class09 halloween candy

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Here we analyze a candy dataset from the 538 website. This is a CSV file from their GitHub repository.

data import

```
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
```

data exploration

- **Q1**. How many different candy types are in this dataset?

  85 candy types

```
nrow(candy)
```

```
[1] 85
```

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

  38 fruity candies

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

```
[1] 38
```

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

```
candy["Milk Duds",]$winpercent
```

```
[1] 55.06407
```

- **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
```

```
#install.packages("skimr")
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	

- **Q.** What is the least-liked candy in the dataset?

  Nik L Nip

```
row.names(candy[which.min(candy$winpercent),])
```

```
[1] "Nik L Nip"
```

- **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

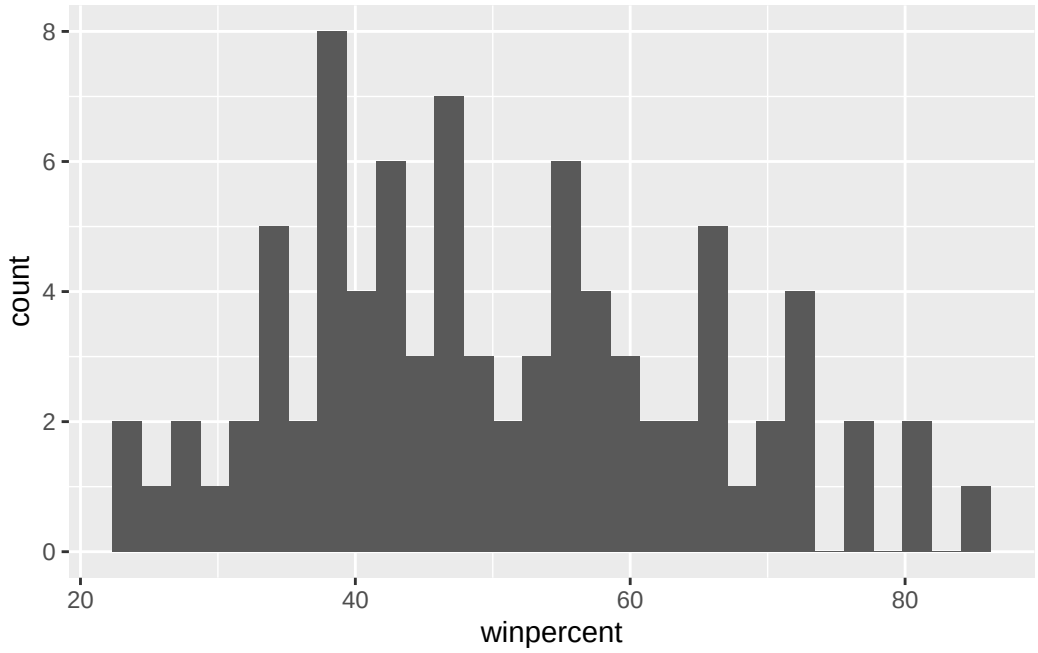
- **Q7**. What do you think a zero and one represent for the `candy$chocolate` column?

  A zero represents a `FALSE` and a one represents `TRUE`

- **Q8**. Plot a histogram of `winpercent` values

```
library(ggplot2)
ggplot(candy) +
  aes(winpercent) +
  geom_histogram()
```

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



- **Q9**. Is the distribution of `winpercent` values symmetrical?

  No, slight right skew

- **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?

  chocolate candy is higher ranked

```
#winpercent for chocolate candy
choco <- candy$winpercent[candy$chocolate==1]
# winpercent for fruity candy
fruit <- candy$winpercent[candy$fruity==1]
#is the mean chocolate winpercent greater than mean fruity winpercent?
mean(choco) > mean(fruit)
```

```
[1] TRUE
```

- **Q12**. Is this difference statistically significant?

  yes, pvalue < 0.0001

```
t.test(choco, y=fruit)
```

```
    Welch Two Sample t-test

data:  choco and fruit
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
```

overall candy rankings

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

  Nik L Nip, Boston Baked Bean, Chiclets, Super Bubble, Jawbusters

```
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) %>%
  row.names()
```

```
[1] "Nik L Nip"          "Boston Baked Beans" "Chiclets"
[4] "Super Bubble"       "Jawbusters"
```

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

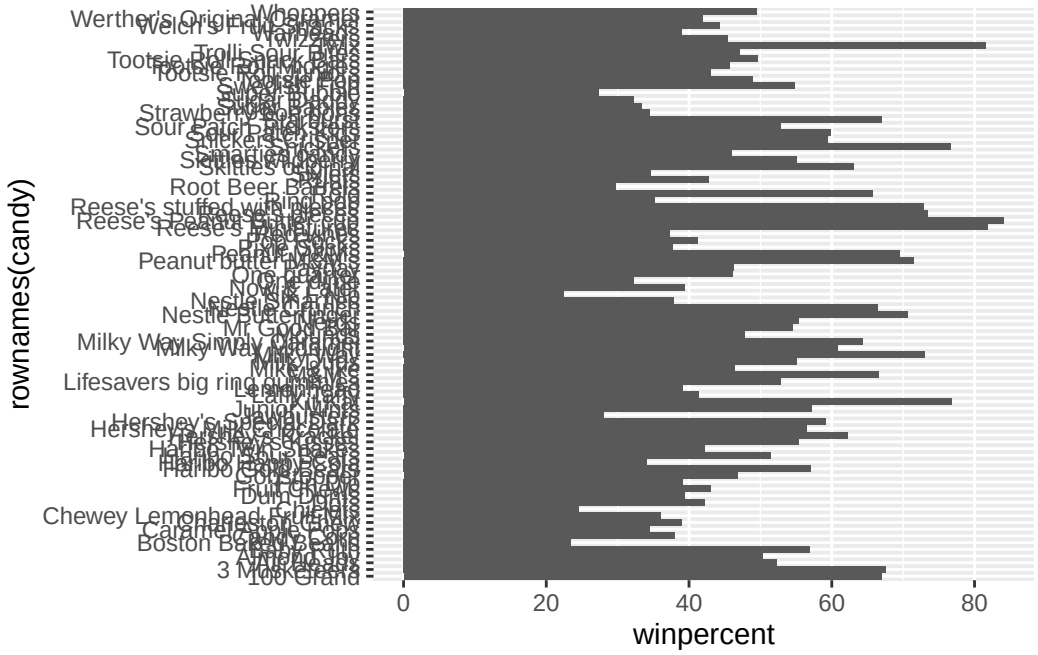
  Reese's Peanut Butter cup, Reese's Miniatures, Twix, Kit Kat, Snickers

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

```
[1] "Reese's Peanut Butter cup" "Reese's Miniatures"
[3] "Twix"                      "Kit Kat"
[5] "Snickers"
```

- library(dplyr)candy %>% arrange(winpercent) %>% head(5) %>% row.names()**Q15**. Make a first barplot of candy ranking based on `winpercent` values.

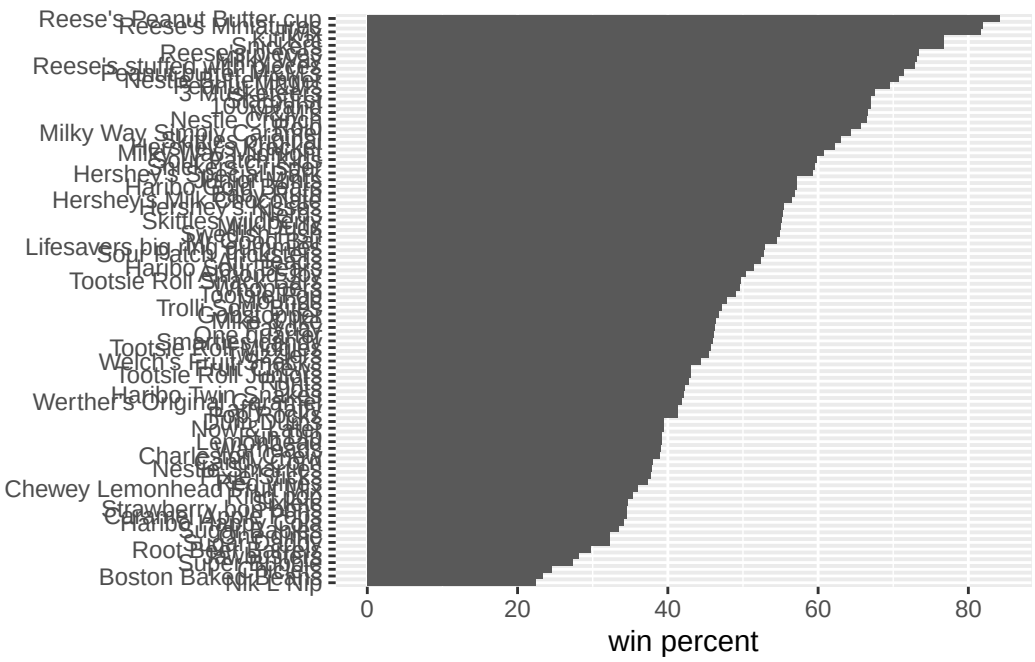
```
ggplot(candy) +
  aes(winpercent, rownames(candy)) +
  geom_col()
```



- **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() +
  labs(x="win percent", y=NULL)
```




```
ggsave("barplot1.png", width=17, height=2)
```

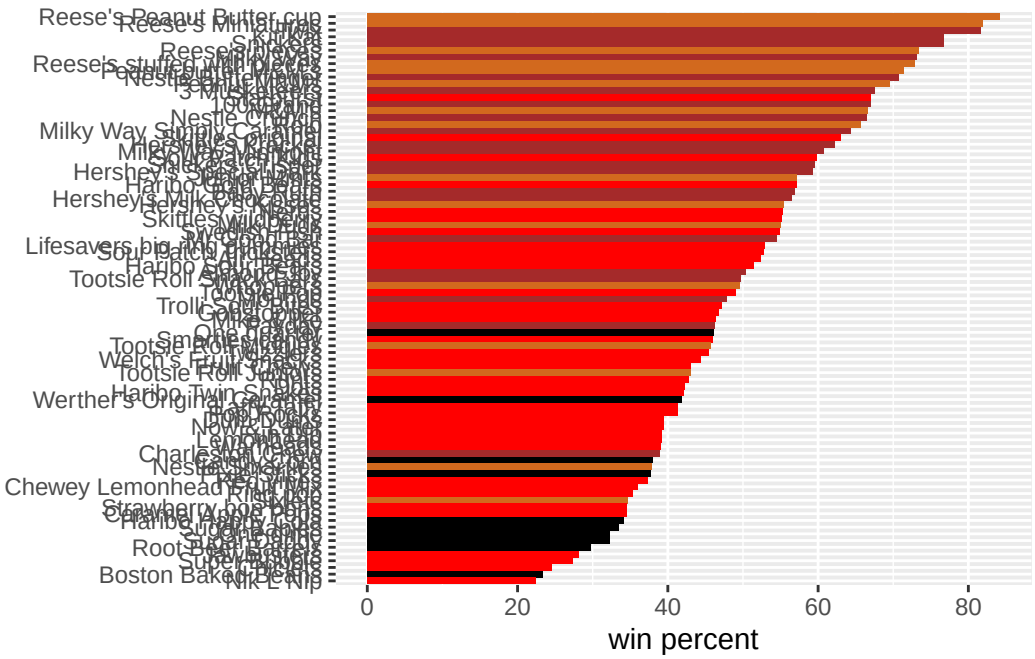
You can insert any image using this markdown syntax: ![optional caption]()

```
![](barplot1.png)
```

Add some color to our ggplot.

```
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)] = "red"
```

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col(fill=my_cols) +
  labs(x="win percent", y=NULL)
```



- **Q17**. What is the worst ranked chocolate candy?

  Sixlets

- **Q18**. What is the best ranked fruity candy?

  Starburst

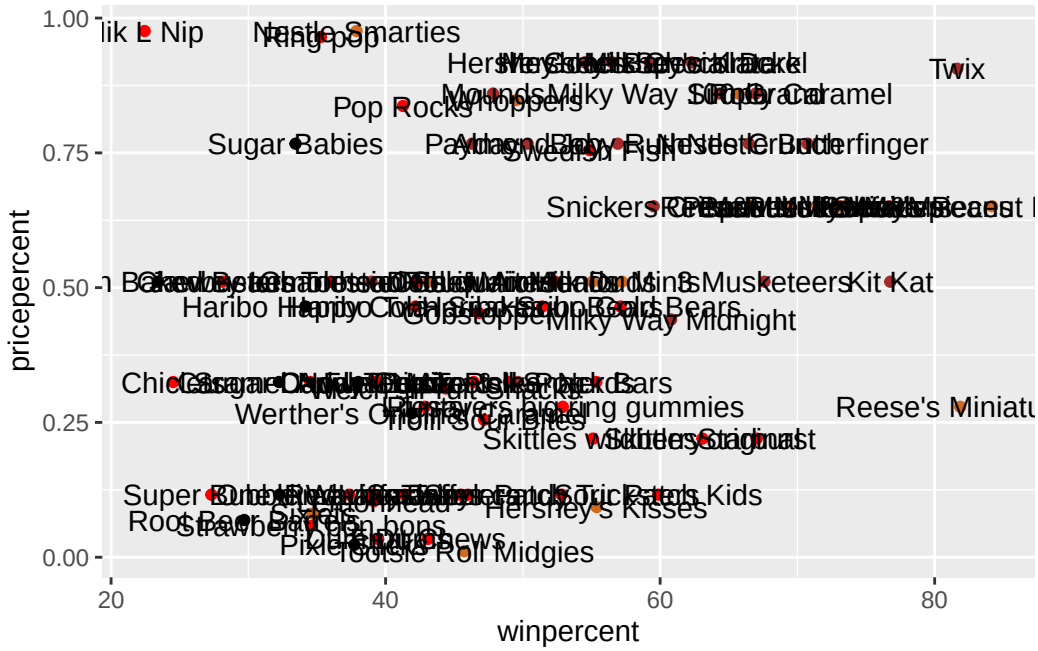
taking a look at pricepercent

```
candy$pricepercent
```

```
 [1] 0.860 0.511 0.116 0.511 0.511 0.767 0.767 0.511 0.325 0.325 0.511 0.511
[13] 0.325 0.511 0.034 0.034 0.325 0.453 0.465 0.465 0.465 0.465 0.093 0.918
[25] 0.918 0.918 0.511 0.511 0.511 0.116 0.104 0.279 0.651 0.651 0.325 0.511
[37] 0.651 0.441 0.860 0.860 0.918 0.325 0.767 0.767 0.976 0.325 0.767 0.651
[49] 0.023 0.837 0.116 0.279 0.651 0.651 0.651 0.965 0.860 0.069 0.279 0.081
[61] 0.220 0.220 0.976 0.116 0.651 0.651 0.116 0.116 0.220 0.058 0.767 0.325
[73] 0.116 0.755 0.325 0.511 0.011 0.325 0.255 0.906 0.116 0.116 0.313 0.267
[85] 0.848
```

If we want to see what is a good candy to buy in terms of winpercent and pricepercent, we can plot these two variables and then see the best candy for the least amount of money.

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

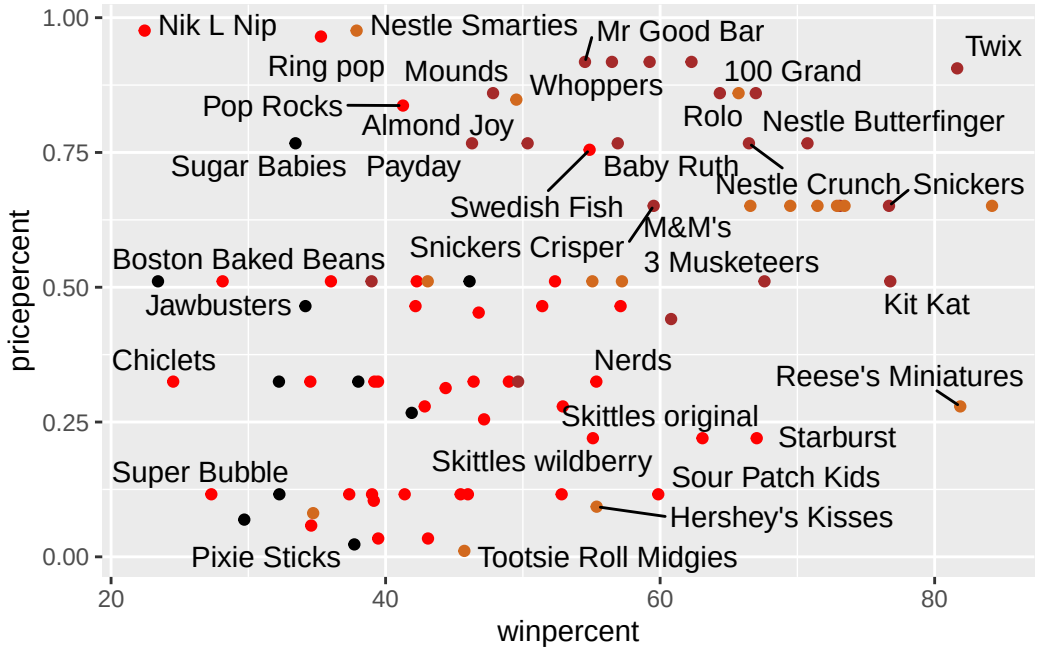


to avoid overplotting the labels, we can use an add on package called `ggrepel()`

```
#install.packages("ggrepel")
library(ggrepel)
```

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

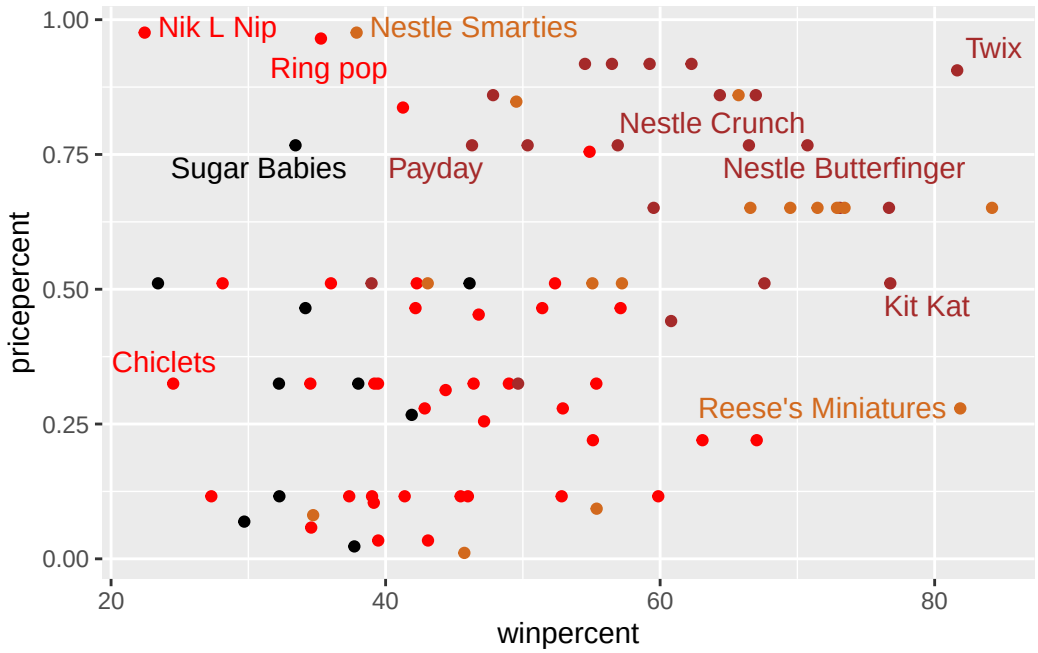
```
Warning: ggrepel: 50 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Play with `max.overlaps()` parameter to `geom_text_repel()`

```
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(max.overlaps=5, col=my_cols)
```

```
Warning: ggrepel: 74 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```

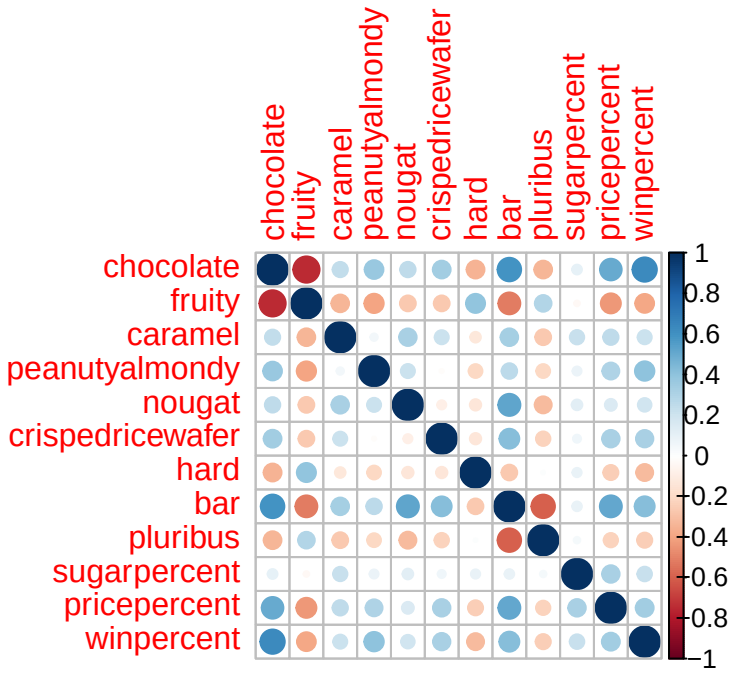


exploring the correlation structure

```
#install.packages("corrplot")
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)?

  fruity-chocolate

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

  chocolate-bar

on to PCA

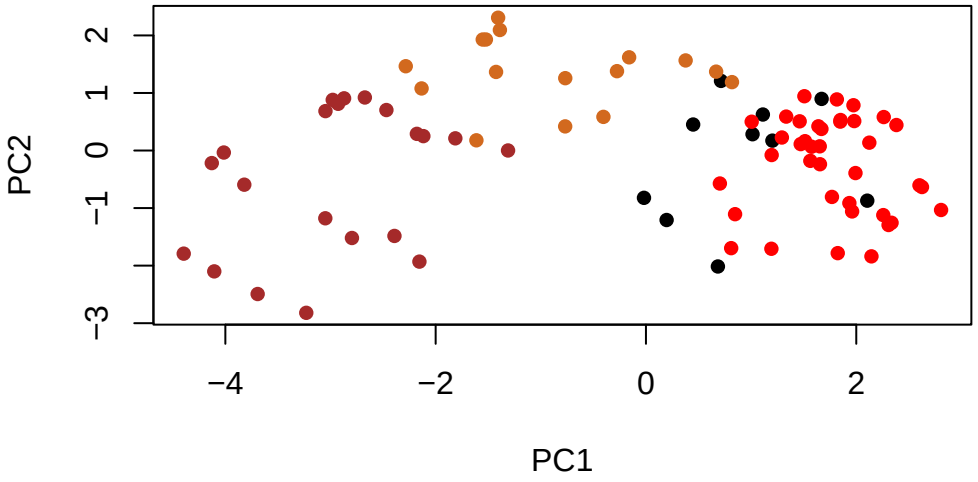
The main function for this is `prcomp()` and here we know we need to scale our data with the `scale=TRUE` argument

```
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
```

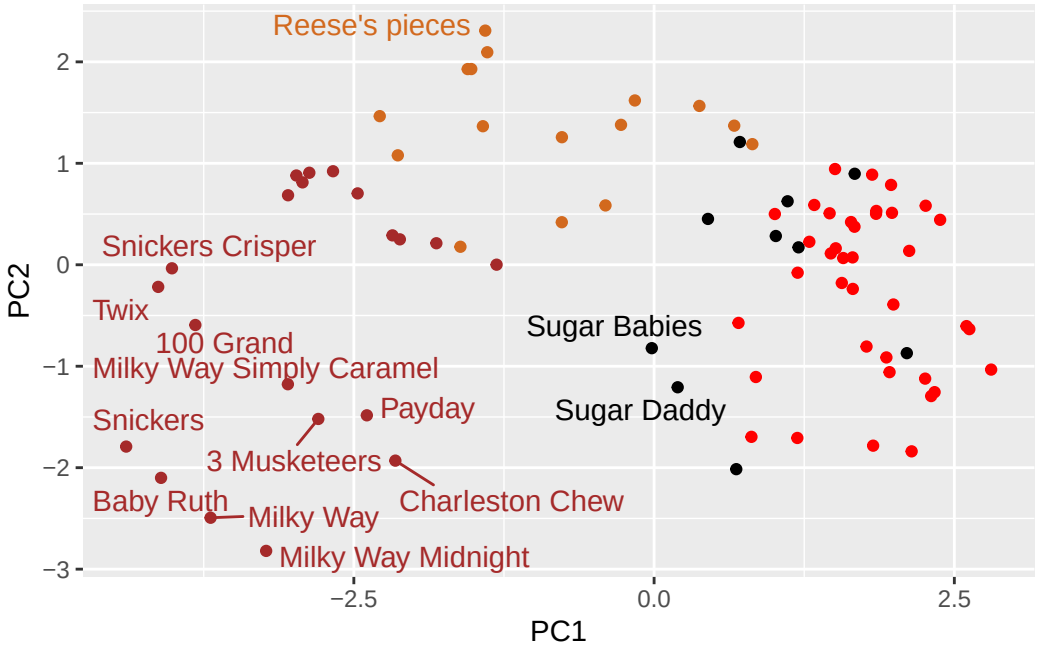
```r
plot(pca$x[,1:2], col=my_cols, pch=16)
```



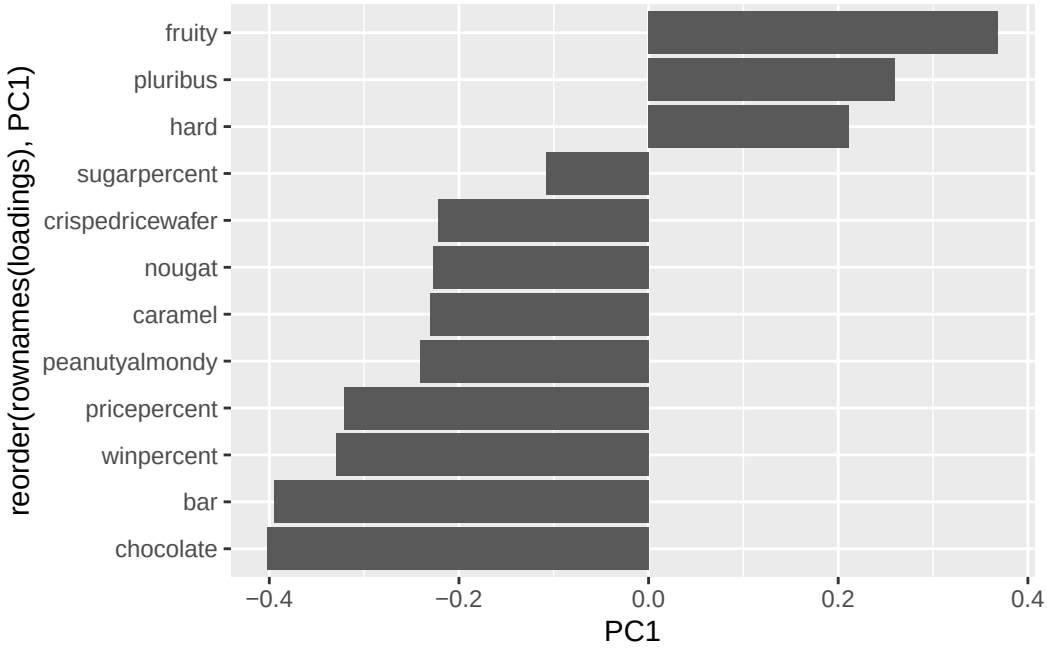

```r
# Make a new data-frame with our PCA results and candy data
my_candy <- cbind(candy, pca$x[,1:3])
```

```r
candyplot <- ggplot(my_candy) +
  aes(PC1, PC2, label=rownames(my_candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, max.overlaps=5)

candyplot
```

```
Warning: ggrepel: 71 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```




```
loadings <- as.data.frame(pca$rotation)

ggplot(loadings) +
  aes(PC1, reorder(rownames(loadings),PC1)) +
  geom_col()
```



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

  fruity, pluribus, and hard; this makes sense because fruity candies tend to be hard and come in multiples (like Skittles)