Class 9: Halloween Mini-Project

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Exploratory Analysis of Halloween Candy

Loading 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
```

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

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

```
[1] 38
```

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

```
candy["Tootsie Pop",]$winpercent
```

```
[1] 48.98265
```

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
```

```
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?

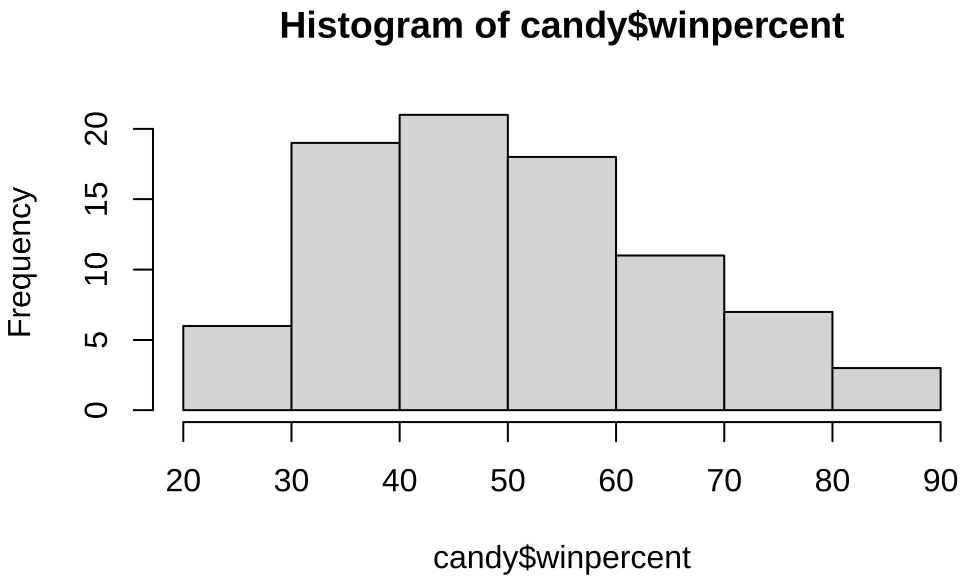
The *winpercent* variable/column is on a different scale. It is values from 0-100% whereas the other columns are binary (0 or 1).

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

0 and 1 represent True or False. That candy either is not fruity (0) or is fruity (1).

Q8. Plot a histogram of winpercent values

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



Q9. Is the distribution of winpercent values symmetrical?

Yes, you can assume a normal distribution by Shapiro-Wilk test.

```
shapiro.test(candy$winpercent)
```

```


	Shapiro-Wilk normality test

data:  candy$winpercent
W = 0.9773, p-value = 0.1391
```

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

```
sum <- summary(candy$winpercent)
median <- as.numeric(sum["Median"])
```

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

Higher

```r
choco.winp <- candy$winpercent[as.logical(candy$chocolate)]
fruit.winp <- candy$winpercent[as.logical(candy$fruity)]
mean(choco.winp) > mean(fruit.winp)
```

```
[1] TRUE
```

Q12. Is this difference statistically significant?

Yes

```r
t.test(choco.winp, fruit.winp)
```

```

	Welch Two Sample t-test

data:  choco.winp and fruit.winp
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 
```

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

```r
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?

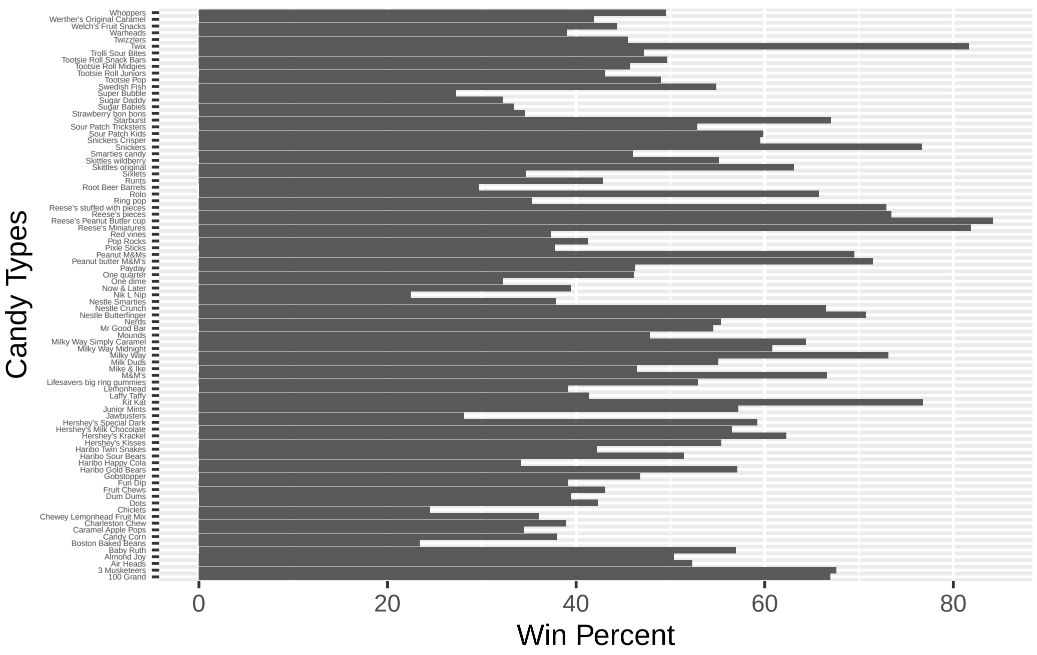
```
head(candy[order(candy$winpercent, decreasing = TRUE),], n=5)
```

```
                          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
```

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

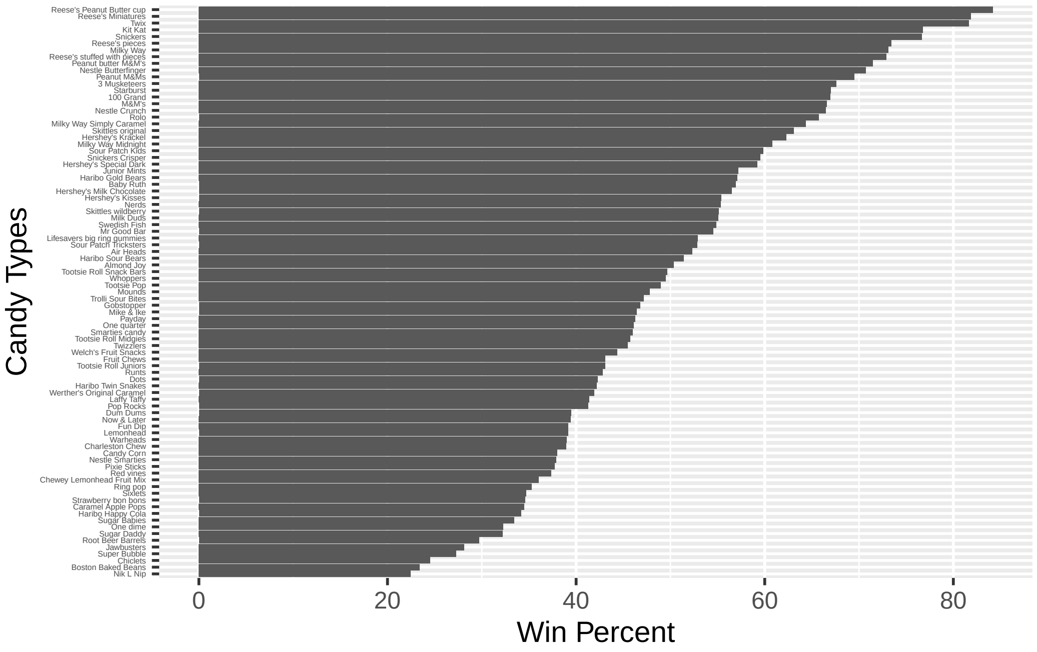
```
library(ggplot2)

ggplot(candy) +
  aes(winpercent, rownames(candy)) +
  geom_col() +
  labs(y = "Candy Types", x = "Win Percent") +
  theme(axis.text.y = element_text(size = 3))
```



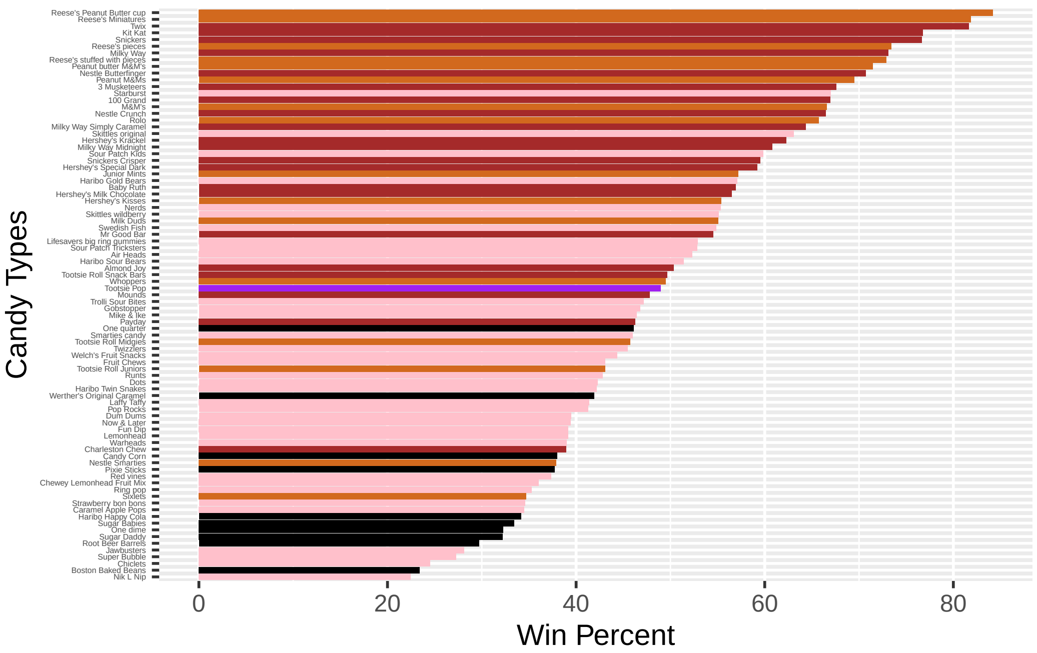
Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col() +
  labs(y = "Candy Types", x = "Win Percent") +
  theme(axis.text.y = element_text(size = 3))
```



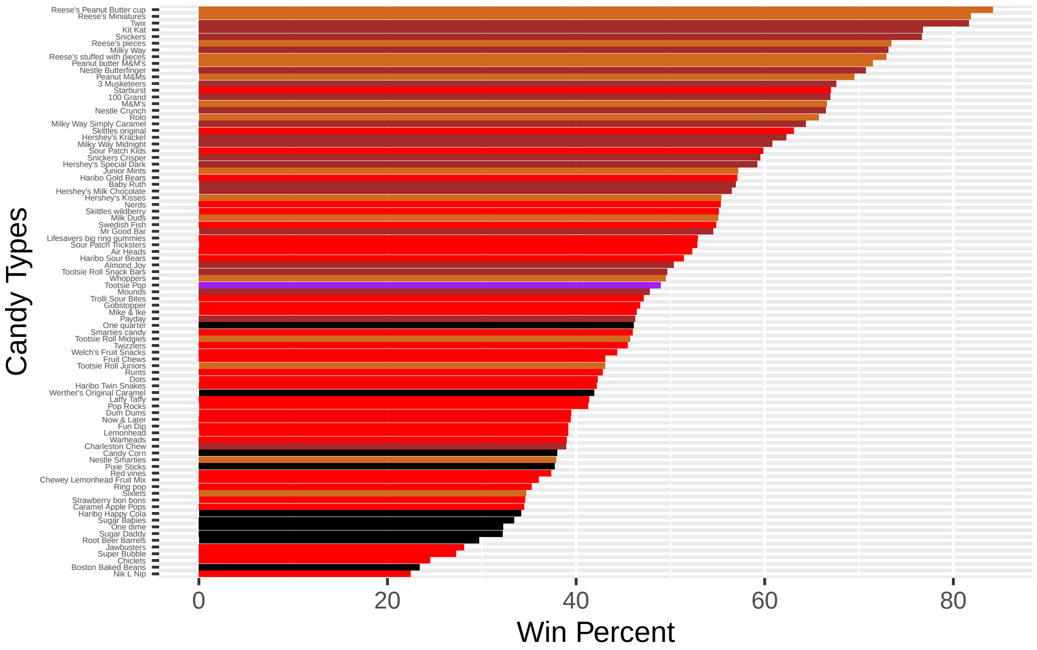
```r
my_cols=rep("black", nrow(candy))
my_cols[as.logical(candy$chocolate)] = "chocolate"
my_cols[as.logical(candy$bar)] = "brown"
my_cols[as.logical(candy$fruity)] = "pink"
my_cols[rownames(candy) == "Tootsie Pop"] = "purple"

ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col(fill = my_cols) +
  labs(y = "Candy Types", x = "Win Percent") +
  theme(axis.text.y = element_text(size = 3))
```



```
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)] = "red"
my_cols[rownames(candy) == "Tootsie Pop"] = "purple"

ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col(fill = my_cols) +
  labs(y = "Candy Types", x = "Win Percent") +
  theme(axis.text.y = element_text(size = 3))
```



Q17. What is the worst ranked chocolate candy?

Sixlets

Q18. What is the best ranked fruity candy?

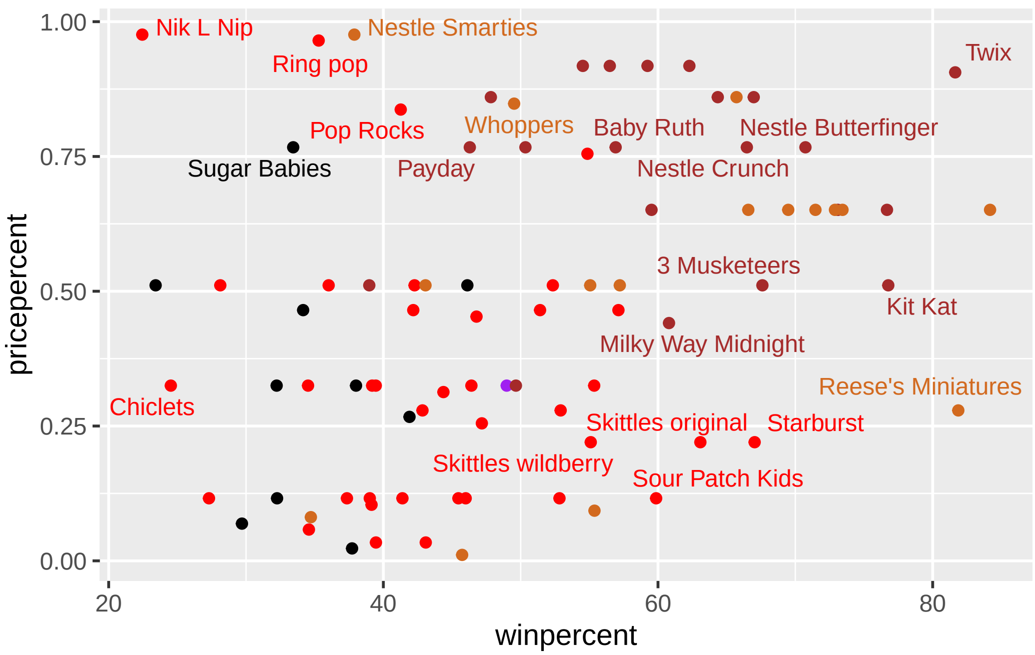
Starburst

Taking a look at pricepercent

```
library(ggrepel)

#price vs win
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, 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?

Twix

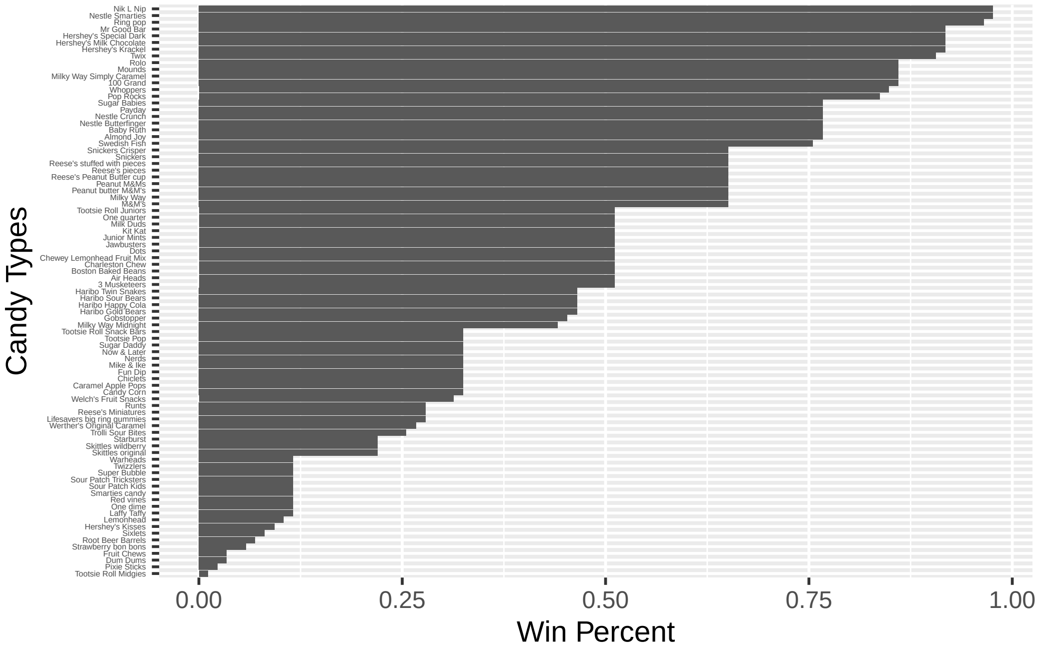
Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular?

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

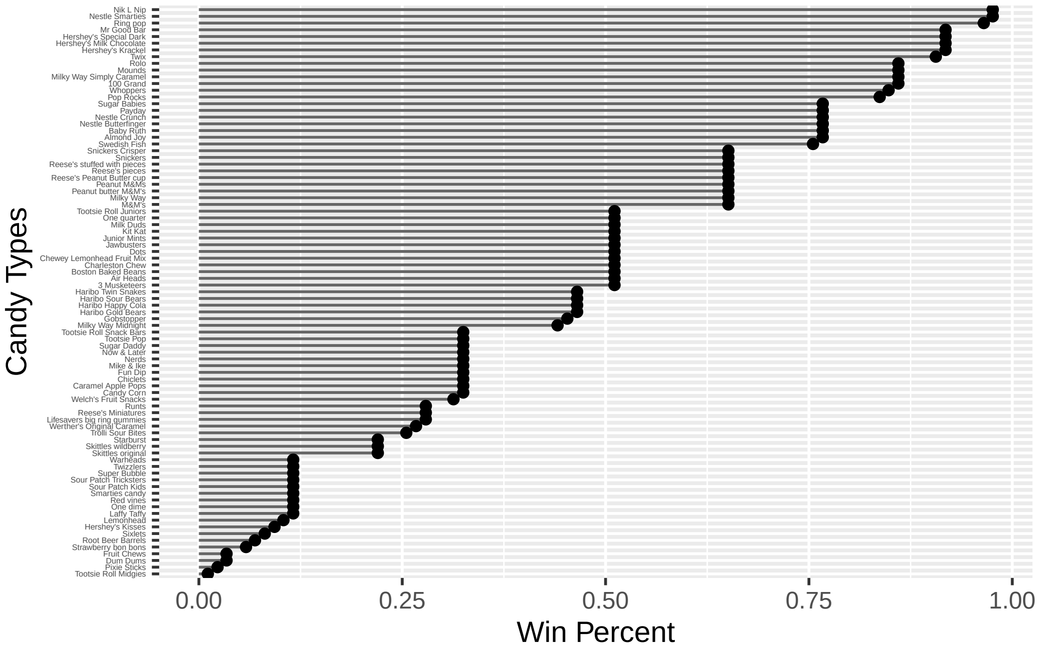
```
                         pricepercent winpercent
Nik L Nip                       0.976   22.44534
Nestle Smarties                 0.976   37.88719
Ring pop                        0.965   35.29076
Hershey's Krackel               0.918   62.28448
Hershey's Milk Chocolate        0.918   56.49050
```

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().

```r
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_col() +
  labs(y = "Candy Types", x = "Win Percent") +
  theme(axis.text.y = element_text(size = 3))
```



```r
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_segment(aes(yend = reorder(rownames(candy), pricepercent), xend = 0), col = "gray40")
  geom_point() +
  labs(y = "Candy Types", x = "Win Percent") +
  theme(axis.text.y = element_text(size = 3))
```

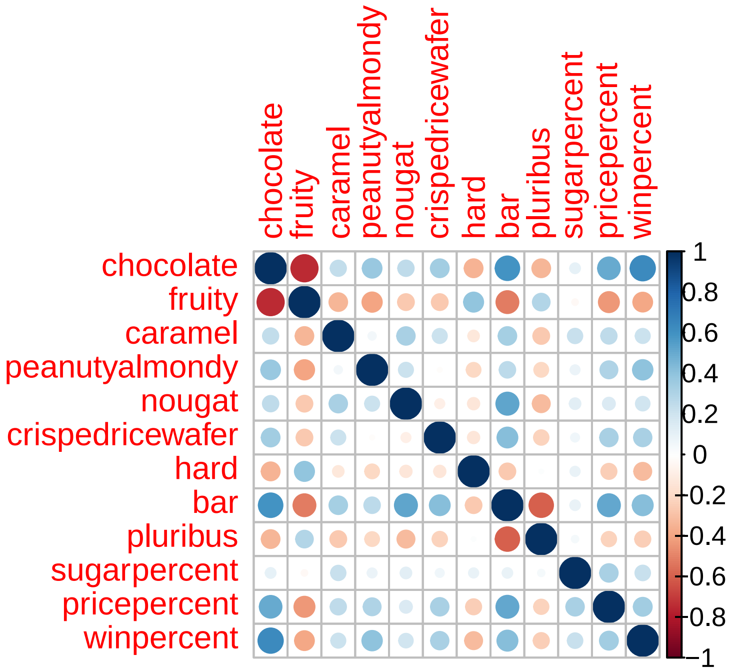


Exploring correlation structure

```r
library(corrplot)
```

```
corrplot 0.92 loaded
```

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



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

Fruity and chocolate are anti-correlated and have a negative value.

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

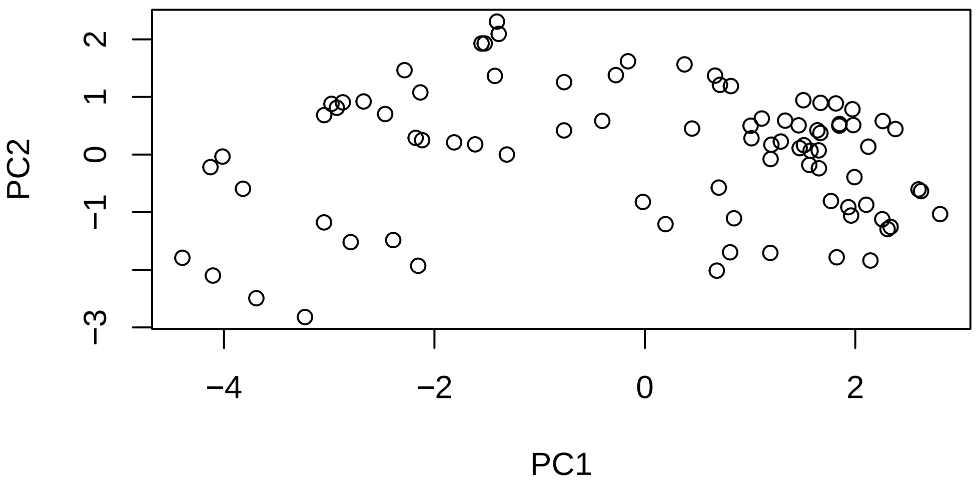
winpercent and chocolate are the most postively correlated.

PCA

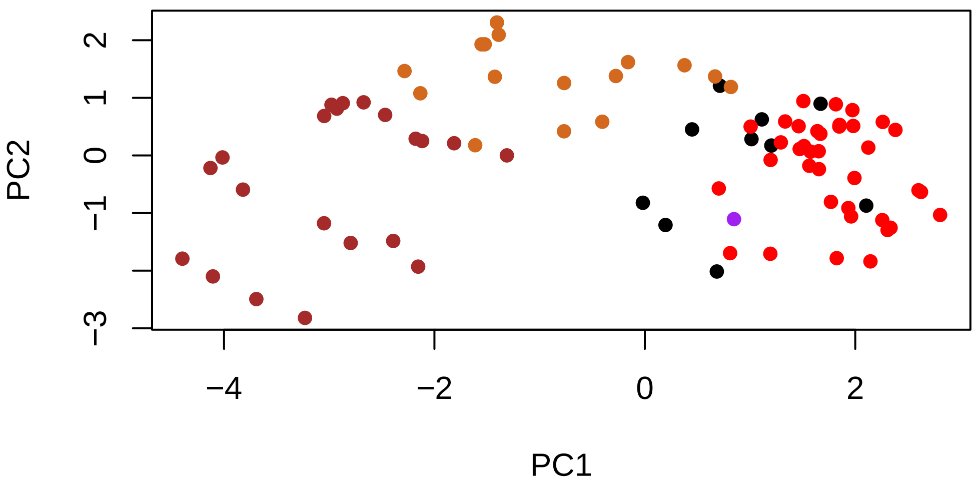
```
pca <- prcomp(candy, scale = T)
summary(pca)
```

```
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
```

```
plot(pca$x[,1], pca$x[,2], xlab="PC1", ylab="PC2")
```



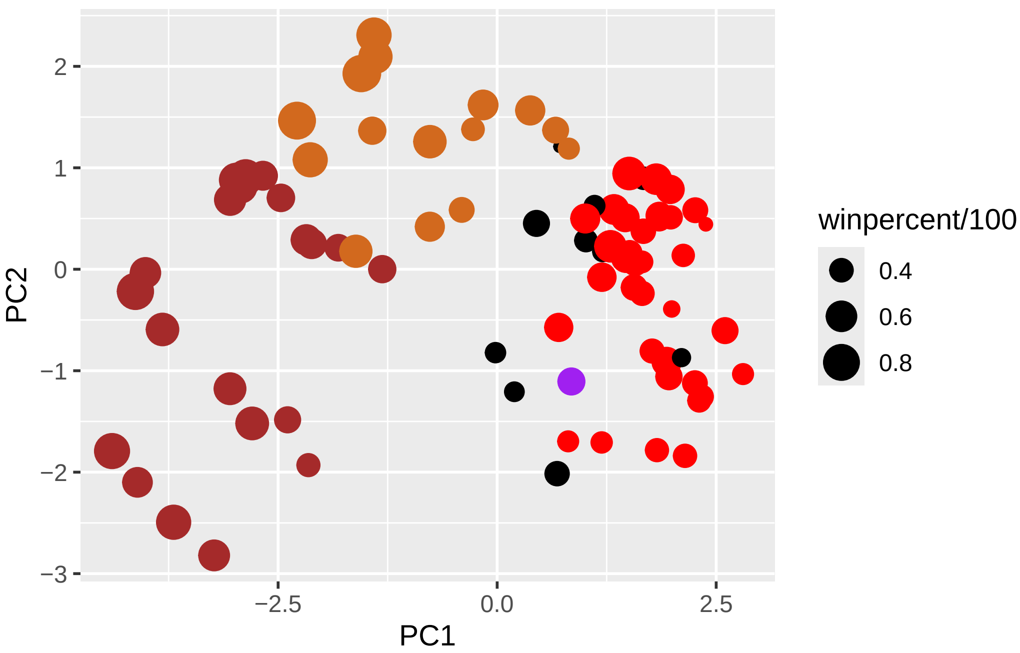
```
plot(pca$x[,1:2], col=my_cols, pch=16)
```



```
# 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(PC1, PC2, size=winpercent/100, text=rownames(my_data),
        label = rownames(my_data)) +
        geom_point(col=my_cols)

p
```

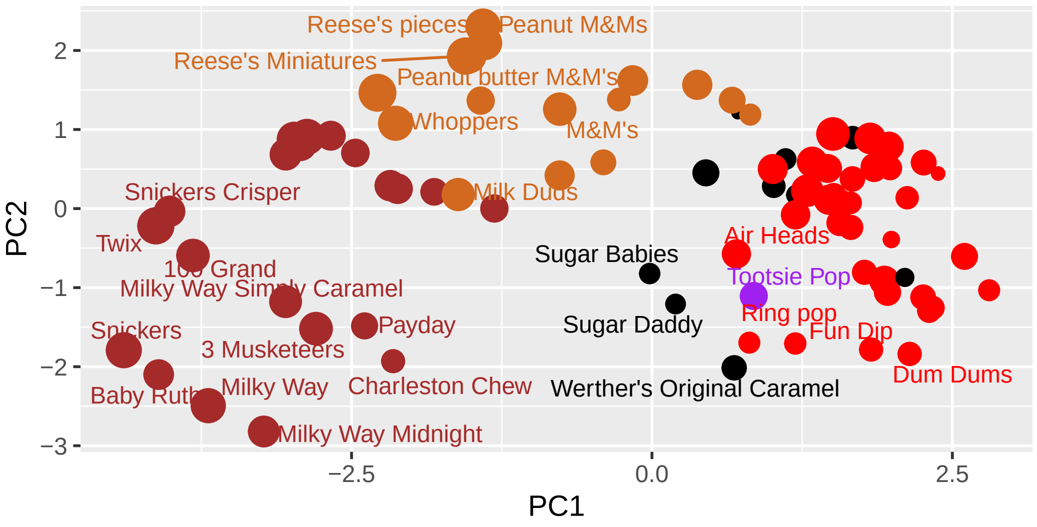


```
p + geom_text_repel(size=3.3, col=my_cols, max.overlaps = 7)  +
  theme(legend.position = "none") +
  labs(title="Halloween Candy PCA Space",
       subtitle="Colored by type: chocolate bar (dark brown), chocolate other (light brown),
       caption="Data from 538")
```

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

Halloween Candy PCA Space

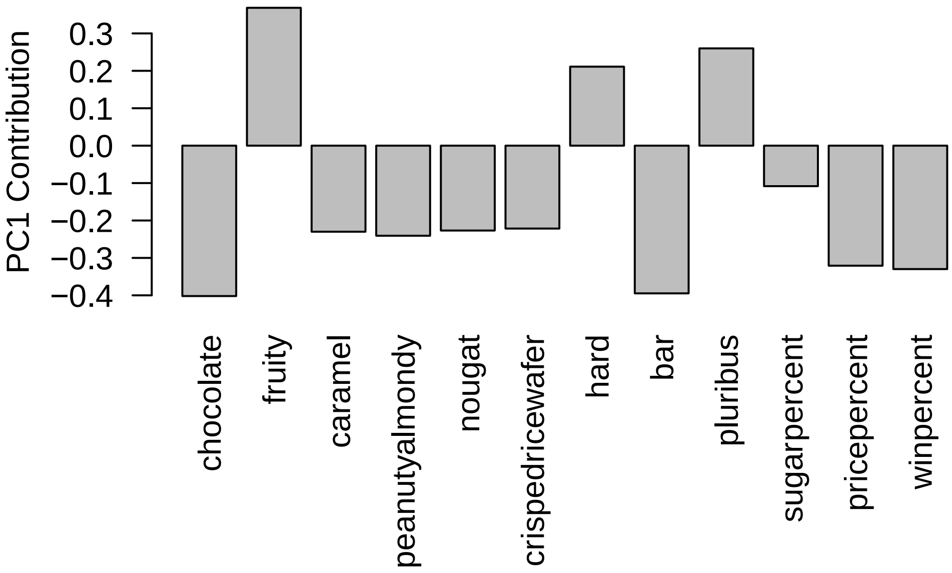
Colored by type: chocolate bar (dark brown), chocolate other (light brown),



Data from 538

```
#library(plotly)
#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. These make sense because most halloween candy is either chocolatey or fruity, most hard candy is fruity, and many pluribus candy (like skittles) are also fruity.