Class 11 Candy Lab

Gen Dantay BIMM 143

538 candy data: PCA and more

```
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?

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

```
[1] 38
```

What are these fruity candies specifically? We can use ==

```
rownames ( candy[candy$fruity == 1, ] )
```

```
 [1] "Air Heads"                   "Caramel Apple Pops"         
 [3] "Chewey Lemonhead Fruit Mix"  "Chiclets"                   
 [5] "Dots"                        "Dum Dums"                   
 [7] "Fruit Chews"                 "Fun Dip"                    
 [9] "Gobstopper"                  "Haribo Gold Bears"          
[11] "Haribo Sour Bears"           "Haribo Twin Snakes"         
[13] "Jawbusters"                  "Laffy Taffy"                
[15] "Lemonhead"                   "Lifesavers big ring gummies"
[17] "Mike & Ike"                  "Nerds"                      
[19] "Nik L Nip"                   "Now & Later"                
[21] "Pop Rocks"                   "Red vines"                  
[23] "Ring pop"                    "Runts"                      
[25] "Skittles original"           "Skittles wildberry"         
[27] "Smarties candy"              "Sour Patch Kids"            
[29] "Sour Patch Tricksters"       "Starburst"                  
[31] "Strawberry bon bons"         "Super Bubble"               
[33] "Swedish Fish"                "Tootsie Pop"                
[35] "Trolli Sour Bites"           "Twizzlers"                  
[37] "Warheads"                    "Welch's Fruit Snacks"       
```

How often does my favorite candy win?

```
candy["M&M's", ]$winpercent
```

```
[1] 66.57458
```

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

```
candy["Reese's Peanut Butter cup", ]$winpercent
```

```
[1] 84.18029
```

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
```

New skim function

You can use the :: function if you don't want to download the whole package. The library will only apply to this code chunk.

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

```
#library("skimr")
```

```
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?

The "hist" / `winpercent` column is not numeric; instead it is a visual bar graph from 0-100.

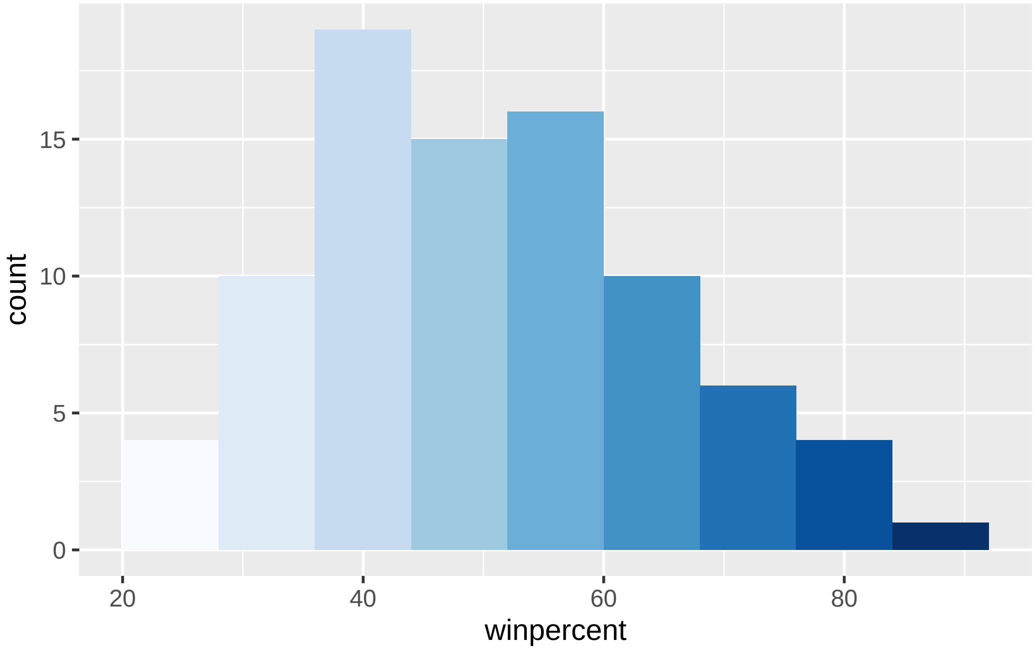
Q7. What do you think a zero and one represent for the candy$chocolate column?

One means that the candy does have chocolate, while zero means that it does not have chocolate.

Data analysis

Q8. Plot a histogram of winpercent values

```r
library(ggplot2)

ggplot(candy, aes(winpercent)) +
  geom_histogram(binwidth = 8, fill = blues9)
```



Q9. Is the distribution of winpercent values symmetrical? Nope

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

```
mean(candy$winpercent)
```

```
[1] 50.31676
```

I would say it is slightly above 50% **Q11. On average is chocolate candy higher or lower ranked than fruit candy?**

```
# Chocolate candy

# Filters, gets row values, calculates mean
mean ( candy$winpercent[as.logical(candy$chocolate)] )
```

```
[1] 60.92153
```

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

```
[1] 44.11974
```

On average, chocolate candy is ranked higher than fruit candy by almost 20%!

Q12. Is this difference statistically significant?

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

t.test(chocolate, fruity)
```

```

	Welch Two Sample t-test

data:  chocolate and fruity
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 
```

Yes, the difference is statistically significant.

Overall candy rankings

Use `sort` to sort vectors.

```r
# For example
x <- c(5, 2, 10)

# sort(x, decreasing = TRUE) inverses the sort
sort(x)
```

```
[1]  2  5 10
```

The buddy function to `sort()` that is often more useful is called `order()`. It returns the "indices" of the input that would result in it being sorted.

```r
order(x) # Shows position of sorted values
```

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

```r
x[ order(x) ] #Sorted values
```

```
[1]  2  5 10
```

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

```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
```

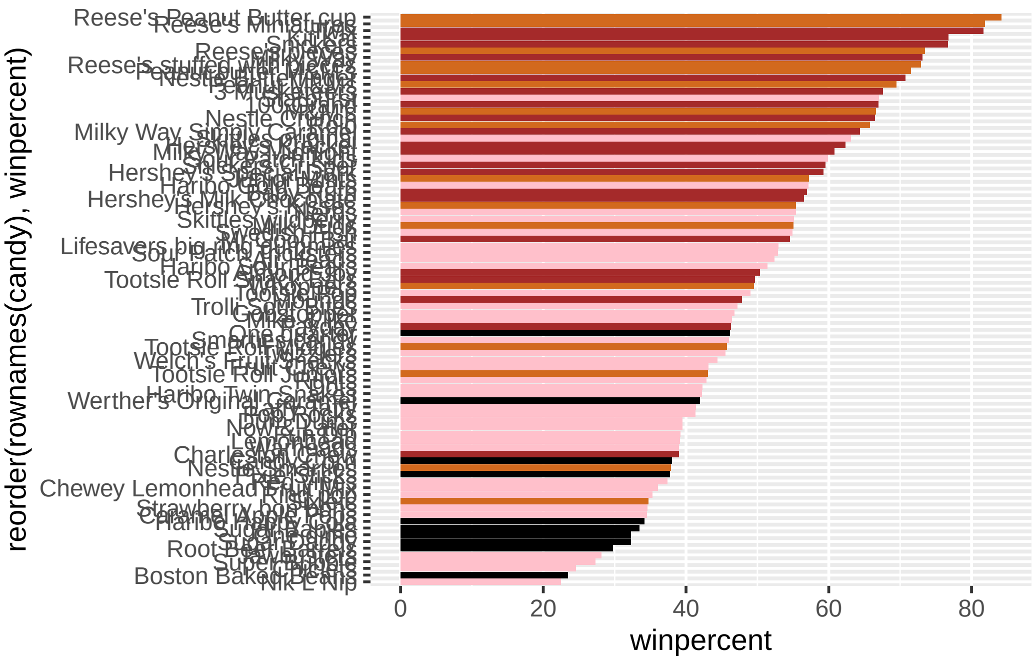
Q14. What are the top 5 all time favorite candy types out of this set?

```r
ord <- order(candy$winpercent, decreasing = TRUE)
head(candy[ord, ], 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. Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

```r
# Color according to category
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

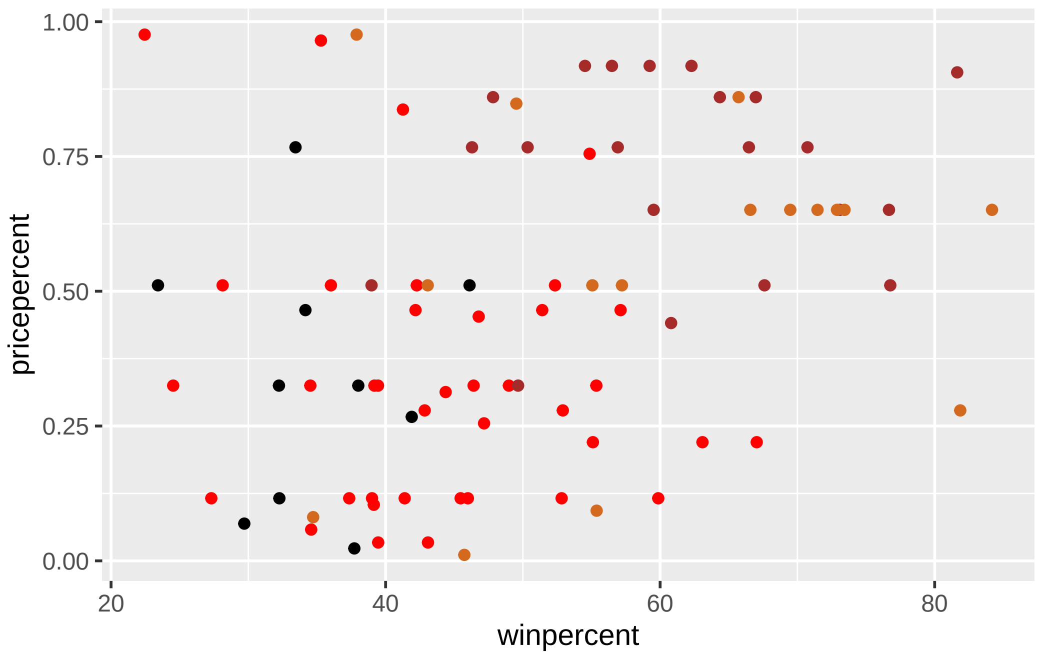
Q18. What is the best ranked fruity candy? Starburst

Looking at pricepercent

What is the best candy for the least money?

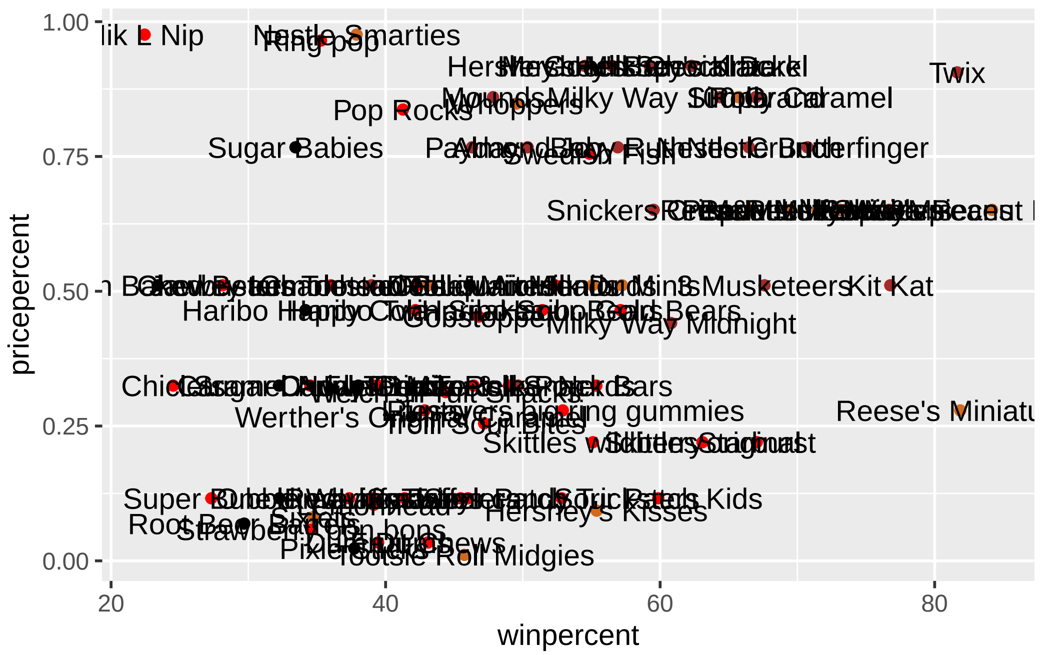
```
my_cols[as.logical(candy$fruity)] = "red"
```

```
# How about a plot of price vs win
ggplot(candy) +
  aes(winpercent, pricepercent) +
  geom_point(col=my_cols)
```



Add some labels?

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



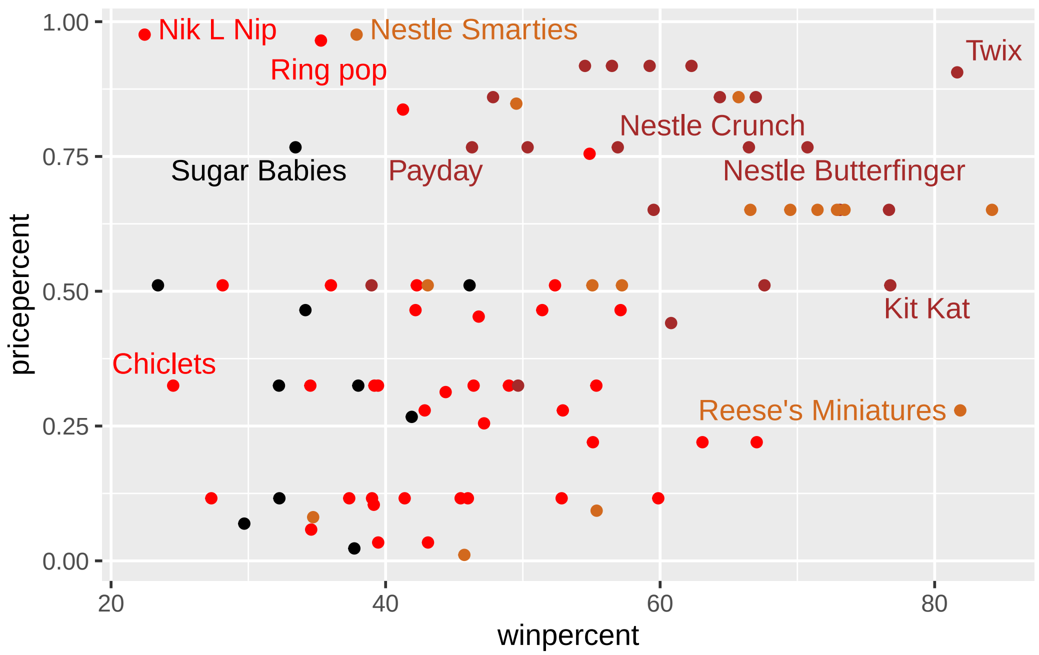
To deal with overlapping labels, we instal the **ggrepel** package.

```
installed.packages("ggrepel")
```

```
 Package LibPath Version Priority Depends Imports LinkingTo Suggests
 Enhances License License_is_FOSS License_restricts_use OS_type Archs
 MD5sum NeedsCompilation Built
```

```
library(ggrepel)

ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(max.overlaps = 5, col=my_cols) # Default: 10
```

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



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? The least popular is Nik L Nip!

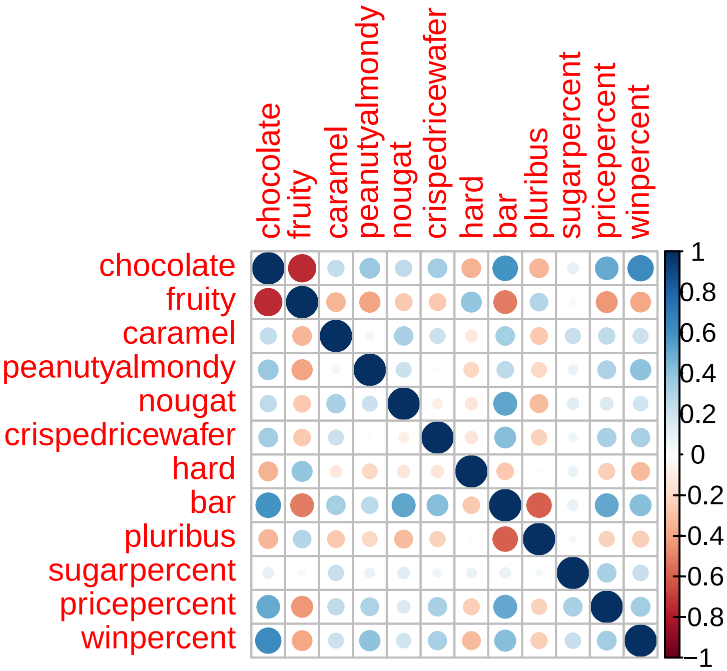
Exploring correlation structure

Pearson correlation goes between -1 and 1, with 0 indicating no correlation. Values close to 1 are considered to be highly correlated.

```
#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)? Chocolate and fruit are anti-correlated.

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

Principle Component Analysis

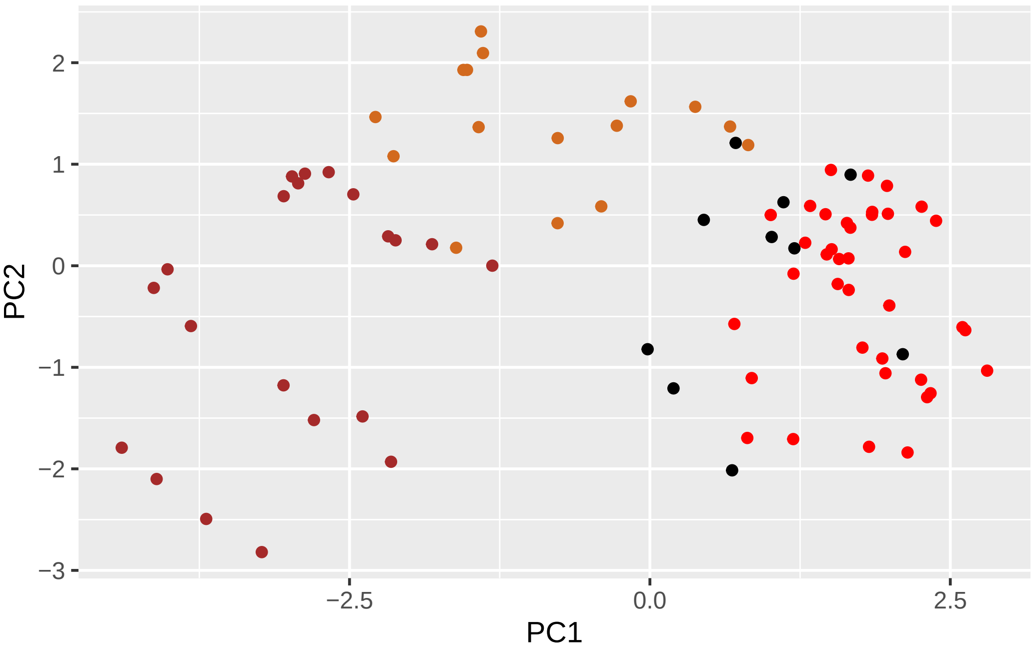
The base R function for PCA is called `prcomp()` and we can set "scale = TRUE/FALSE".

```
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
```

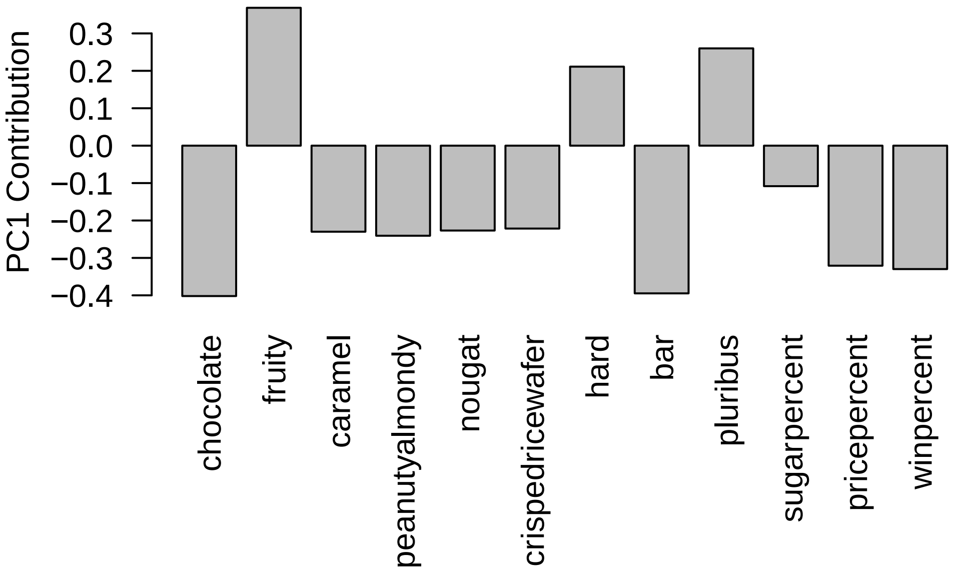
The main result of PCA - ie. the new PC plot (projection of candy on our new PC axis) is contained in `pca$x`.

```
pc <- as.data.frame(pca$x)

library(ggplot2)
library(ggrepel)

ggplot(pc) + aes(PC1, PC2, label = rownames(pc)) +
  geom_point(col=my_cols) #+
```



```
  # geom_text_repel(max.overlaps = 5)
```

```
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? The above barplot shows me visually, the correlation in two different ways: horizontal and vertical. This is another way to view the correlation plot.