Class09: Halloween Mini-Project

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1.Importing candy data:

```
candy.file <- "candy-data.txt"
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
```

85 different types of candy are in the dataset

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

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

```
[1] 38
```

38 fruity types of candy are in the dataset

2. What is your favorite candy?

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

My favorite candy is Twix:

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

```
[1] 81.64291
```

Win percent of Twix is 81%

Q4. What is the `winpercent` value for "Kitkat"?

```
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
```

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

```
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	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	▂▇▇▅▂▁▁▁▁

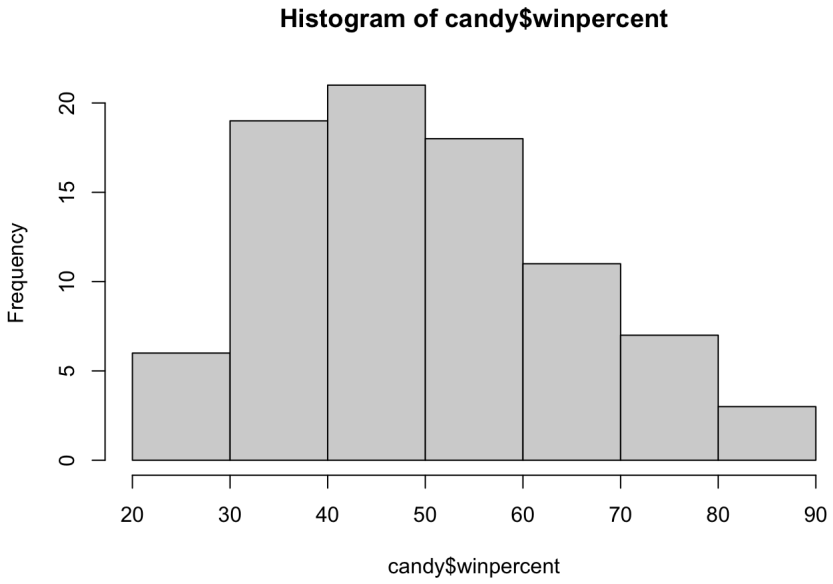
The winpercent variable looks to be on a different scale than the others, all of the statistics in that row are much greater than the rest.

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

A zero means that that particular candy does not contain chocolate, and a 1 means that the candy does contain chocolate.

Q8. Plot a histogram of winpercent values

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



Q9. Is the distribution of winpercent values symmetrical?

No, it is skewed to the right.

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

The center is below 50%

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

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

```
[1] 60.92153
```

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

```
[1] 44.11974
```

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

Q12. Is this difference statistically significant?

```
t.test(chocolate.rank, fruity.rank)
```

```
    Welch Two Sample t-test

data:  chocolate.rank and fruity.rank
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
```

Since the p-value is below 0.05 , the difference between the rankings of fruity and chocolate candy are statistically significant.

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
```

Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, and Jawbusters are the least liked candy types.

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

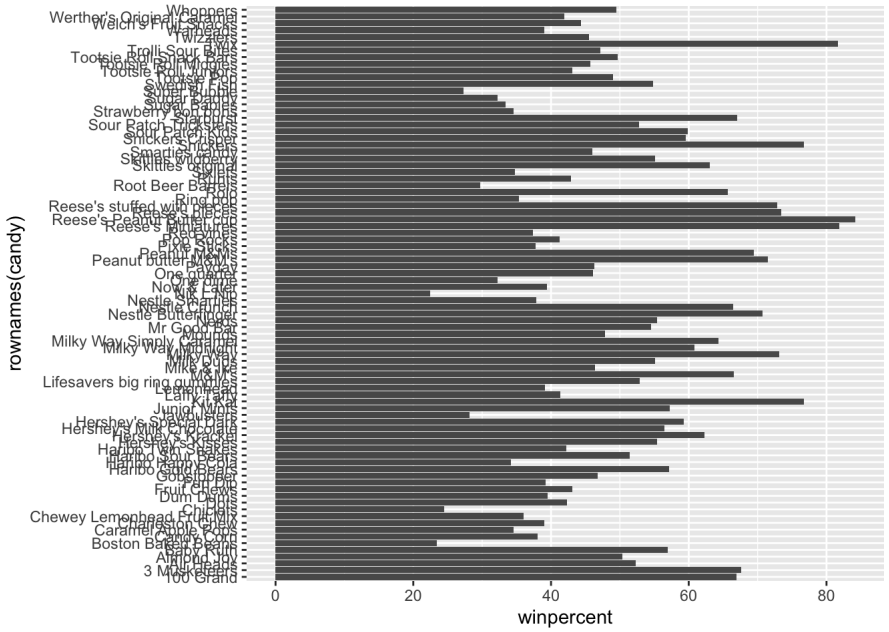
```
tail(candy[order(candy$winpercent),], n=5)
```

```
                        chocolate fruity caramel peanutyalmondy nougat
Snickers                        1      0       1              1      1
Kit Kat                         1      0       0              0      0
Twix                            1      0       1              0      0
Reese's Miniatures              1      0       0              1      0
Reese's 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
Reese's Miniatures                     0    0   0        0        0.034
Reese's 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
Reese's Miniatures             0.279   81.86626
Reese's Peanut Butter cup      0.651   84.18029
```

Snickers, Kit Kat, Twix, Reese's Minis, and Reese's Peanut Butter cup are the most favorite.

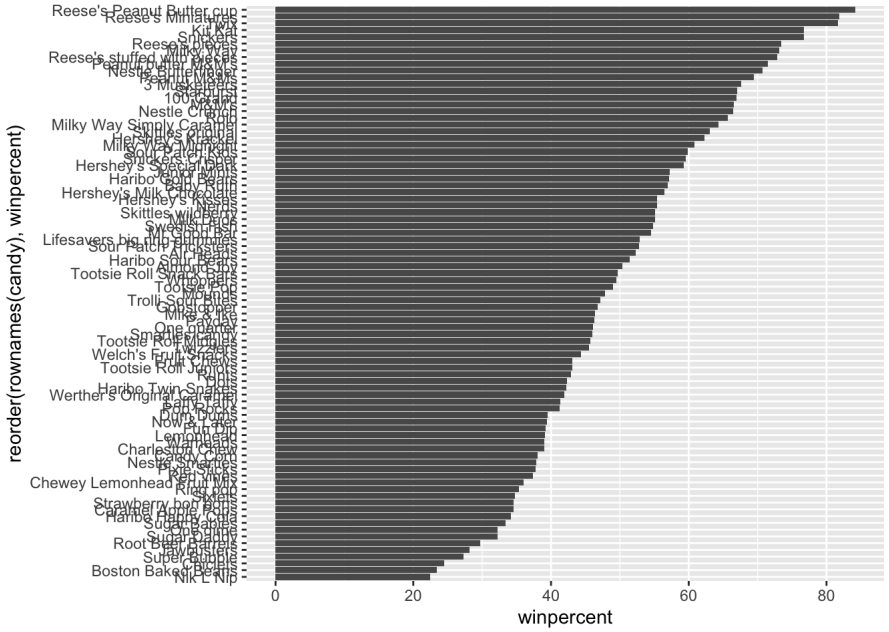
Q15. Make a first barplot of candy ranking based on winpercent values.

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

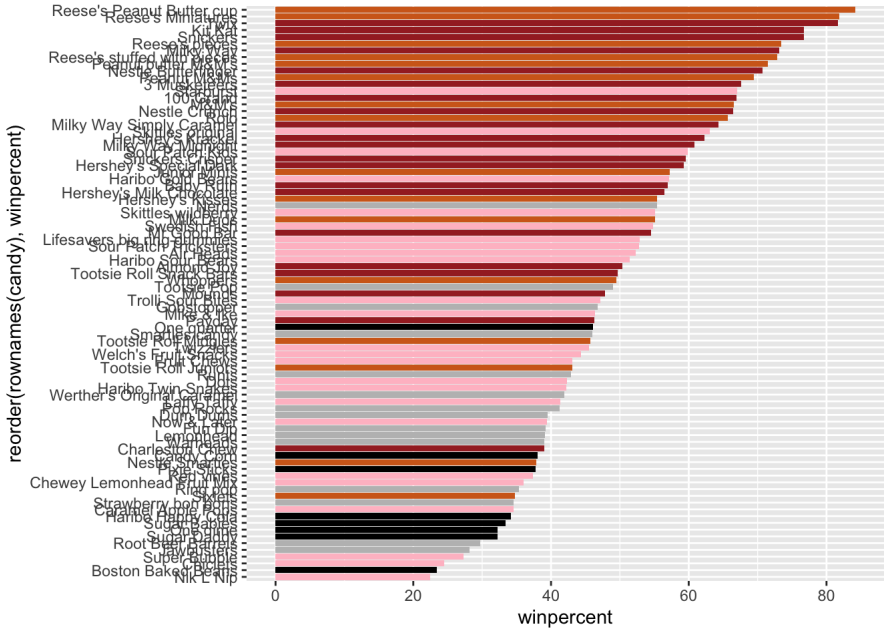


Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

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




```
#select column by candy$___, set as.logical then designate color
my_cols=rep("black", nrow(candy))
my_cols[as.logical(candy$chocolate)] = "chocolate"
my_cols[as.logical(candy$bar)] = "brown"
my_cols[as.logical(candy$fruity)] = "pink"
my_cols[as.logical(candy$hard)]="grey"
#ggplot using set colors
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_col(fill=my_cols)
```



Q17. What is the worst ranked chocolate candy?

Sixlets

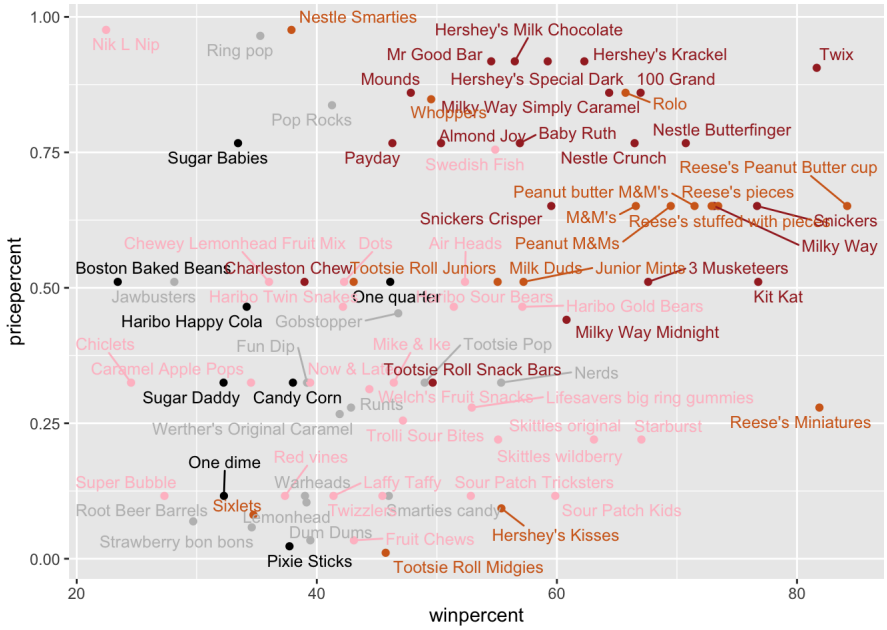
Q18. What is the best ranked fruity candy?

Starburst

4. Taking a look at pricepoint

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?

```
library(ggrepel)

# plot of price vs winpercent
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, size=3.3, max.overlaps = 52)
```



Reese's Miniatures are the best bang for your buck.

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

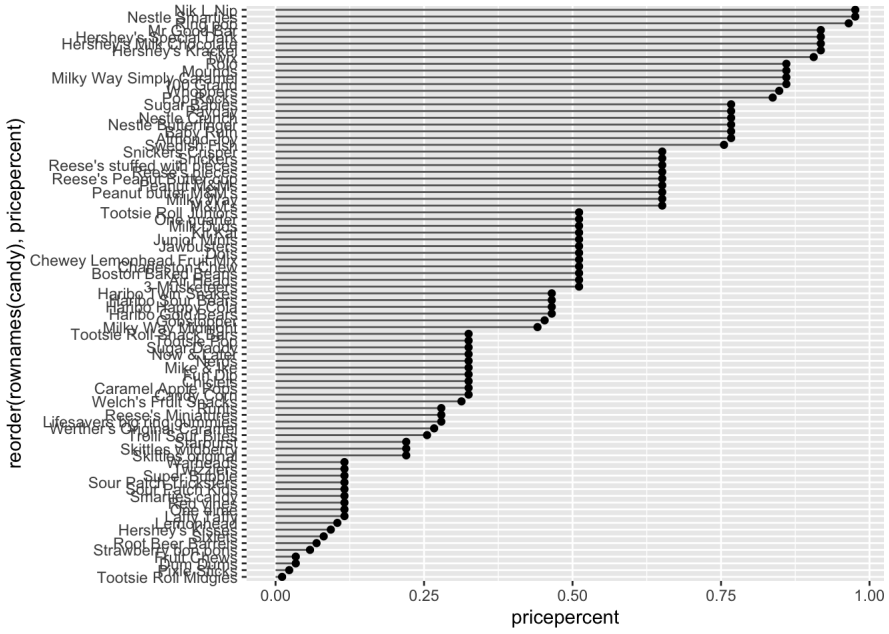
```
ord <- order(candy$pricepercent, decreasing = TRUE)
head( candy[ord,c(11,12)], n=5 )
```

	pricepercent	winpercent
Nik L Nip	0.976	22.44534
Nestle Smarties	0.976	37.88719
Ring pop	0.965	35.29076
Hershey's Krackel	0.918	62.28448
Hershey's Milk Chocolate	0.918	56.49050

The top 5 most expensive candies are Nik L Nip, Nestle Smartiesm Ring popm 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().

```
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_segment(aes(yend = reorder(rownames(candy), pricepercent),
                   xend = 0), col="gray40") +
    geom_point()
```

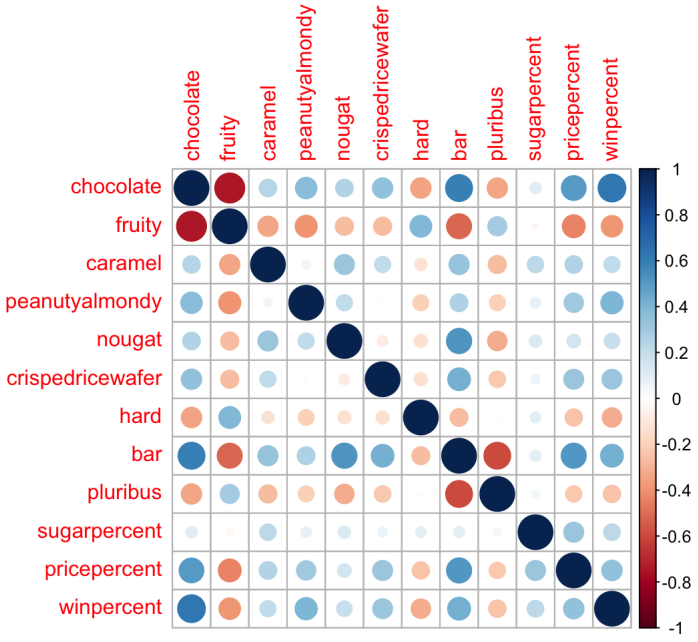


5. Exploring the correlation structure

```
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)?

Chocolate and fruity are anti-correlated.

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

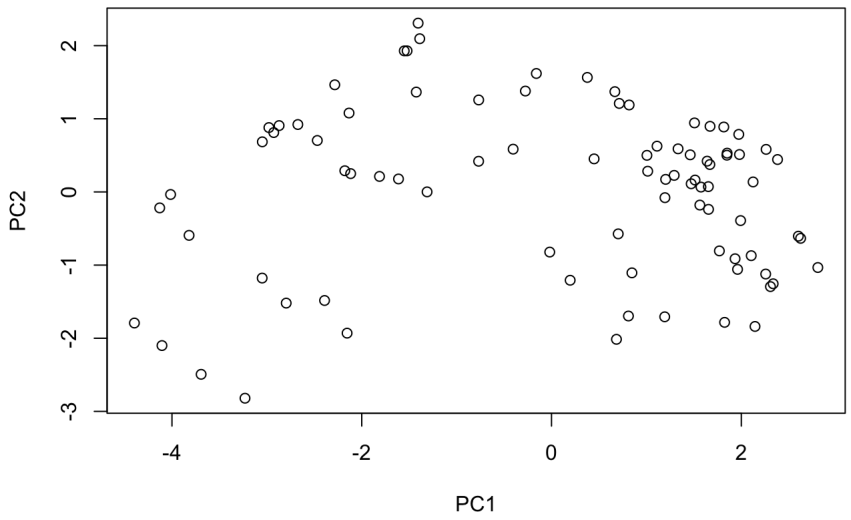
Chocolate and winpercent are the most positively correlated.

6. PCA

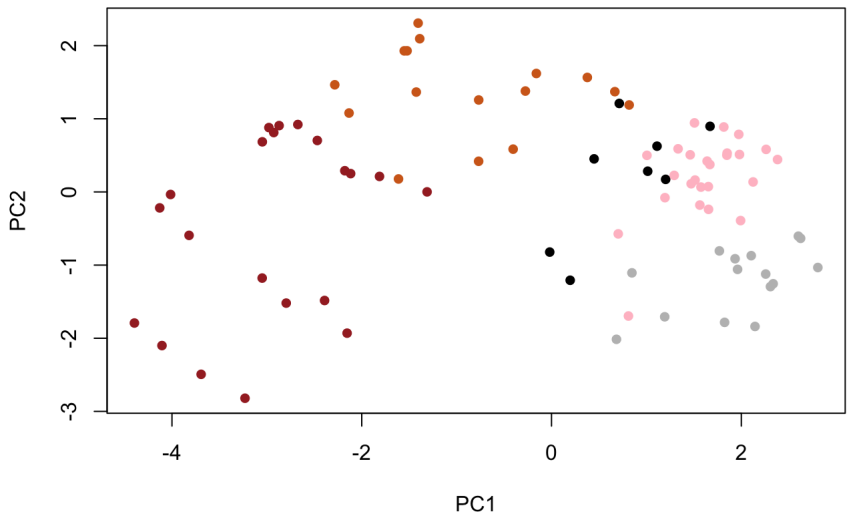
```
pca <- prcomp(candy, scale=TRUE)
summary(pca)
```

```
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$x[,1:2]) #plot of main PCA score of PC1 vs PC2
```

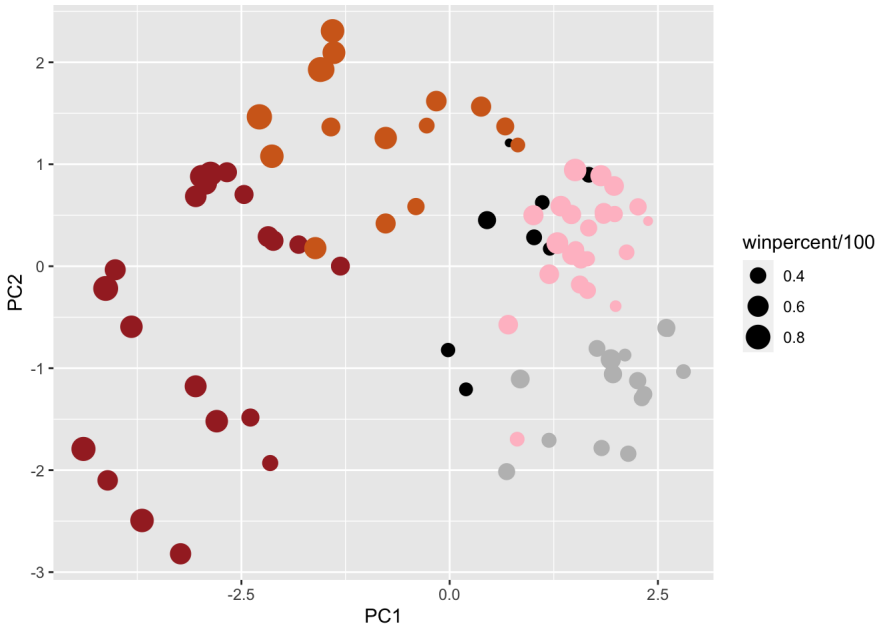



```
plot(pca$x[,1:2], col=my_cols, pch=16)
```

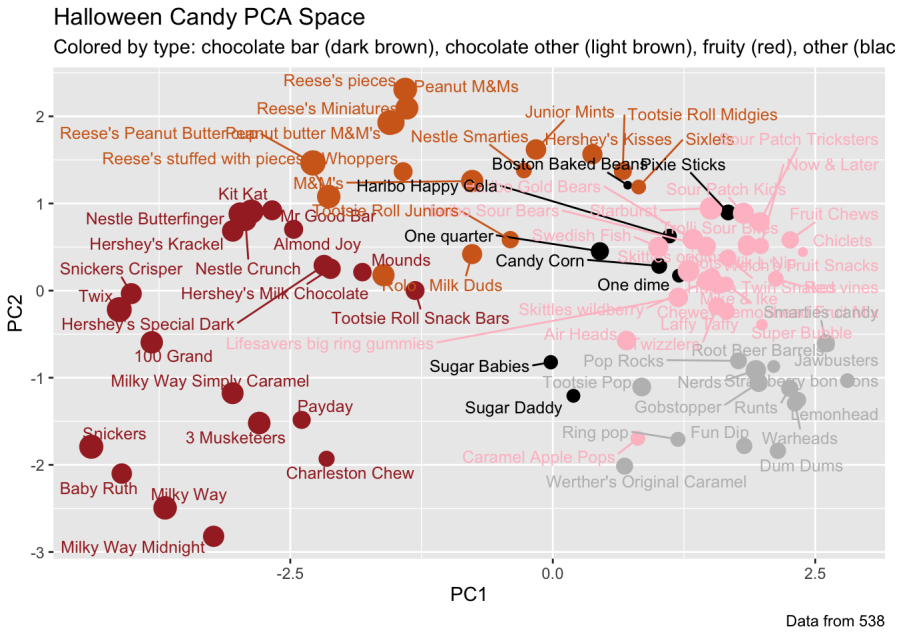


```
#add color and change plotting character
```

```
# 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
```



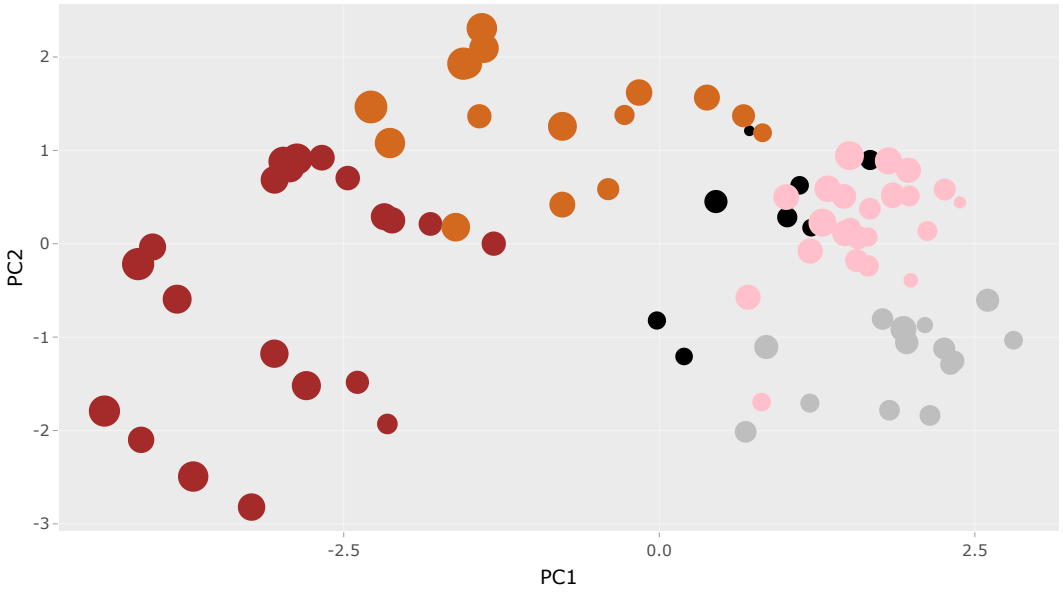

```
library(ggrepel)

p + geom_text_repel(size=3.3, col=my_cols, max.overlaps = 52)  +
  theme(legend.position = "none") +
  labs(title="Halloween Candy PCA Space",
       subtitle="Colored by type: chocolate bar (dark brown), chocolate other (light brown), fruity (red), other (black)",
       caption="Data from 538")
```



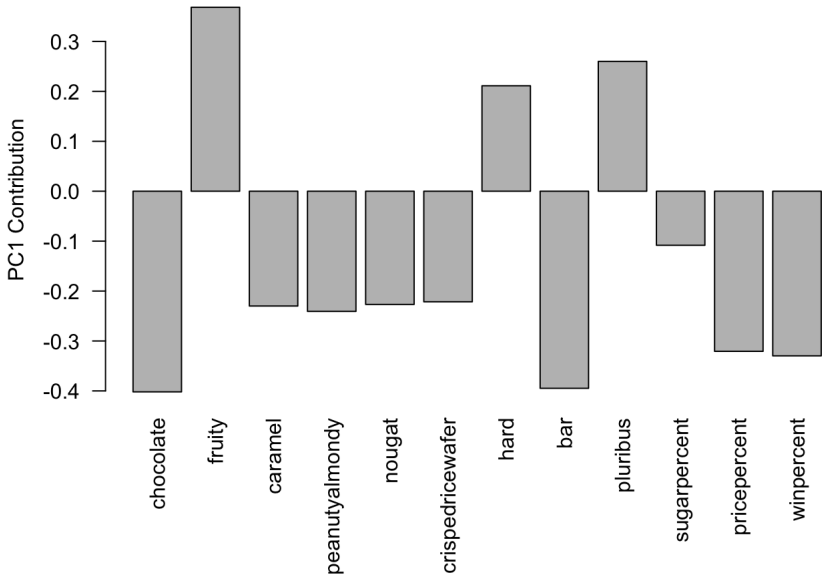
```
library(plotly)
```

```
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?

Fruity, hard, and pluribus are picked up strongly by PC1 in the positive direction. This makes sense because these characteristics show negative correlations with the other variables. On the corrplot, fruity is highly negatively correlated with chocolate and is moderately negatively correlated with several othr variables, such as bar and price. Pluribus is highly negatively correlated with bar and is weakly negatively correlated with most other variables. Hard does not show any negative correlations of high magnitude, but shows small negative coorelations with most other categories in the plot. PCA shows which variables have the highest variance, so this plot shows the variables which have the most negative correlations by placing them on opposite ends of the scale.