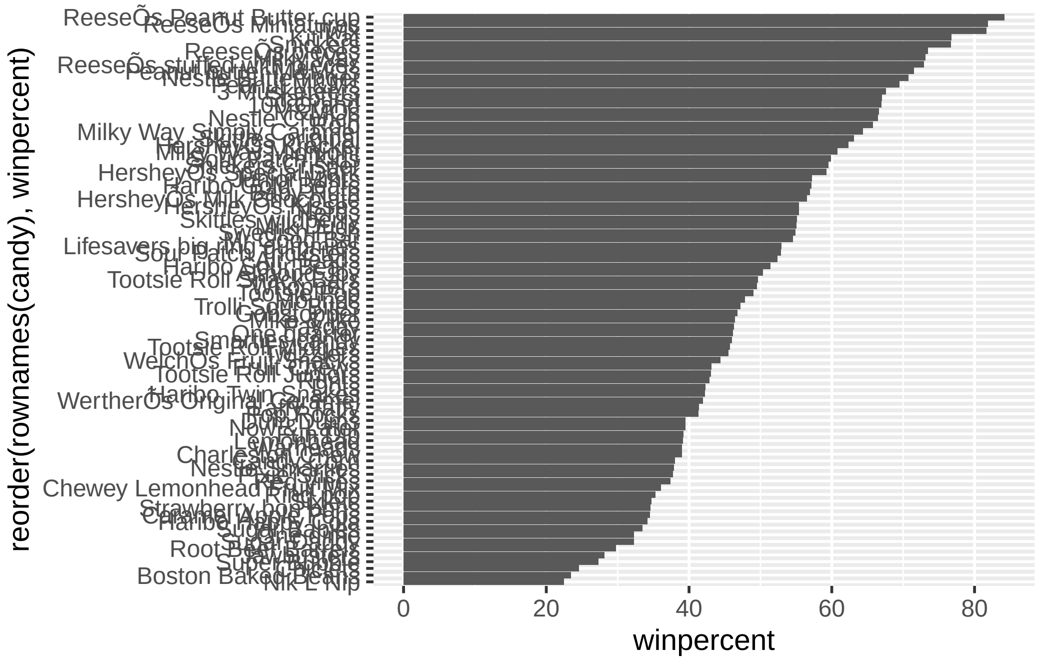
Q15 make a barplot

The default barplot, made with `geom_col()` has the bars

```r
ggplot(candy)+
  aes(winpercent,row.names(candy),winpercent) +
  geom_col()
```



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



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

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

Lets setup a color vector (that signifies candy type) that we can then use for some

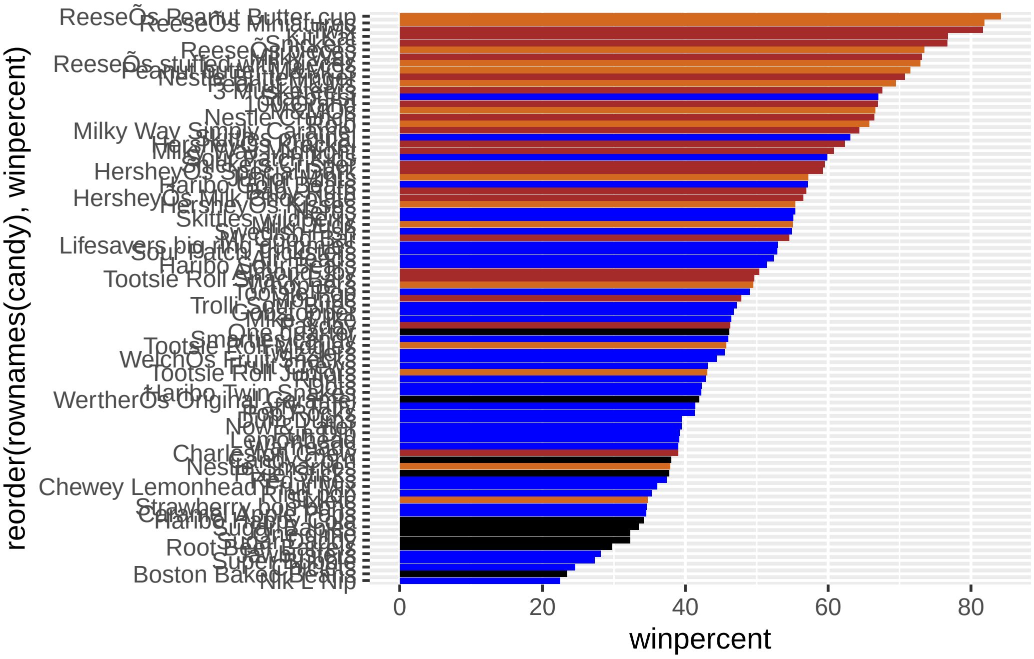
```
my_cols <- rep("black", nrow(candy))
#my_cols
my_cols[as.logical(candy$chocolate)] <- "chocolate"
my_cols[as.logical(candy$bar)] <- "brown"
my_cols[as.logical(candy$fruity)] <- "blue"
my_cols
```

```
 [1] "brown"     "brown"     "black"     "black"     "blue"      "brown"
 [7] "brown"     "black"     "black"     "blue"      "brown"     "blue"
[13] "blue"      "blue"      "blue"      "blue"      "blue"      "blue"
[19] "blue"      "black"     "blue"      "blue"      "chocolate" "brown"
[25] "brown"     "brown"     "blue"      "chocolate" "brown"     "blue"
[31] "blue"      "blue"      "chocolate" "chocolate" "blue"      "chocolate"
[37] "brown"     "brown"     "brown"     "brown"     "brown"     "blue"
```

```
[43] "brown"     "brown"     "blue"      "blue"      "brown"     "chocolate"
[49] "black"     "blue"      "blue"      "chocolate" "chocolate" "chocolate"
[55] "chocolate" "blue"      "chocolate" "black"     "blue"      "chocolate"
[61] "blue"      "blue"      "chocolate" "blue"      "brown"     "brown"
[67] "blue"      "blue"      "blue"      "blue"      "black"     "black"
[73] "blue"      "blue"      "blue"      "chocolate" "chocolate" "brown"
[79] "blue"      "brown"     "blue"      "blue"      "blue"      "black"
[85] "chocolate"
```

Use this vector

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

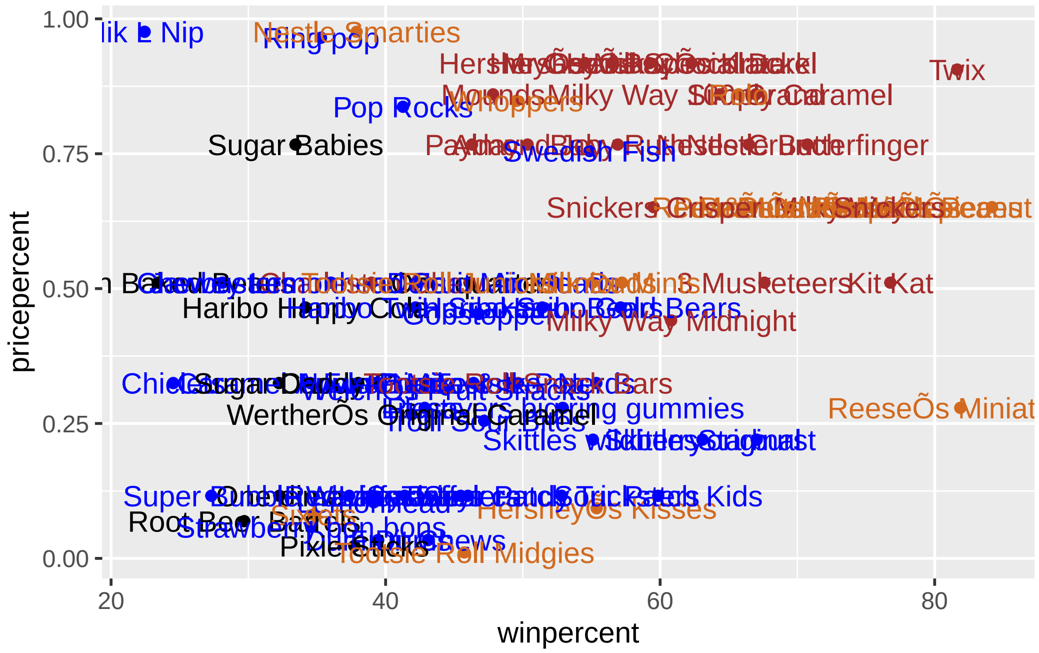


#5 Exploring the correlation structure

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

One way to get at this would be to make

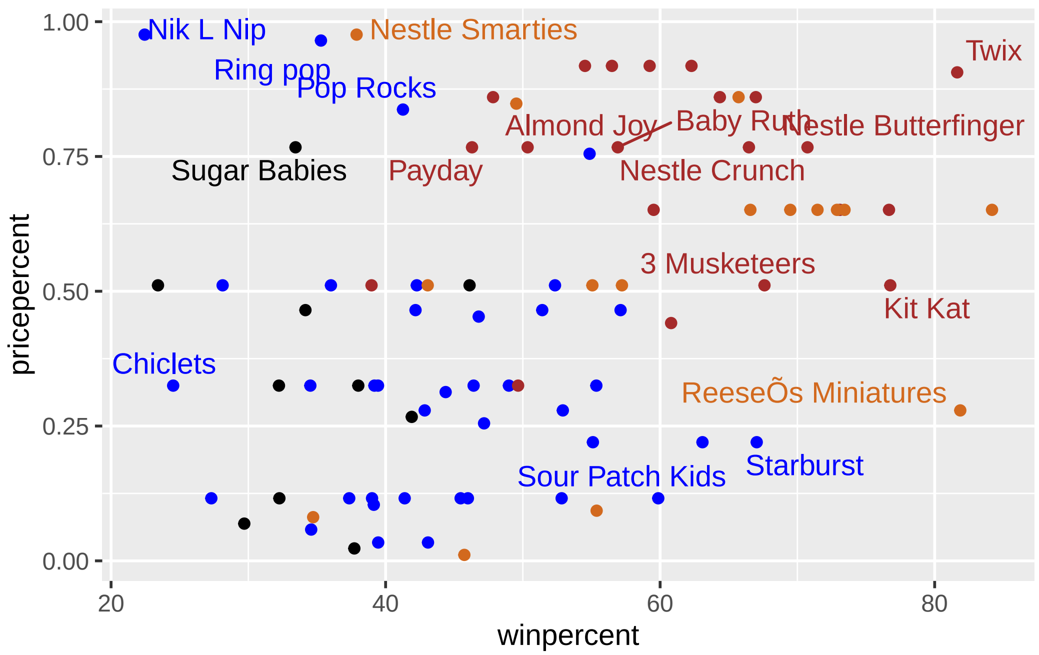
```
ggplot(candy)+
  aes(winpercent, pricepercent, label=rownames(candy))+
  geom_point(col=my_cols) +
  geom_text(col=my_cols)
```



```
library(ggrepel)
```

```
ggplot(candy)+
  aes(winpercent, pricepercent, label=rownames(candy))+
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, max.overlaps = 7)
```

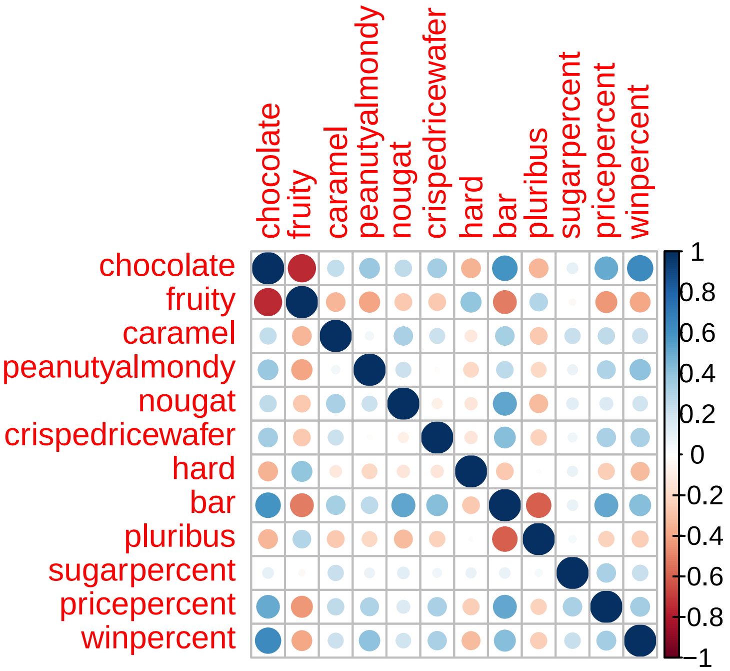
```
Warning: ggrepel: 68 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



```
library(corrplot)
```

```
corrplot 0.92 loaded
```

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



#PCA Principal Component Analysis

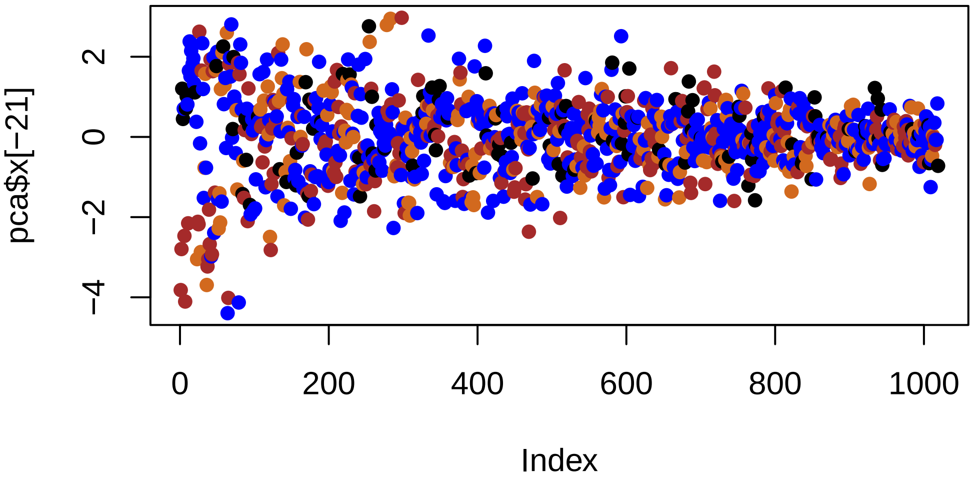
The main function that always there for us is `prcomp()`. It has an important argument that is set to `scale=false`

```
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
```

PCA plot = PC1 V. PC2

```
plot(pca$x[-21], col=my_cols, pch=16)
```

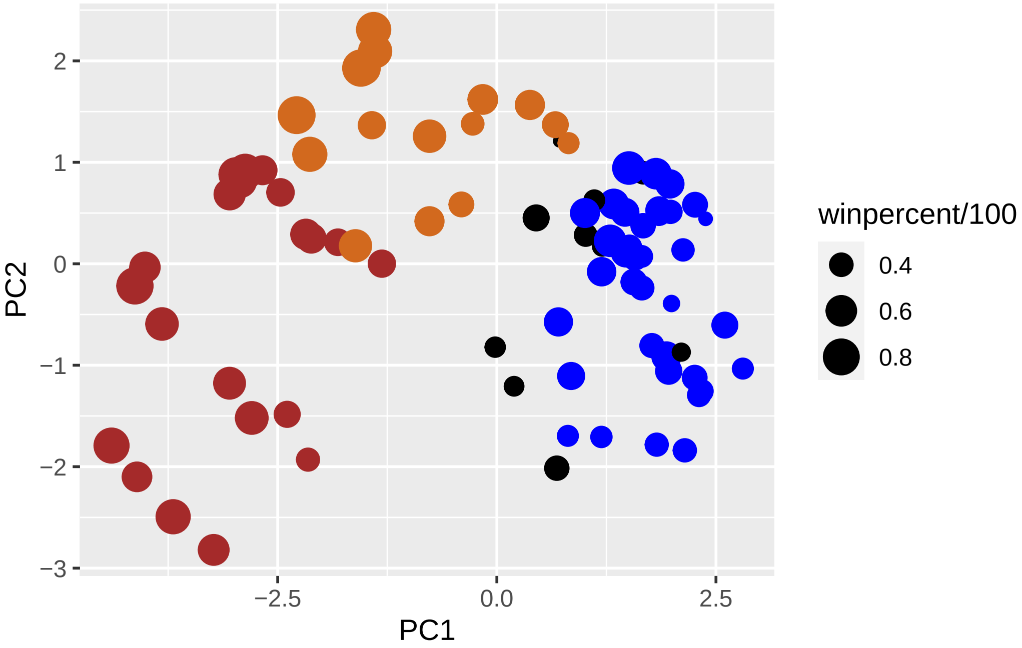


Nicer plot . Ggplot only works with data,frames, as input so I need my_data=

```
# 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
```



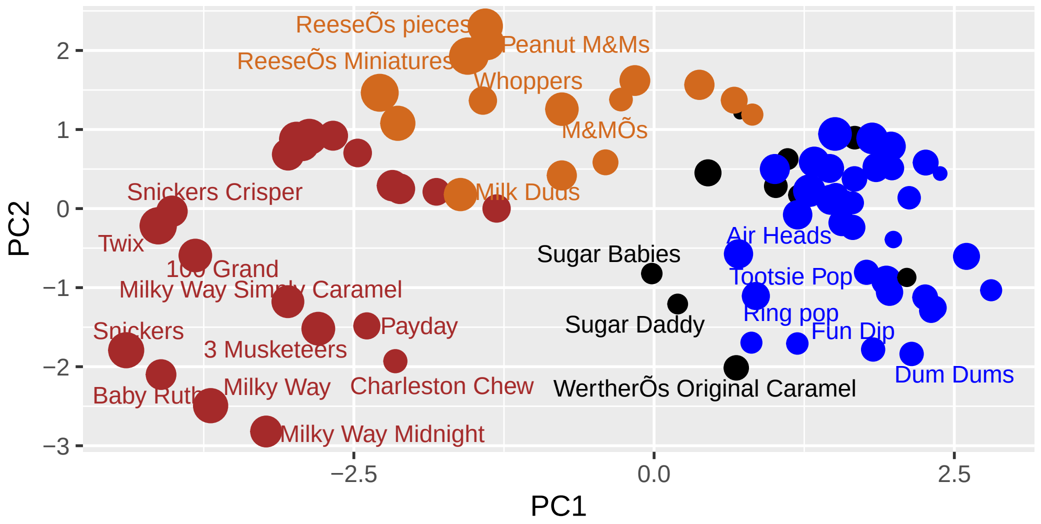
```
library(ggrepel)

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: 60 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