Class 9: Halloween Candy Mini-Project

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

Date Import

```
candy_file <- "candy-data.csv"

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
```

Q1. How many different candy types are in this dataset? 85 different candy types

```
nrow(candy)
```

```
[1] 85
```

Q2. How many fruity candy types are in the dataset? There are 38 fruity candy types

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

```
[1] 38
```

Data Exploration

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

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

```
[1] 76.67378
```

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
```

```
x <- c(5, 3, 4, 1)
sort(x)
```

```
[1] 1 3 4 5
```

```
order(x)
```

```
[1] 4 2 3 1
```

```
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
```

```
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

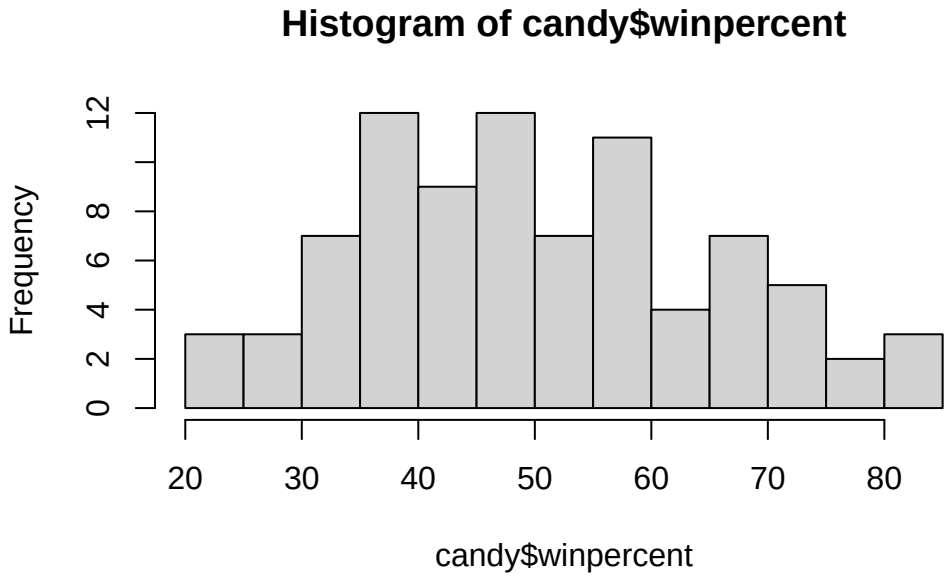
skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
chocolate	0	1	0.44	0.50	0.00	0.00	0.00	1.00	1.00	
fruity	0	1	0.45	0.50	0.00	0.00	0.00	1.00	1.00	
caramel	0	1	0.16	0.37	0.00	0.00	0.00	0.00	1.00	
peanutyalmondy	0	1	0.16	0.37	0.00	0.00	0.00	0.00	1.00	
nougat	0	1	0.08	0.28	0.00	0.00	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? sugarpercent,pricepercent, winpercent

Q7. What do you think a zero and one represent for the candy$chocolate column? I think it represents whether or not the candy contains chocolate

Q8. Plot a histogram of winpercent values

```
hist(candy$winpercent, breaks = 20)
```



Q9. Is the distribution of winpercent values symmetrical? No.

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

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

First find all chocolate candy and their $winpercent values Next summarize these values into one number Then do the same for fruit candy and compare the numbers

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

```
[1] 60.92153
```

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

```
[1] 44.11974
```

```
#Find all chocolate candy and their $winpercent values
choc <- candy$winpercent[candy$chocolate ==1]
# Summarize these values into one number
mean(choc)
```

```
[1] 60.92153
```

```
#Do the same for fruit candy and compare the numbers
fruit <- candy$winpercent[candy$fruity ==1]
mean(fruit)
```

```
[1] 44.11974
```

Q12. Is this difference statistically significant? Yes, this difference is statistically significant.

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

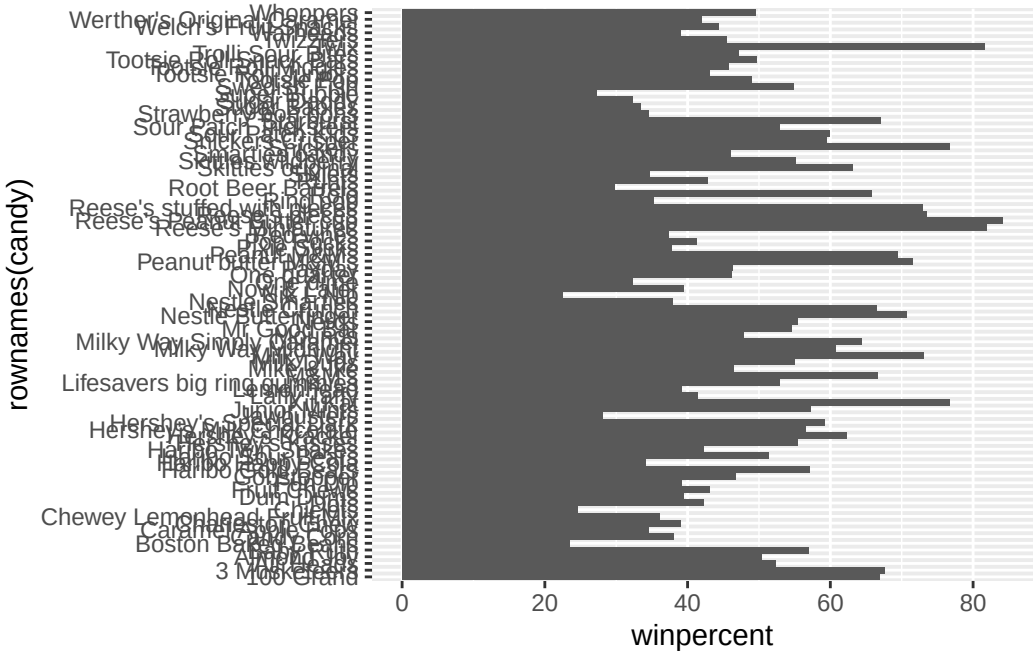
```
    Welch Two Sample t-test

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
```

Overall Candy Rankings

Q13. What are the five least liked candy types in this set? Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, Jawbusters

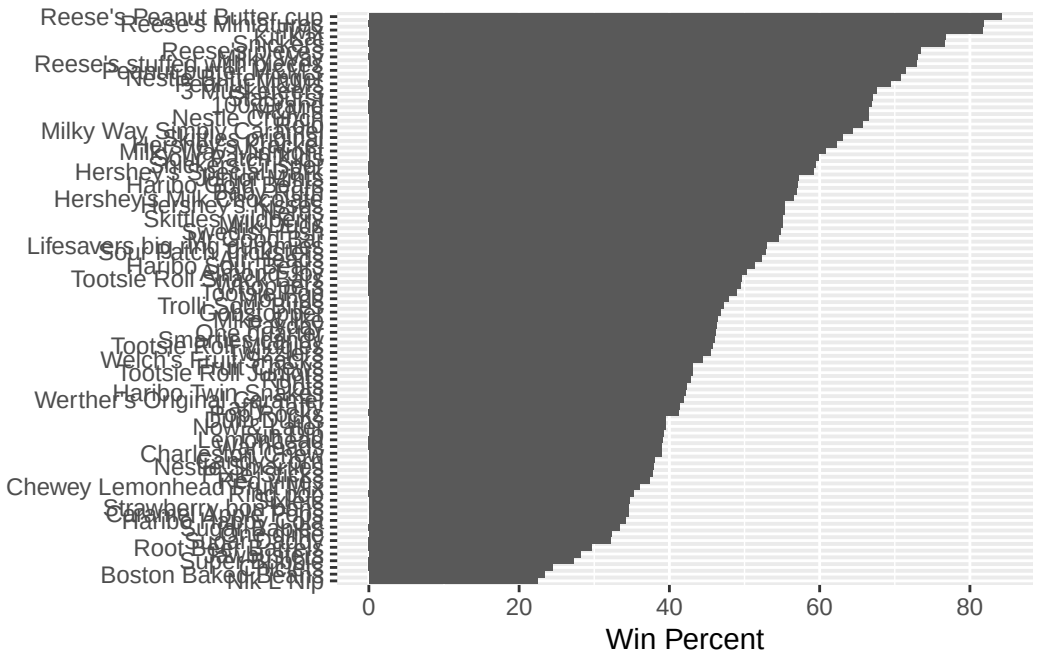
Q14. What are the top 5 all time favorite candy types out of this set? Reese's Peanut Butter cup, Reese's Miniatures, Twix, Kit Kat, Snickers

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

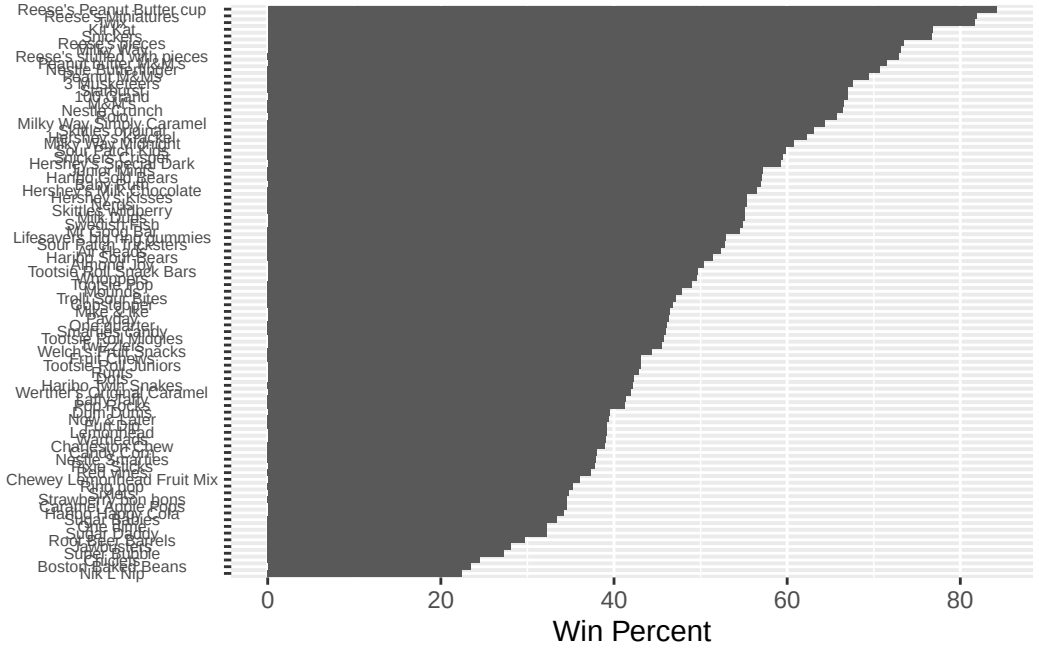


Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

```
candygraph <- ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col() +
  labs(x = "Win Percent", y = NULL)
candygraph
```




```
candygraph + theme(axis.text.y = element_text(angle = 0, hjust = 0.5, vjust = 0.5)) + theme(a
```



```r
ggsave('barplot1.png', width = 7, height = 10 )
```

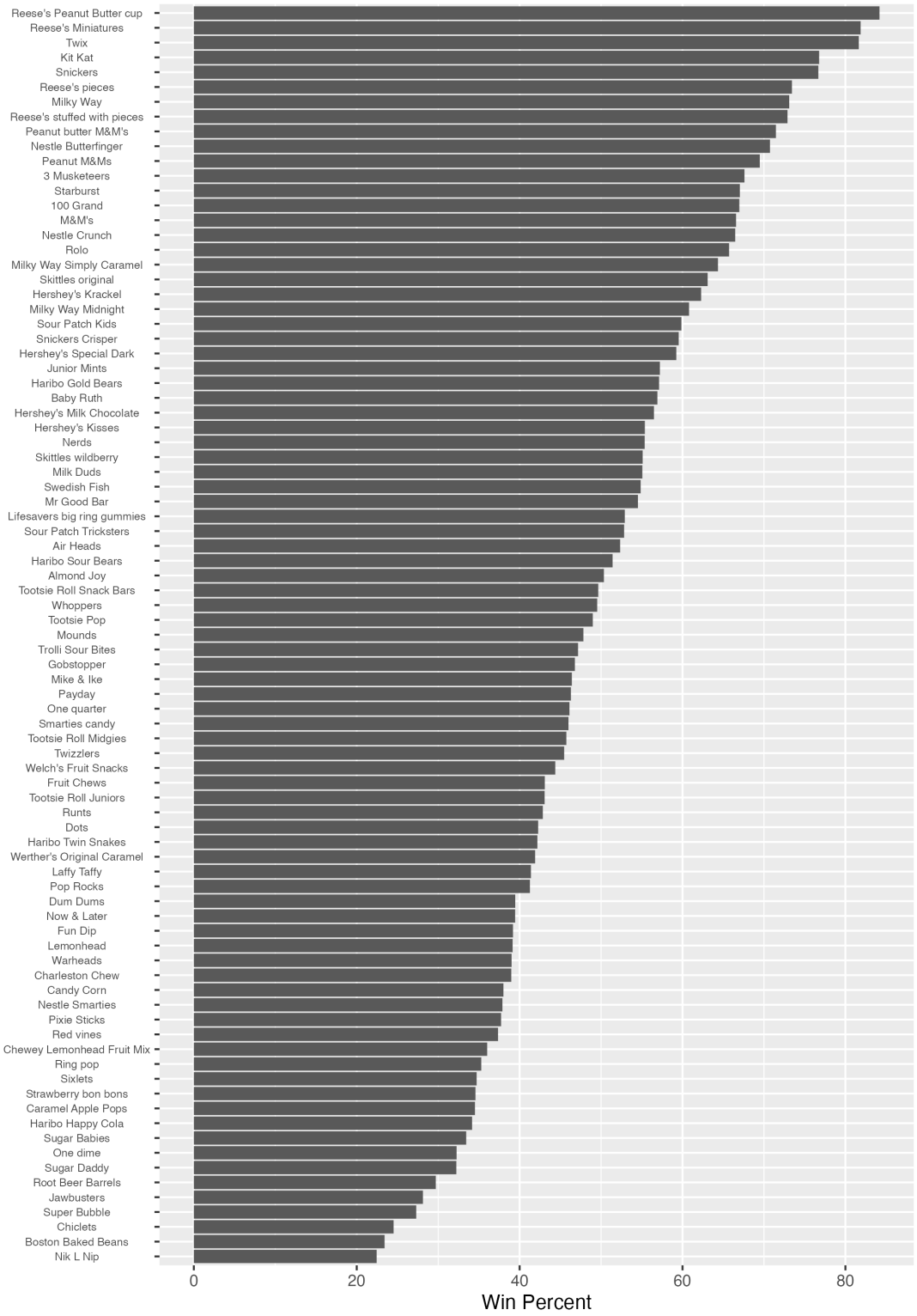
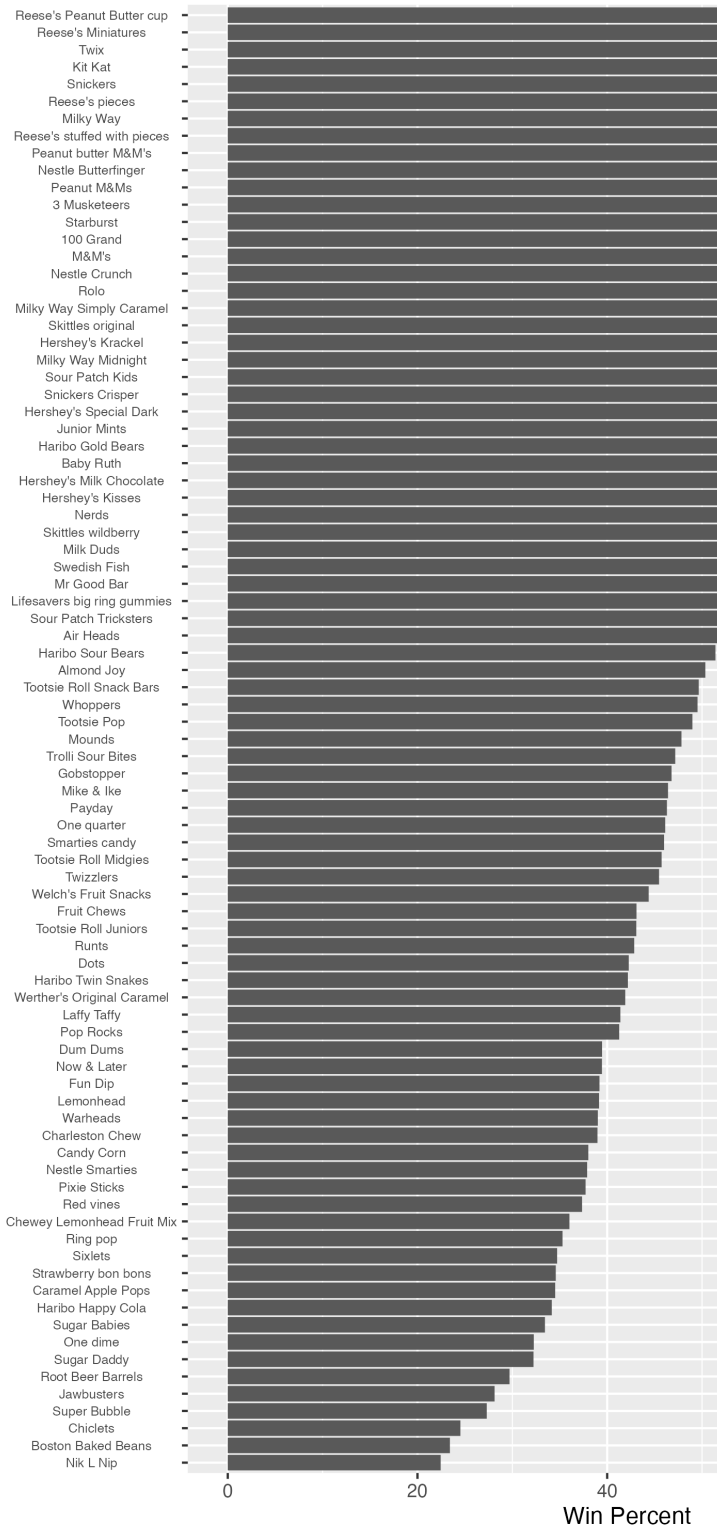


Figure 1: better graph

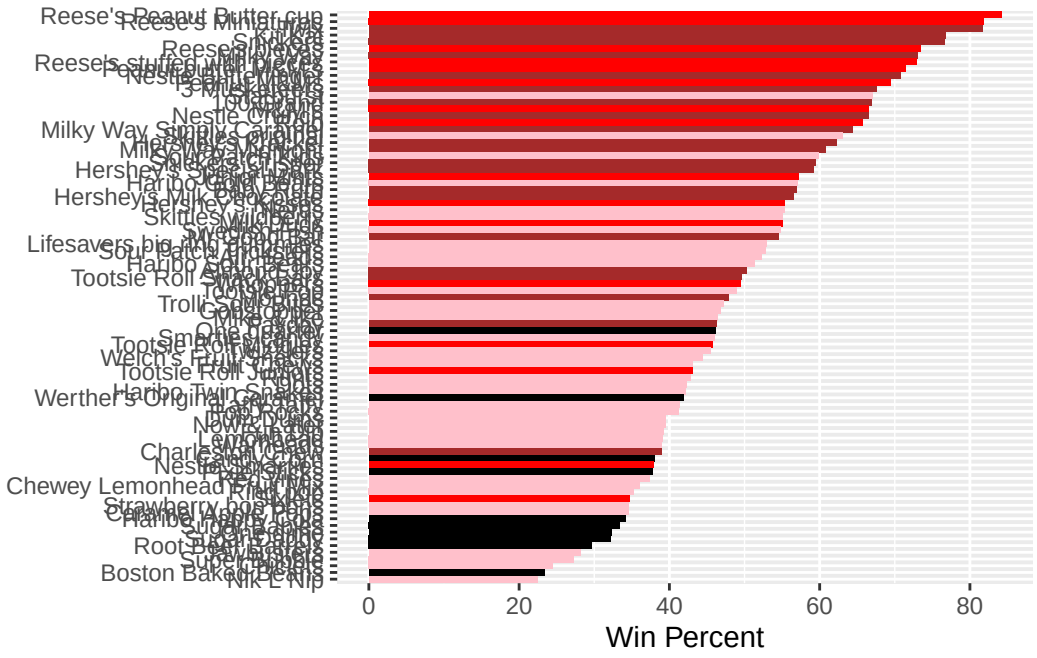


You can insert any image usin this markdown synthax:

Add some color to our ggplot. We need to make a custom color vector.

```
# start will all black vector of colors
my_cols <- rep("black", nrow(candy))
my_cols[as.logical(candy$chocolate)] <- "red"
my_cols[as.logical(candy$bar)] = "brown"
my_cols[as.logical(candy$fruity)] = "pink"
```

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



Q17. What is the worst ranked chocolate candy? Sixlets

Q18. What is the best ranked fruity candy? Starburst

#Taking a look at pricepercent

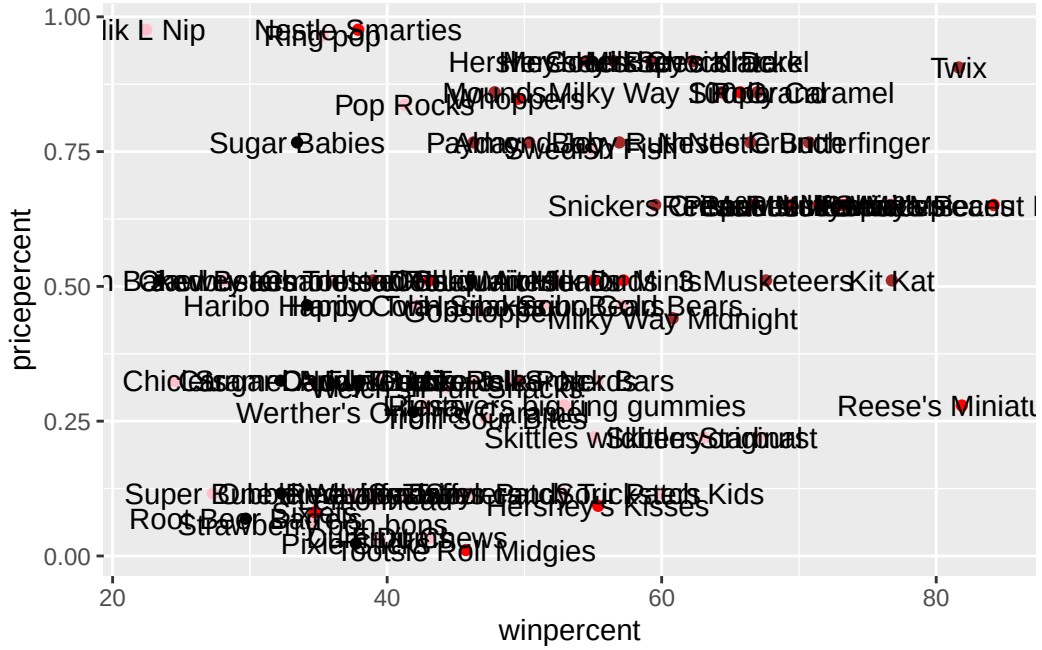
```
candy$pricepercent
```

```
 [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 these two variables 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 overlaps of all these labels we can use an add on package called ggrepel

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

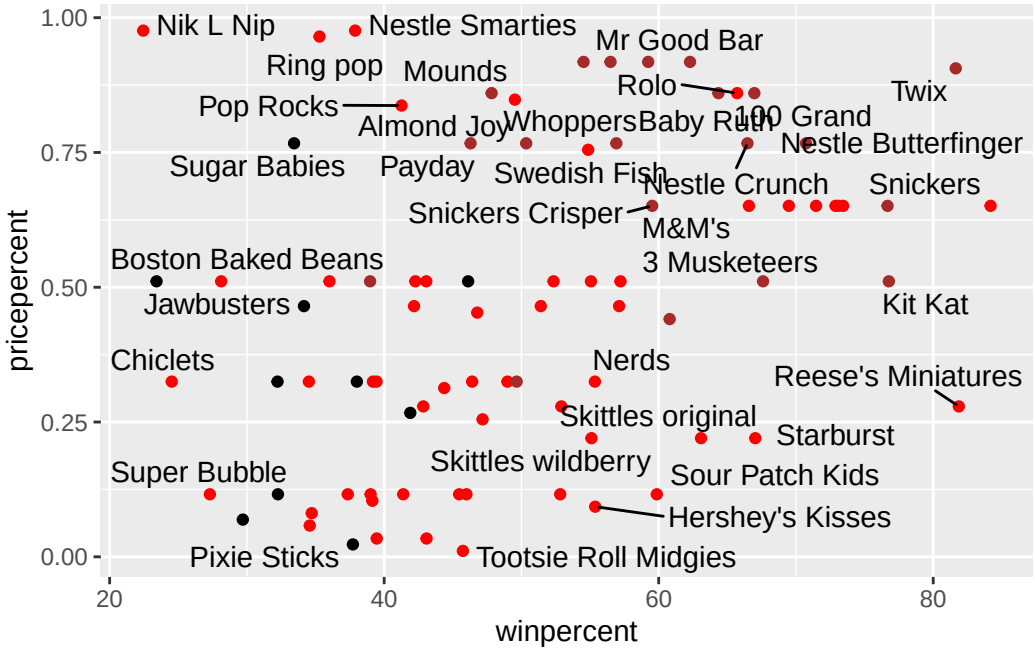
```
  geom_text() +
  geom_text_repel()
```

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

Play with the `max.overlaps` parameter to `geom_text_repel()`

```
#Too hard to see pink
my_cols[as.logical(candy$fruity)] = "red"

ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col= my_cols) +
  geom_text_repel(max.overlaps=10)
```

```
Warning: ggrepel: 50 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? Reese's Miniatures

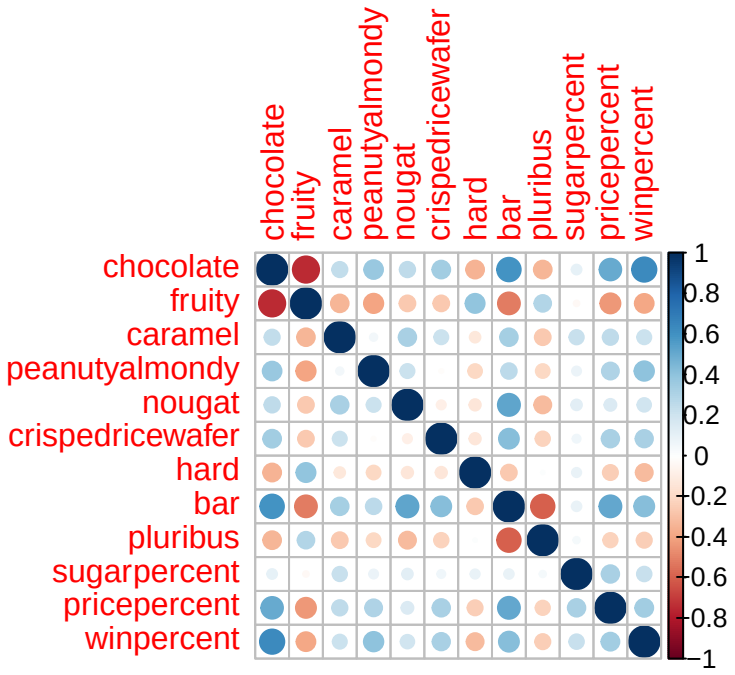
Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular? Nik L Nip, Ring Pop, Nestle Smarties, Mounds, Pop Rocks; Nik L Nip is the least popular.

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 & fruity

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

PCA

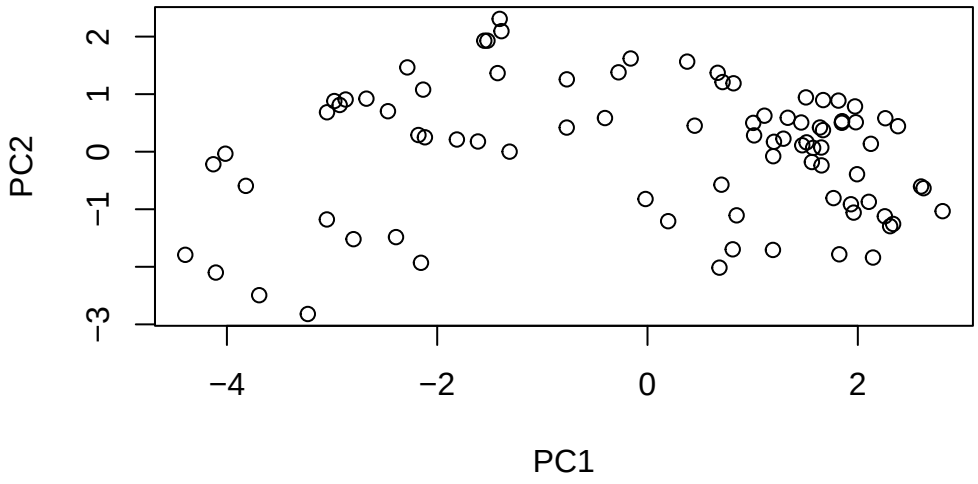
The main function for this is called `prcom()` and here we know we need to scale our data with the `scale=TRUE` argument.

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

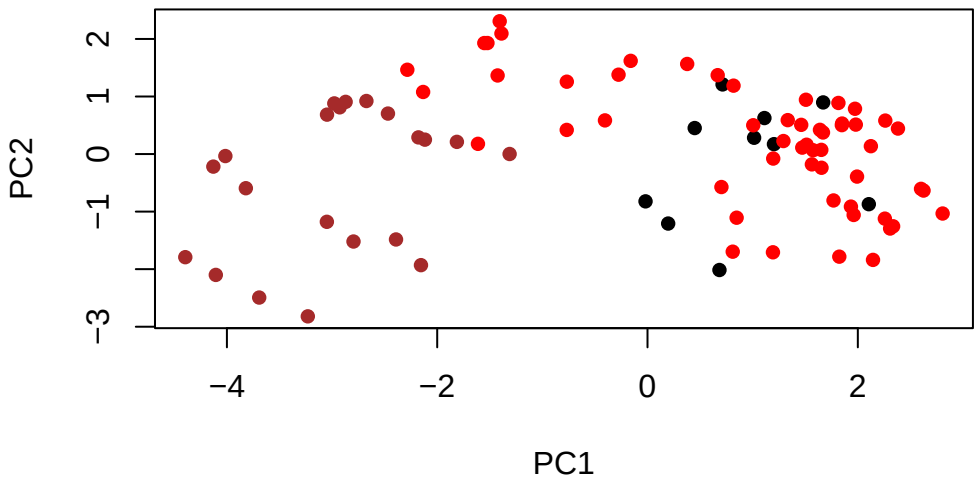
```
Importance of components:
                          PC1    PC2    PC3     PC4    PC5     PC6     PC7
Standard deviation     2.0788 1.1378 1.1092 1.07533 0.9518 0.81923 0.81530
Proportion of Variance 0.3601 0.1079 0.1025 0.09636 0.0755 0.05593 0.05539
Cumulative Proportion  0.3601 0.4680 0.5705 0.66688 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])
```

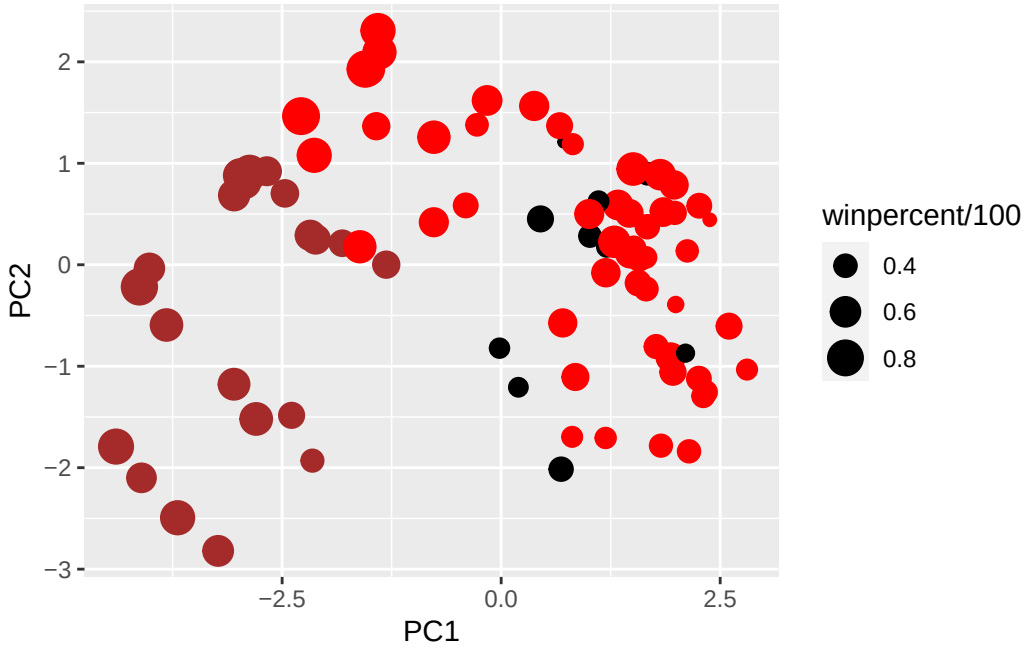



```
plot(pca$x[,1:2], col=my_cols, pch=16)
```



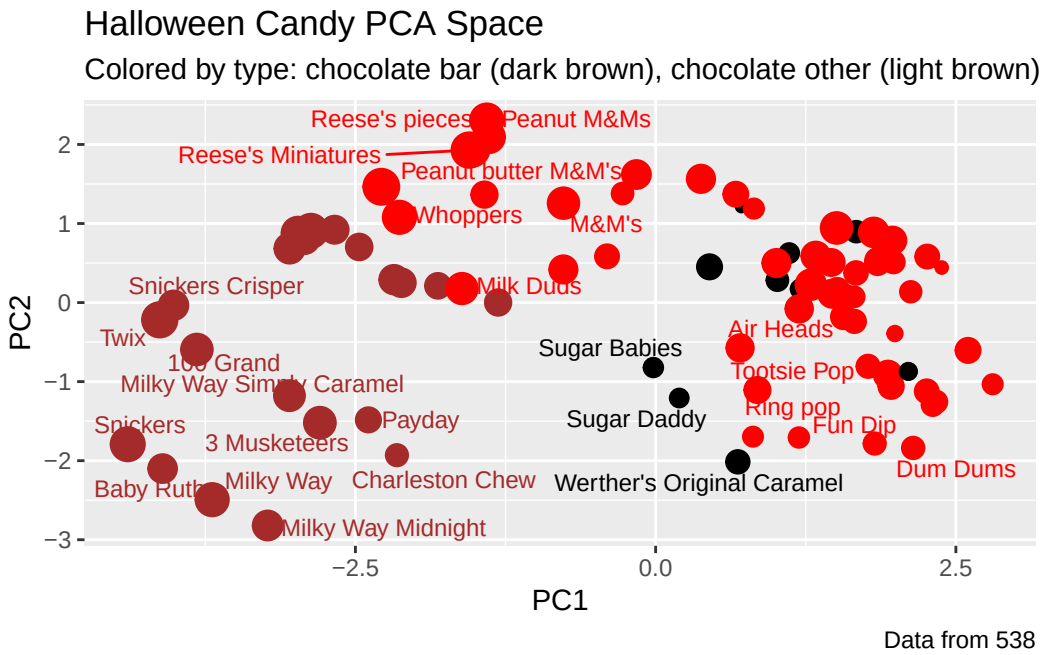

```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])
```

```
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
```



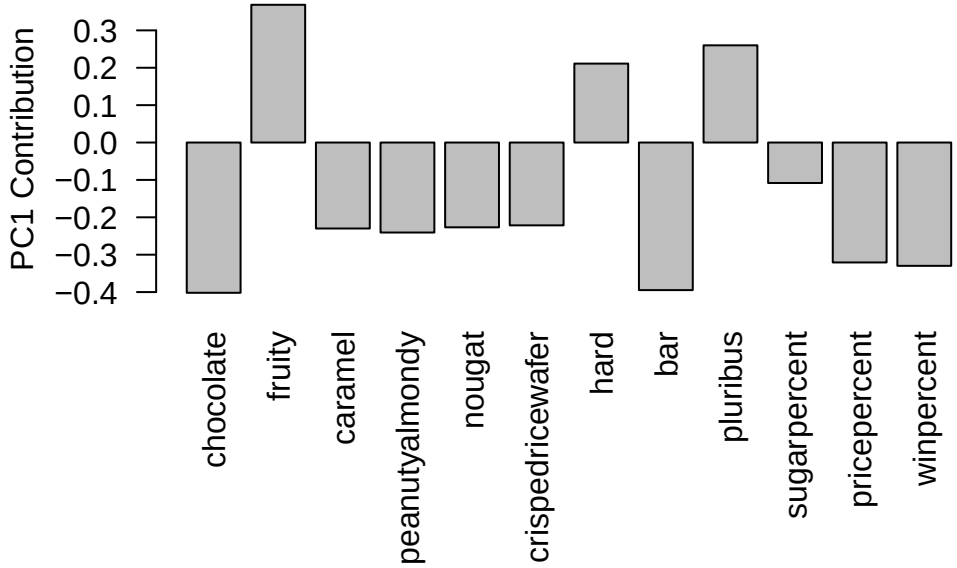

```
library(ggrepel)

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



loadings plot

```
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, & pluribus; yes this makes sense to me as these are typical characteristics of fruit candy.