Class10.Halloween Candy Mini Project

Lidia Gallegos

Background

Here we go explore 538 Halloween candy data. They recently ran a rather large poll to determine which candy their readers like best. From their website: "While we don't know who exactly voted, we do know this: 8,371 different IP addresses voted on about 269,000 randomly generated candy match-ups".

```
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?

```
nrow(candy)
```

```
[1] 85
```

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

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

```
[1] 38
```

Winpercent

One of the most interesting variables in the dataset is 'winpercent'. For a given candy this value is the percentage of people who prefer this candy over another randomly chosen candy from the dataset (what 538 term a matchup). Higher values indicate a more popular candy.

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

```
[1] 81.64291
```

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] "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"
```

```
candy["Almond Joy",]$winpercent
```

```
[1] 50.34755
```

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
```

A useful function from the skimr package

There is a useful skim() function in the skimr package that can help give you a quick overview of a given dataset.

```
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 chocolate column seems to be on a different scale of just zeros and ones as opposed to the other columns.

```
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
```

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

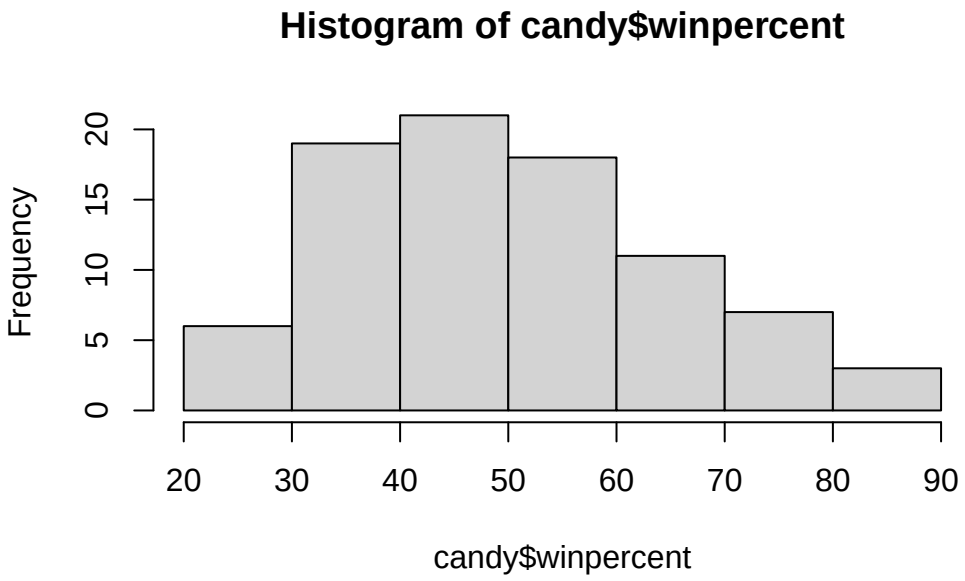
I think a zero indicates that the candy is not a chocolate while a one indicates that the camdy is a chocolate, almost like a "True or False".

```
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
```

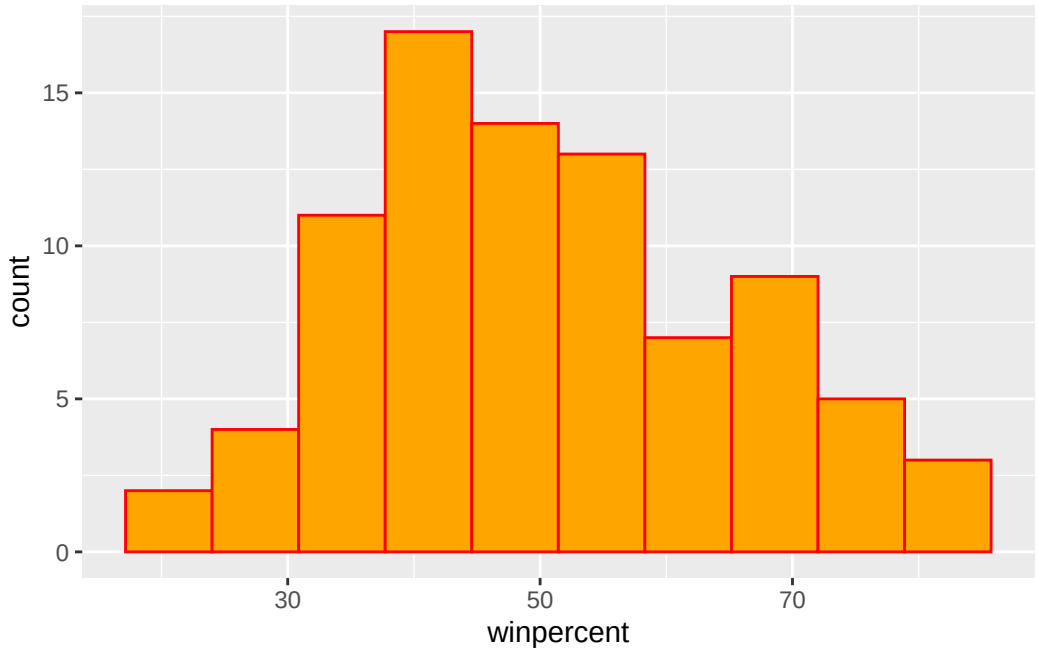
Q8. Plot a histogram of winpercent values

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




```
library(ggplot2)
```

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



Q9. Is the distribution of winpercent values symmetrical?

The distribution of winpercent values is somewhat symmetrical, but not quite.

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

The center of the distribution is above 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
```

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

```
[1] 44.11974
```

On average, the chocolate candy is ranked higher than fruit candy.

Q12. Is this difference statistically significant?

Since p-value = 2.871e-08, this difference is statistically significant.

```
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
```

Candy Ranking

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
```

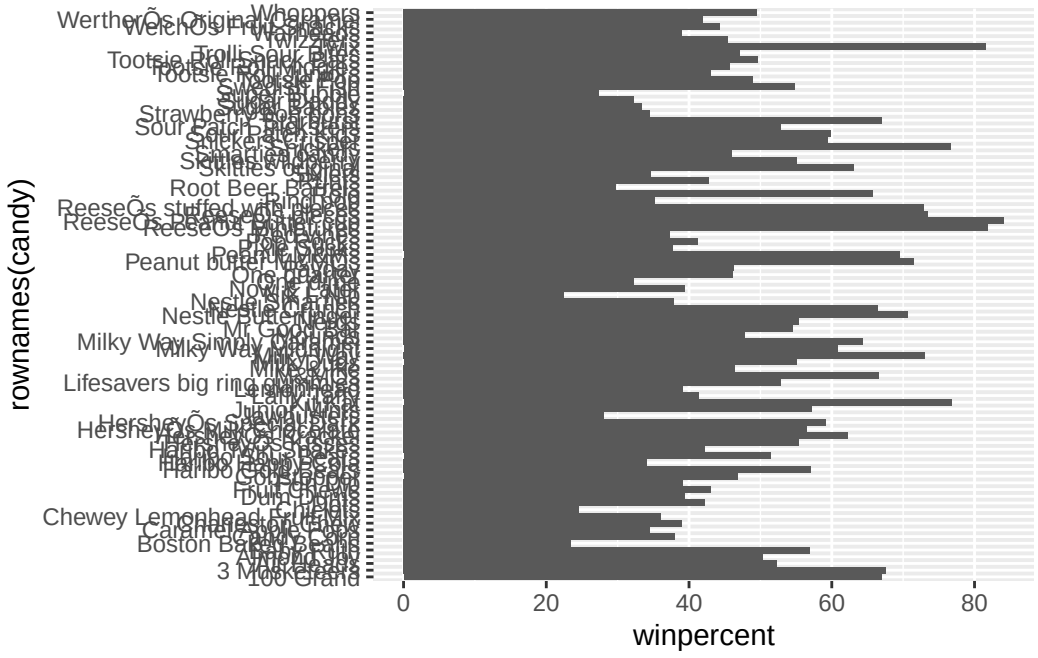
```
Nik L Nip                       0     0     0        1        0.197        0.976
Boston Baked Beans              0     0     0        1        0.313        0.511
Chiclets                        0     0     0        1        0.046        0.325
Super Bubble                    0     0     0        0        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
```

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

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

```
library(ggplot2)

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

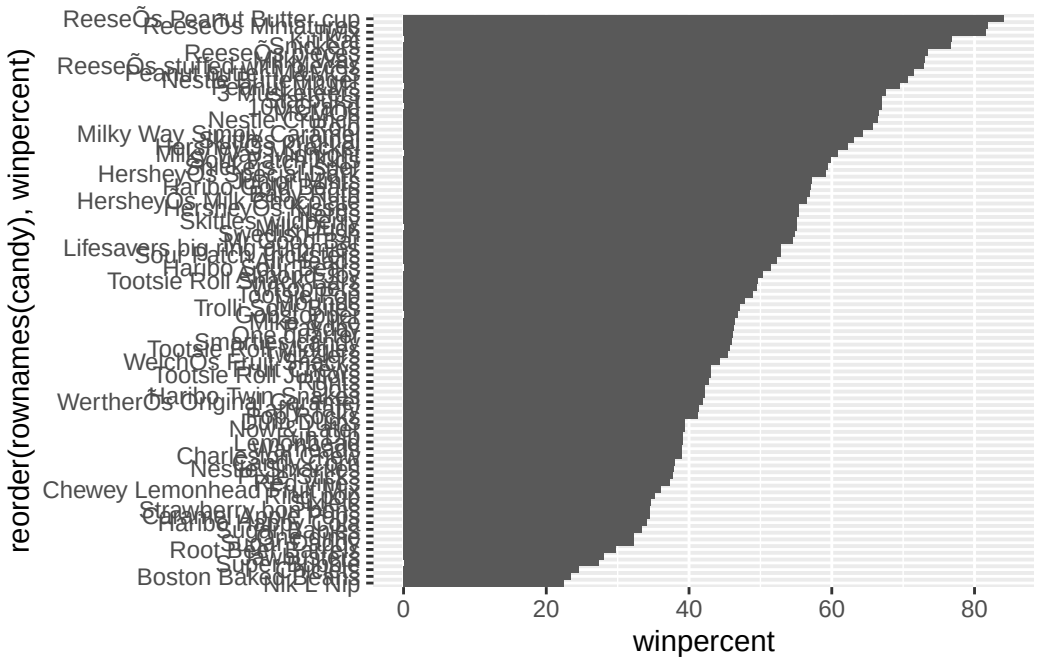


Q16. This is quite ugly, use the reorder() function to get the bars sorted by

winpercent?

```
library(ggplot2)

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



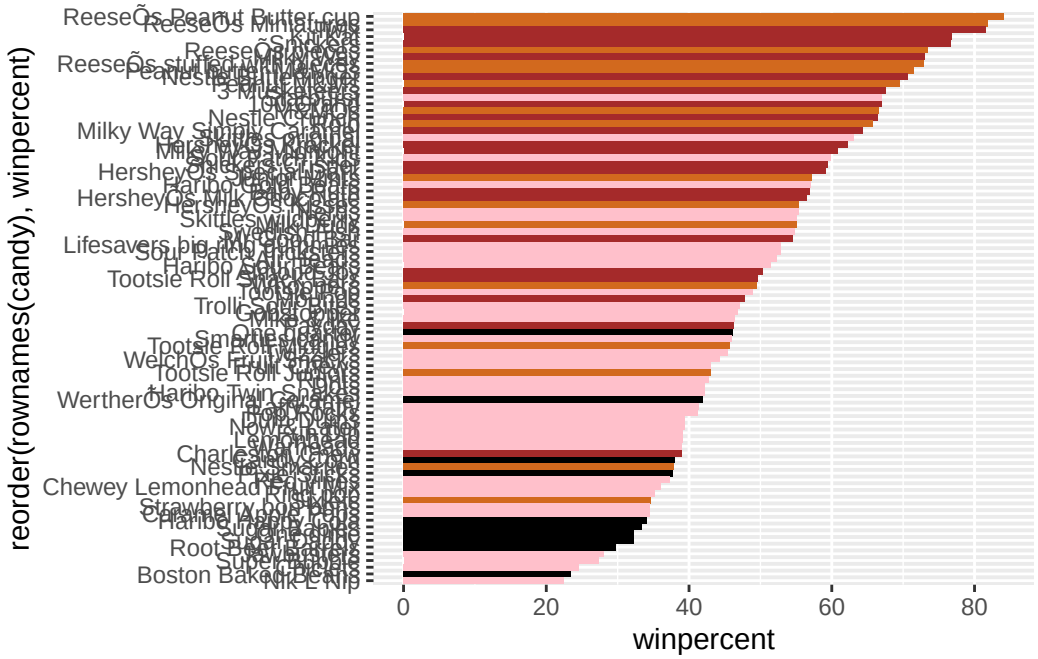

```
my_cols=rep("black", nrow(candy))
my_cols[as.logical(candy$chocolate)] = "chocolate"
my_cols[as.logical(candy$bar)] = "brown"
my_cols[as.logical(candy$fruity)] = "pink"

my_cols
```

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

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

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




```
ggsave("tmp.png")
```

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

Q17. What is the worst ranked chocolate candy?

Q18. What is the best ranked fruity candy?

Taking a look at pricepercent

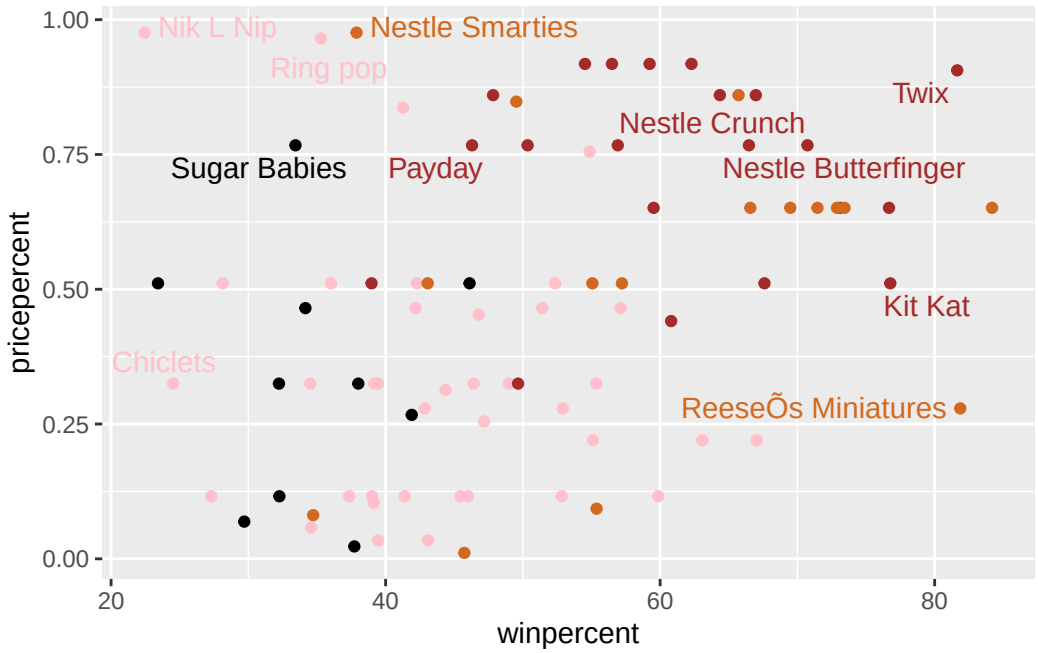
Q19. Which candy type is the highest ranked in terms of winpercent for the least money - i.e. offers the most bang for your buck?

Reese's miniatures are the highest ranked in terms of winpercent for the least money.

```
library(ggrepel)

# plot of price vs win...who will be the winner?
# we use 'geom_text_repel' to repel the labels and prevent overlap
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, size=4, max.overlaps = 5)
```

```
Warning: ggrepel: 74 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



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

The least popular of these is Nik L Lip.

```
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
```

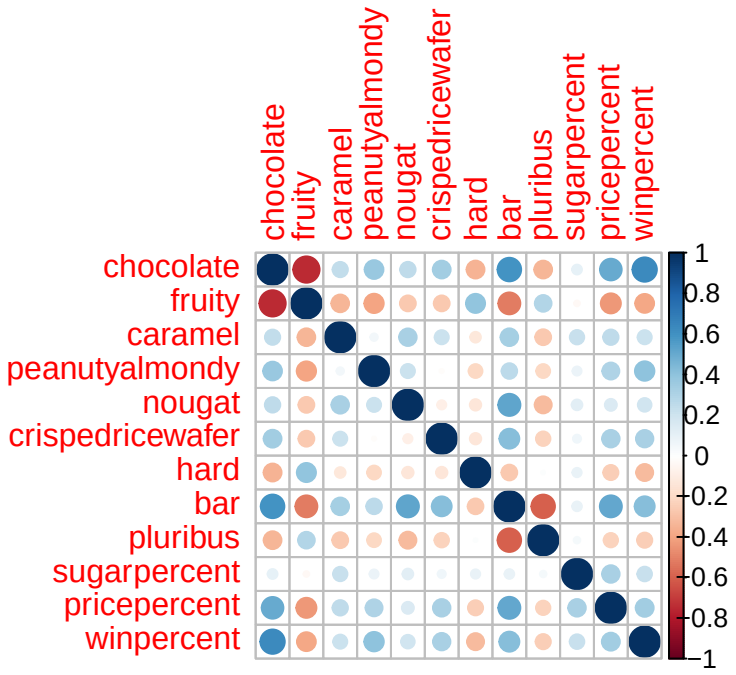
Exploring the correlation structure

We'll use correlation and view the results with the corrplot package to plot a correlation matrix.

```
# install.packages("corrplot") first
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 variables are anti-correlated.

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

Chocolate and winpercent variables are most posotively correlated.

Principal Component Analysis

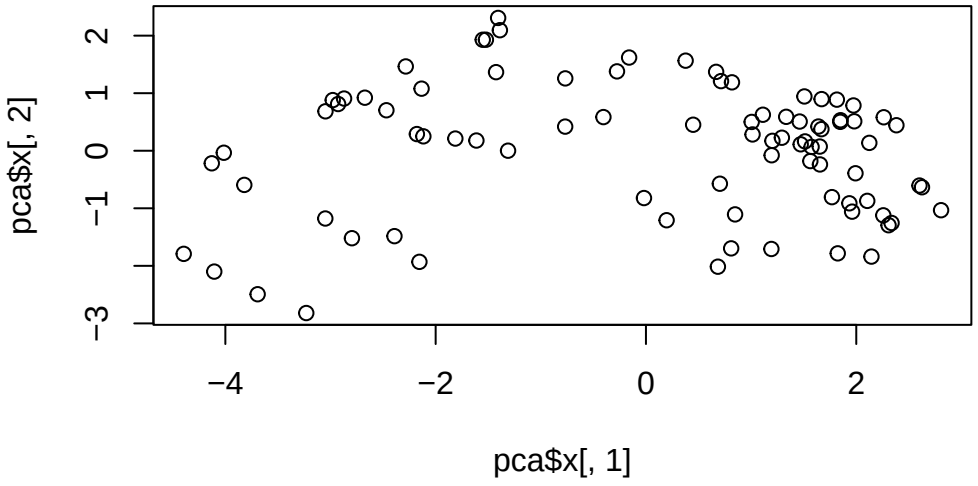
Let's apply PCA using the 'prcomp()' function to our candy dataset remembering to set the 'scale=TRUE' argument because the 'winpercent' and 'pricepercent' values are on a different scale.

```
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
```

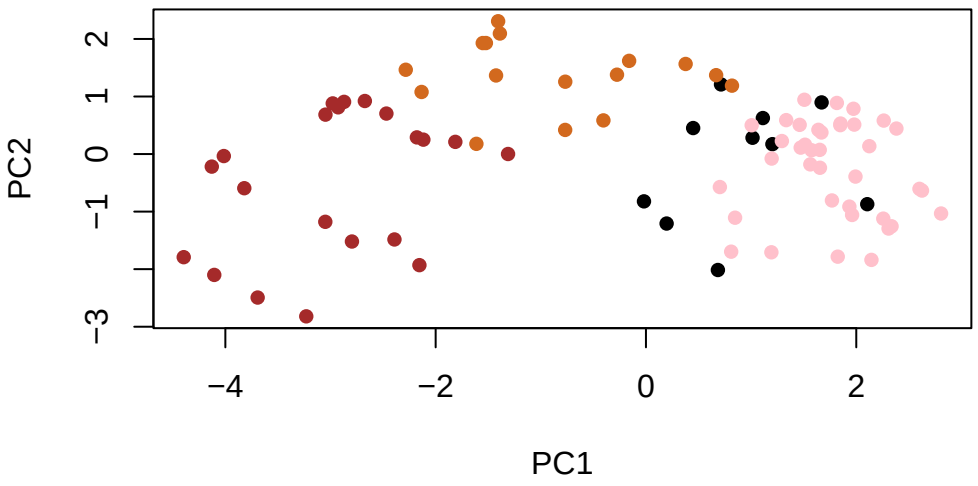
```
Cumulative Proportion  0.3601 0.4680 0.5705 0.66688 0.7424 0.79830 0.85369
                           PC8     PC9    PC10    PC11    PC12
Standard deviation     0.74530 0.67824 0.62349 0.43974 0.39760
Proportion of Variance 0.04629 0.03833 0.03239 0.01611 0.01317
Cumulative Proportion  0.89998 0.93832 0.97071 0.98683 1.00000
```

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



Changing the plotting character and adding some color:

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

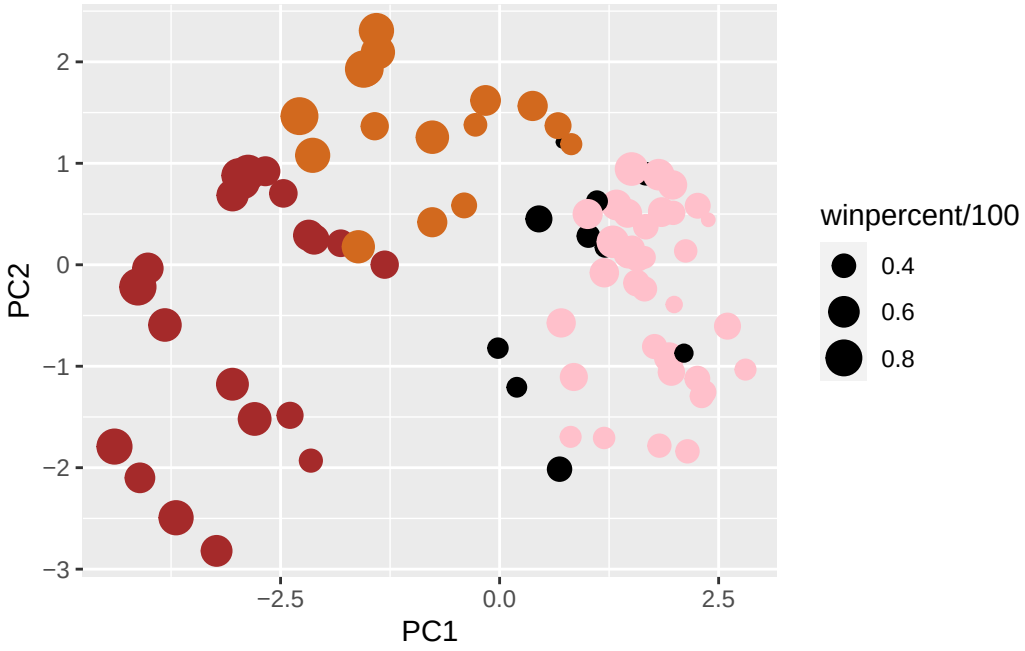


Make a prettier plot with the ggplot2 package!

```
# 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
```

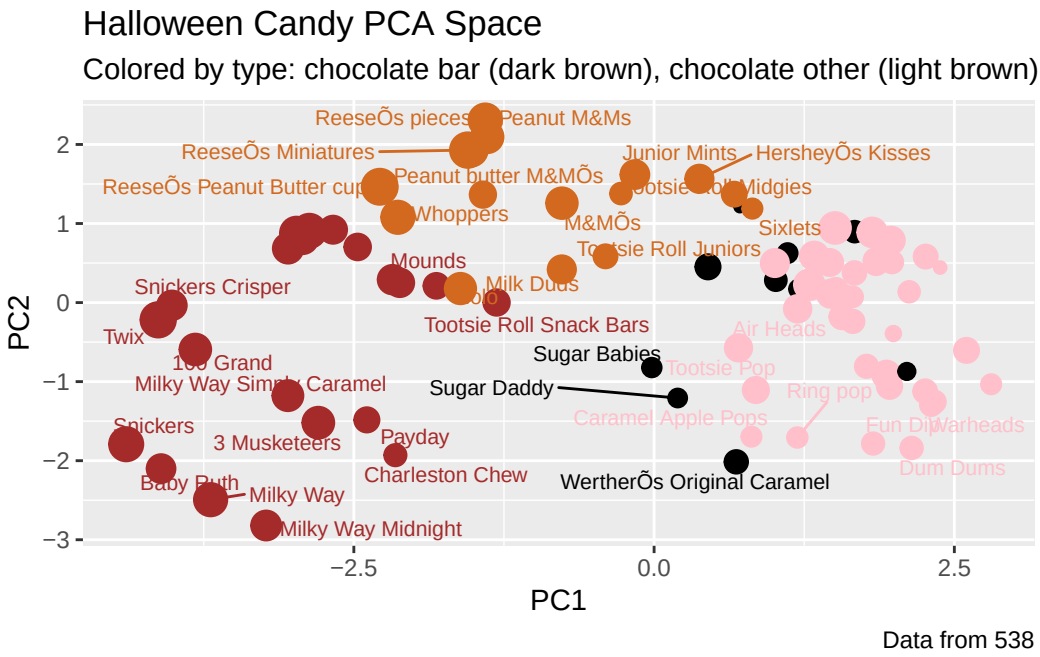


Use the ggrepel package and the function 'ggrepel::geom_text_repel()' to label up the plot without overlapping candy names (add a title and subtitle too):

```
library(ggrepel)

p + geom_text_repel(size=2.8, 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: 48 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



*Pass the ggplot object 'p' to plotly like so to generate an interactive plot that you can mouse over to see labels:

```
# First install.packages("plotly")
library(plotly)
```

```
Attaching package: 'plotly'
```

```
The following object is masked from 'package:ggplot2':

    last_plot
```

```
The following object is masked from 'package:stats':

    filter
```

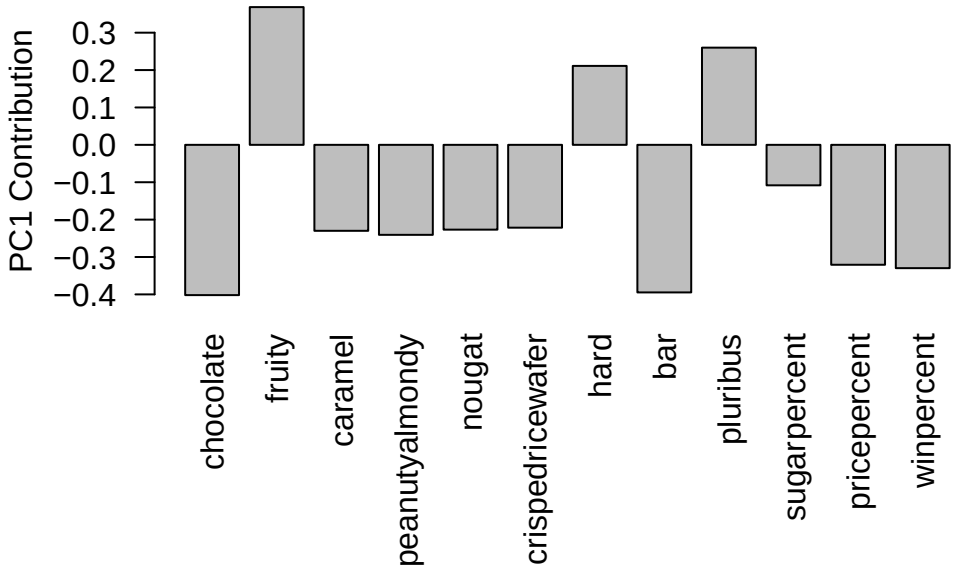
```
The following object is masked from 'package:graphics':

    layout
```

```
ggplotly(p)
```

Let's look at PCA of our loadings...

```
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?

The original variables picked up strongly by PC1 in the positive direction are Fruity, Hard and Pluribus.