Class 10: Halloween Mini Project

Libby (pid: A69047570)

Libraries

```
library(readr)
library(ggplot2)
library(tidyverse)
```

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
```

```
flextable::flextable(head(candy))
```

chocolate	fruity	caramel	peanutyalmondy	nougat	crispedricewafer	hard	bar	pluribus	s
1	0	1	0	0	1	0	1	0	
1	0	0	0	1	0	0	1	0	
0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	
0	1	0	0	0	0	0	0	0	
1	0	0	1	0	0	0	1	0	

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
```

Section 2: what is your favorite candy?

q3. What is your favorite candy in the dataset and what is it's winpercent value?

```
candy["Laffy Taffy", ]$winpercent
```

```
[1] 41.38956
```

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() function in the skimr package that can help give you a quick overview of a given da
skim(candy)
```

Table 2: 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?

winpercent looks like it is on a 0-100% scale whereas the other columns are 0-1.

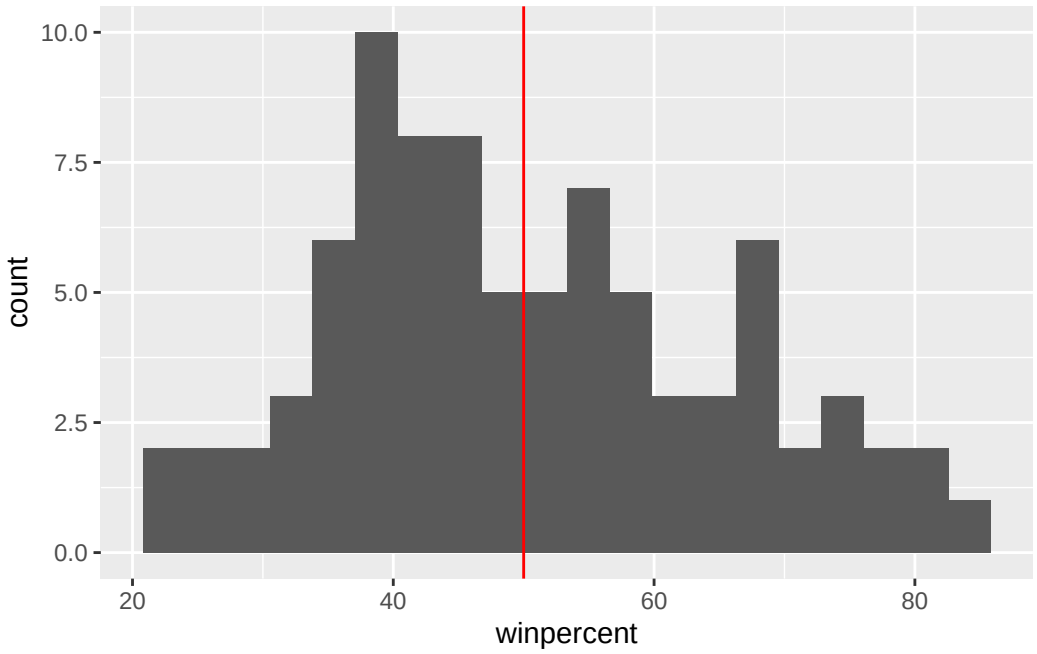
Q7. What do you think a zero and one represent for the candy$chocolate column?

They are representing conditionals. TRUE is 1 and FALSE is 0.

A good place to start any exploratory analysis is with a histogram. You can do this most easily with the base R function hist(). Alternatively, you can use ggplot() with geom_hist(). Either works well in this case and (as always) its your choice.

Q8. Plot a histogram of winpercent values

```
ggplot(candy, aes(x=winpercent)) +
  geom_histogram(bins=20) +
  geom_vline(xintercept = 50, color="red")
```

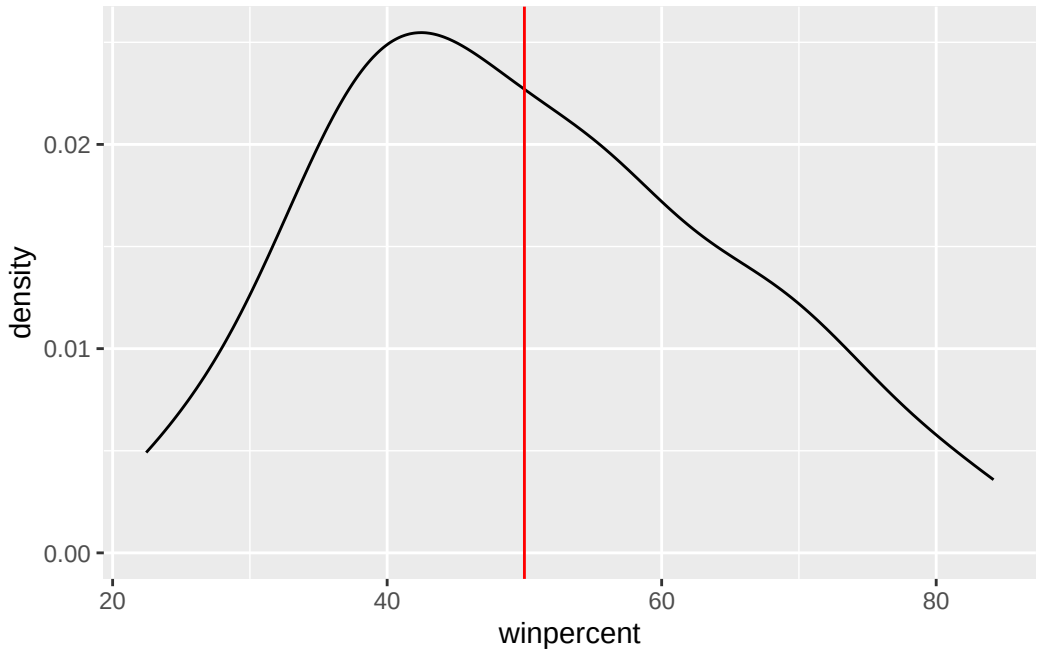


Q9. Is the distribution of winpercent values symmetrical?

It's not perfectly symmetrical, let's try a density plot. As you can see it is skewed to the left a bit.

```
ggplot(candy, aes(x=winpercent)) +
  geom_density(bins=20) +
  geom_vline(xintercept = 50, color="red")
```

```
Warning in geom_density(bins = 20): Ignoring unknown parameters: `bins`
```



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

Although the mean is above 50 (slightly at 50.3 %) due to outliers, the center of the distribution (median) is below 50% at 47.82%

```
win <- candy$winpercent

summary(win)
```

```
   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 candy is ranked higher than fruit candy on average at a win percent of 60.02% for chocolate compared to 44.12% of fruity candy

```
# 1. Find all chocolate candy in the dataset
# 2. Extract their winpercent values
# 3. Find the mean of the values
chocolate <- candy |>
  filter(chocolate == 1) |>
  summary(winpercent)
```

```
# Mean :60.92

fruity <- candy |>
  filter(fruity == 1) |>
  summary(winpercent)
# Mean :44.12

# Alternative:
# 1. Find all chocolate candy in the dataset
choc.inds <- as.logical(candy$chocolate)
choc.candy <- candy[choc.inds, ]
# 2. Extract their winpercent values
choc.win  <- choc.candy$winpercent
# 3. Find the mean of the values
mean(choc.win)
```

```
[1] 60.92153
```

```
# 1. Find all fruity candy in the dataset
fruity.inds <- as.logical(candy$fruity)
fruity.candy <- candy[fruity.inds, ]
# 2. Extract their winpercent values
fruity.win  <- fruity.candy$winpercent
# 3. Find the mean of the values
mean(fruity.win)
```

```
[1] 44.11974
```

Q12. Is this difference statistically significant?

Yes the answer is statistically significant, so chocolate candy is ranked higher than fruity candy, suggested here by the pvalue of 2.871e-08

```
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
```

3. Overall Candy Rankings

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

```
# with base 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
```

```
# with dplyr
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
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
```

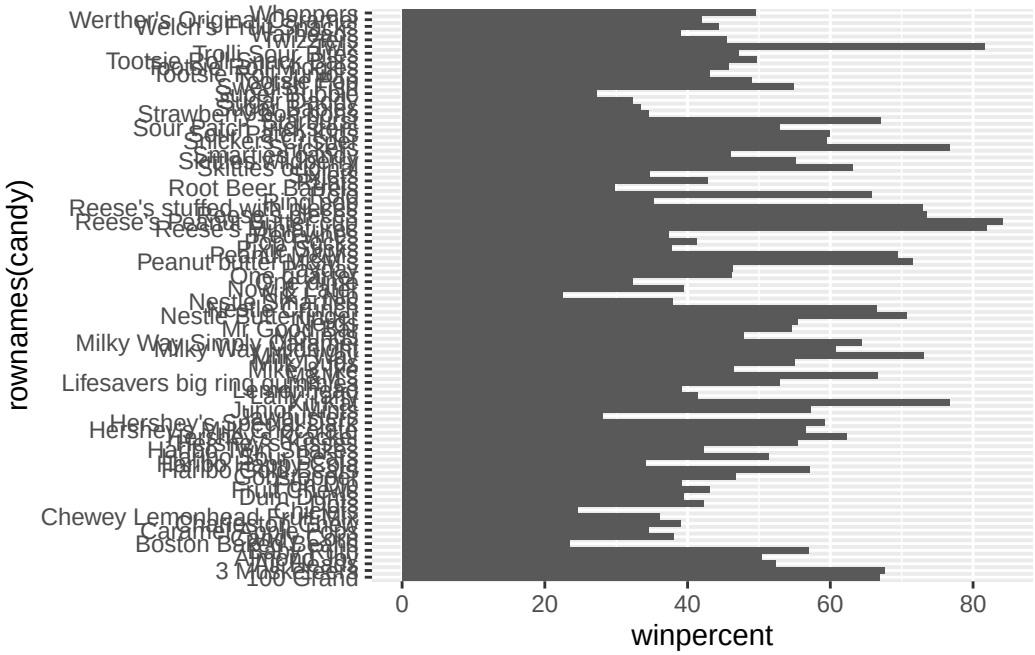
Q14. What are the top 5 all time favorite candy types out of this set?

```
candy |>
  arrange(-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_col()
```




```
x <- c(10,2,5,1)
order(x)
```

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

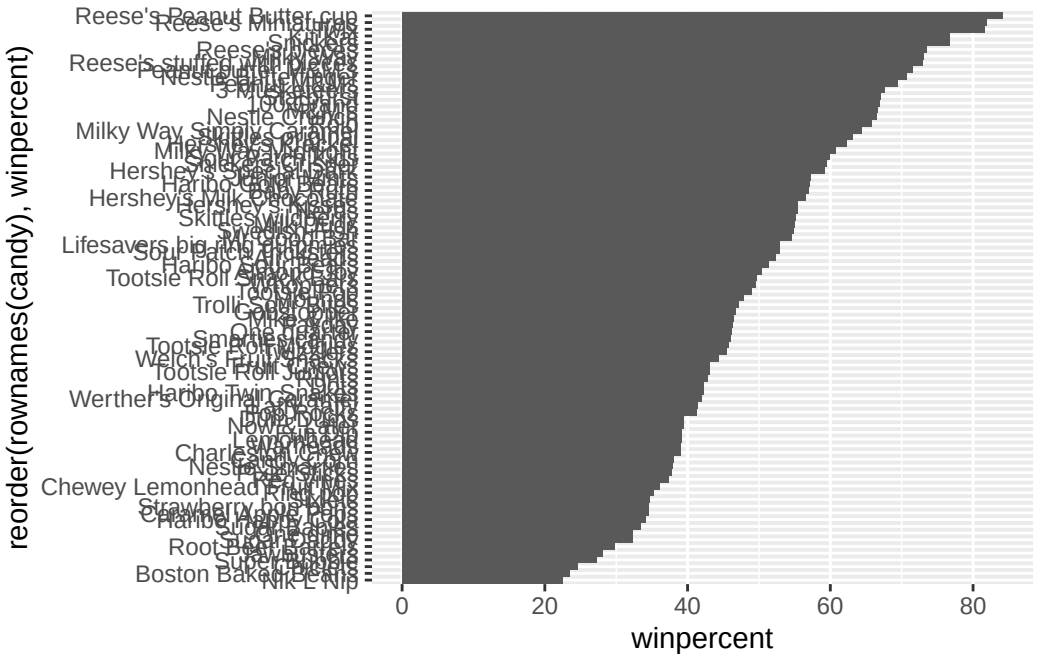
```
ord.ind <- order(candy$winpercent)
head(candy[ord.ind, ], 5)
```

```
                    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
```

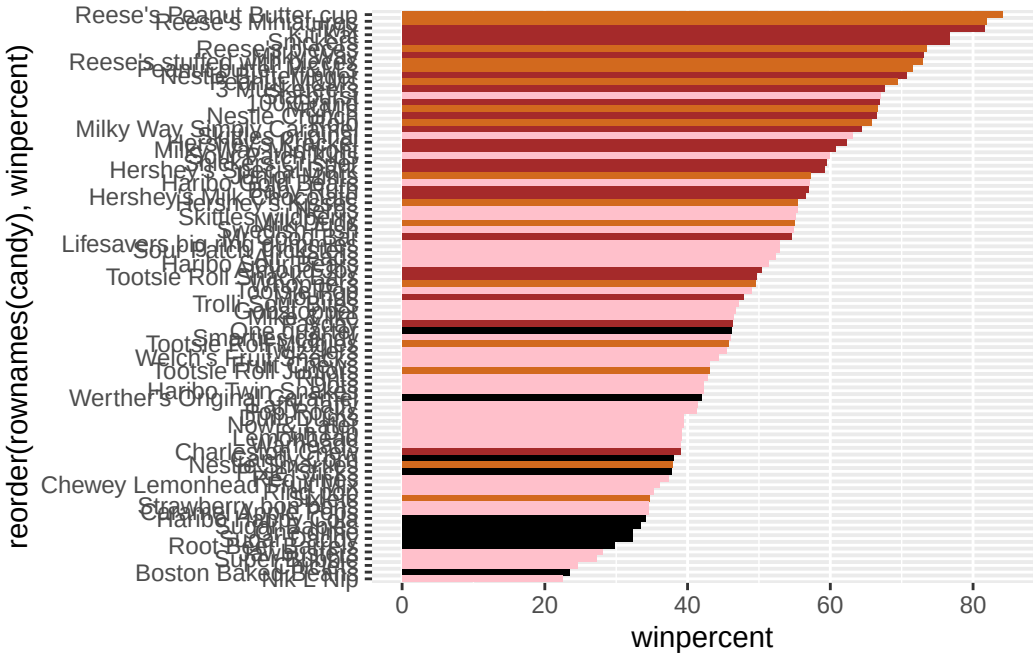
Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

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




```
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)
```



Q17. What is the worst ranked chocolate candy?

Sixlets are the worst ranked chocolate candy!

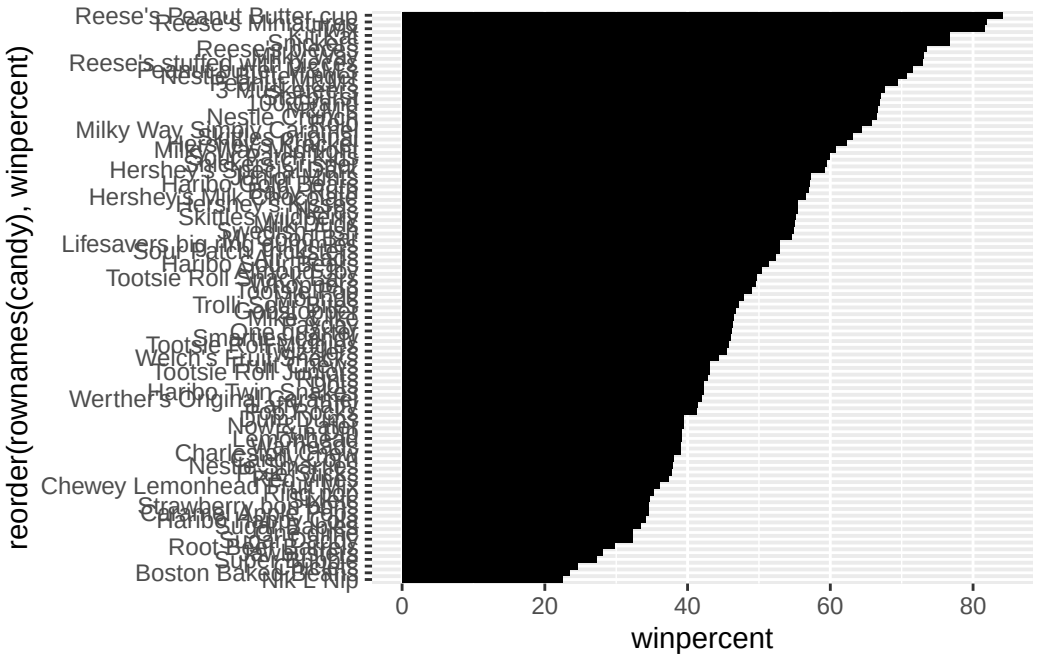
```
my_cols <- rep("black", nrow(candy))
candy$chocolate==1
```

```
 [1]  TRUE  TRUE FALSE FALSE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE FALSE
[13] FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE FALSE  TRUE  TRUE
[25]  TRUE  TRUE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE  TRUE FALSE  TRUE
[37]  TRUE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE  TRUE FALSE FALSE FALSE  TRUE
[49] FALSE FALSE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE FALSE  TRUE
[61] FALSE FALSE  TRUE FALSE  TRUE  TRUE FALSE FALSE FALSE FALSE FALSE FALSE
[73] FALSE FALSE  TRUE  TRUE  TRUE  TRUE FALSE  TRUE FALSE FALSE FALSE FALSE
[85]  TRUE
```

```
my_cols
```

```
 [1] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[10] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[19] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[28] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[37] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[46] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[55] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[64] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[73] "black" "black" "black" "black" "black" "black" "black" "black" "black"
[82] "black" "black" "black" "black"
```

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



Q18. What is the best ranked fruity candy?

Starburst is the best ranked fruity candy!

Section 4

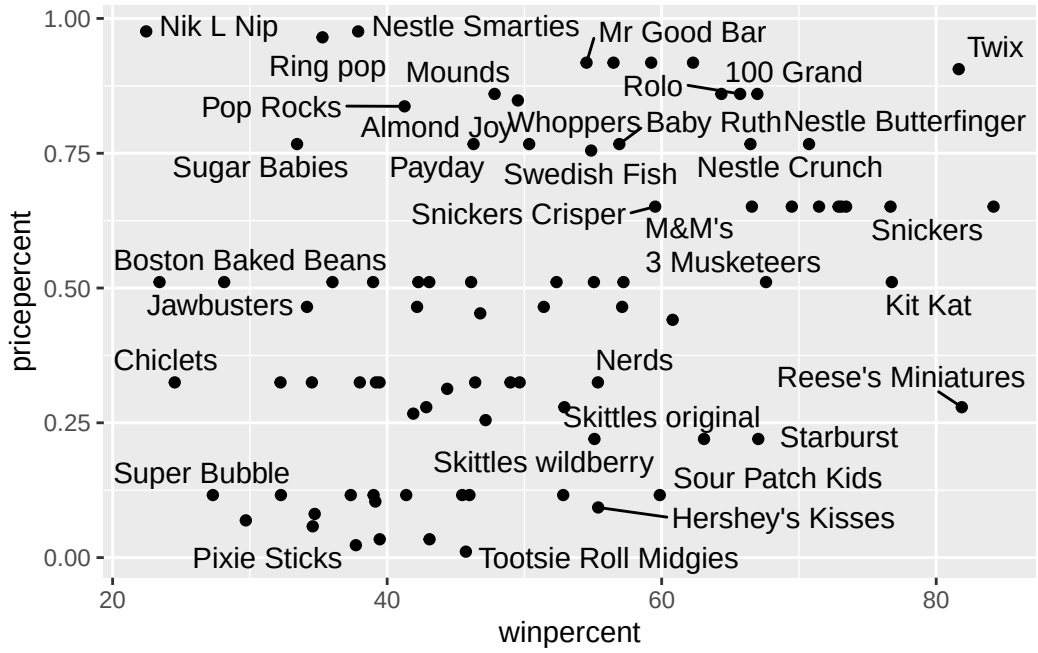
Winpercent v PricePercent

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?

The fruity candies offer more band for your buck, with Starburst seeming to be the highest ranked for best cost, reeses miniatures may contend with it too, but it does have a slightly higher price percent.

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

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



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
```

Correlation structure

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

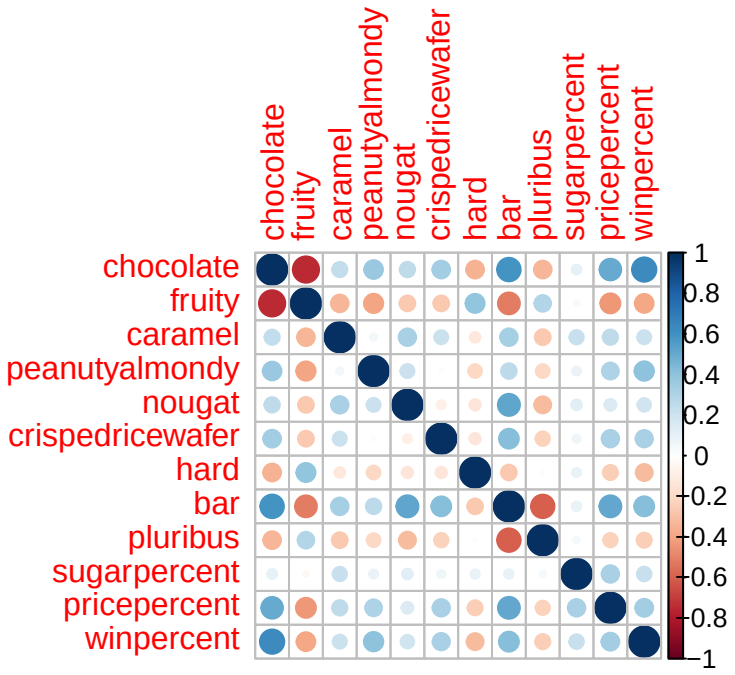
fruity and chocolate are anti-correlated, also pluribus and bar but less so than fruity and chocolate

```
cij <- cor(candy) # takes all cols in dataset, so an nxn correlation matrix
```

```
library(corrplot)
```

```
corrplot 0.95 loaded
```

```
corrplot(cij)
```



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

Aside from the 1:1 match, when items are paired against themselves, chocolate and winpercent are most positively correlated.

6. Principal Component Analysis

The main function in base R for this `prcomp()` remember it has a scale parameter you basically always want to use; `scale=TRUE`

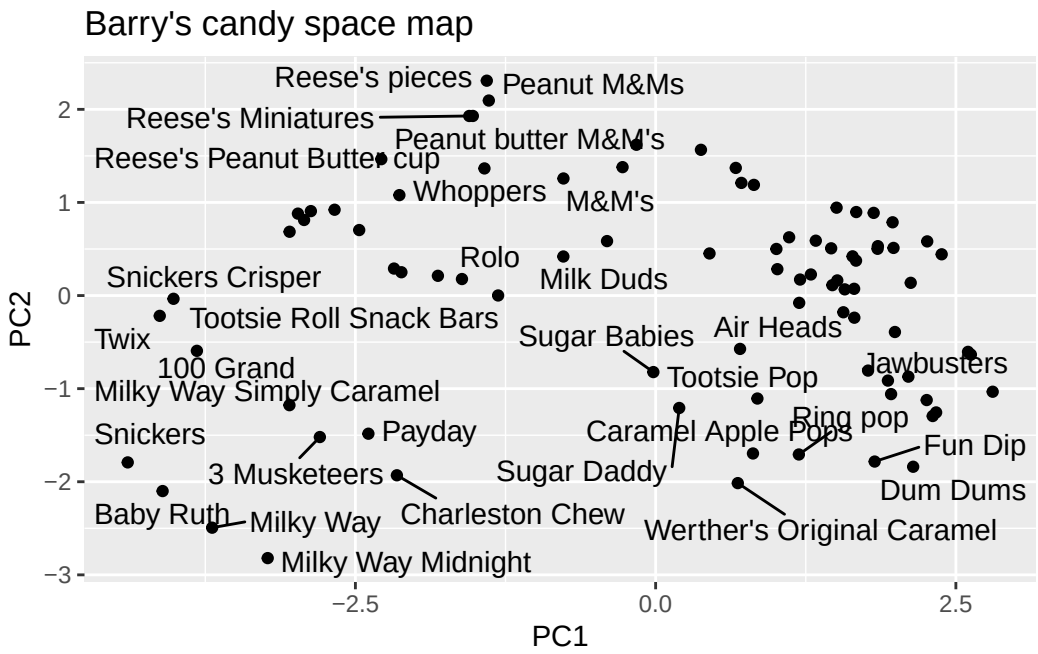
```
pca <- prcomp(candy, scale=TRUE)
summary(pca)
```

```
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
```

Let's first look at our first main result figure - the "PC Plot" or PC1 v PC2 plot

```
ggplot(pca$x) + # shows where candies lie
  aes(PC1, PC2, label=rownames(pca$x)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols) +
  labs(title = "Barry's candy space map")
```

```
Warning: ggrepel: 54 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Don't forget about your variable loadings – how the original variables contribute to your new PCs….

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

Fruity, hard, and pluribus are most strongly picked up by PC1 in the positive direction. This makes sense because most fruity candy does seem to be hard, and because it is cheaper comes in multiples more than chocolate candy.

```
ggplot(pca$rotation) +
  aes(PC1, rownames(pca$rotation)) +
  geom_col()
```