class09:Halloween Mini-Project

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Here we analyze a candy dataset form the 538 website. This is a CSV file from their GitHub repository.

Importing 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
```

Data Exploration

> Q1. How many different candy types are in this dataset?

```
nrow(candy)
```

```
[1] 85
```

There are 85 different types of candy in this data set.

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

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

```
[1] 38
```

There are 38 candies that are labeled as fruity in the data set.

Whats your favorite Candy

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

```
candy["Reese's Peanut Butter cup",]$winpercent
```

```
[1] 84.18029
```

My favorate, Reese's peanut butter cups have a win percentage of 84.18%.

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

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

```
[1] 76.7686
```

The win percent for kit kat is 76.76%

> Q5. What is the winpercent value for "Tootsie Roll Snack Bars"?

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

```
[1] 49.6535
```

The win percent for the tootsie roll is 49.65%.

> What is the least liked candy in the dataset - lowest winpercent?

```
inds <- order(candy$winpercent)
head(candy[inds,])
```

```
                   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
Root Beer Barrels          0      0       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
Root Beer Barrels                 0    1   0        1        0.732        0.069
                   winpercent
Nik L Nip            22.44534
Boston Baked Beans   23.41782
Chiclets             24.52499
Super Bubble         27.30386
Jawbusters           28.12744
Root Beer Barrels    29.70369
```

The least liked candy is the Nik L Nip with a win percent of 22.44%.

```
library("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?

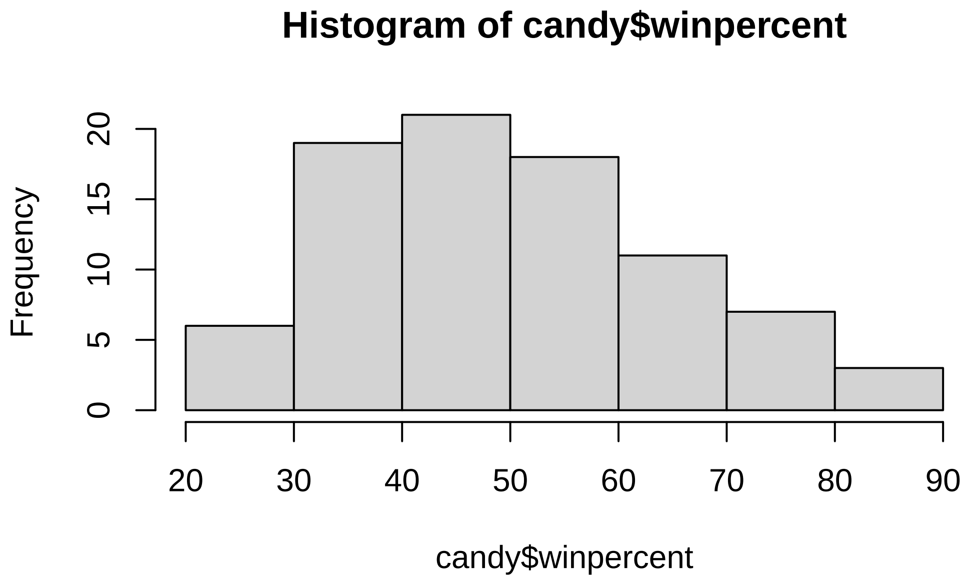
The winpercent column is not in the range of 0 to 1 unlike the other columns.

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

The 1 and 0 represents if the candy is chocolate(1) or not(0).

> Q8. Plot a histogram of winpercent values

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



Q9. Is the distribution of winpercent values symmetrical?

No, the histogram is skewed.

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

The center of distribution is below 50%.

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

```
#using candy$winpercent to find all the winpercent values & taking the mean of those value
choco.mean <- mean(candy$winpercent[as.logical(candy$chocolate)])

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

choco.mean
```

```
[1] 60.92153
```

```
fruity.mean
```

```
[1] 44.11974
```

On average, choclate candy has a higher ranking than fruity candies as chocolate ranks at 60.9% and fruity at 44.1%.

> Q12. Is this difference statistically significant?

```r
t.test(candy$winpercent[as.logical(candy$chocolate)],
       candy$winpercent[as.logical(candy$fruity)] )
```

```

	Welch Two Sample t-test

data:  candy$winpercent[as.logical(candy$chocolate)] and candy$winpercent[as.logical(candy$fr
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 
```

Yes, the p.value of the t-test is smaller than 0.05 which means the null is rejected and the means are statistically significant.

Overall Candy Rankings

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

```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
```

The five least liked 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?

```r
head(candy[order(candy$winpercent,decreasing = T),], n=5)
```

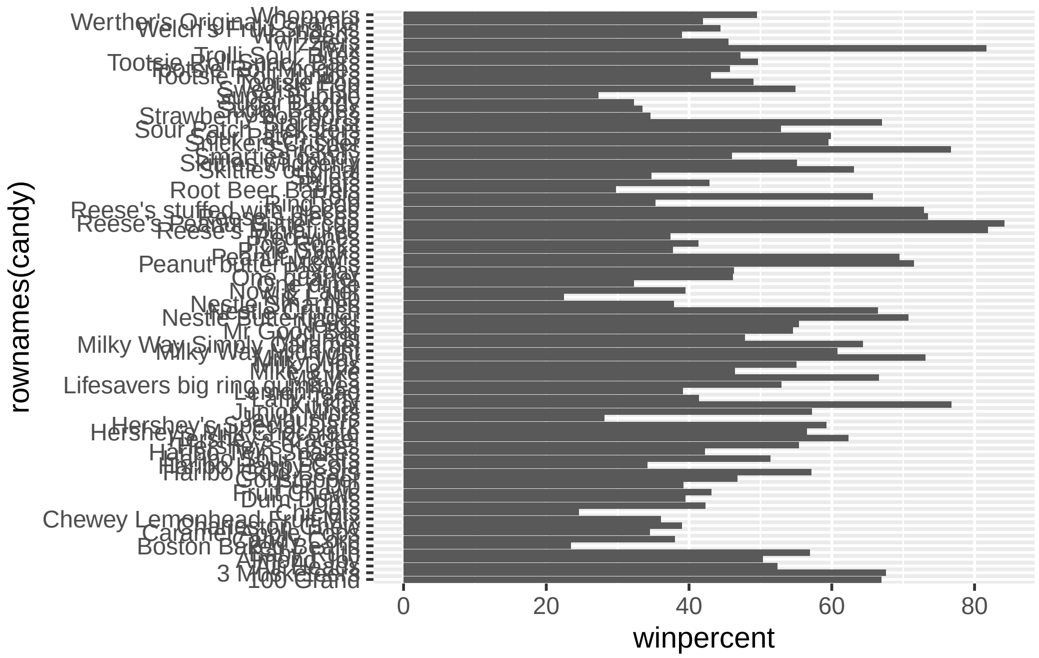
```
                          chocolate fruity caramel peanutyalmondy nougat
Reese's Peanut Butter cup         1      0       0              1      0
Reese's Miniatures                1      0       0              1      0
Twix                              1      0       1              0      0
Kit Kat                           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
```

The top 5 most liked candies are Reese’s Peanut butter cups, reese’s miniatures, Twix, Kit Kats and snickers.

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

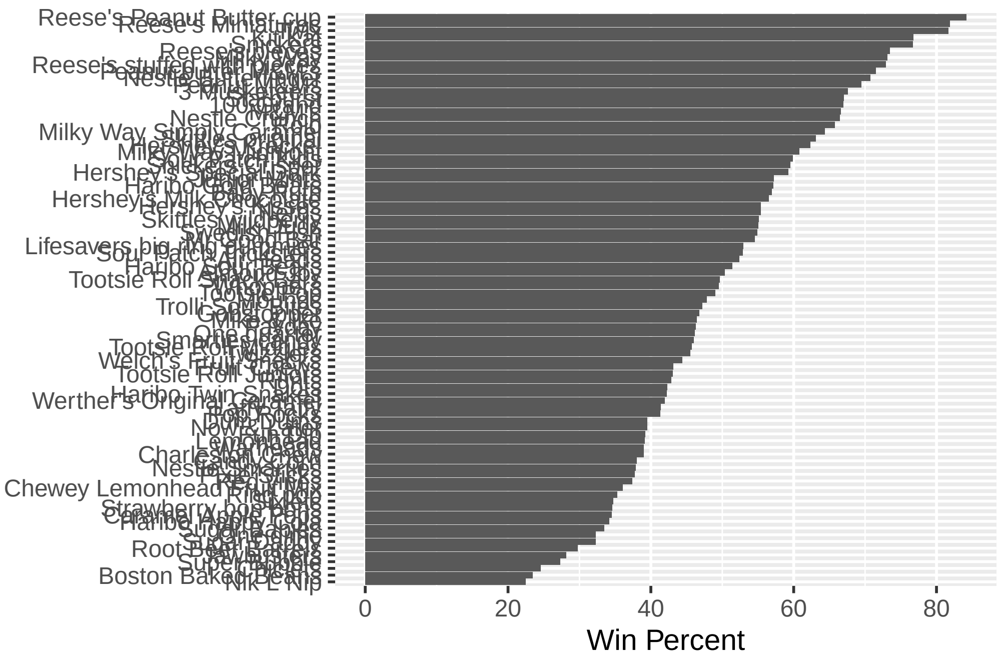
```r
library(ggplot2)

ggplot(candy, aes(x= winpercent, y= rownames(candy))) +
  geom_col()
```

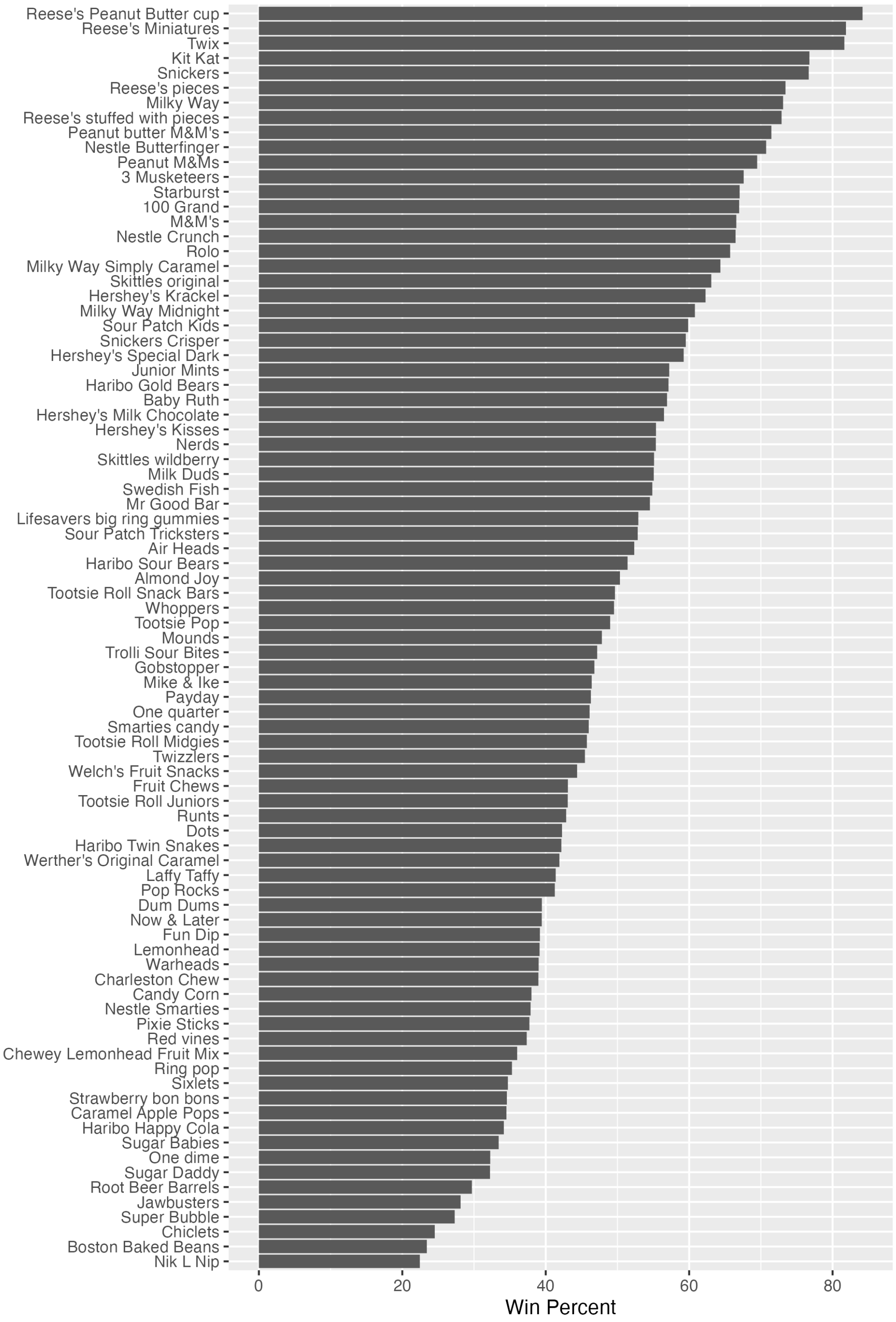


Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

```r
# `reorder` is changing the rowname order in accordance with the winpercent as it is the y
ggplot(candy, aes(winpercent, reorder(rownames(candy),winpercent)))+
  geom_col() +
  labs(x="Win Percent", y= "")
```



```
#to fix the aspect ratio saving it can allow to manually set the ratio to the 7 by 10
ggsave('barplot1.png', width = 7, height = 10)
```


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
Win Percent

You

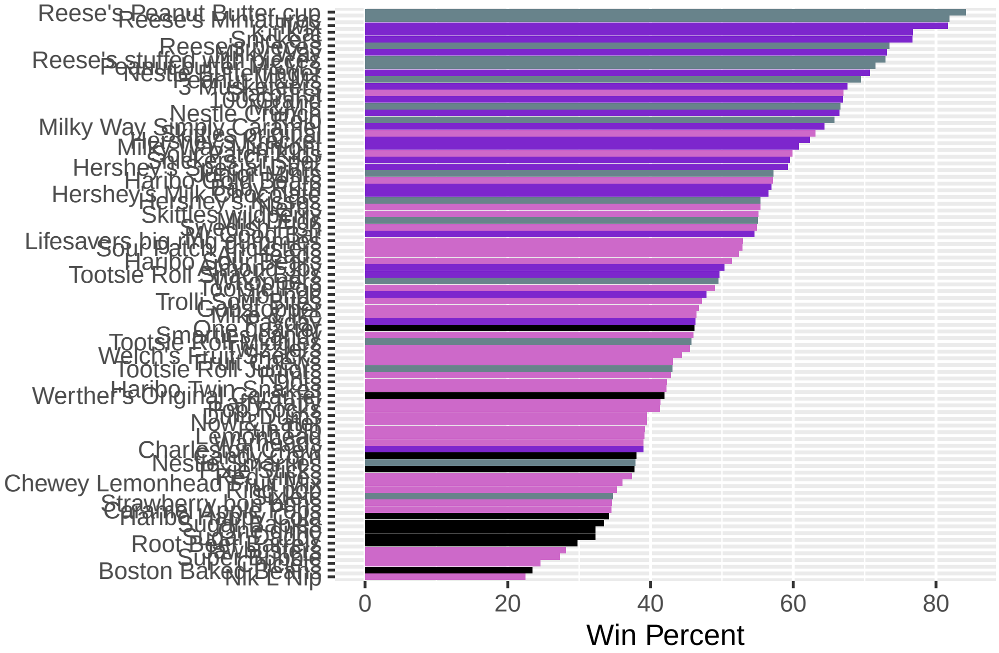
can insert any image using the exclamation mark w/ square braket markdown syntax

Time for Color

We need a custom color vector to add color to our ggplot.

```
#setting the vector to be as long as all rows
my_cols <- rep("black", nrow(candy))
# using the as logical to assign true and false & assign chocolate color to the trues
my_cols[as.logical(candy$chocolate)] = "lightblue4"
my_cols[as.logical(candy$bar)] = "purple3"
my_cols[as.logical(candy$fruity)] = "orchid3"
```

```
ggplot(candy, aes(winpercent, reorder(rownames(candy),winpercent)))+
  geom_col(fill = my_cols) +
  labs(x="Win Percent", y= "")
```



Q17. What is the worst ranked chocolate candy?

Sixlets are the worst ranked chocolate candy.

Q18. What is the best ranked fruity candy?

Starburst are the best ranked fruity candy.

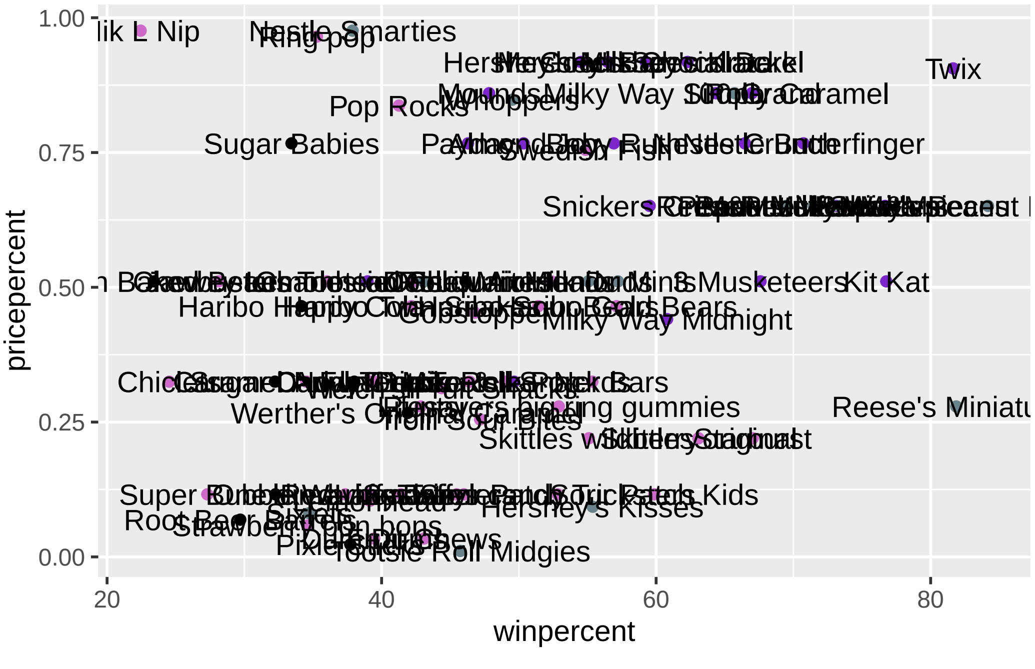
Price Percent

```
candy$pricepercent
```

```
 [1] 0.860 0.511 0.116 0.511 0.511 0.767 0.767 0.511 0.325 0.325 0.511 0.511
[13] 0.325 0.511 0.034 0.034 0.325 0.453 0.465 0.465 0.465 0.465 0.093 0.918
[25] 0.918 0.918 0.511 0.511 0.511 0.116 0.104 0.279 0.651 0.651 0.325 0.511
[37] 0.651 0.441 0.860 0.860 0.918 0.325 0.767 0.767 0.976 0.325 0.767 0.651
[49] 0.023 0.837 0.116 0.279 0.651 0.651 0.651 0.965 0.860 0.069 0.279 0.081
[61] 0.220 0.220 0.976 0.116 0.651 0.651 0.116 0.116 0.220 0.058 0.767 0.325
[73] 0.116 0.755 0.325 0.511 0.011 0.325 0.255 0.906 0.116 0.116 0.313 0.267
[85] 0.848
```

If we want to see what is a good candy to buy in terms of winpercent and pricepercent, we can plot the two varaibles and then see the best candy for the least amount of money.

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

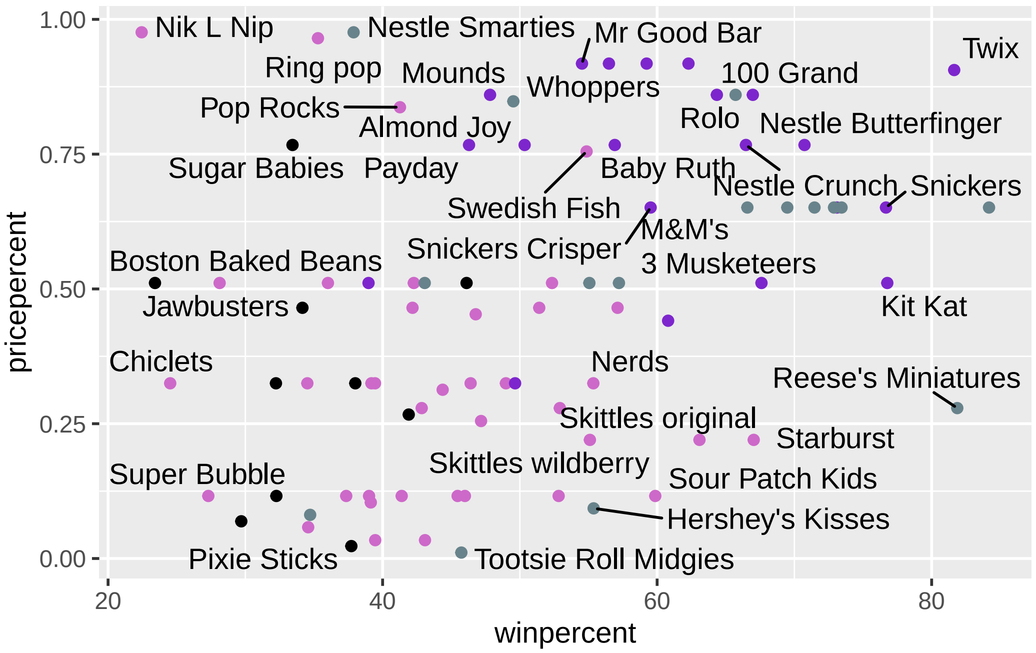


To avoid the overplotting of all these labels, we can use an add on package called ggrepl

```r
library(ggrepel)

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

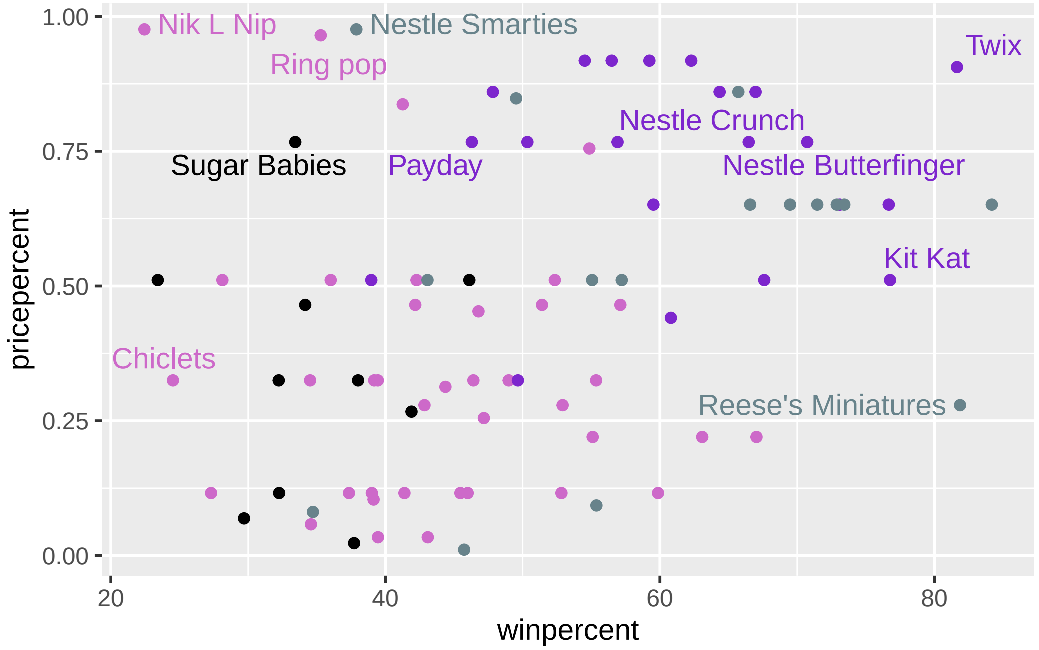
```
Warning: ggrepel: 50 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Play with max.overlaps parameter in `geom_text_repel()`

```r
ggplot(candy, aes(winpercent, pricepercent, label=rownames(candy))) +
  geom_point(col = my_cols) +
  geom_text_repel(max.overlaps = 5, col=my_cols)
```

```
Warning: ggrepel: 74 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?

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

```
                          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
```

Reese's minis have the second highest winrate of 81.86% with a pricepercent of 0.279, making it the best ranked and most economical.

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

```
ord_price <- order(candy$pricepercent, decreasing = TRUE)
head( candy[ord_price,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
```

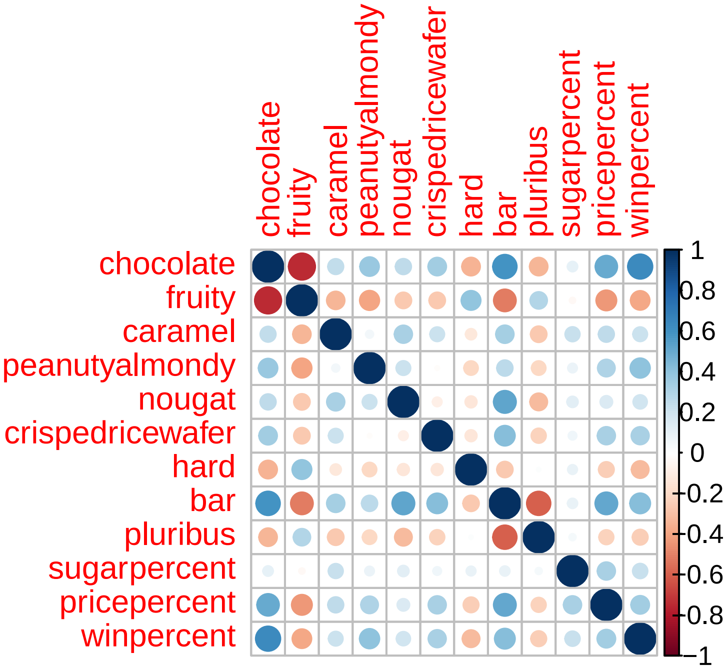
The top 5 are Nik L Nip, Nestle Smarties, Ring Pops, Hershey's krackel, Hershey's milk chocolate with the least popular as Nik L Nip.

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)?

Fruity and chocolate values are anti-correlated with each other since the circle is large and dark red. It is unlikely that fruit and chocolate are together.

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

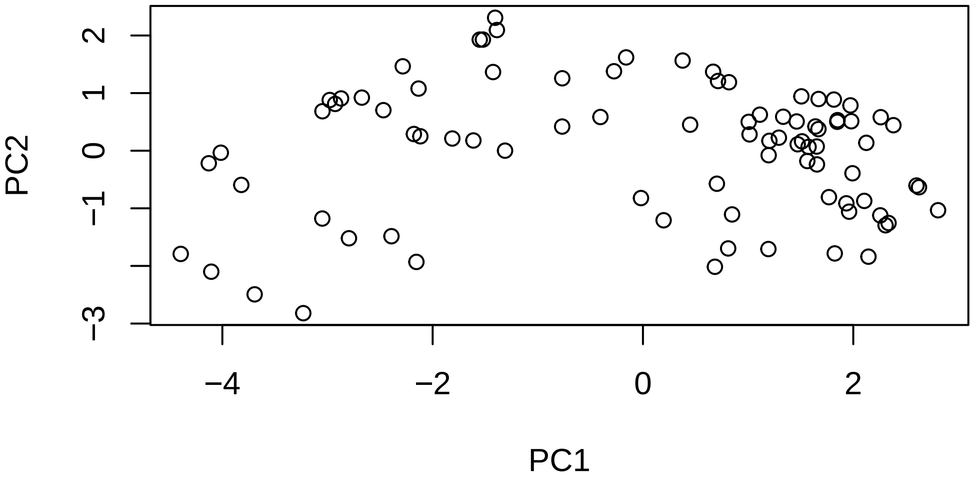
Other than a variable against itself, the winpercent and chocolate variables are highly correlated with a large size and dark blue color.

6 PCA

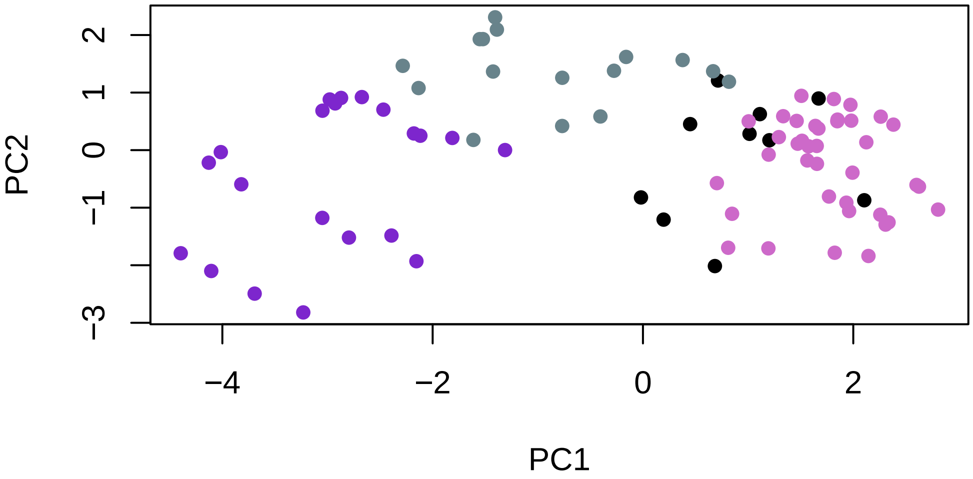
```
pca <- prcomp(candy, scale=TRUE)
summary(pca)
```

```
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])
```



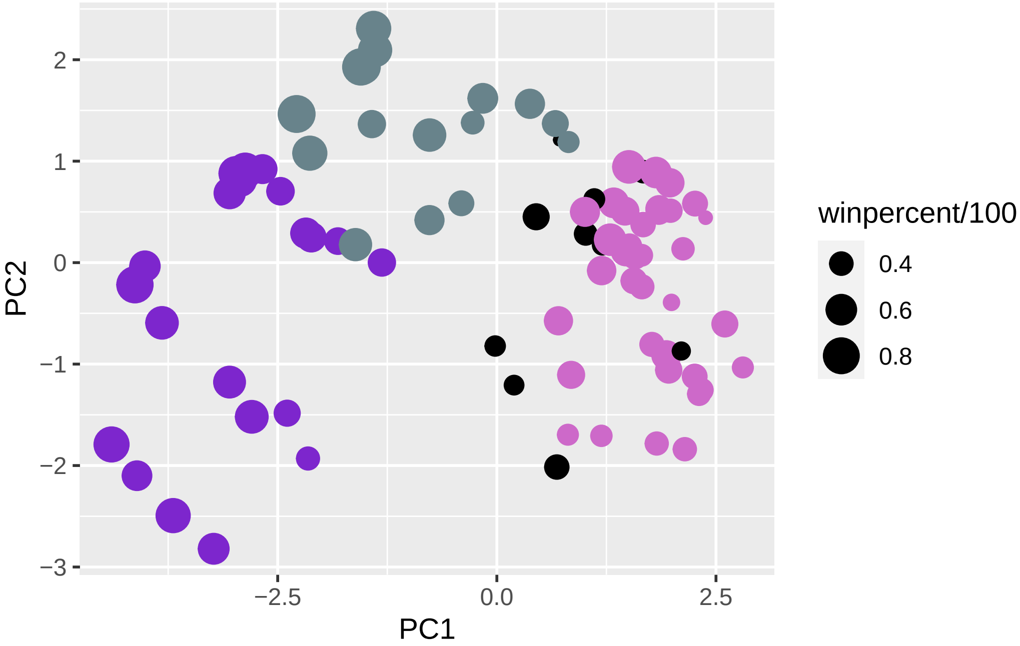
```
plot(pca$x[,1:2], col=my_cols, pch=16)
```



```r
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])
```

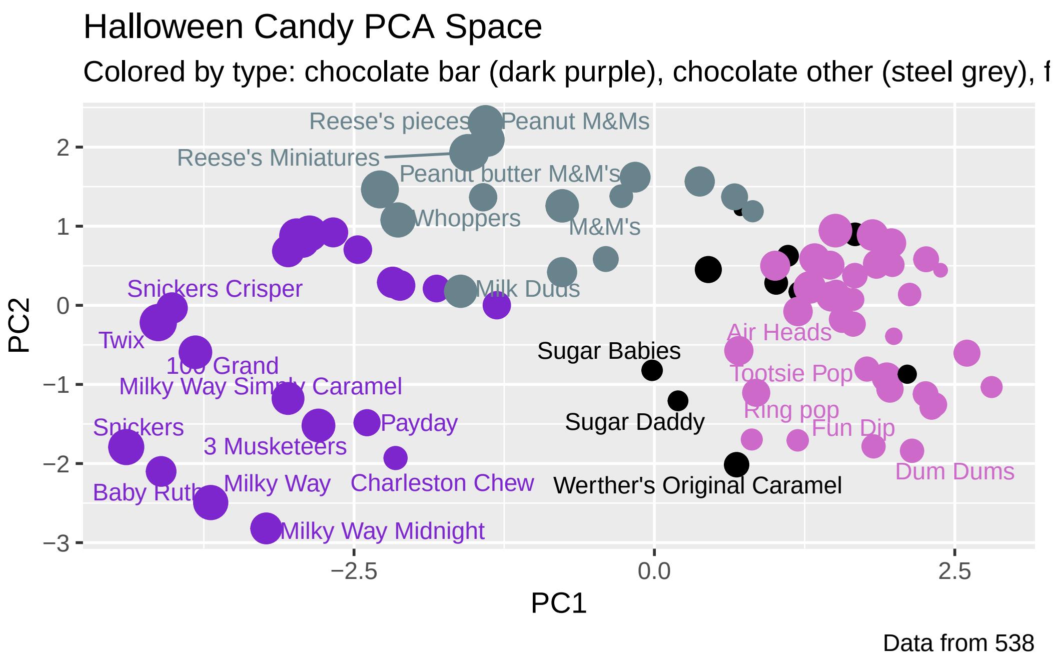
```r
#set the size to show the win percentage
p <- ggplot(my_data) +
        aes(x=PC1, y=PC2,
            size=winpercent/100,
            text=rownames(my_data),
            label=rownames(my_data)) +
        geom_point(col=my_cols)

p
```



```r
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 purple), chocolate other (steel grey
       caption="Data from 538")
```

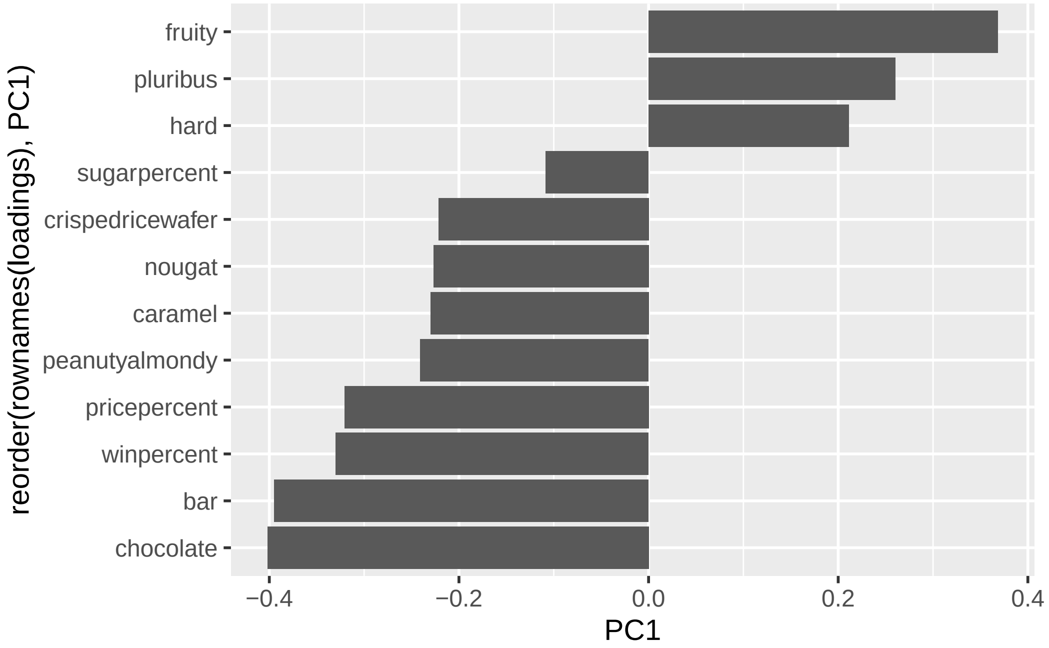
```
Warning: ggrepel: 59 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



##loadings plot

```
loadings <- as.data.frame(pca$rotation)

ggplot(loadings, aes(PC1, reorder(rownames(loadings), PC1))) +
  geom_col()
```



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

Fruity, hard and pluribus variables are picked up in the positive PC1 direction. This makes sense because it echos what we found and what we know about candy correlations. Fruity candies are more likely to come with many like starburts or skittles and are more likely to be hard. It also makes sense they are in the opposite direction of chocolate and chocolate associated factors like nougat.