Halloween Candy

Julia Ainsworth

Quarto

In this mini-project we will examine 538 Halloween Candy data. What is your favorite candy? What is nougat anyway??

Importing the candy dataset

```
candy <- read.csv("candy-data.csv", 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 the dataset?

```
num_fruity_candies <- sum(candy$fruity)
num_fruity_candies
```

```
[1] 38
```

Finding out how popular the candy is:

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

```
[1] 81.64291
```

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

A: Reese's pieces

```
candy["ReeseÕs pieces", ]$winpercent
```

```
[1] 73.43499
```

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
```

Installed the skimr package:

```
#can use skimr::skim()

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?

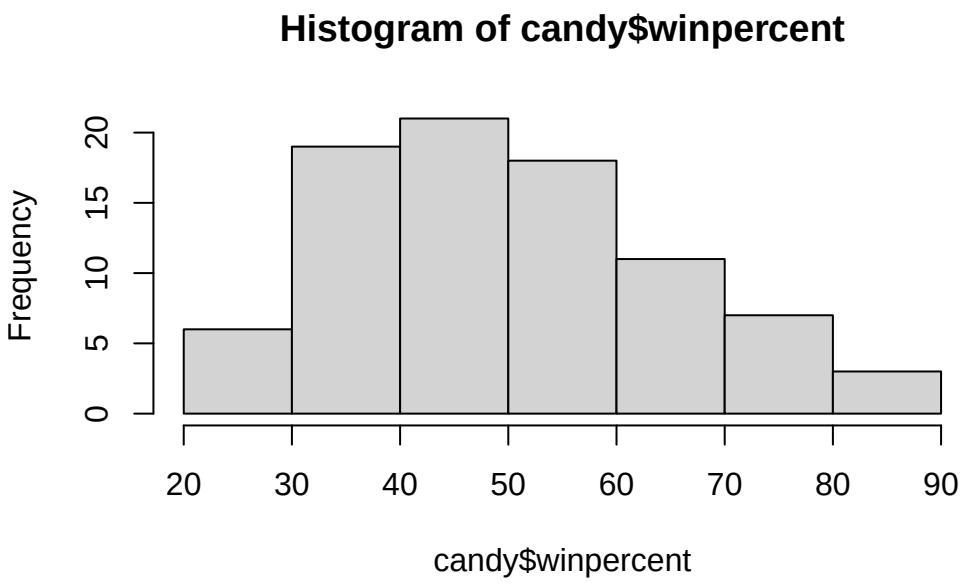
A: winpercent is on a different scale than the rest of the columns in the dataset

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

Probably true or false for whether the candy contains chocolate or not

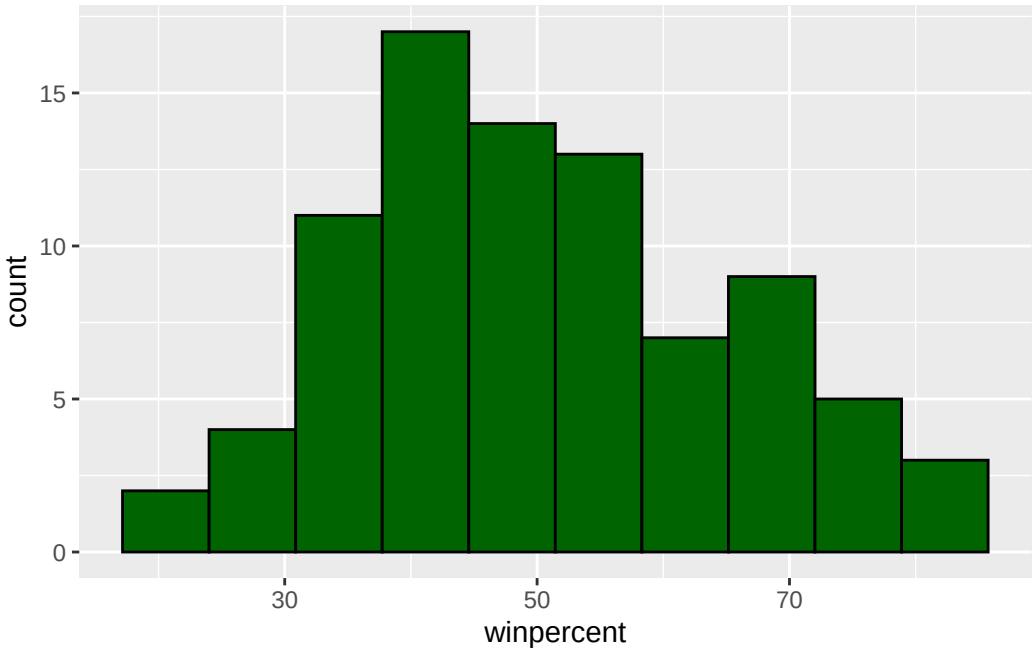
Q8. Plot a histogram of winpercent values

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



Alternately, using ggplot

```
library(ggplot2)
ggplot(candy) +
  aes(winpercent) +
  geom_histogram(bins =10, col="black", fill="darkgreen")
```



Q9. Is the distribution of winpercent values symmetrical?

No

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

Below

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

Higher!

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

```
[1] 60.92153
```

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

```
[1] 44.11974
```

Q12. Is this difference statistically significant?

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

```
    Welch Two Sample t-test

data:  chocolate.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
```

A: looks like yes!

3. Overall Candy Rankings

The base R `sort()` and `order()` functions are very useful!

```
x <- c(5, 2, 1, 6)
sort(x)
```

```
[1] 1 2 5 6
```

```
# versus

x[order(x)]
```

```
[1] 1 2 5 6
```

We can arrange this dataset using dplyr This one arranges them in ascending order so we can see the lowest 5

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

```
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 %>%
  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(desc(winpercent)) %>%
  head(n=5)
```

	chocolate	fruity	caramel	peanutyalmondy	nougat
ReeseÕs Peanut Butter cup	1	0	0	1	0
ReeseÕs 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
ReeseÕs Peanut Butter cup	0	0	0	0	0.720
ReeseÕs 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

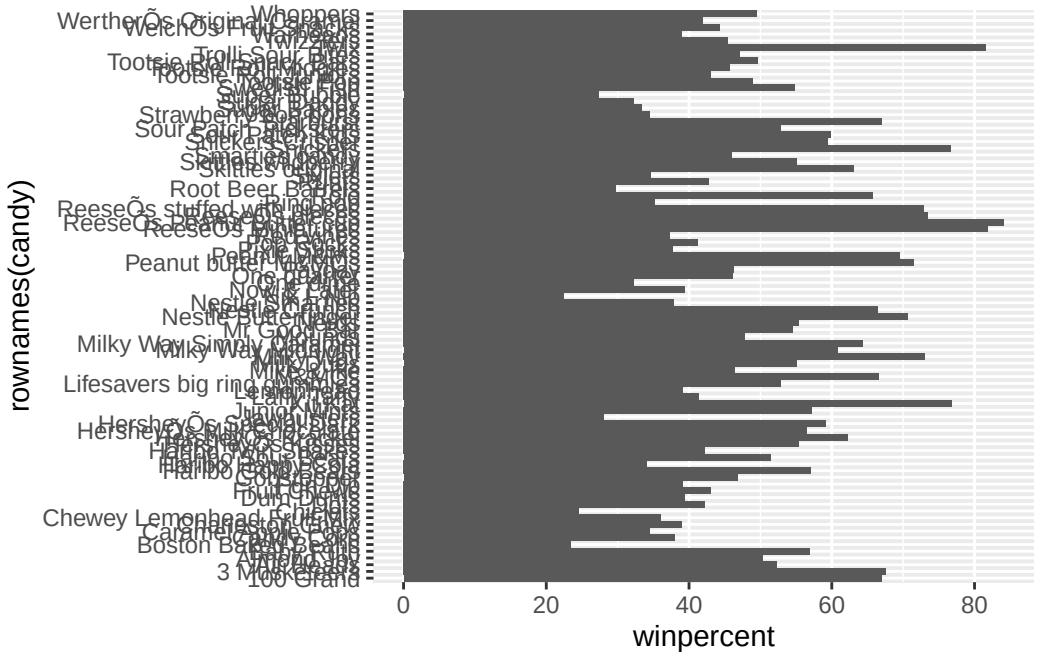
	pricepercent	winpercent
ReeseÕs Peanut Butter cup	0.651	84.18029
ReeseÕs Miniatures	0.279	81.86626
Twix	0.906	81.64291
Kit Kat	0.511	76.76860
Snickers	0.651	76.67378

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

Using ggplot: (note: use geom_col over geom_bar most of the time!!)

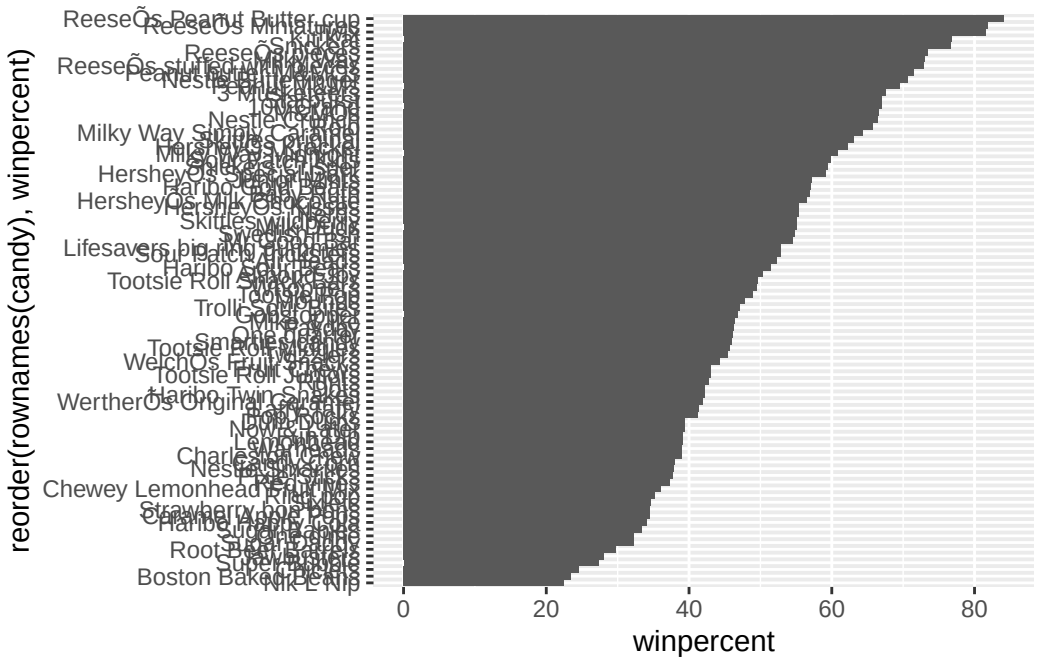
```
library(ggplot2)

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



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

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



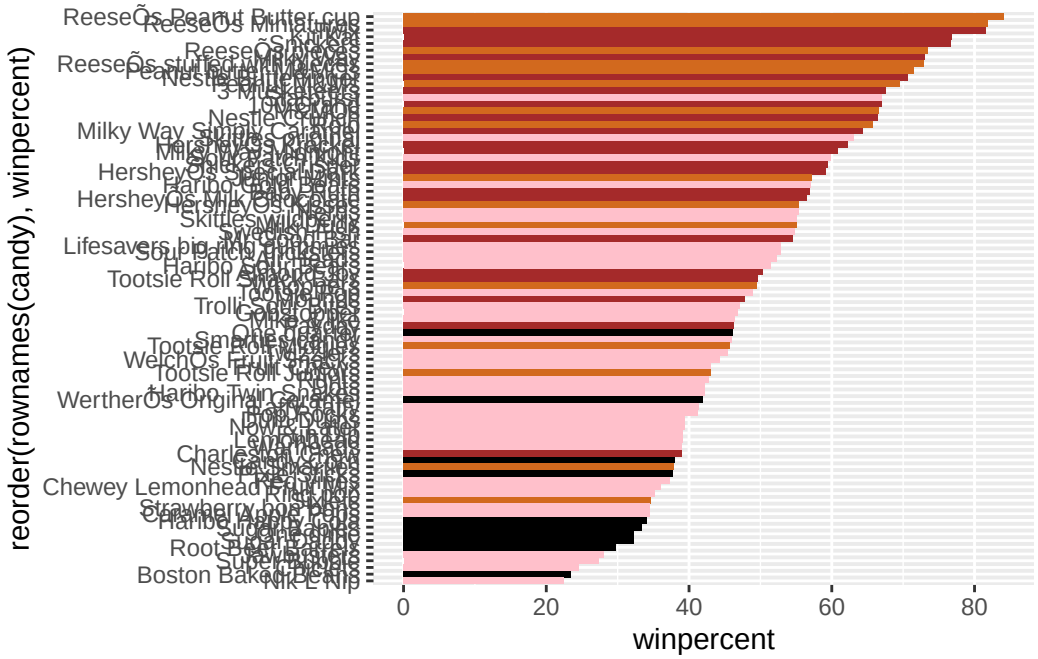
If I wanted to save this, I would use:

```
#If I want to save this barplot
# ggsave("mybarplot.png")
```

To use colors for the plot, we need to set up a vector with colors

```
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?

A: Nik E Nip

- Q18. What is the best ranked fruity candy?

A: Starburst

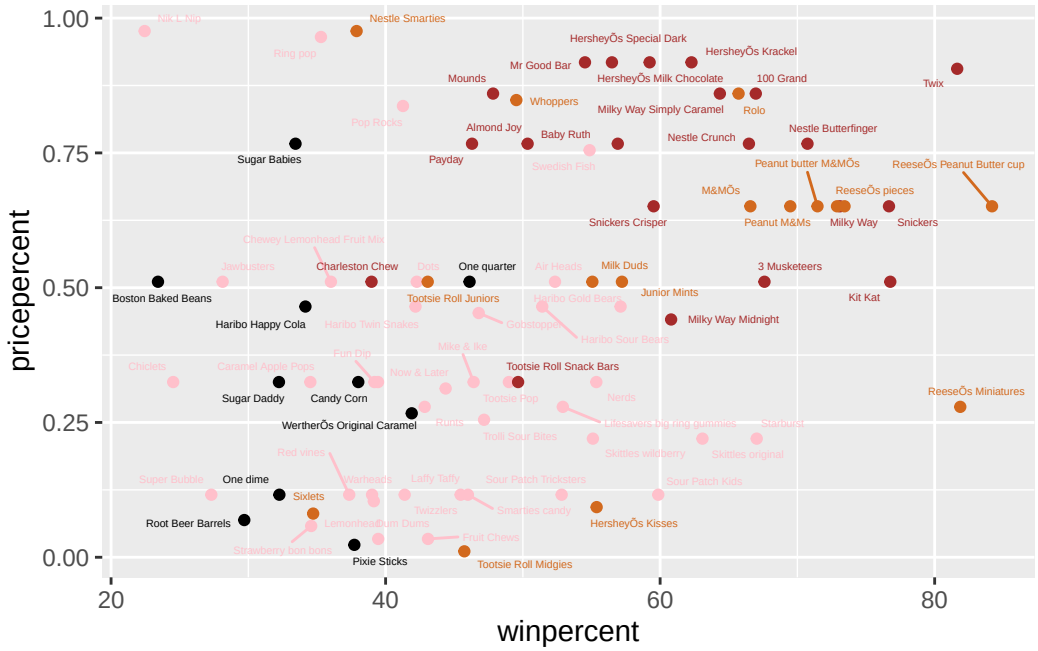
Now we can use ggrepel to make the text labels easier to read

```
library(ggrepel)

#A plot of price vs the percentage of winning

ggplot(candy) +
  aes(winpercent, pricepercent, label =rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, size = 1.4, max.overlaps = 11)
```

```
Warning: ggrepel: 2 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```




```
# this combination of arguments for text_repel gets us a plot with everything labeled
```

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?

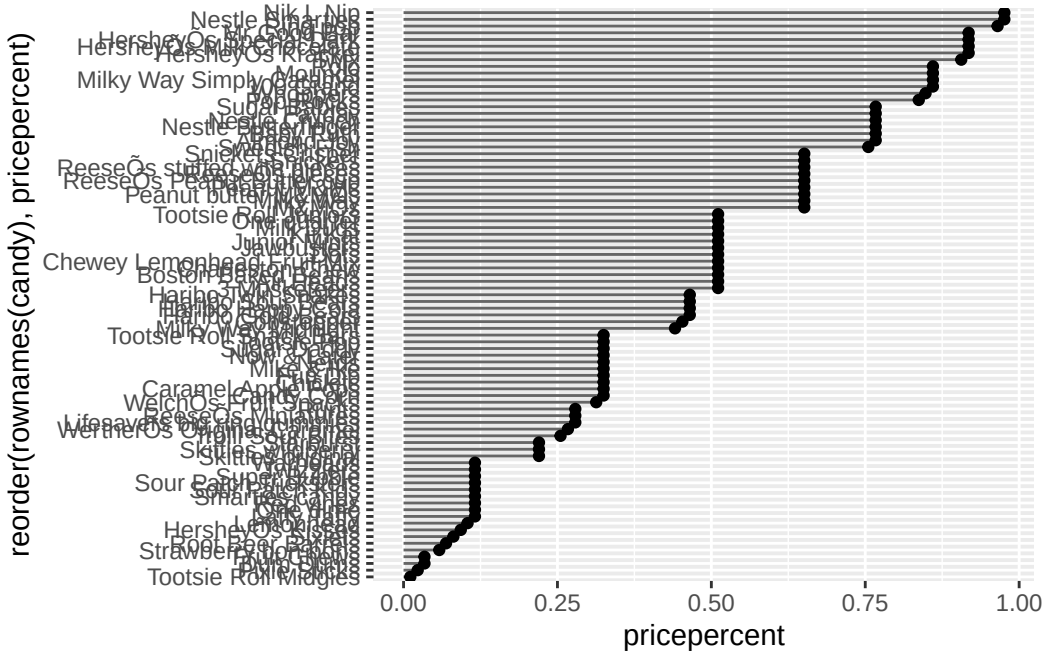
```
ord <- order(candy$pricepercent, decreasing = T)
head( candy[ord, c(11,12)], n =5)
```

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

The least popular among the most expensive candy types is Nik L Nip

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().

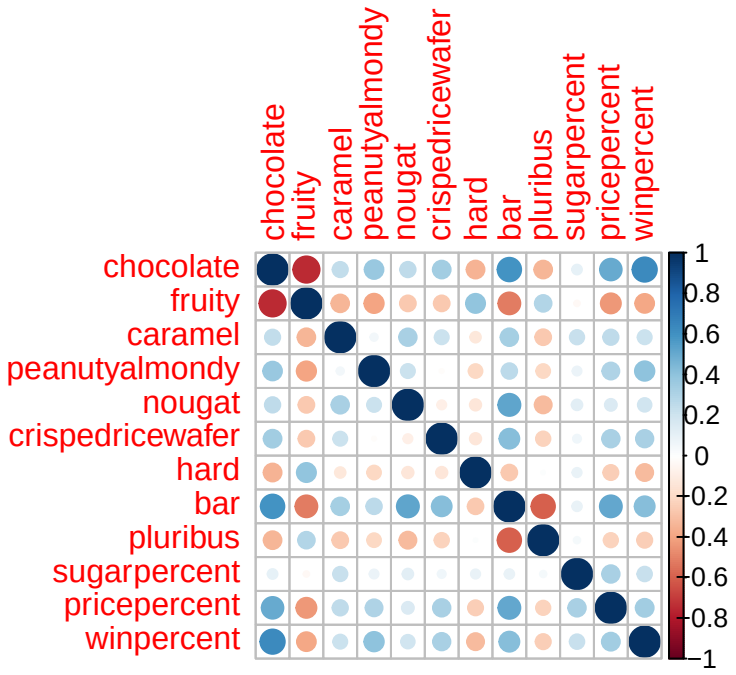
```
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_segment(aes(yend  =reorder(rownames(candy), pricepercent),
                   xend=0), col="gray40") +
  geom_point()
```




```
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 and fruit!

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

Winpercent and chocolate seem to be associated

Now we can use PCA to the candy dataset, remembering that we need to scale the data because winpercent is at a different scale than the rest of the data (0 to 100 instead of 0 to 1)

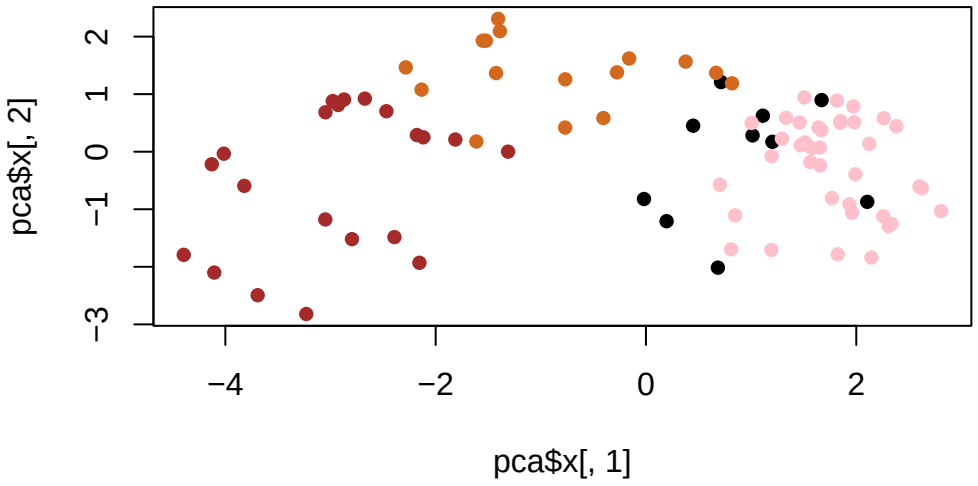
```
pca <- prcomp(candy, scale = T)
summary(pca)
```

```
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
```

Now we can plot PC1 vs PC2

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

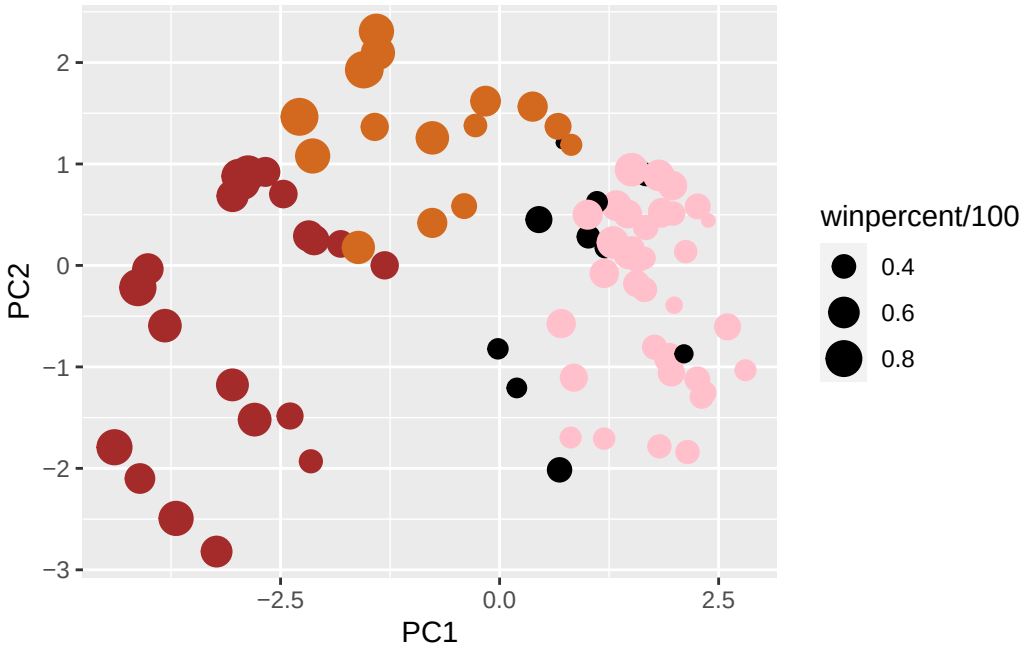


Now we can make a new dataframe with our PCA results and candy data to be able to plot this with ggplot

```
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
```

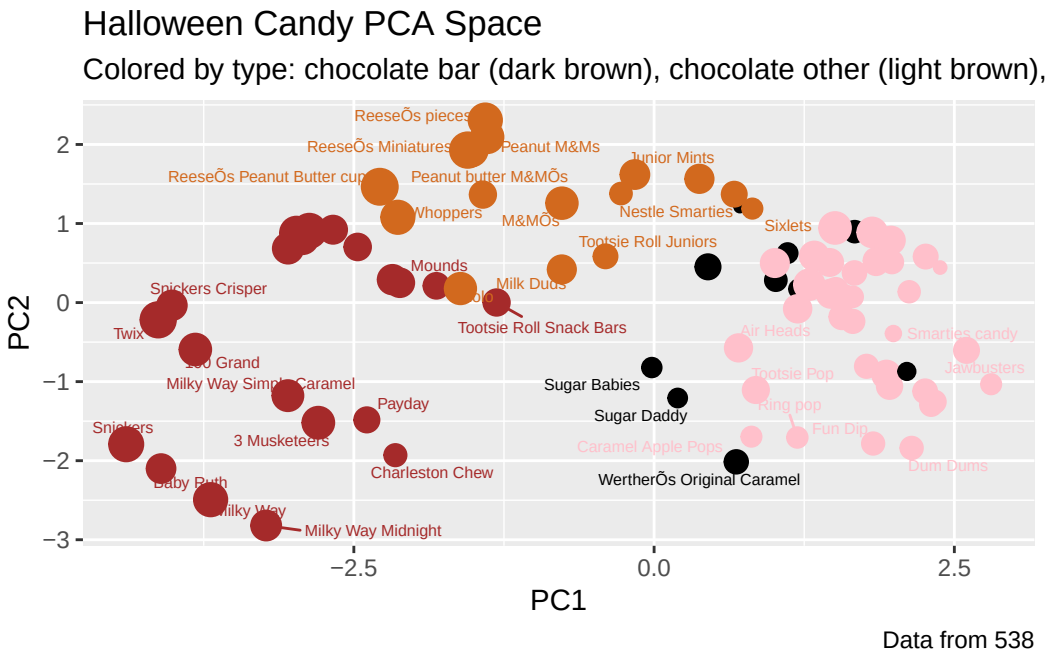


Then we will add non-overlapping candy names, title, and a subtitle

```
library(ggrepel)

p + geom_text_repel(size = 2.2, 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 bro
       caption = "Data from 538")
```

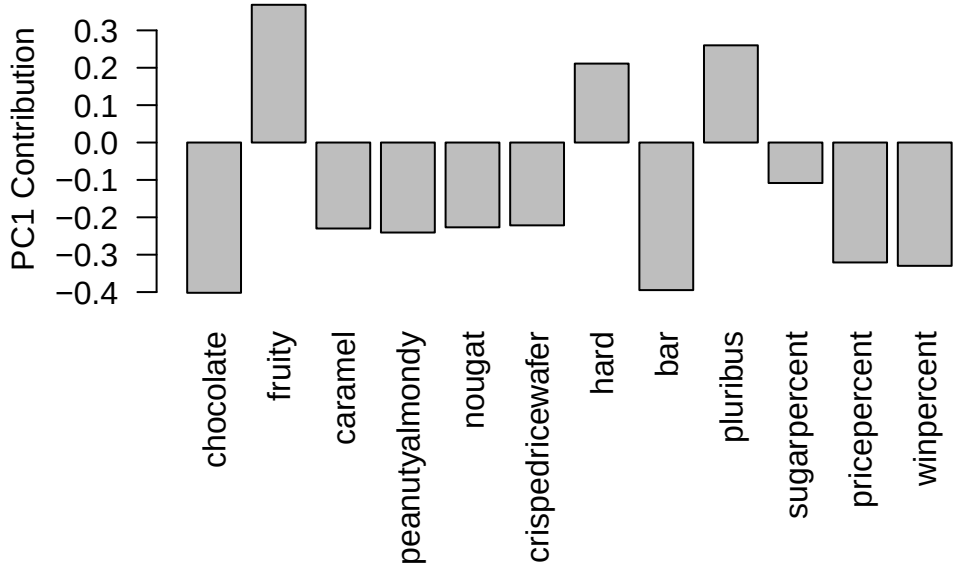
```
Warning: ggrepel: 48 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Also trying plotly to be able to mouse over the plot: Note: this worked, but the pdf did not like it!! I have commented it out

```
# 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?

Yes! It is showing us what we've seen throughout the dataset, where fruity and pluribus are very different from chocolate and bar