Class 10: Mini Project

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Importing Candy 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?

```
dim(candy)
```

```
[1] 85 12
```

```
nrow(candy)
```

```
[1] 85
```

There are 85 different candy types in this dataset.

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

```
sum(candy[,"fruity"])
```

```
[1] 38
```

```
table(candy$fruity)
```

```
 0  1
47 38
```

There are 38 fruity candy types in the data set.

What is your favorite candy

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

```
[1] 81.64291
```

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

```
#first view all the names of candies
row.names(candy)
```

```
 [1] "100 Grand"                 "3 Musketeers"
 [3] "One dime"                  "One quarter"
 [5] "Air Heads"                 "Almond Joy"
 [7] "Baby Ruth"                 "Boston Baked Beans"
 [9] "Candy Corn"                "Caramel Apple Pops"
[11] "Charleston Chew"           "Chewey Lemonhead Fruit Mix"
[13] "Chiclets"                  "Dots"
[15] "Dum Dums"                  "Fruit Chews"
```

```
[17] "Fun Dip"                      "Gobstopper"
[19] "Haribo Gold Bears"            "Haribo Happy Cola"
[21] "Haribo Sour Bears"            "Haribo Twin Snakes"
[23] "Hershey's Kisses"             "Hershey's Krackel"
[25] "Hershey's Milk Chocolate"     "Hershey's Special Dark"
[27] "Jawbusters"                   "Junior Mints"
[29] "Kit Kat"                      "Laffy Taffy"
[31] "Lemonhead"                    "Lifesavers big ring gummies"
[33] "Peanut butter M&M's"          "M&M's"
[35] "Mike & Ike"                   "Milk Duds"
[37] "Milky Way"                    "Milky Way Midnight"
[39] "Milky Way Simply Caramel"     "Mounds"
[41] "Mr Good Bar"                  "Nerds"
[43] "Nestle Butterfinger"          "Nestle Crunch"
[45] "Nik L Nip"                    "Now & Later"
[47] "Payday"                       "Peanut M&Ms"
[49] "Pixie Sticks"                 "Pop Rocks"
[51] "Red vines"                    "Reese's Miniatures"
[53] "Reese's Peanut Butter cup"    "Reese's pieces"
[55] "Reese's stuffed with pieces" "Ring pop"
[57] "Rolo"                         "Root Beer Barrels"
[59] "Runts"                        "Sixlets"
[61] "Skittles original"            "Skittles wildberry"
[63] "Nestle Smarties"              "Smarties candy"
[65] "Snickers"                     "Snickers Crisper"
[67] "Sour Patch Kids"              "Sour Patch Tricksters"
[69] "Starburst"                    "Strawberry bon bons"
[71] "Sugar Babies"                 "Sugar Daddy"
[73] "Super Bubble"                 "Swedish Fish"
[75] "Tootsie Pop"                  "Tootsie Roll Juniors"
[77] "Tootsie Roll Midgies"         "Tootsie Roll Snack Bars"
[79] "Trolli Sour Bites"            "Twix"
[81] "Twizzlers"                    "Warheads"
[83] "Welch's Fruit Snacks"         "Werther's Original Caramel"
[85] "Whoppers"
```

```r
#view favorite candy and its win percent
round(candy["Skittles original",]$winpercent, 2)
```

```
[1] 63.09
```

Skittles original has a win percent of 63.09%

Q4. What is the winpercent value for "Kit Kat"?

```
round(candy["Kit Kat",]$winpercent, 2)
```

```
[1] 76.77
```

Q5. What is the winpercent value for "Tootsie Roll Snack Bars"?

```
round(candy["Tootsie Roll Snack Bars",]$winpercent, 2)
```

```
[1] 49.65
```

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

```
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	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
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	

The "winpercent" column seems to be on a different scale

Q7. What do you think a zero and one represent for the candy$chocolate column? Hint: look at the "Variable type" print out from the skim() function. Most varables (i.e. columns) are on the zero to one scale but not all. Some columns such as chocolate are exclusively either zero or one values.

```
skim(candy$chocolate)
```

Table 3: Data summary

Name	candy$chocolate
Number of rows	85
Number of columns	1
_____	
Column type frequency:	
numeric	1
_____	
Group variables	None

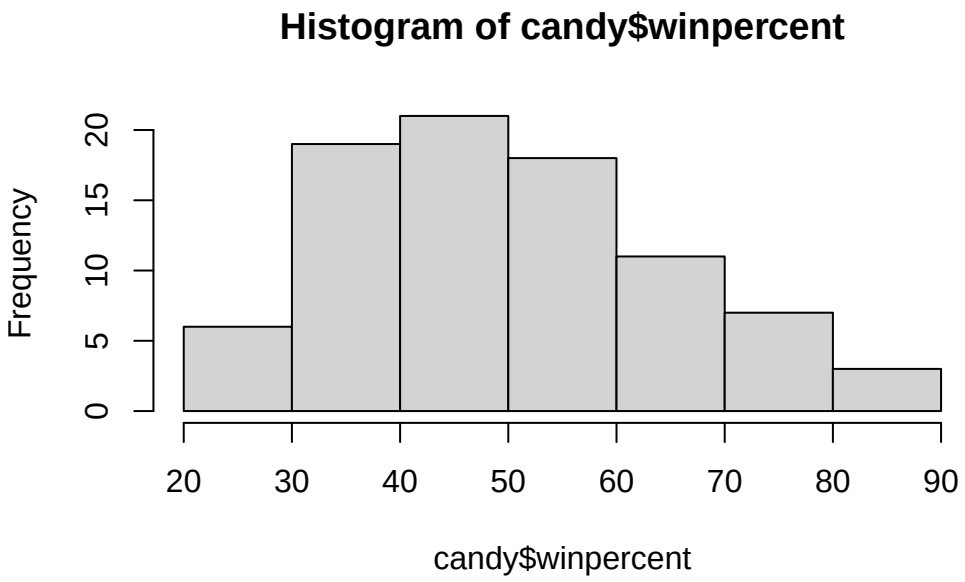
Variable type: numeric

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
data	0	1	0.44	0.5	0	0	0	1	1	

A value of 0 indicates that there is no chocolate within the candy, while a value of 1 indicates that there is chocolate in the candy.

Q8. Plot a histogram of winpercent values

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



Q9. Is the distribution of winpercent values symmetrical?

The distribution is not symmetrical.

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

```
median(candy$winpercent)
```

```
[1] 47.82975
```

The center of the distribution is below 50 %

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

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

```
[1] 60.92153
```

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

```
[1] 44.11974
```

On average, chocolate candy is higher ranked than fruity candy.

Q12. Is this difference statistically significant?

```
t.test( candy$winpercent[as.logical(candy$chocolate)],  candy$winpercent[as.logical(candy$
```

```
    Welch Two Sample t-test

data:  candy$winpercent[as.logical(candy$chocolate)] and candy$winpercent[as.logical(candy$fi
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
```

Due to the p-value of 2.87e-08, we can reject the null hypothesis. Therefore, we have enough evidence to declare the two means are different.

Overall Candy Rankings

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

```
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
```

```
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
```

The five least liked candies are Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, and Jawbusters.

Which apprach do you prefer and why?

I prefer the `order()` function of R studio as it does not require the dplyr package.

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

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

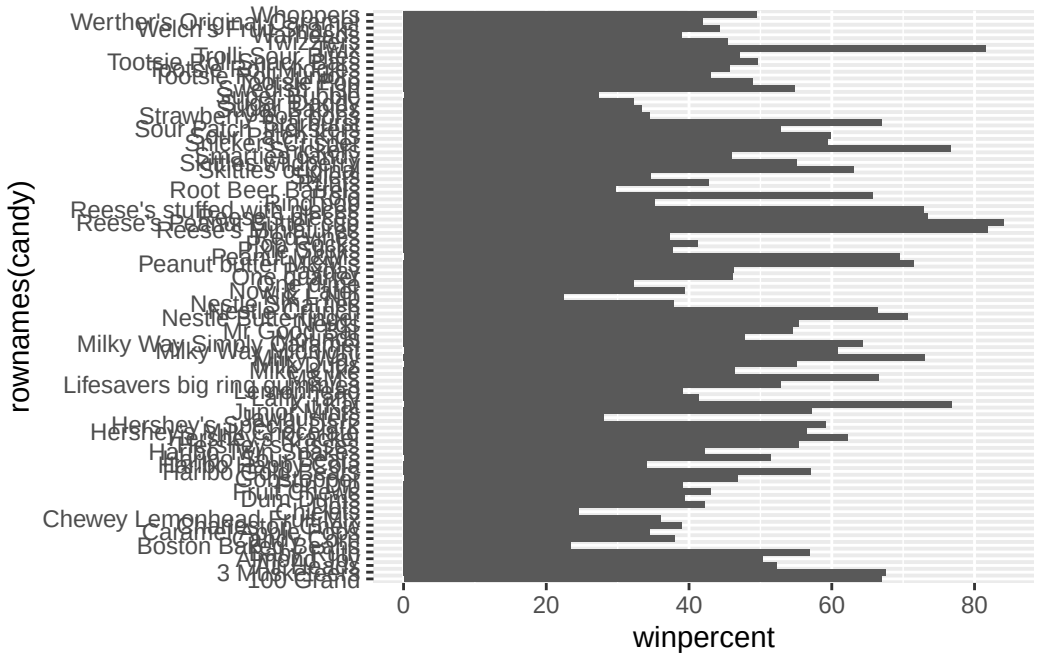
```
                         chocolate fruity caramel peanutyalmondy nougat
Reese's Peanut Butter cup         1      0       0              1      0
Reese's Miniatures                1      0       0              1      0
Twix                              1      0       1              0      0
Kit Kat                           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
```

The top five are Reese's Peanity Butter cup, Reese's Miniatures, Twix, Kit Kat, and Snickers.

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

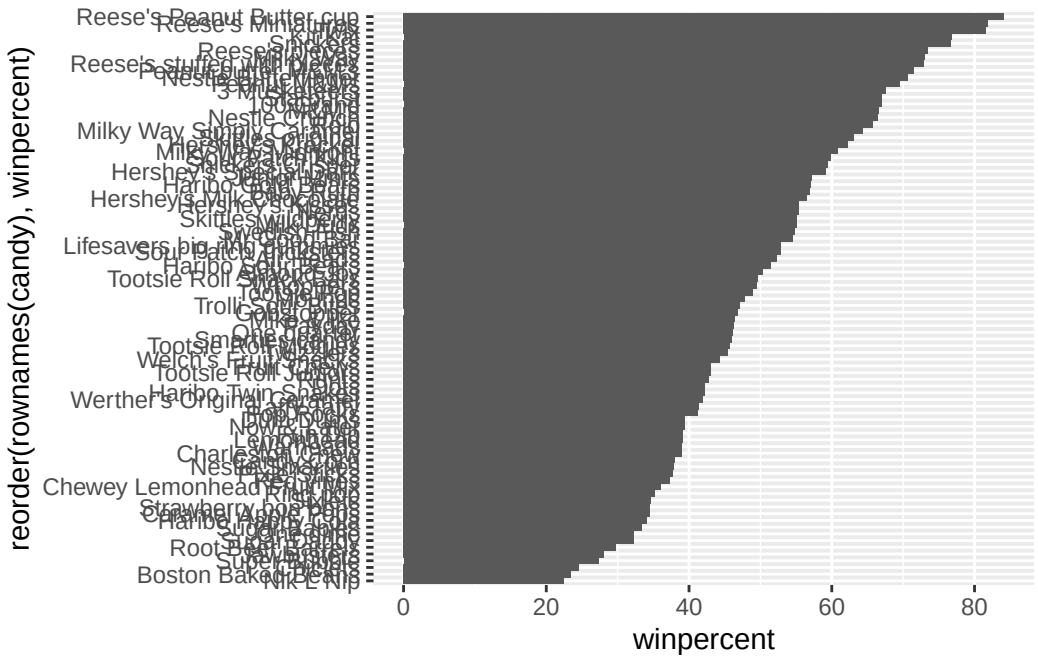
```
library(ggplot2)
```

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



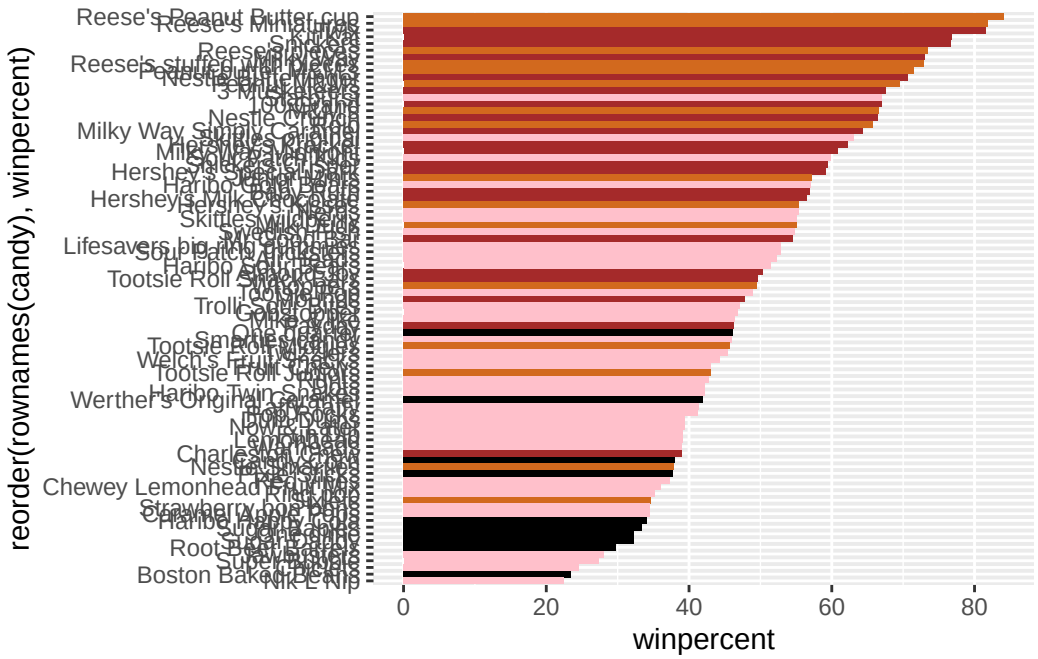
Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

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



Time to add some useful color

```
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?

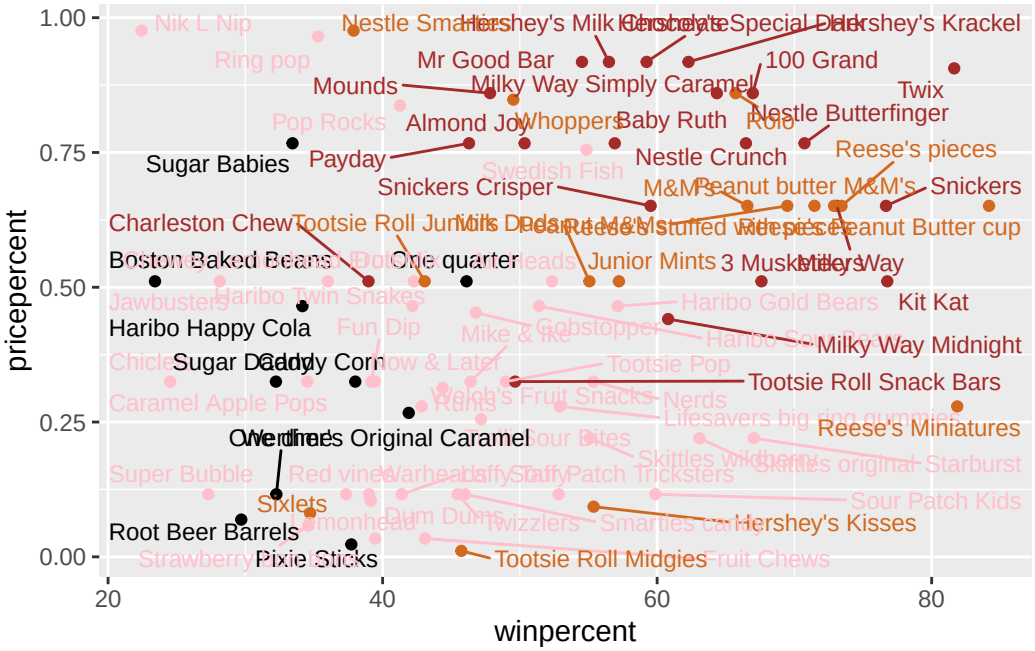
Sixlets

Q18. What is the best ranked fruity candy?

Starburst

Taking a Look at Pricepercent

```
library(ggrepel)

# How about a plot of 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 = 40)
```



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 highest ranked is fruity type candy.

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 )
```

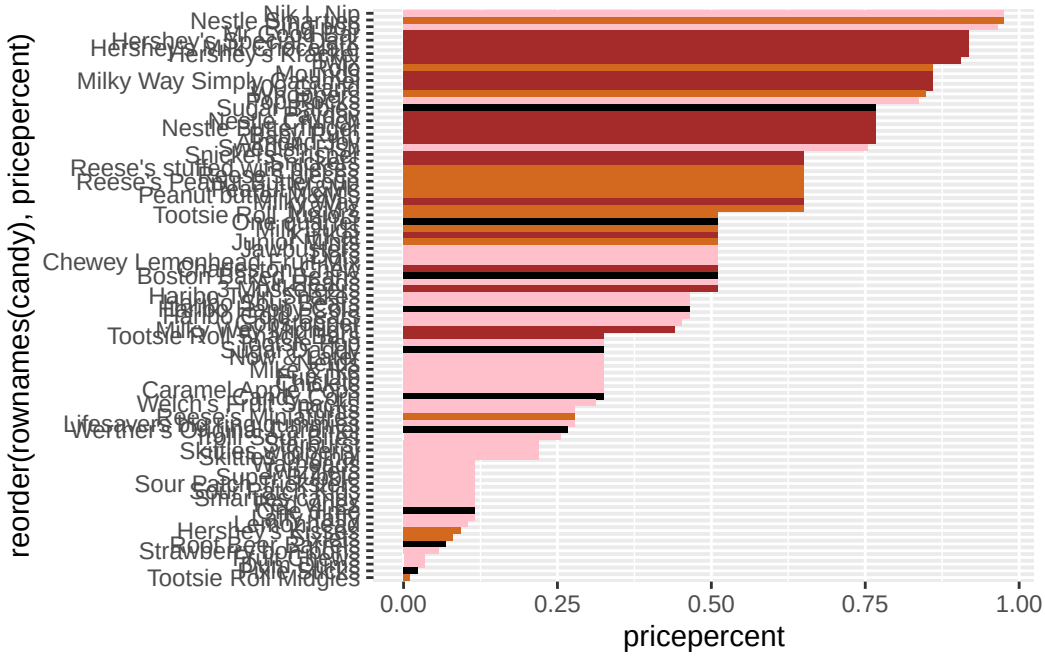
```
                           pricepercent winpercent
Nik L Nip                         0.976   22.44534
Nestle Smarties                   0.976   37.88719
Ring pop                          0.965   35.29076
Hershey's Krackel                 0.918   62.28448
Hershey's Milk Chocolate          0.918  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

The least popular would be Strawberry bon bons.

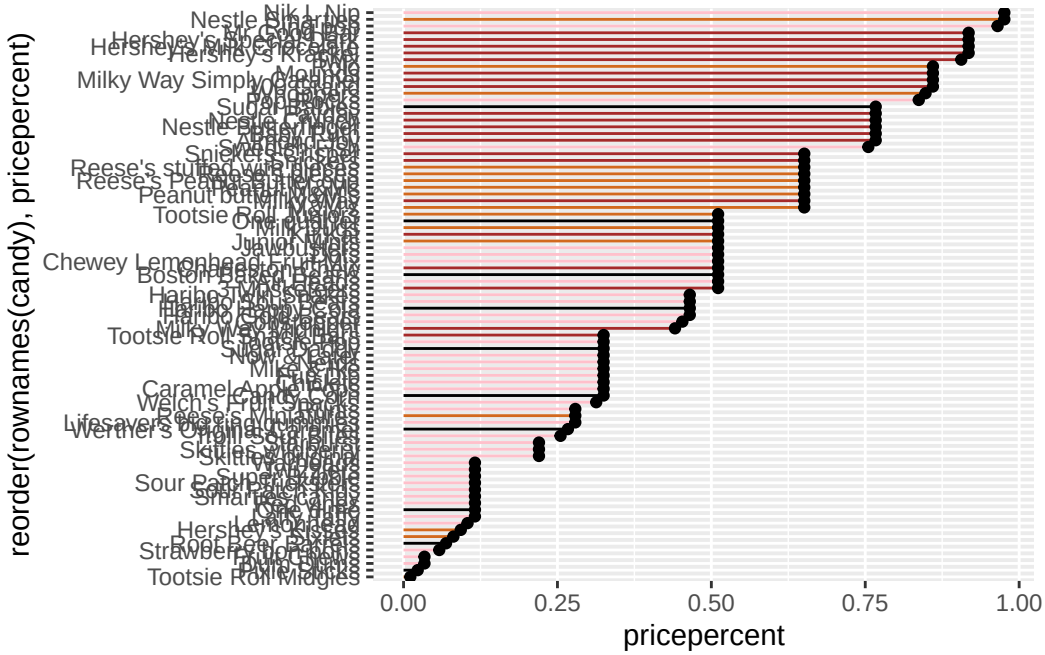
Q21. Make a barplot again with geom_col() this time using pricepercent and then improve this step by step, first ordering the x-axis by value and finally making a

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_col(fill=my_cols)
```




```
#Make a lollipop chart of pricepercent
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_segment(aes(yend = reorder(rownames(candy), pricepercent),
                   xend = 0), col=my_cols) +
    geom_point()
```

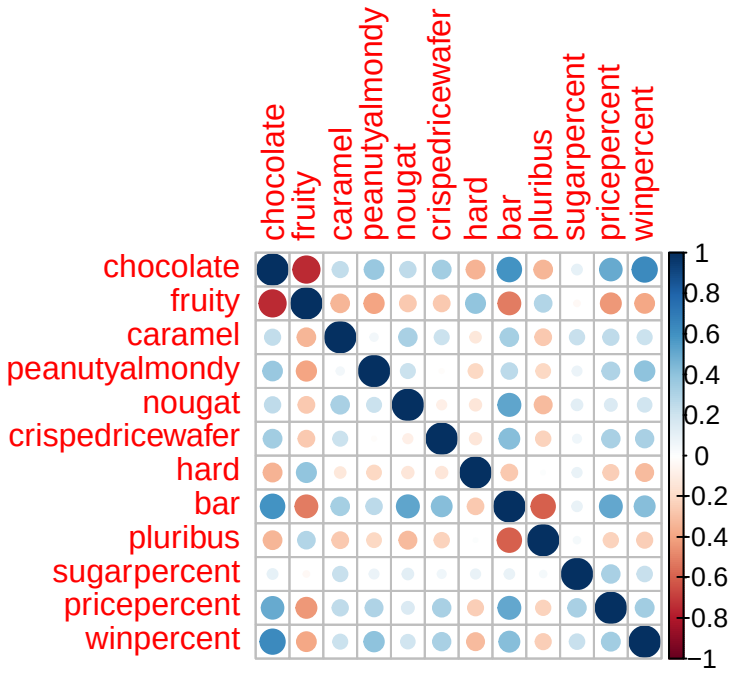


Exploring the Correlation Structure

```
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 fruity

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

Chocolate and bar

Principal Component Analysis

Let's apply PCA using the `prcomp()` function to our candy dataset remembering to set the scale=TRUE argument.

```
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
```

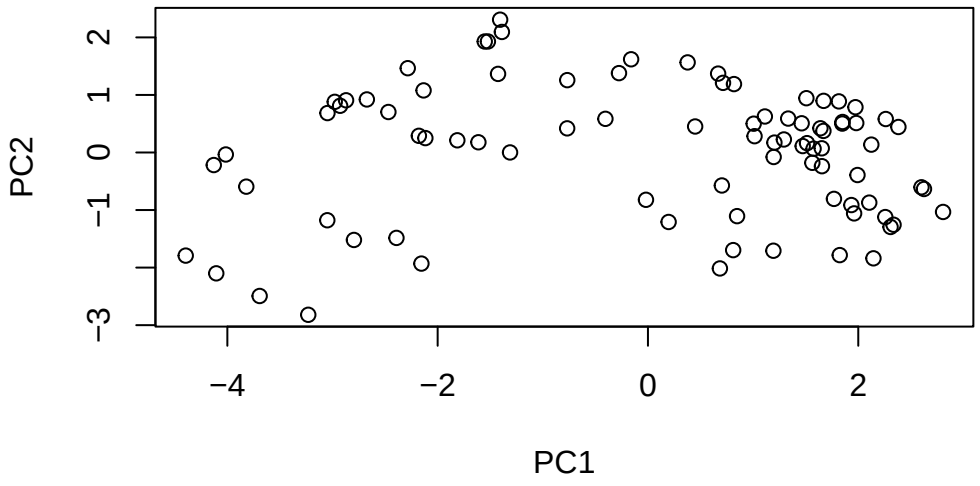
```
                            PC8     PC9    PC10    PC11    PC12
Standard deviation     0.74530 0.67824 0.62349 0.43974 0.39760
Proportion of Variance 0.04629 0.03833 0.03239 0.01611 0.01317
Cumulative Proportion  0.89998 0.93832 0.97071 0.98683 1.00000
```

```
pca$rotation[,1]
```

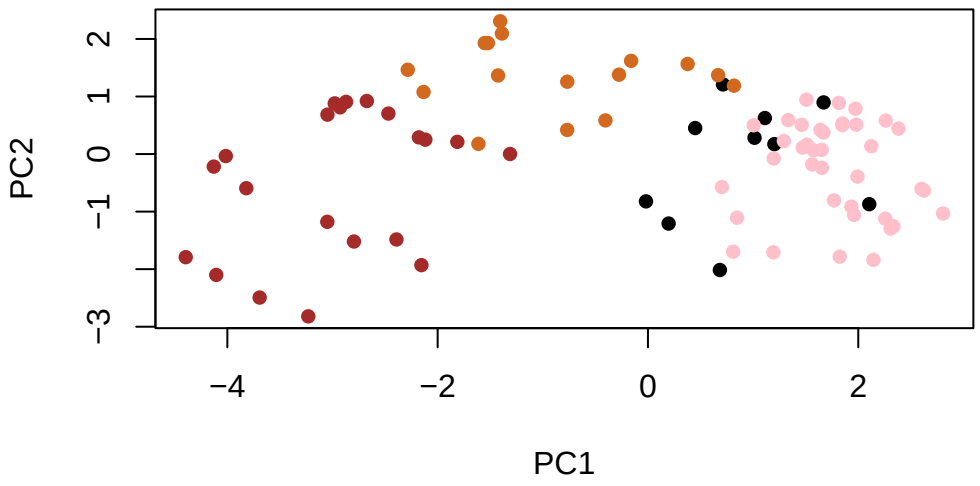
```
     chocolate           fruity          caramel   peanutyalmondy
    -0.4019466        0.3683883       -0.2299709       -0.2407155
        nougat crispedricewafer             hard              bar
    -0.2268102       -0.2215182        0.2111587       -0.3947433
      pluribus     sugarpercent     pricepercent       winpercent
     0.2600041       -0.1083088       -0.3207361       -0.3298035
```

Now plot the results of PC1 vs PC2

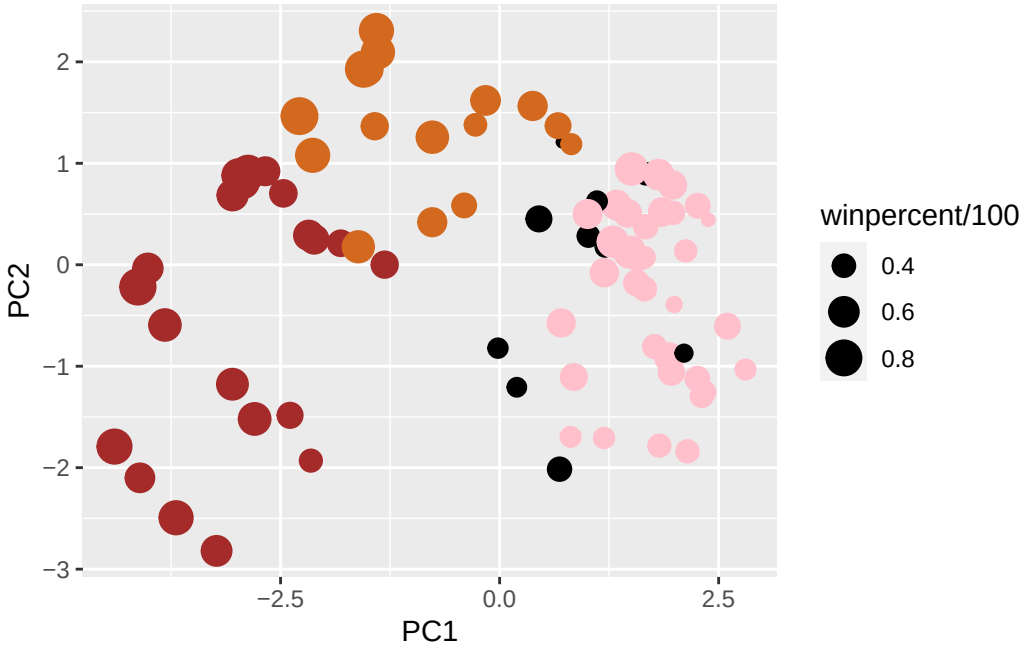
```
plot(pca$x[,1:2])
```



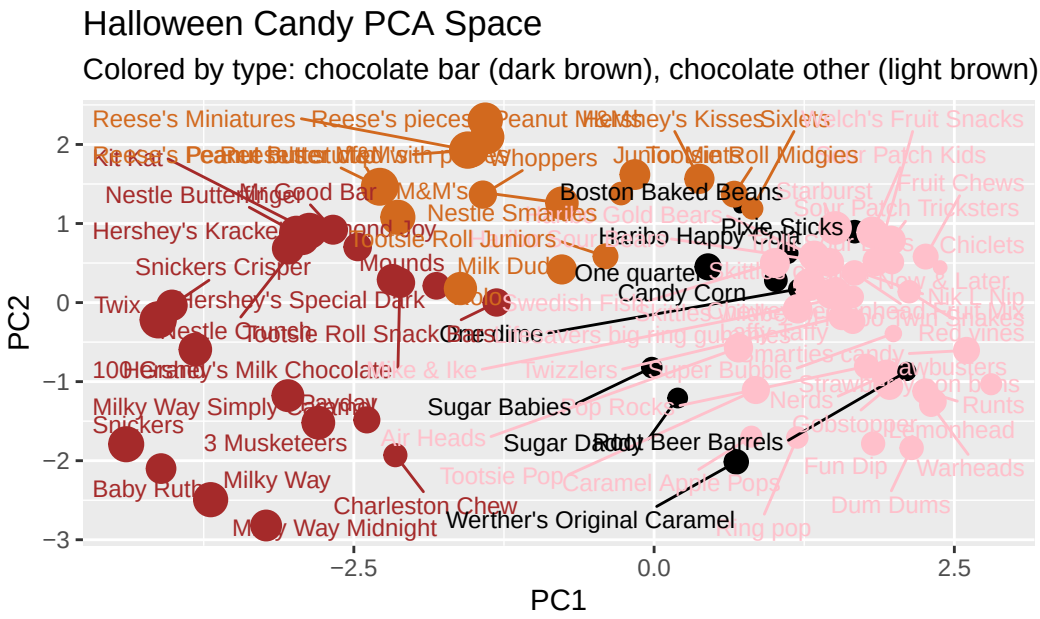

```
plot(pca$x[,1:2], col=my_cols, pch=16)
```




```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])

# Make a ggplot
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
```




```
p + geom_text_repel(size=3.3, col=my_cols, max.overlaps = 40)  +
  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")
```



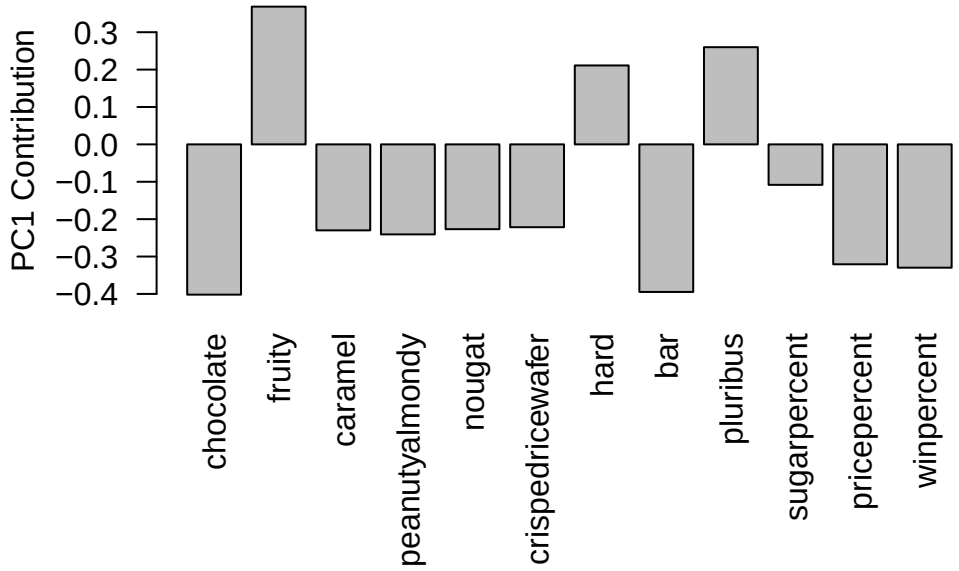
Data from 538

```
library(plotly)
```

```
Attaching package: 'plotly'

The following object is masked from 'package:ggplot2':

    last_plot

The following object is masked from 'package:stats':

    filter

The following object is masked from 'package:graphics':

    layout
```

```
#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 and hard. This makes sense as these two values maintained a a relatively high positive correlation with one another.