Class 9: Candy Mini-Project

Joseph Lo (PID: A18121493)

Table of contents

Background

In this mini-project, you will explore FiveThirtyEight's Halloween Candy dataset.

We will use lots of **ggplot** some basic stats, correlation analysis and PCA to make sense of the landscape of US candy - something hopefully more relatable than the proteomics and transcriptomics work that we will use these methods on throughout the rest of the course.

Data Import

Our dataset is a CSV file so we use `read.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?

```
nrow(candy)
```

```
[1] 85
```

There are 85 in this dataset

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

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

```
[1] 38
```

38 fruity candy types.

Q3. What is your favorite candy (other than Twix) in the dataset and what is it's winpercent value?

```
candy["Milky Way", "winpercent"]
```

```
[1] 73.09956
```

```
library(dplyr)
```

```
Attaching package: 'dplyr'
```

```
The following objects are masked from 'package:stats':

    filter, lag

The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
candy |> filter(row.names(candy) == "Milky Way") |>
  select(winpercent)
```

```
          winpercent
Milky Way   73.09956
```

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
```

Q6. Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset?

Yes! Winpercent seems to be out of 100, which is very different from other columns.

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

```
candy$chocolate
```

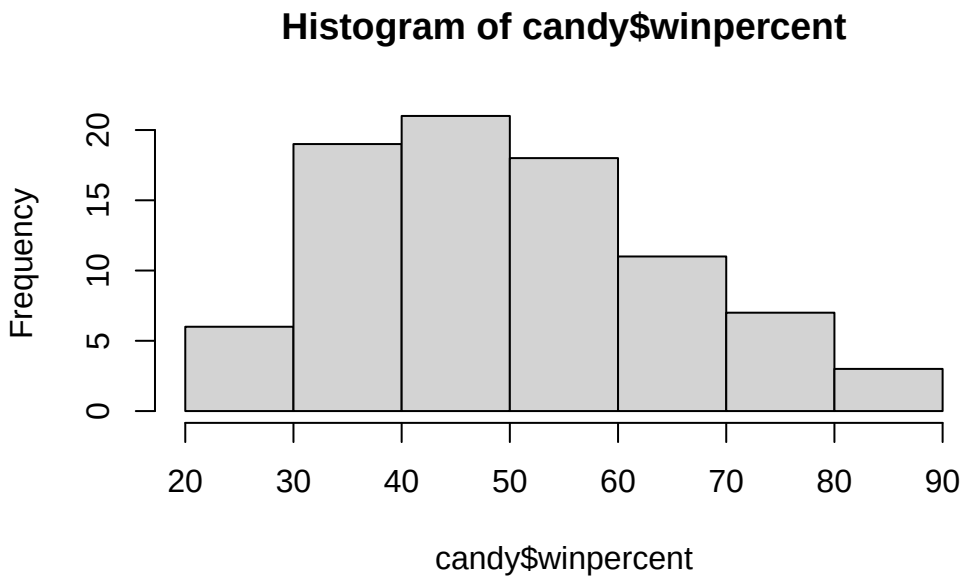
```
 [1] 1 1 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 0 1 1 0 0 0 1 1 0 1 1 1
[39] 1 1 1 0 1 1 0 0 0 1 0 0 0 1 1 1 1 0 1 0 0 1 0 0 1 0 1 1 0 0 0 0 0 0 0 0 1 1
[77] 1 1 0 1 0 0 0 0 1
```

The 1 represents TRUE while the 0 represents FALSE.

Exploratory analysis

Q8. Plot a histogram of winpercent values.

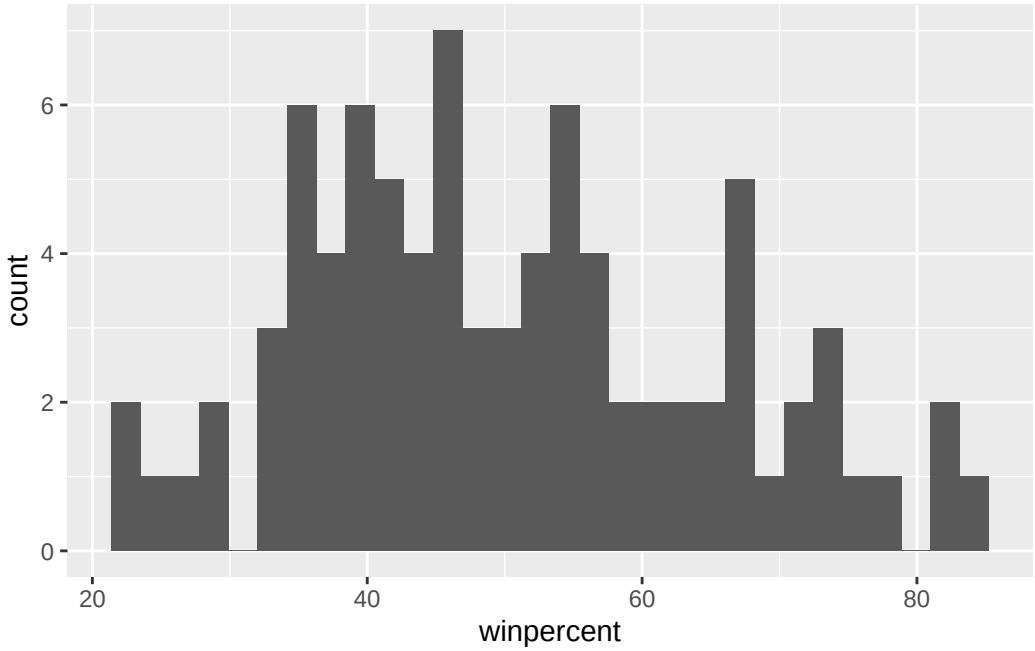
```
hist(candy$winpercent)
```




```
library(ggplot2)

ggplot(candy) +
  aes(winpercent, bins=30)+
  geom_histogram()
```

```
`stat_bin()` using `bins = 30`. Pick better value `binwidth`.
```



Q9. Is the distribution of winpercent values symmetrical?

No, it is skewed to the left.

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

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

```
[1] 50.31676
```

It is above 50%.

```
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?

1. Find all chocolate candy
2. Get their winpercent values
3. Find the mean

4. Find all fruity candy
5. Get their winpercent values
6. Find the mean
7. Compare the two means

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

```
[1] 60.92153
```

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

```
[1] 44.11974
```

Chocolate is higher ranked than fruity candy.

Q12. Is this difference statistically significant?

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

```
    Welch Two Sample t-test

data:  choc.win and fruity.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
```

Yes, they are statistically different cause p-value is less than 0.05.

Overall Candy Rankings

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

```
y <- c("y", "a", "z")
sort(y)
```

```
[1] "a" "y" "z"
```

```
y
```

```
[1] "y" "a" "z"
```

```
order(y)
```

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

```
ord.ind <- order(candy$winpercent)
head(candy[ord.ind, ], 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
```

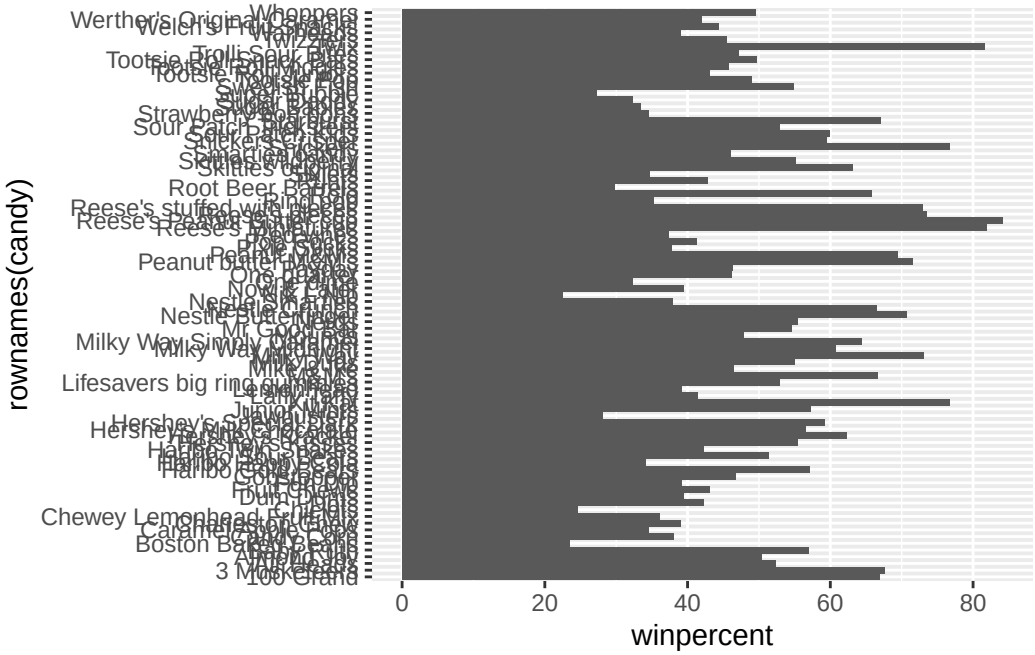
Q14. What are the top 5 all time favorite candy types out of this set?

```
tail(candy[ord.ind, ], 5)
```

```
                         chocolate fruity caramel peanutyalmondy nougat
Snickers                         1      0       1              1      1
Kit Kat                          1      0       0              0      0
Twix                             1      0       1              0      0
Reese's Miniatures               1      0       0              1      0
Reese's Peanut Butter cup        1      0       0              1      0
                         crispedricewafer hard bar pluribus sugarpercent
Snickers                                 0    0   1        0        0.546
Kit Kat                                  1    0   1        0        0.313
Twix                                     1    0   1        0        0.546
Reese's Miniatures                       0    0   0        0        0.034
Reese's Peanut Butter cup                0    0   0        0        0.720
                         pricepercent winpercent
Snickers                        0.651   76.67378
Kit Kat                         0.511   76.76860
Twix                            0.906   81.64291
Reese's Miniatures              0.279   81.86626
Reese's Peanut Butter cup       0.651   84.18029
```

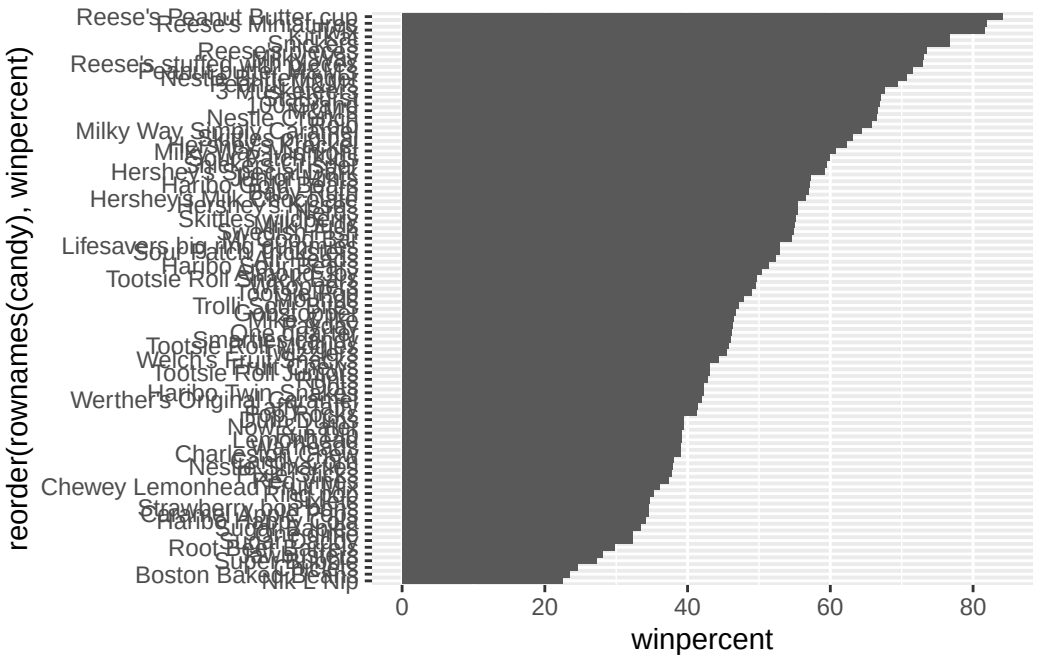
Q15. Make a first barplot of candy ranking based on winpercent values.

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

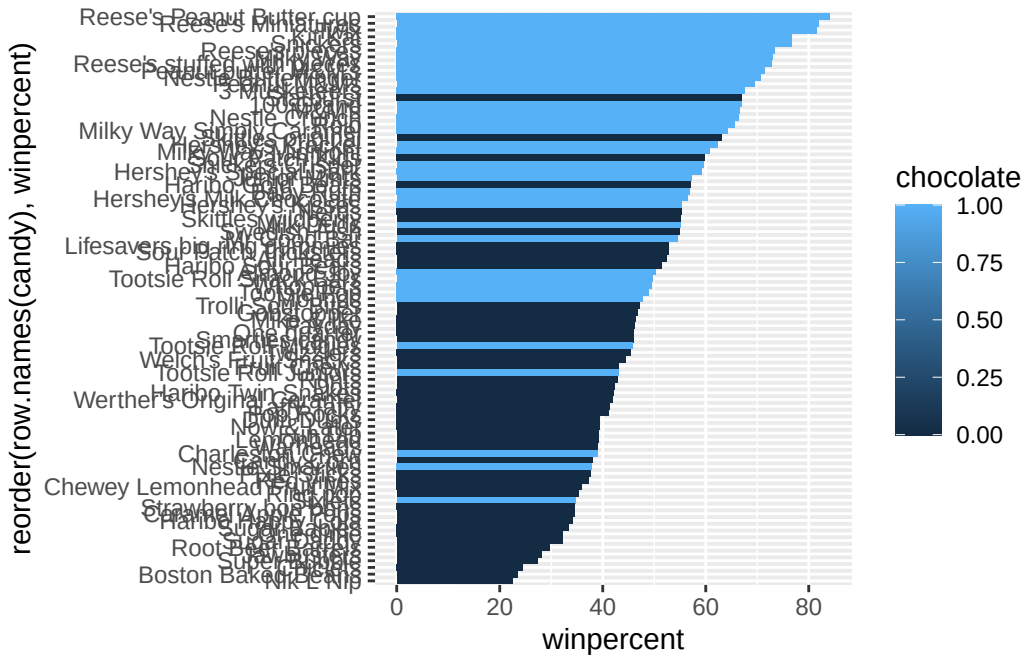


Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

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




```
ggplot(candy) +
  aes(winpercent,
      reorder(row.names(candy), winpercent),
      fill=chocolate)+
  geom_col()
```




```
ylab("")
```

```
<ggplot2::labels> List of 1
 $ y: chr ""
```

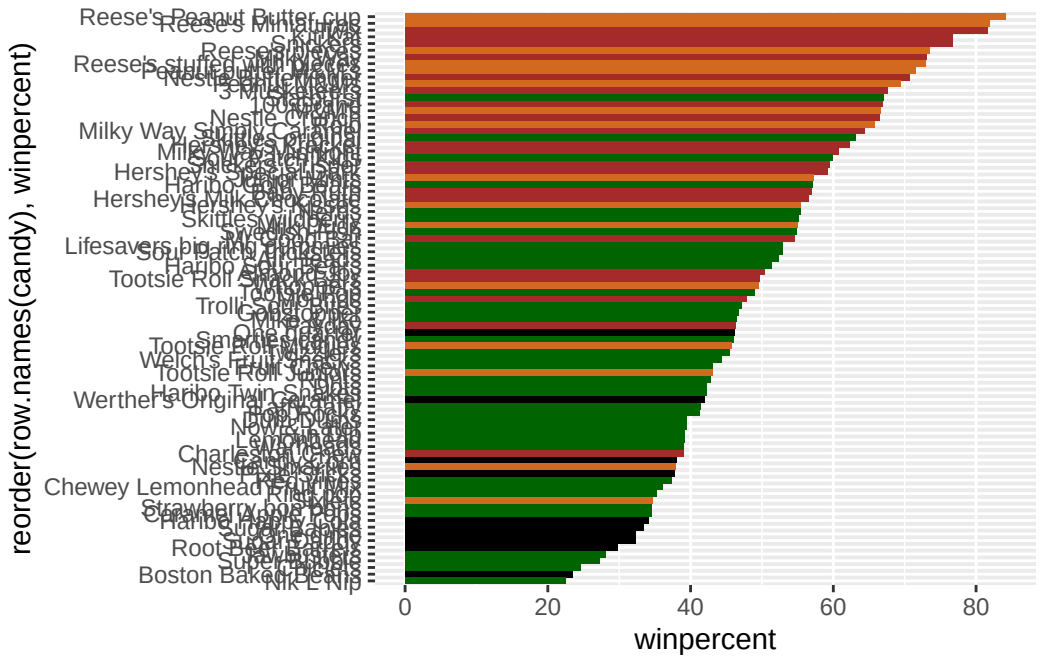
We need a custom color vector

```
my_cols <- rep("black", nrow(candy))
my_cols[candy$chocolate==1] <- "chocolate"
my_cols[candy$bar==1] <- "brown"
my_cols[candy$fruity==1] <- "darkgreen"
my_cols
```

```
 [1] "brown"     "brown"     "black"     "black"     "darkgreen" "brown"
 [7] "brown"     "black"     "black"     "darkgreen" "brown"     "darkgreen"
[13] "darkgreen" "darkgreen" "darkgreen" "darkgreen" "darkgreen" "darkgreen"
[19] "darkgreen" "black"     "darkgreen" "darkgreen" "chocolate" "brown"
[25] "brown"     "brown"     "darkgreen" "chocolate" "brown"     "darkgreen"
[31] "darkgreen" "darkgreen" "chocolate" "chocolate" "darkgreen" "chocolate"
[37] "brown"     "brown"     "brown"     "brown"     "brown"     "darkgreen"
[43] "brown"     "brown"     "darkgreen" "darkgreen" "brown"     "chocolate"
```

```
[49] "black"     "darkgreen" "darkgreen" "chocolate" "chocolate" "chocolate"
[55] "chocolate" "darkgreen" "chocolate" "black"     "darkgreen" "chocolate"
[61] "darkgreen" "darkgreen" "chocolate" "darkgreen" "brown"     "brown"
[67] "darkgreen" "darkgreen" "darkgreen" "darkgreen" "black"     "black"
[73] "darkgreen" "darkgreen" "darkgreen" "chocolate" "chocolate" "brown"
[79] "darkgreen" "brown"     "darkgreen" "darkgreen" "darkgreen" "black"
[85] "chocolate"
```

```
ggplot(candy) +
  aes(winpercent,
      reorder(row.names(candy), winpercent),
      )+
  geom_col(fill=my_cols)
```




```
ylab("")
```

```
<ggplot2::labels> List of 1
 $ y: chr ""
```

Q17. What is the worst ranked chocolate candy?

Sixlets

Q18. What is the best ranked fruity candy?

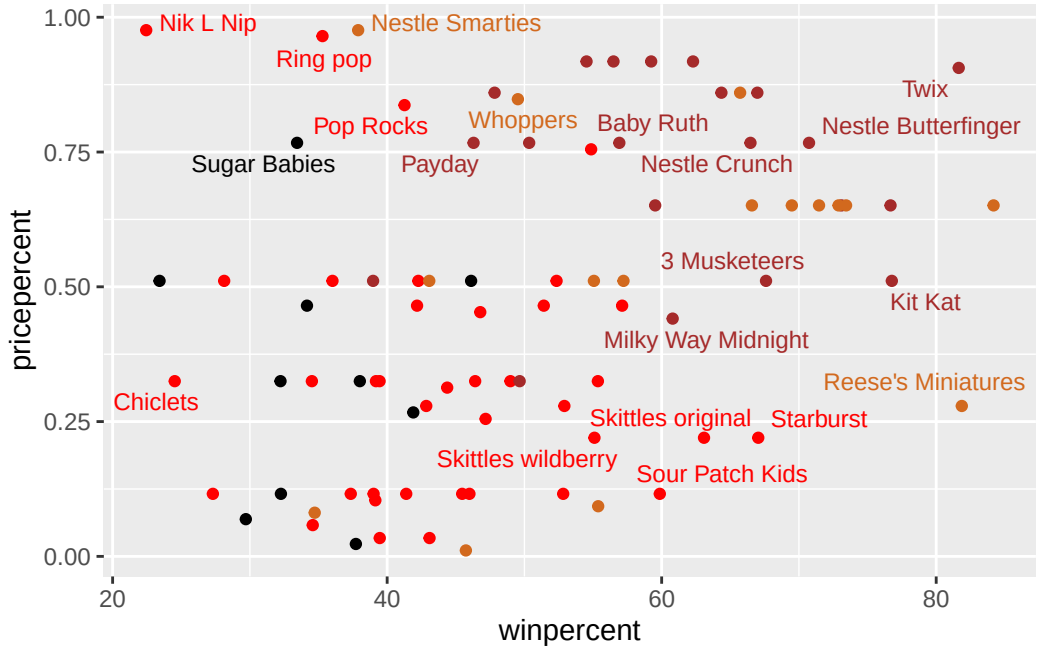
Starburst

Taking a look at pricepercent

```
library(ggrepel)
my_cols[candy$fruity==1] <- "red"

# How about a plot of win vs price
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?

Reese's Miniatures

> 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
```

Nik L Nip, Ring pop, Nestle Smarties, Herhsey's Krackel

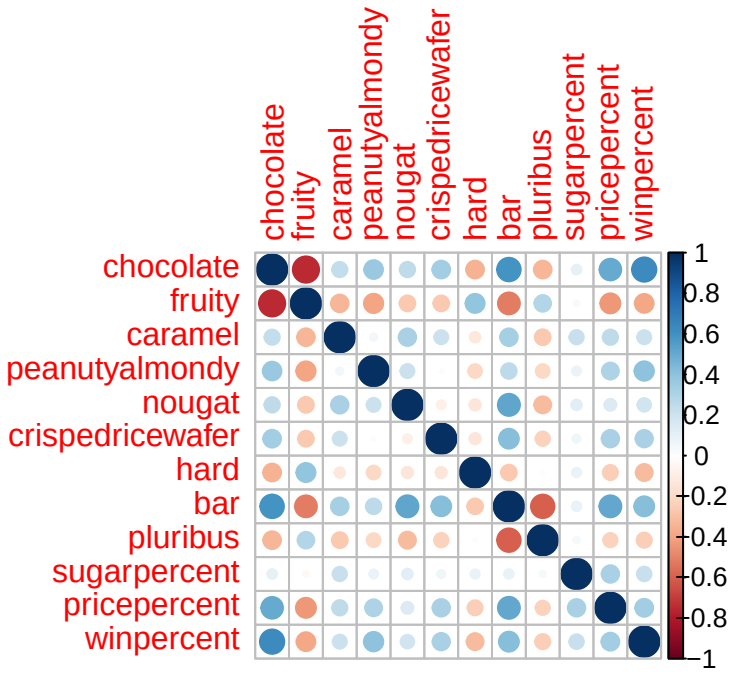
Exploring the correlation structure

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

```
library(corrplot)
```

```
corrplot 0.95 loaded
```

```
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 bar

Principal Component Analysis (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
```

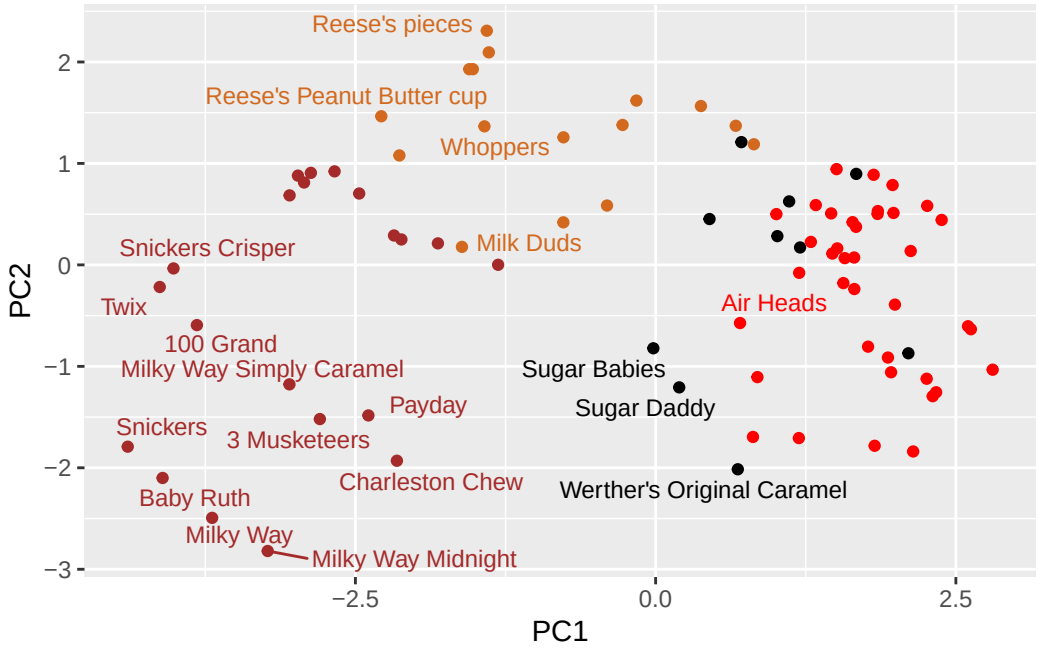
```
Cumulative Proportion  0.89998 0.93832 0.97071 0.98683 1.00000
```

Score plot...

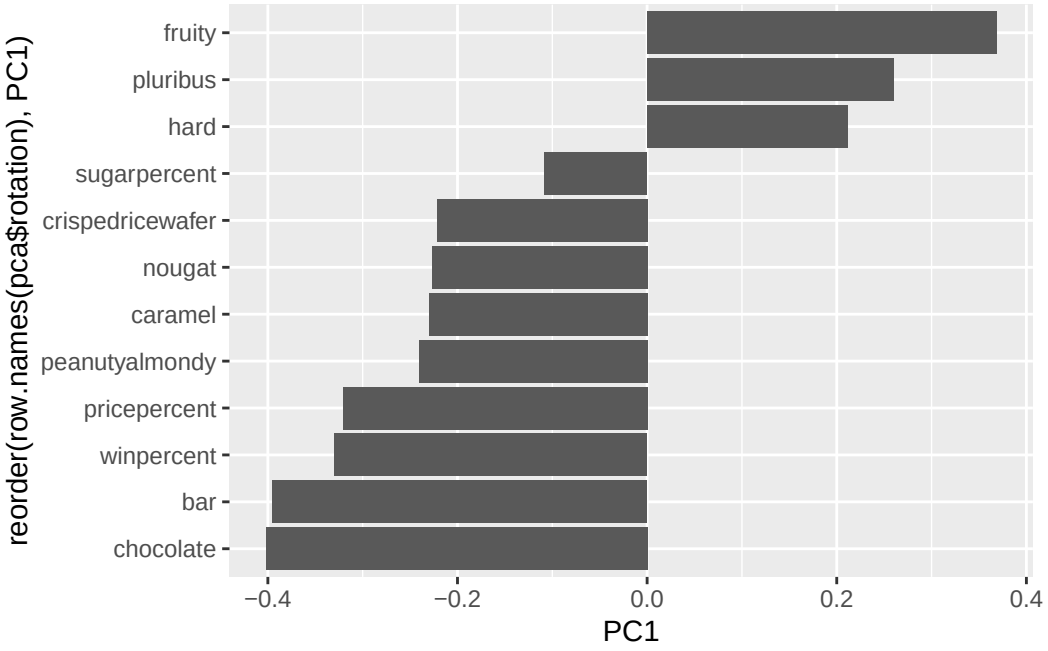
```
p <- ggplot(pca$x) +
  aes(PC1, PC2, label=row.names(pca$x))+
  geom_point(col=my_cols) +
    geom_text_repel(max.overlaps=5, size=3.3, col=my_cols)

p
```

```
Warning: ggrepel: 66 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```




```
ggplot(pca$rotation) +
  aes(PC1,
      reorder(row.names(pca$rotation), PC1)) +
  geom_col()
```




```
#library(plotly)
#ggplotly(p)
```

Q24. Complete the code to generate the loadings plot above. What original variables are picked up strongly by PC1 in the positive direction? Do these make sense to you? Where did you see this relationship highlighted previously?

Fruity, pluribus, and hard are picked up strongly in the positive direction. These make sense to me because they are characteristics of a fruity candy. These features/relationships were highlighted by the correlation plot previously.

Summary

Q25. Based on your exploratory analysis, correlation findings, and PCA results, what combination of characteristics appears to make a "winning" candy? How do these different analyses (visualization, correlation, PCA) support or complement each other in reaching this conclusion?

Combination of chocolate and bar seems to be the winning candy. This is seen with the correlation plot where these two characteristics combined had the deepest shade of blue coloring. The PCA also strongly picked up these combinations in the negative direction, stronger than any fruity candies. In the visualization, there were also more brown coloration and more were in the winpercent area, indicating that chocolate is both the majority and popularity.