Class 10: Halloween Candy Mini Project

Suraj Sidhu (A18512793)

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As it is nearly Halloween and the half way point in the quarter , let's do a mini project to figure out the best candy!

Importing candy data

```
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
```

```
library(tidyverse)
```

```
-- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
v dplyr     1.1.4     v readr     2.1.5
v forcats   1.0.1     v stringr   1.5.2
v ggplot2   4.0.0     v tibble    3.3.0
v lubridate 1.9.4     v tidyr     1.3.1
v purrr     1.1.0
-- Conflicts ------------------------------------------ tidyverse_conflicts() --
x dplyr::filter() masks stats::filter()
x dplyr::lag()    masks stats::lag()
i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to beco
```

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

```
nrow(candy)
```

```
[1] 85
```

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

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

```
[1] 38
```

What is your favorate candy?

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

```
library(dplyr)
candy["Twix", ]$winpercent
```

```
[1] 81.64291
```

```
candy["Sour Patch Kids", ]$winpercent
```

```
[1] 59.864
```

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
```

There is a useful skim() function in the skimr package that can help give you a quick overview of a given dataset. Let's install this package and try it on our candy data.

```
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	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
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?

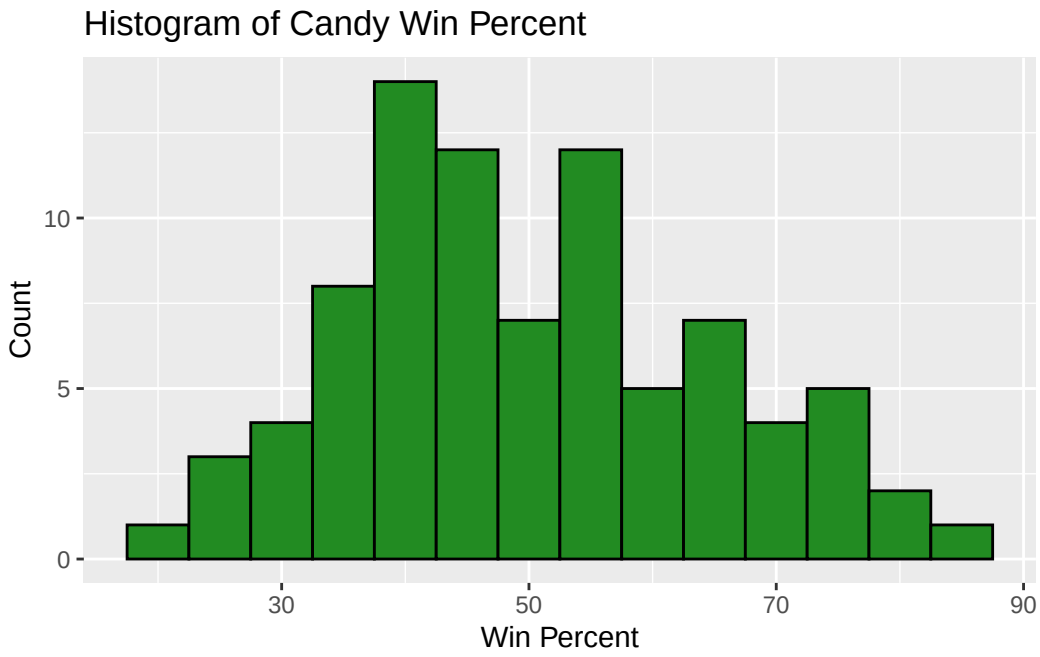
The win percent is on a 0-100 scale, the rest are 0-1

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

0 = the candy **does not** contain chocolate 1 = the candy **does** contain chocolate

Q8. Plot a histogram of winpercent values

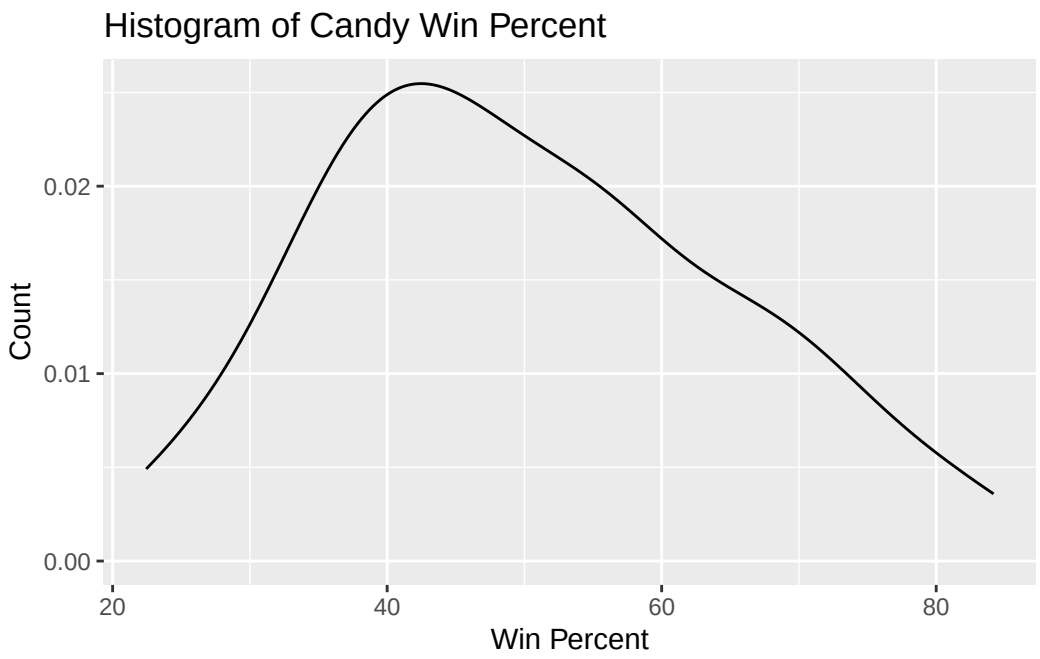
```
library(ggplot2)

ggplot(candy, aes(x = winpercent)) +
  geom_histogram(binwidth = 5, fill = "forestgreen", color = "black") +
  labs(title = "Histogram of Candy Win Percent", x = "Win Percent", y = "Count")
```



Q9. Is the distribution of winpercent values symmetrical?

```
ggplot(candy, aes(x = winpercent)) +
  geom_density(binwidth = 5) +
  labs(title = "Histogram of Candy Win Percent", x = "Win Percent", y = "Count")
```

```
Warning in geom_density(binwidth = 5): Ignoring unknown parameters: `binwidth`
```



No it is not

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

```
mean(candy$winpercent)
```

```
[1] 50.31676
```

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

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

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

```
# Chocolate candies
mean(candy$winpercent[as.logical(candy$chocolate)])
```

```
[1] 60.92153
```

```
# Fruity candies
mean(candy$winpercent[as.logical(candy$fruity)])
```

```
[1] 44.11974
```

Q12. Is this difference statistically significant?

```
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
```

Difference is statistically significant ($p < 0.05$)

Overall Candy Rankings

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

```
candy %>% arrange(winpercent) %>% head(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
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
```

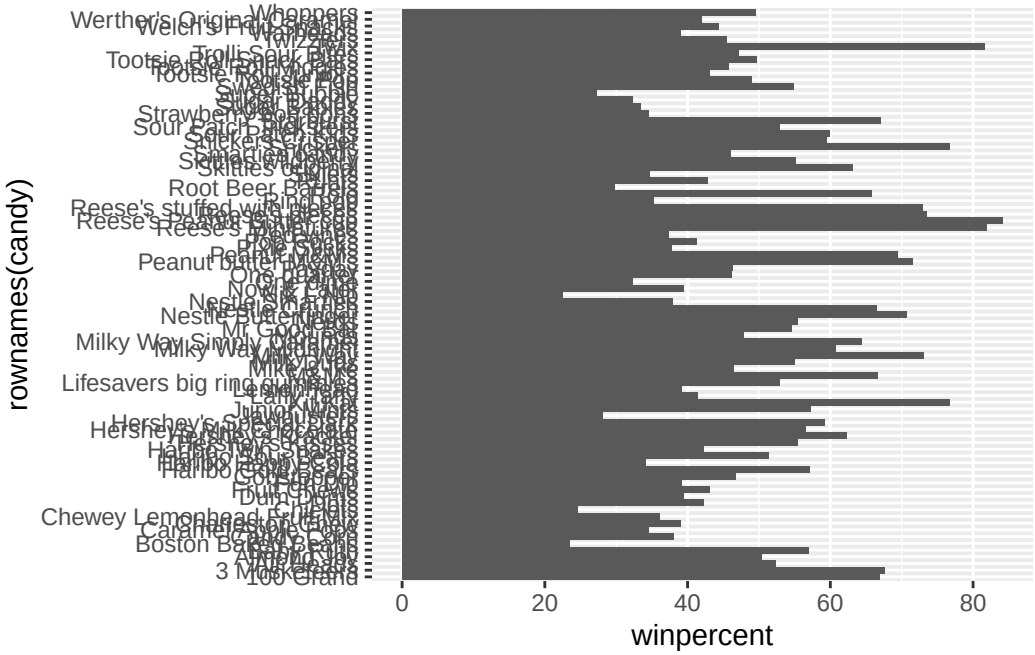
Q14. What are the top 5 all time favorite candy types out of this set?

```
candy %>% arrange(desc(winpercent)) %>% head(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
```

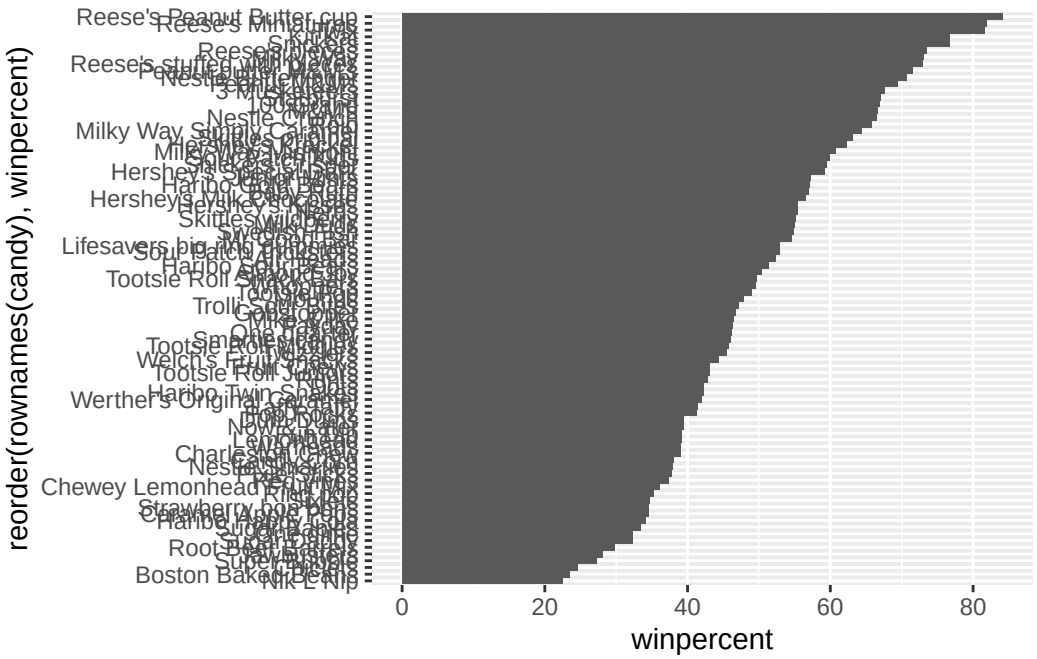
Q15. Make a first barplot of candy ranking based on winpercent values.

```
ggplot(candy) +
  aes(winpercent,rownames(candy)) +
  geom_bar(stat = "identity")
```

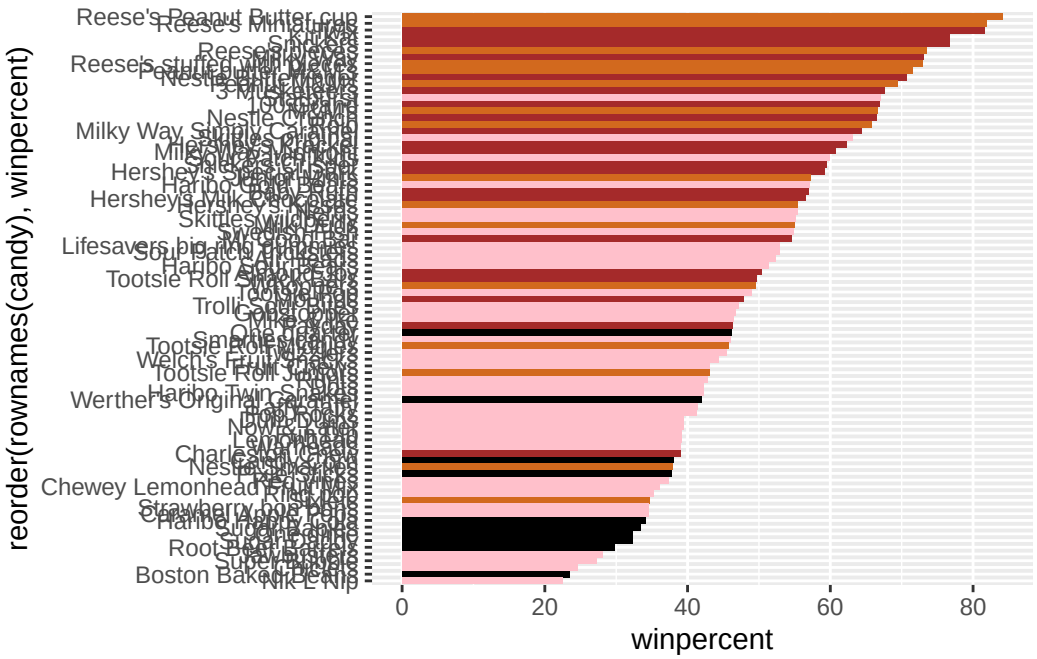


Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_bar(stat = "identity")
```




```
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"

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



Now, for the first time, using this plot we can answer questions like: > Q17. What is the worst ranked chocolate candy?

```
candy_choc <- candy[as.logical(candy$chocolate), ]
rownames(candy_choc)[which.min(candy_choc$winpercent)]
```

```
[1] "Sixlets"
```

Q18. What is the best ranked fruity candy?

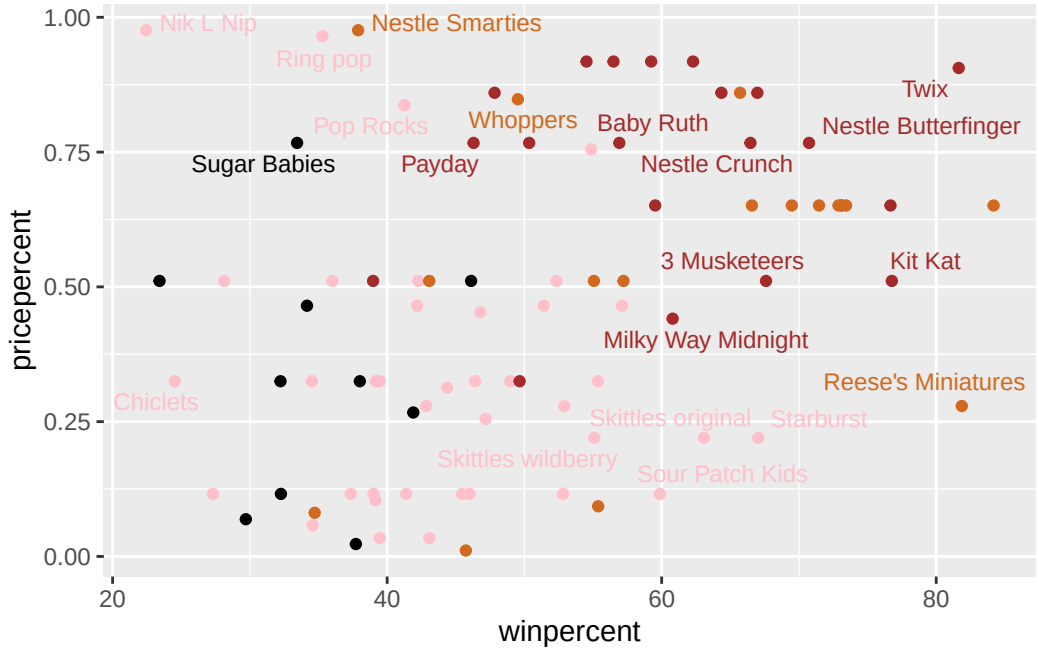
```
candy_fruity <- candy[as.logical(candy$fruity), ]
rownames(candy_fruity)[which.max(candy_fruity$winpercent)]
```

```
[1] "Starburst"
```

Taking a look at pricepercent

```
library(ggrepel)
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?

```
# Calculate win/price ratio
bang_for_buck <- candy$winpercent / candy$pricepercent

# Find candy with highest ratio
rownames(candy)[which.max(bang_for_buck)]
```

```
[1] "Tootsie Roll Midgies"
```

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

Order by pricepercent descending

```
expensive_candies <- candy[order(-candy$pricepercent), ]
```

Top 5 most expensive

```
top5_expensive <- head(expensive_candies, 5)
top5_expensive
```

```
                        chocolate fruity caramel peanutyalmondy nougat
Nik L Nip                       0      1       0              0      0
Nestle Smarties                 1      0       0              0      0
Ring pop                        0      1       0              0      0
Hershey's Krackel               1      0       0              0      0
Hershey's Milk Chocolate        1      0       0              0      0
                        crispedricewafer hard bar pluribus sugarpercent
Nik L Nip                              0    0   0        1        0.197
Nestle Smarties                        0    0   0        1        0.267
Ring pop                               0    1   0        0        0.732
Hershey's Krackel                      1    0   1        0        0.430
Hershey's Milk Chocolate               0    0   1        0        0.430
                        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
```

Least popular among these 5

```
rownames(top5_expensive)[which.min(top5_expensive$winpercent)]
```

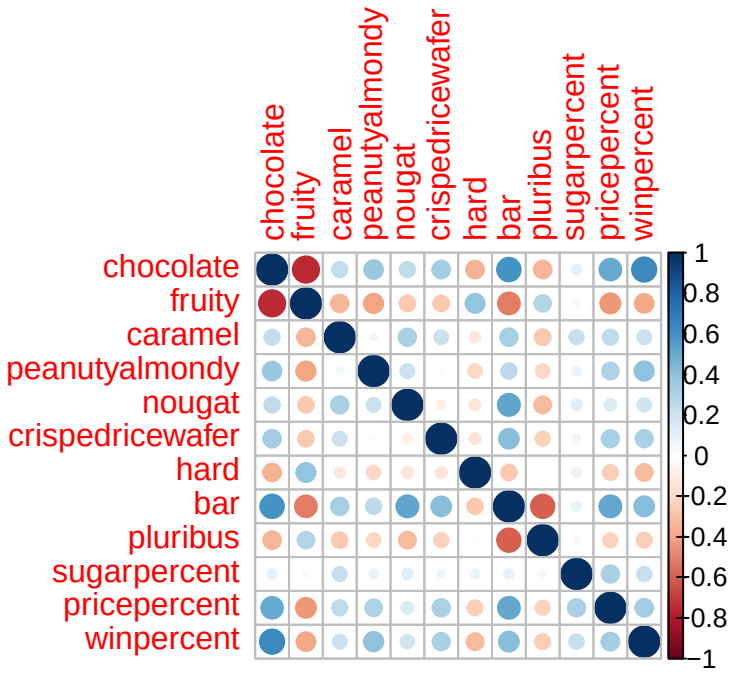
```
[1] "Nik L Nip"
```

Exploring the 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)?

chocolate and fruity

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

chocolate and bars ; most candy bars contain chocolate

Principal Component Analysis

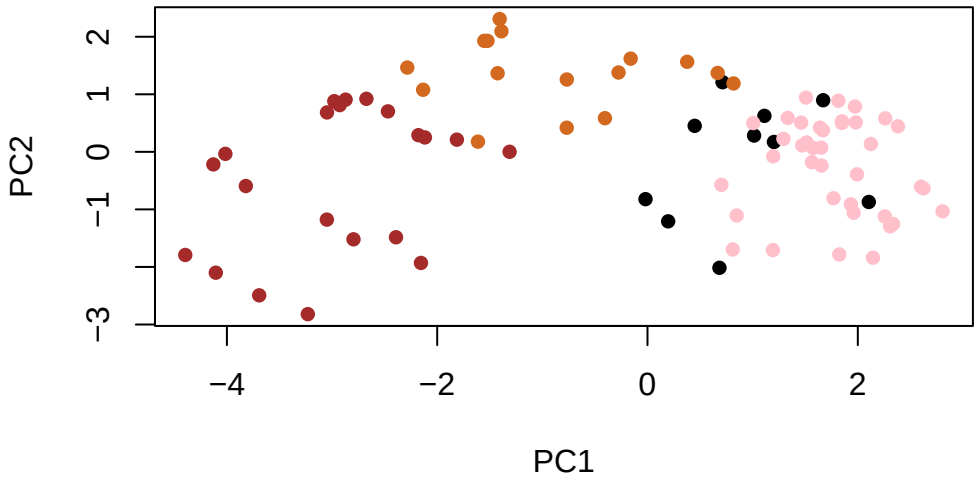
```
pca <- prcomp(candy, scale = TRUE)
summary(pca)
```

```
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 PC1 vs PC2

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



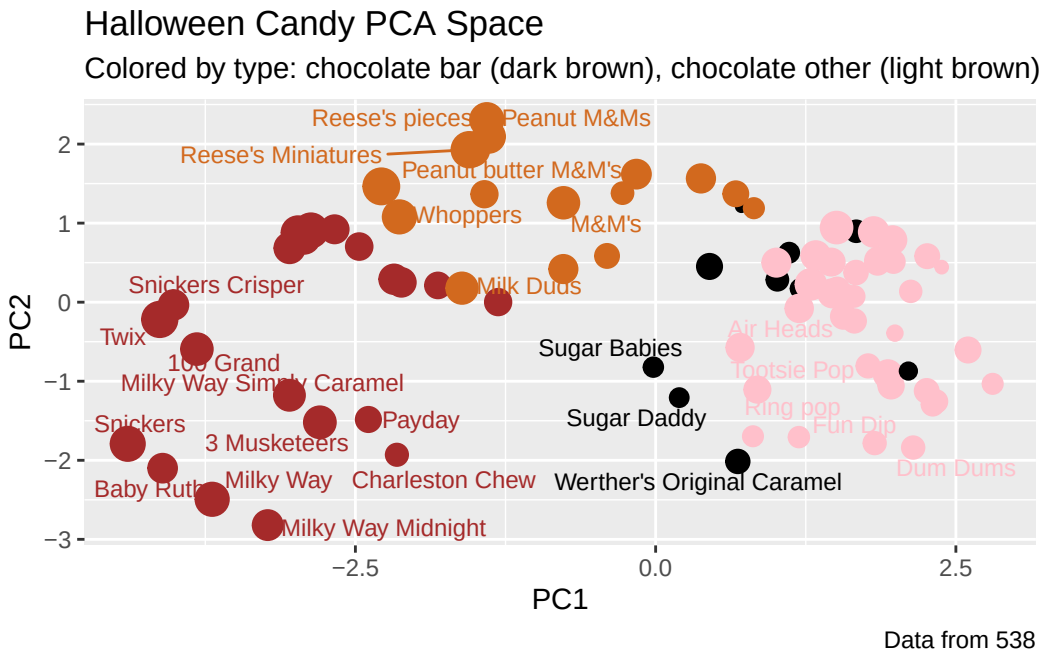
Combine PCA scores with original candy data

```
my_data <- cbind(candy, pca$x[,1:3])
library(ggrepel)

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)
```

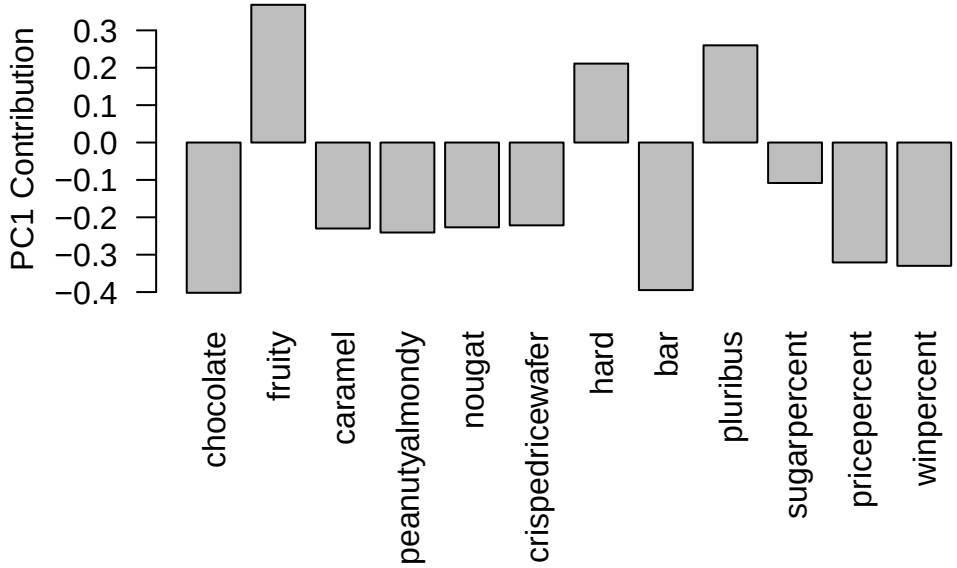
```
library(ggrepel)

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
```




```
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?

PC1 picks up variables like chocolate, bar, peanutyalmondy, and pluribus strongly in the positive direction. This makes sense because these features often occur together in candies. Conversely, fruity contributes negatively, separating fruity candies from chocolatey bars along PC1.