Class 9 Halloween Candy

Allen (A16897142)

Table of contents

What is your favorite candy? 2
Exploratory Analysis 2
Overall Candy Rankings 6
Price Percent 11
Correlation Structure 12
Principal Component Analysis 13

We will be using a halloween candy data to see the correlation between structure and principal components of halloween candy.

```
url <- "https://raw.githubusercontent.com/fivethirtyeight/data/master/candy-power-ranking/ca
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
```

1. How many different candy types are in the dataset?

```
dim(candy)
```

```
[1] 85 12
```

There are 85 different candies in this dataset.

2. How many fruity candies are in the dataset?

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

```
[1] 38
```

There are 38 fruity candies.

What is your favorite candy?

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

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

```
[1] 81.64291
```

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

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

```
[1] 76.7686
```

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

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

```
[1] 49.6535
```

Exploratory Analysis

We can use **skimr** to get an overview of a dataset. Espicially if you are looking at a dataset for the first time.

```
library(skimr)
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?

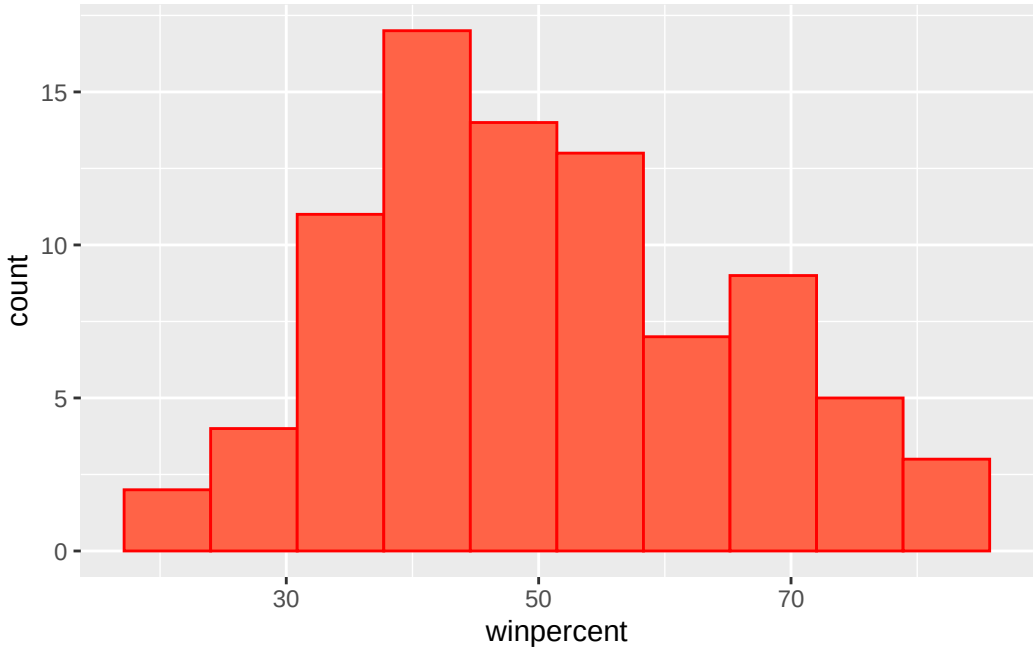
The last column: `candy$winpercent` is a different scale compared to other variables.

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

Zeroes are candies that are not chocolate (false logical) while ones are candies that are chocolate (true logical).

Q8. Plot a histogram of winpercent values

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



Q9. Is the distribution of winpercent values symmetrical?

From the histogram, the distribution of winpercent is not symmetrical.

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

```
summary(candy$winpercent)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  22.45   39.14   47.83   50.32   59.86   84.18 
```

Around 50%, only slightly below (median is 47.83).

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

```
choc.inds <- candy$chocolate == 1
choc.candy <- candy[choc.inds,]
choc.win <- choc.candy$winpercent
mean(choc.win)
```

```
[1] 60.92153
```

```
fruit.inds <- candy$fruity == 1
fruit.candy <- candy[fruit.inds,]
fruit.win <- fruit.candy$winpercent
mean(fruit.win)
```

```
[1] 44.11974
```

The mean of winpercent of chocolate candy is higher, so it is ranked higher than fruit candy.

Q12. Is this difference statistically significant?

```
t.test(choc.win,fruit.win)
```

```
    Welch Two Sample t-test

data:  choc.win and fruit.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
```

With a p-value of 2.871e-08, we reject the null hypothesis, and that there is a significant difference between the winpercents of chocolate candies and fruity candies.

Overall Candy Rankings

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

You can use either `sort()`function to help with sorting the data into high and low. `Order()` will tell you how to rearrange it, the original values place arranged in ascending order.

```
inds <- order(candy$winpercent)
##The 45th candy is the least liked candy
head(candy[inds,],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?

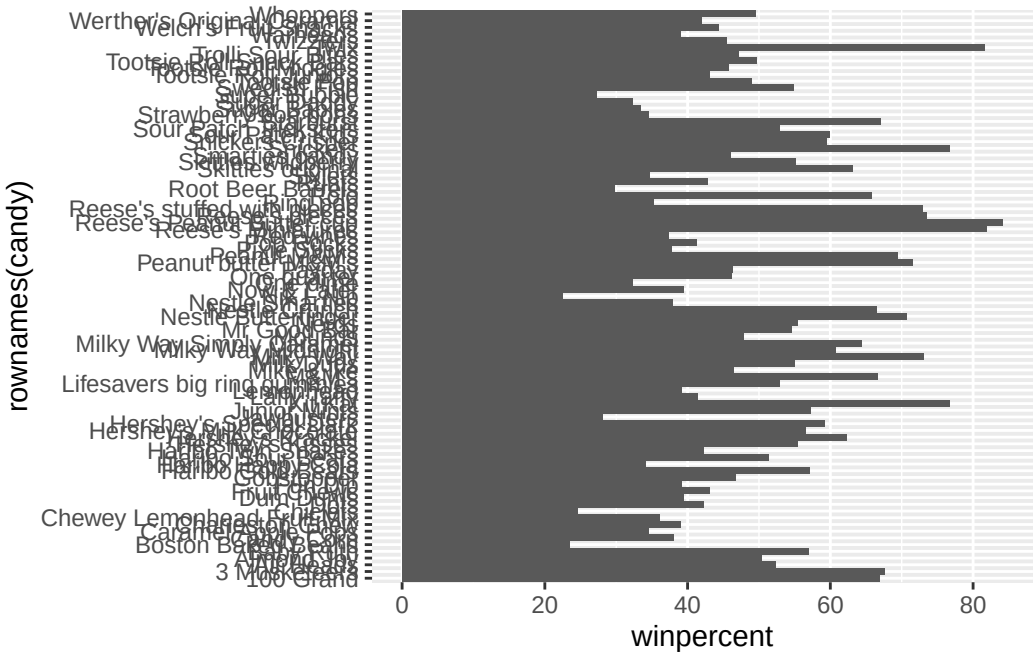
```
inds <- order(candy$winpercent, decreasing=T)
head(candy[inds,],5)
```

```
                        chocolate fruity caramel peanutyalmondy nougat
Reese's Peanut Butter cup         1      0       0              1      0
Reese's 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
```

```
Reese's Peanut Butter cup                0    0    0        0        0.720
Reese's 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
Reese's Peanut Butter cup         0.651   84.18029
Reese's Miniatures                0.279   81.86626
Twix                              0.906   81.64291
Kit Kat                           0.511   76.76860
Snickers                          0.651   76.67378
```

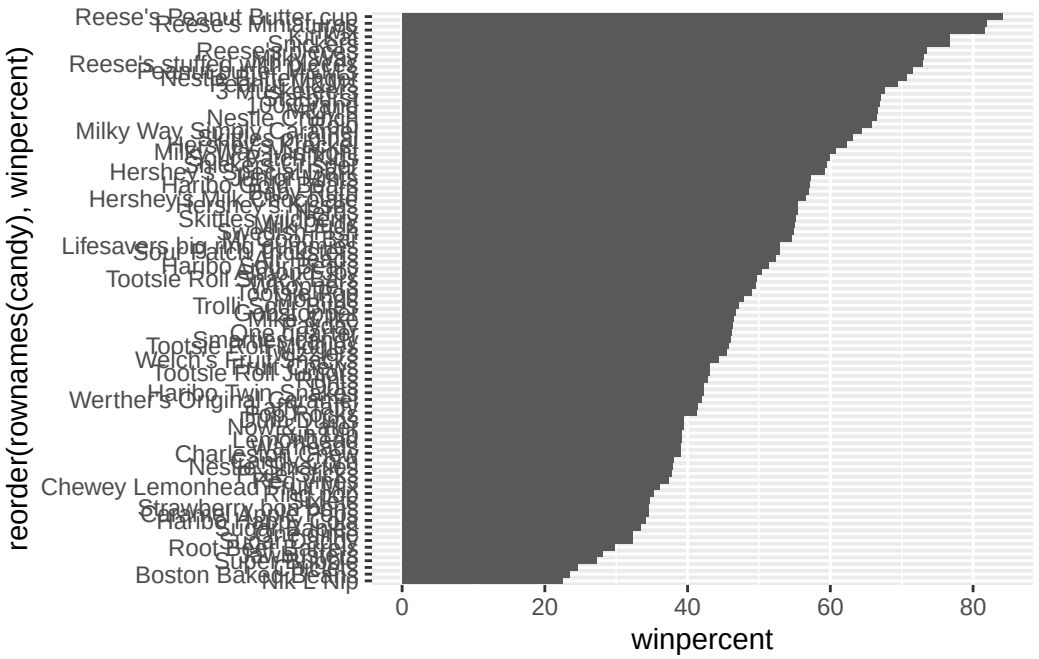
Q15. Make a first barplot of candy ranking based on winpercent values.

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



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

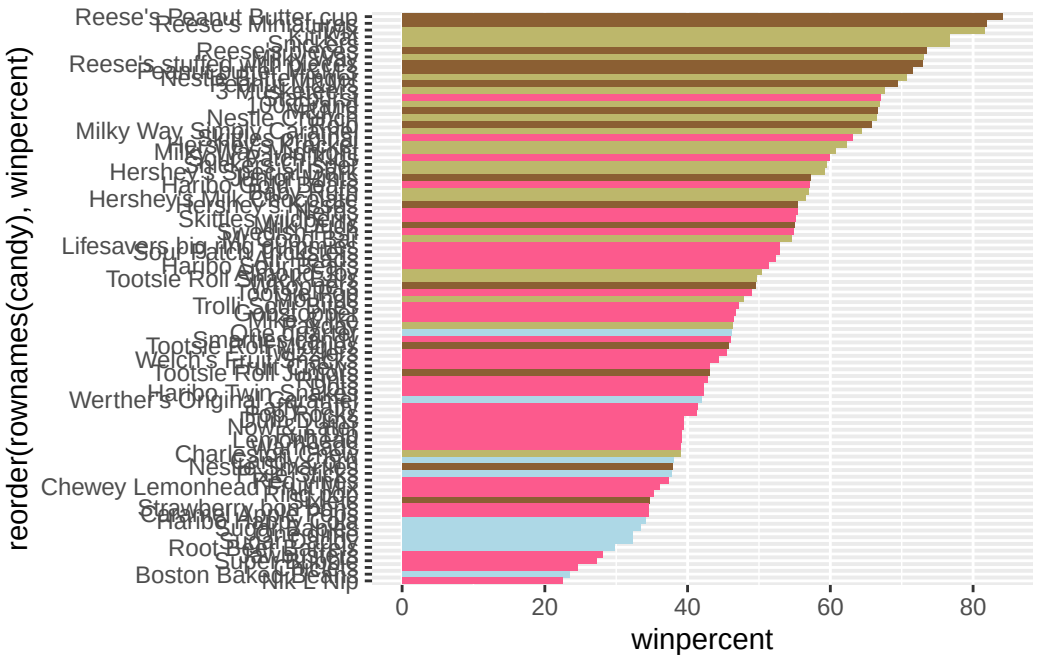
```
ggplot(candy)+
aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_col()
```



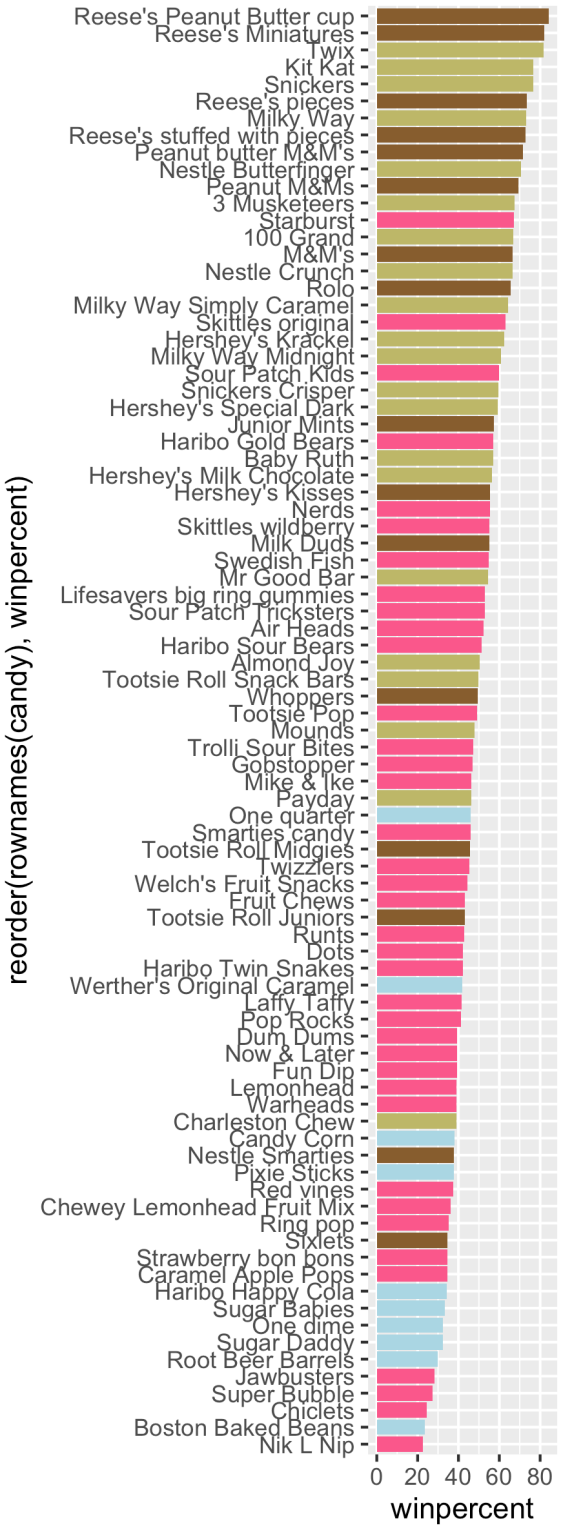
Add some helpful custom color, and add color to help determine the type of candy:

```
mycols <- rep("#ADD8E6",nrow(candy))
mycols[as.logical(candy$chocolate)] = "#8B5F33"
mycols[as.logical(candy$fruity)] = "#FC5A8D"
mycols[as.logical(candy$bar)] = "#BDB76B"

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




```
ggsave("mybarplot.png", width=3, height=8)
```


reorder(rownames(candy), winpercent)
Reese's Peanut Butter cup
Reese's Miniatures
Twix
Kit Kat
Snickers
Reese's pieces
Milky Way
Reese's stuffed with pieces
Peanut butter M&M's
Nestle Butterfinger
Peanut M&Ms
3 Musketeers
Starburst
100 Grand
M&M's
Nestle Crunch
Rolo
Milky Way Simply Caramel
Skittles original
Hershey's Krackel
Milky Way Midnight
Sour Patch Kids
Snickers Crisper
Hershey's Special Dark
Junior Mints
Haribo Gold Bears
Baby Ruth
Hershey's Milk Chocolate
Hershey's Kisses
Nerds
Skittles wildberry
Milk Duds
Swedish Fish
Mr Good Bar
Lifesavers big ring gummies
Sour Patch Tricksters
Air Heads
Haribo Sour Bears
Almond Joy
Tootsie Roll Snack Bars
Whoppers
Tootsie Pop
Mounds
Trolli Sour Bites
Gobstopper
Mike & Ike
Payday
One quarter
Smarties candy
Tootsie Roll Midgies
Twizzlers
Welch's Fruit Snacks
Fruit Chews
Tootsie Roll Juniors
Runts
Dots
Haribo Twin Snakes
Werther's Original Caramel
Laffy Taffy
Pop Rocks
Dum Dums
Now & Later
Fun Dip
Lemonhead
Warheads
Charleston Chew
Candy Corn
Nestle Smarties
Pixie Sticks
Red vines
Chewey Lemonhead Fruit Mix
Ring pop
Sixlets
Strawberry bon bons
Caramel Apple Pops
Haribo Happy Cola
Sugar Babies
One dime
Sugar Daddy
Root Beer Barrels
Jawbusters
Super Bubble
Chiclets
Boston Baked Beans
Nik L Nip
0
20
40
60
80
winpercent

Q17. What is the worst ranked chocolate candy?

Worst ranked chocolate candy is sixlets

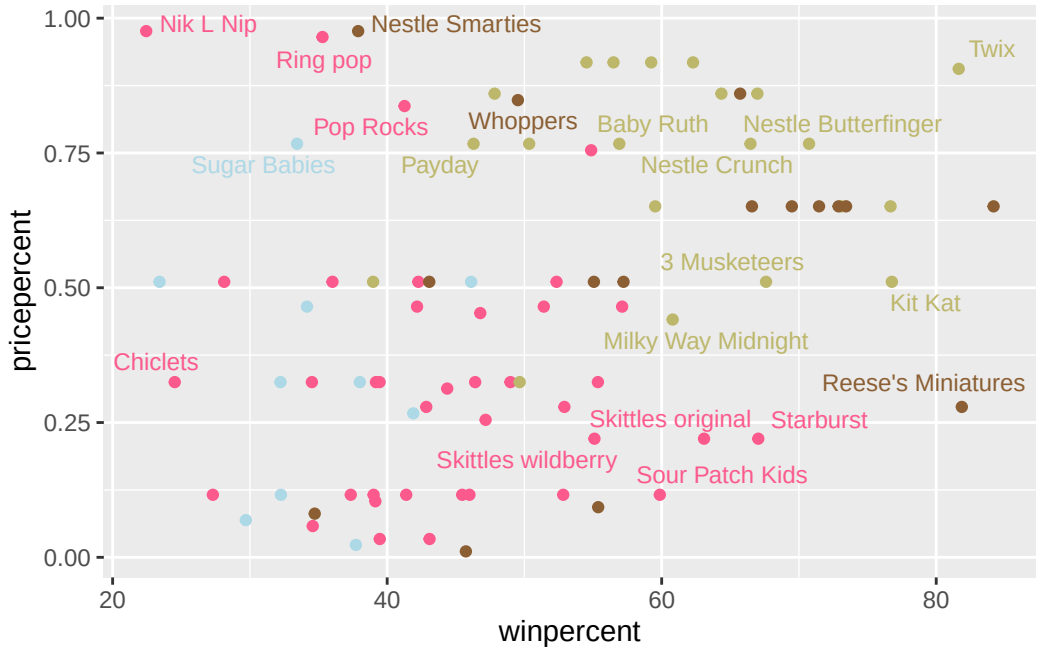
Q18. What is the best ranked fruity candy?

Best ranked fruity candy is starbursts

Price Percent

```
library(ggrepel)
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=mycols) +
  geom_text_repel(col=mycols, size=3.3, max.overlaps = 5)
```

```
Warning: ggrepel: 65 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?

Most bottom right have the highest win percent and lowest price. These are Reece's Minis, Starbursts, Skittles, Sour Patch Kids and Skittles Wildberry

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

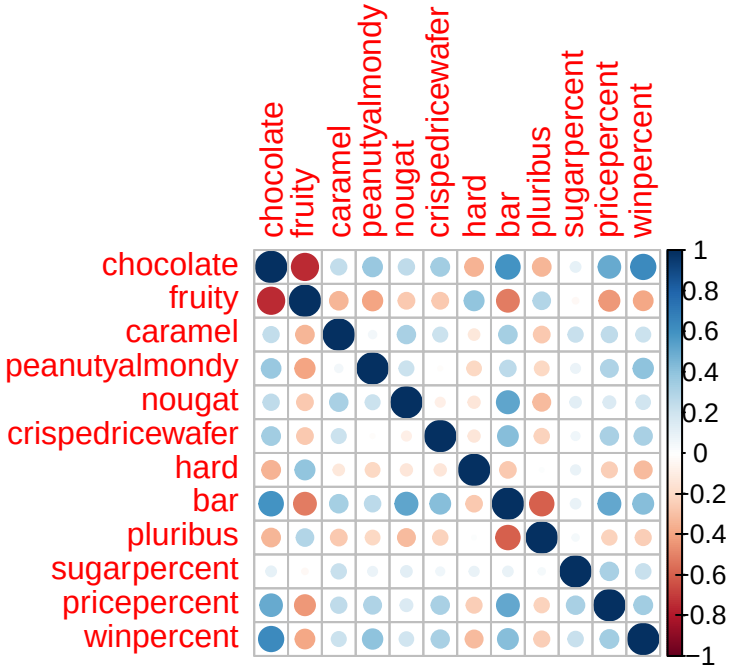
Most top left have the lowest win percent, but the highest price. These are Nik L Nip, Ring Pop, Nestle Smarties (my least favorite), Sugar Babies, and Pop Rocks

Correlation Structure

```
library(corrplot)
```

```
corrplot 0.95 loaded
```

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



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

Fruity and Candy are the most anti-correlated. A value of -0.74. Closest to negative 1.

```
cij["chocolate","fruity"]
```

```
[1] -0.7417211
```

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

Most correlated (aside from each other) is chocolate and bar (0.6) as well as chocolate and winpercent (0.64), meaning that chocolate candies are more popular.

```
cij["chocolate","bar"]
```

```
[1] 0.5974211
```

```
cij["chocolate","winpercent"]
```

```
[1] 0.6365167
```

Principal Component Analysis

Time to scale our data `candy`.

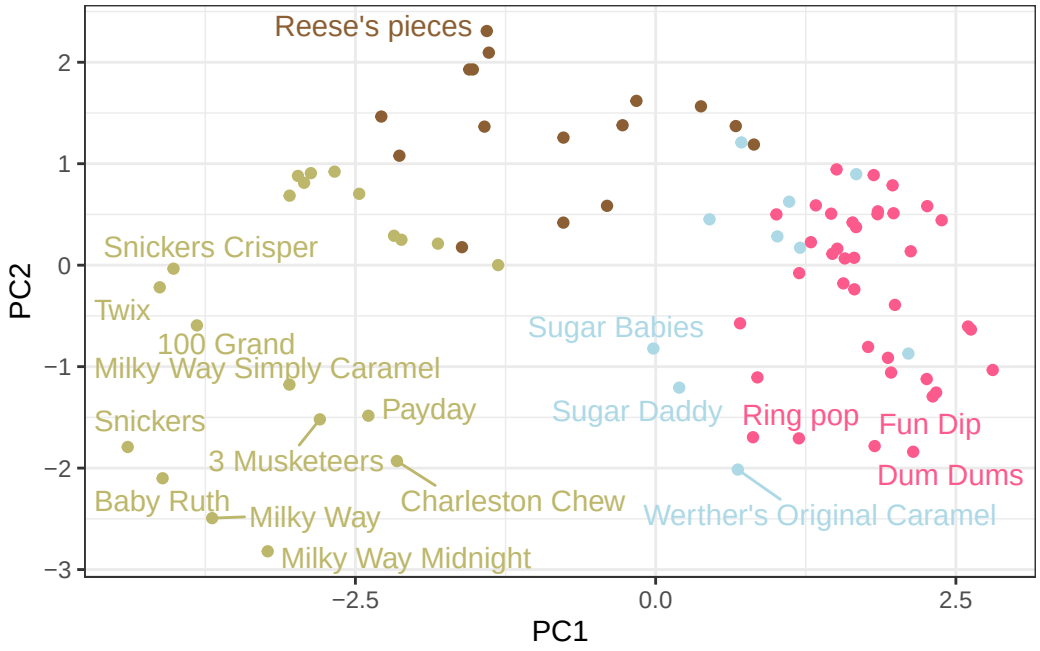
```
pca <- prcomp(candy,scale=T)
summary(pca)
```

```
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
```

First result is the PCA plot:

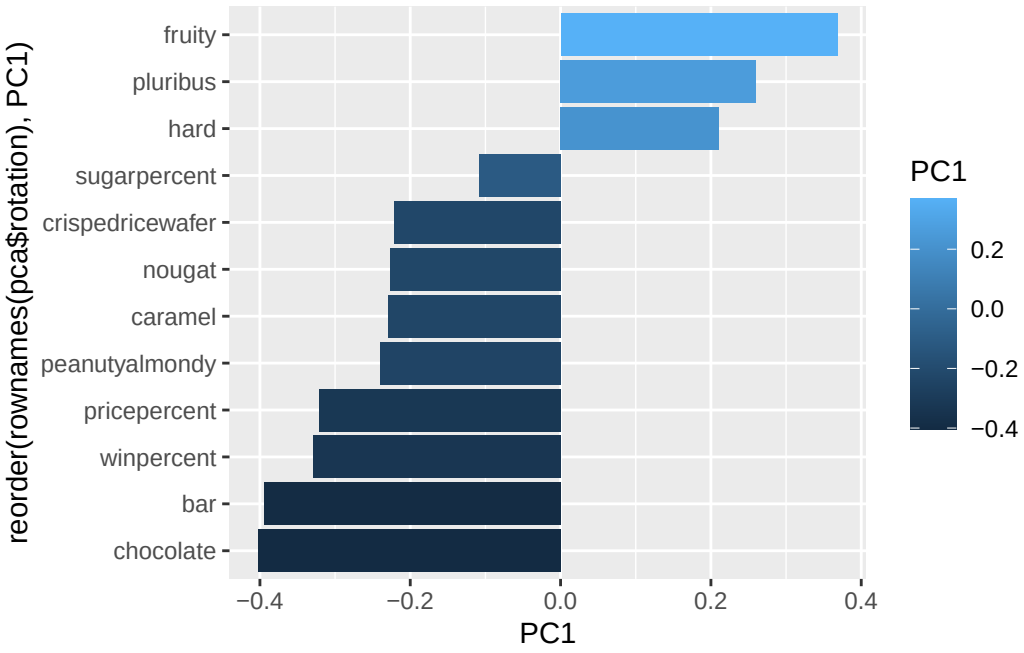
```
library(ggrepel)
ggplot(pca$x)+
  aes(PC1,PC2, label=rownames(pca$x))+
  geom_point(col=mycols)+
  geom_text_repel(max.overlaps = 6, col=mycols)+
  theme_bw()
```

```
Warning: ggrepel: 67 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



The second main PCA results is the `pca$rotation` plot. We plot this to make a "loadings" plot.

```
ggplot(pca$rotation)+
  aes(PC1, reorder(rownames(pca$rotation),PC1), fill=PC1)+
  geom_col()
```



Q24. What original variables are picked up strongly by PC1 in the positive direction? Do these make sense to you?

This plot shows that fruity, hard and pluribus contribute to PCA1 in the positive direction. This shows they are correlated together, so that makes sense that they are picked up strongly in the positive direction.