Halloween Candy Mini-Project

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1. Importing candy data

```
candy_file <- "candy-data.csv"

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?

```
nrow(candy)
```

```
[1] 85
```

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

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

```
[1] 38
```

###2. What is your favorate candy?

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

My favourite candy: One dime

```
candy["One dime", ]$winpercent
```

```
[1] 32.26109
```

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
```

###Using the `skim()` function:

```
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	
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?

Variable winpercent, it is on 0-100 scale while other variables are all between 0-1.

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

Zero for candy$chocolate column means the candy does not contain chocolate, while one means the candy contain chocolate.

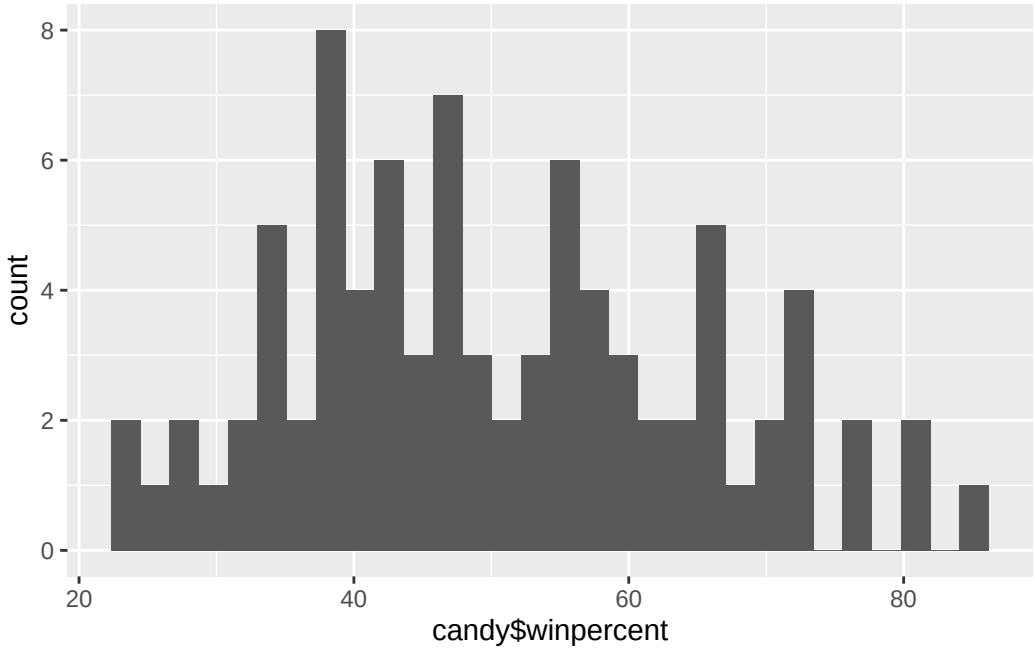
Q8. Plot a histogram of winpercent values

```
library(ggplot2)
```

```
ggplot(candy,
       aes(x = candy$winpercent)) +
  geom_histogram()
```

```
Warning: Use of `candy$winpercent` is discouraged.
i Use `winpercent` instead.
```

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



Q9. Is the distribution of winpercent values symmetrical?

Not symmetrical, the distribution is skewed to the right.

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

The center of the distribution is below 50%

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

```
choc_candy <- candy$winpercent[as.logical(candy$chocolate)]
fruit_candy <- candy$winpercent[as.logical(candy$fruity)]

mean_winpercent_chocolate <- mean(choc_candy)
mean_winpercent_fruity <- mean(fruit_candy)

mean_winpercent_chocolate
```

```
[1] 60.92153
```

```
mean_winpercent_fruity
```

```
[1] 44.11974
```

```
mean_winpercent_chocolate > mean_winpercent_fruity
```

```
[1] TRUE
```

On average chololate containing candy is higher ranked than fruity candy.

Q12. Is this difference statistically significant?

```
t.test(choc_candy, fruit_candy)
```

```
    Welch Two Sample t-test

data:  choc_candy and fruit_candy
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?

```
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(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
```

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

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

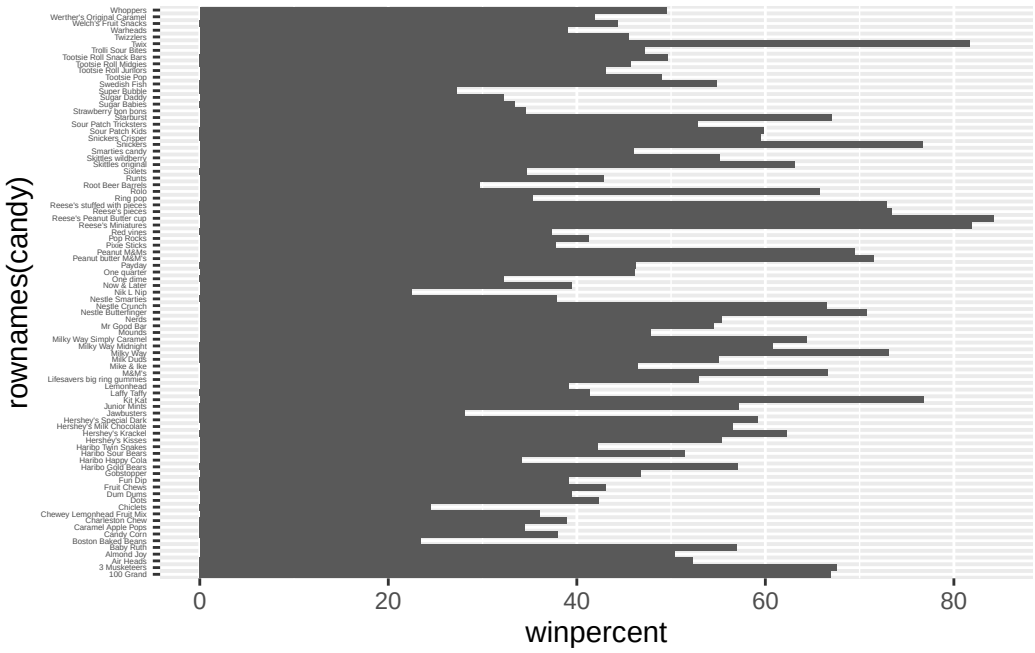
```
                        chocolate fruity caramel peanutyalmondy nougat
Reese's Peanut Butter cup         1      0       0              1      0
Reese's Miniatures                1      0       0              1      0
Twix                              1      0       1              0      0
Kit Kat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

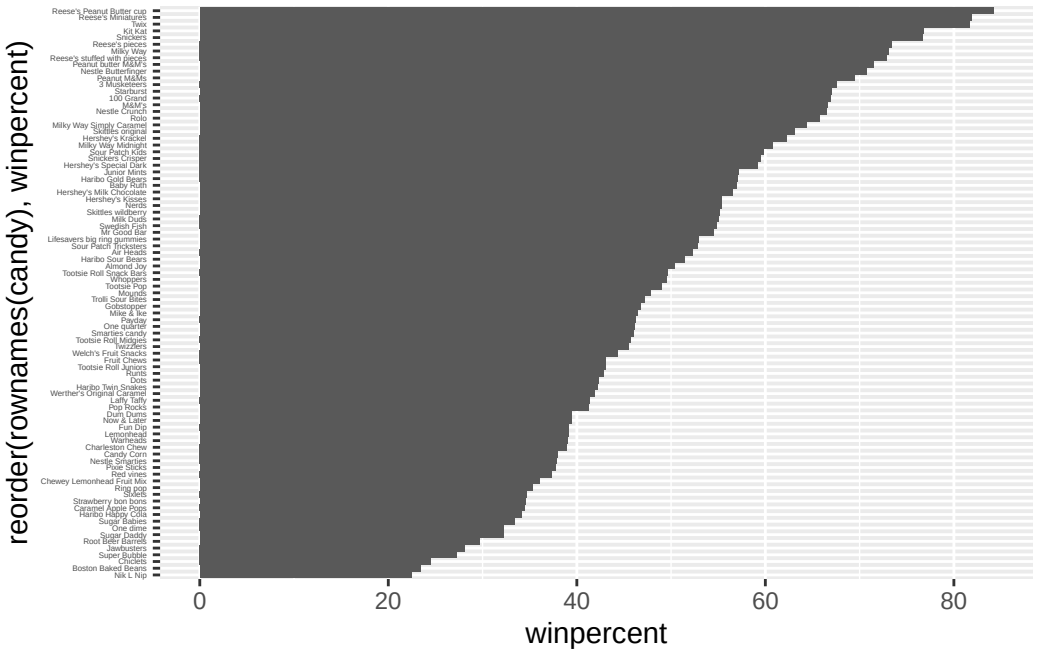
```
library(ggplot2)

ggplot(candy,
       aes(x = winpercent, y = rownames(candy))) +
      geom_col() +
  theme(axis.text.y = element_text(size = 3))
```



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

```
ggplot(candy,
       aes(x = winpercent, y = reorder(rownames(candy),winpercent))) +
      geom_col() +
  theme(axis.text.y = element_text(size = 3))
```

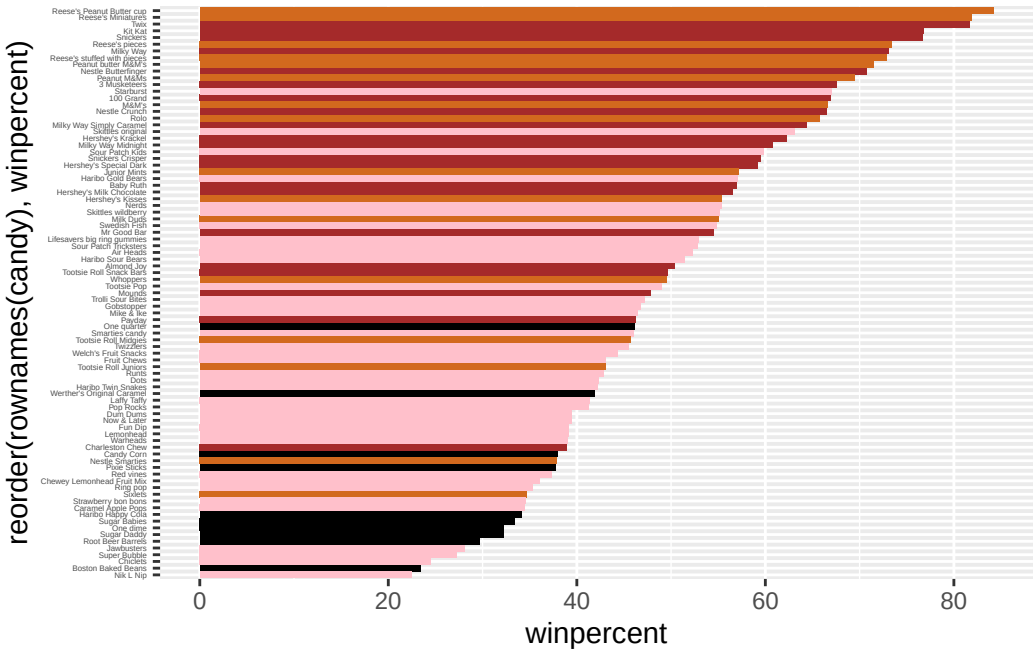


Let's setup a color vector (that signifies candy type) that we can then use for some future plots. We start by making a vector of all black values (one for each candy). Then we overwrite chocolate (for chocolate candy), brown (for candy bars) and red (for fruity candy) values.

```
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"
```

Now let's try our barplot with these colors. Note that we use fill=my_cols for `geom_col()`. Experiment to see what happens if you use col=mycols.

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_col(fill=my_cols) +
  theme(axis.text.y = element_text(size = 3))
```



Q17. What is the worst ranked chocolate candy?

Sixlets

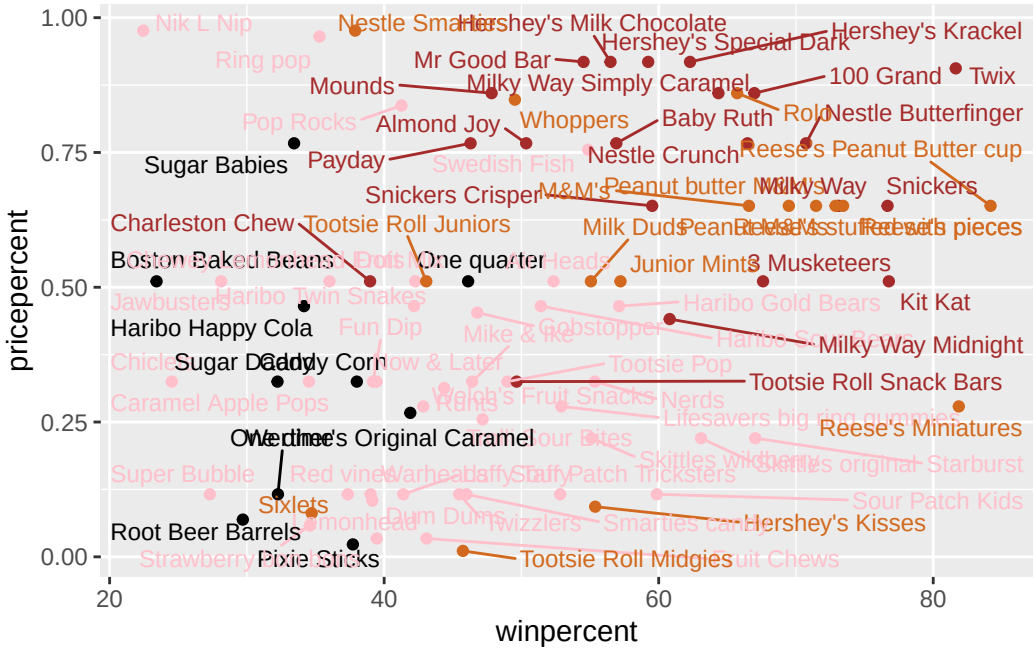
Q18. What is the best ranked fruity candy?

Starburst

4. 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 = 100)
```



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?

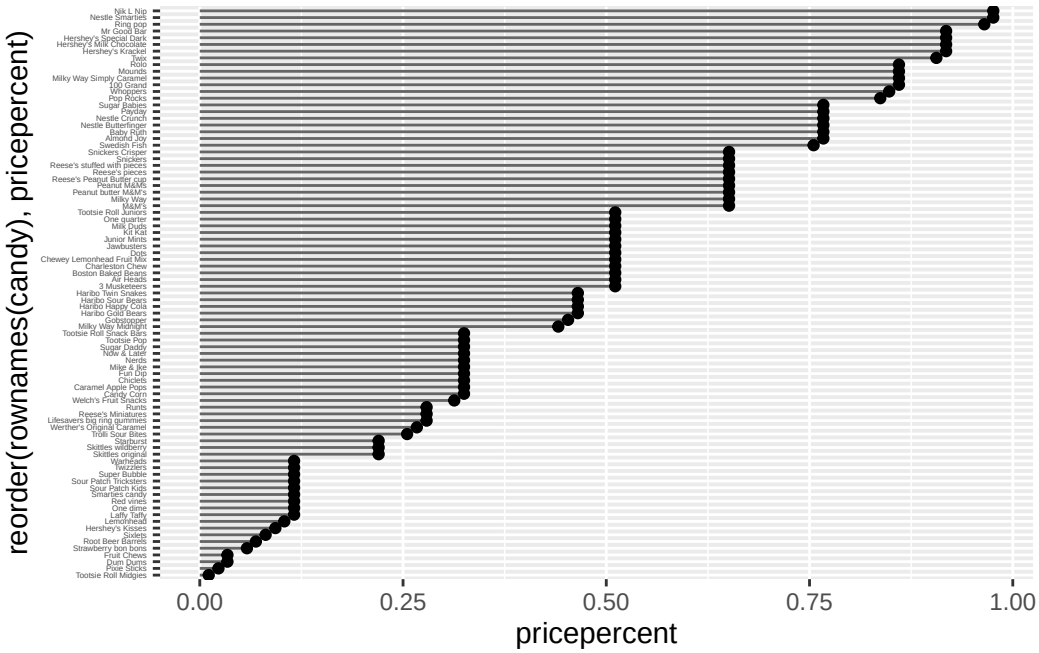
```
ord <- order(candy$pricepercent, decreasing = TRUE)
head(candy[ord,c(11,12)], n=5)
```

```
                      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
```

The least popular from the most expensive is Nik L Nip.

Optional 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()`.

```
# 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="gray40") +
    geom_point() +
  theme(axis.text.y = element_text(size = 3))
```

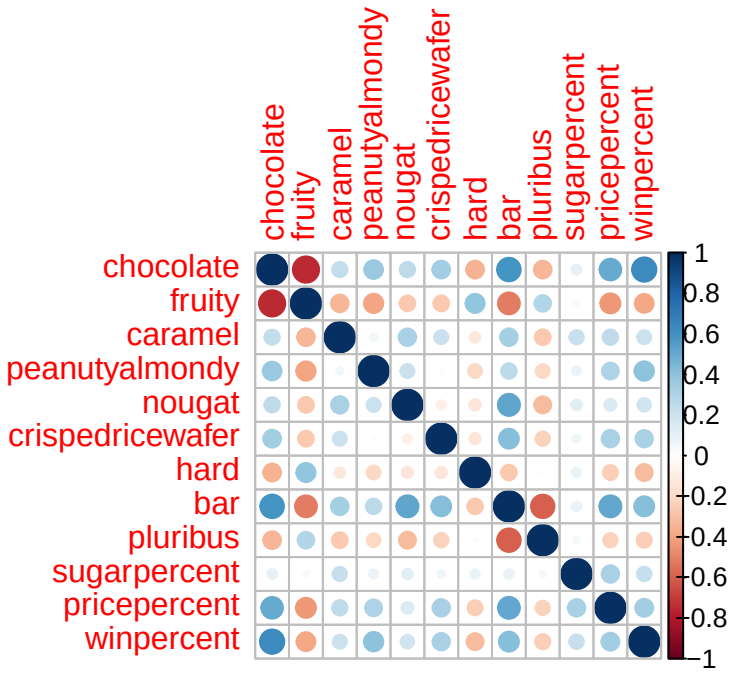


5. Exploring the correlation structure

```
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)?

Variables fruity and chocolate are strongly anti-correlated. Variables pluribus and bar are the next most anti-correlated. There are others also have minus values, but are not strongly correlated.

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

Variables winpercent and chocolate, and bar and chocolate are most positively correlated.

6. Principal Component Analysis

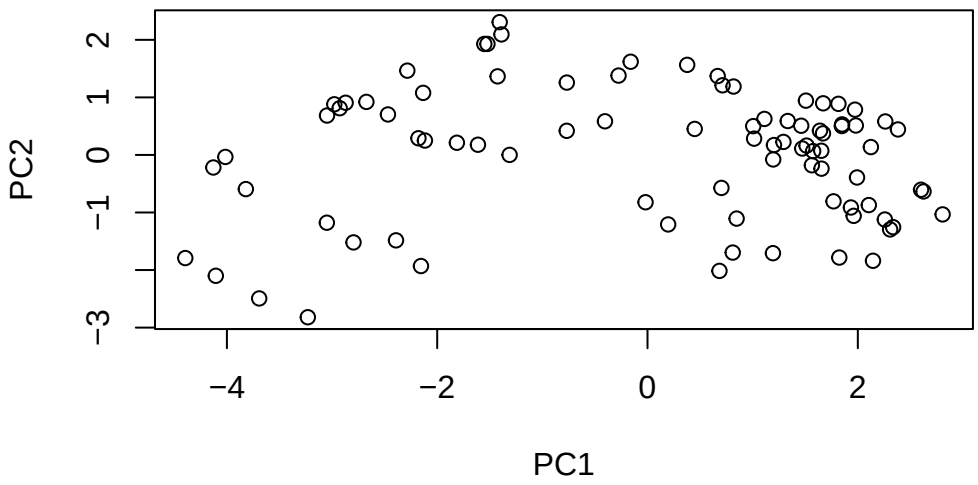
```
pca <- prcomp(candy, scale = T )
summary(pca)
```

```
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
```

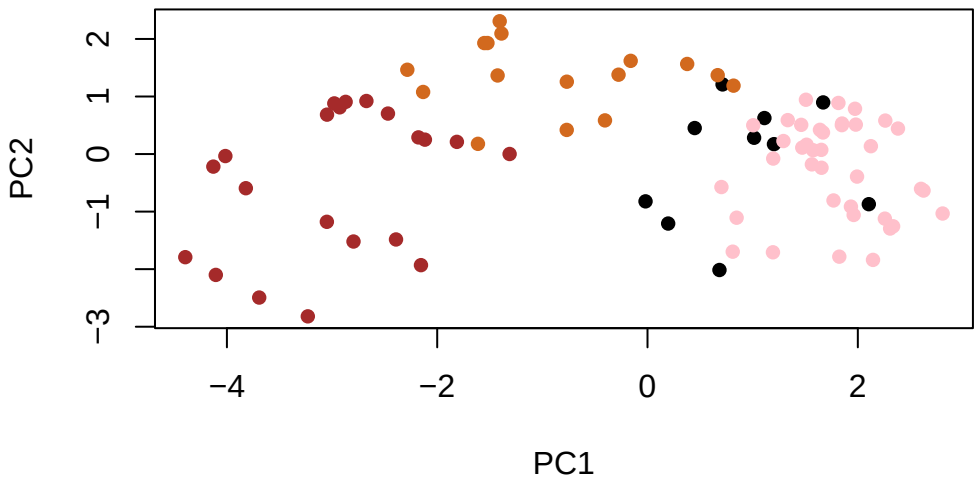
```
Standard deviation     0.74530 0.67824 0.62349 0.43974 0.39760
Proportion of Variance 0.04629 0.03833 0.03239 0.01611 0.01317
Cumulative Proportion  0.89998 0.93832 0.97071 0.98683 1.00000
```

Plot main PCA score plot of PC1 vs PC2.

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



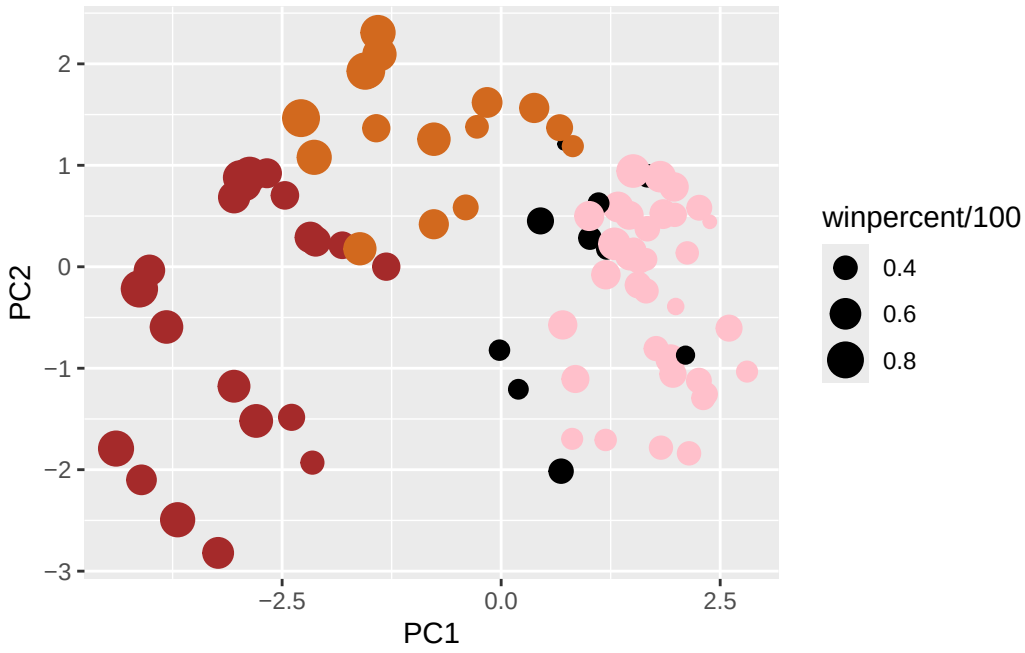

```
plot(pca$x[,1:2], col=my_cols, pch=16)
```




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

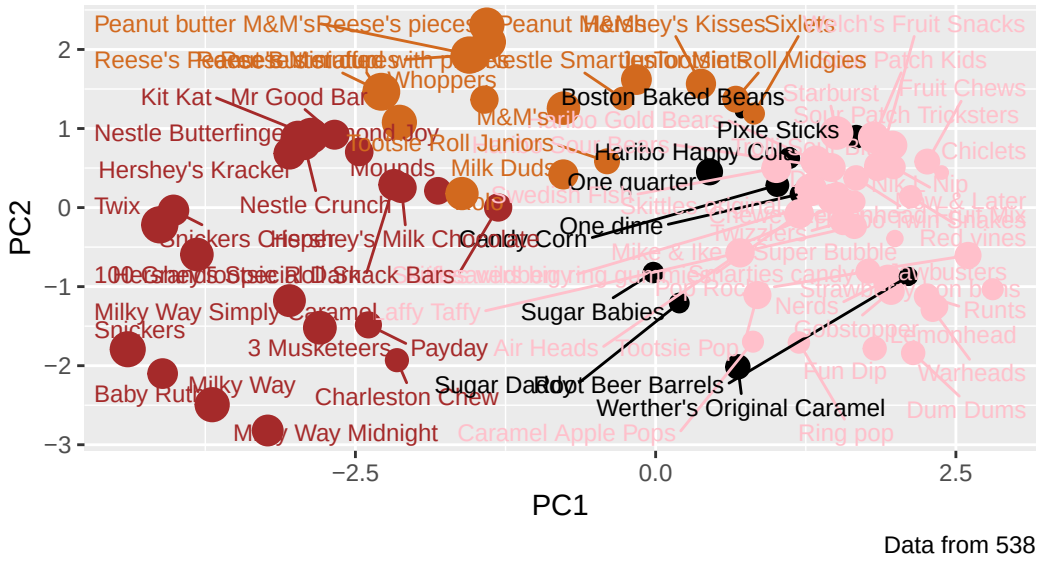
```
p <- ggplot(my_data) +
        aes(x=PC1, y=PC2,
            size=winpercent/100,
            text=rownames(my_data),
            label=rownames(my_data)) +
        geom_point(col=my_cols)

p
```




```
library(ggrepel)

p + geom_text_repel(size=3.3, col=my_cols, max.overlaps = 100)  +
  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

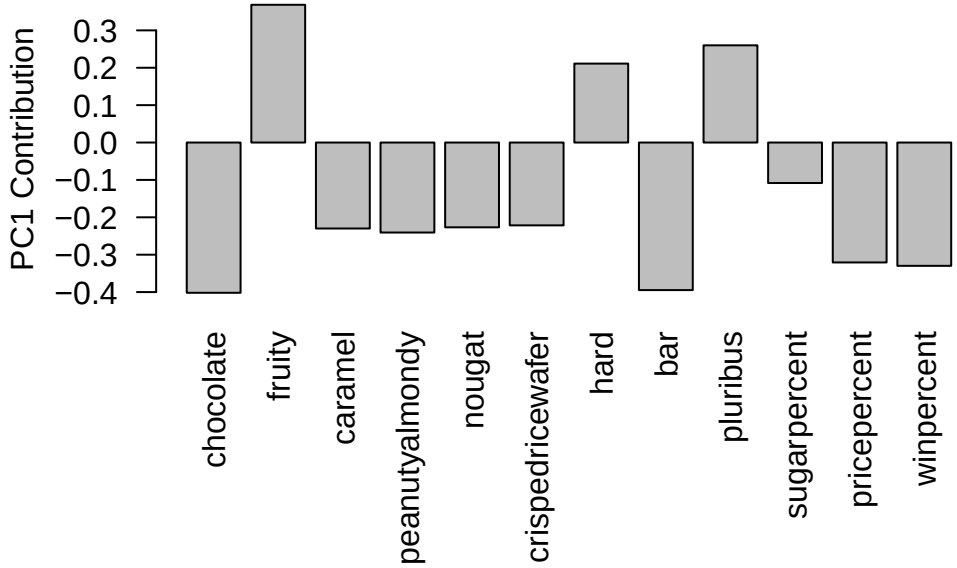
Interactive plot to see the labels:

```
#library(plotly)

#ggplotly(p)
```

Let's finish by taking a quick look at PCA our loadings. Do these make sense to you? Notice the opposite effects of chocolate and fruity and the similar effects of chocolate and bar (i.e. we already know they are correlated).

```
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?

Variables chocolate, fruity, and bar are picked up strongly by PC1. This plot is consistent with the correlation, as chocolate and bar are strongly positively correlated and chocolate and fruity are strongly negatively correlated.