Class11: Candy Project

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In today's class we will examine

```
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 this dataset?

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

```
[1] 38
```

Q. What are these fruity candy?

We can use the == ; candy$fruity == 1 will give us a set of TRUE/FALSE values

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

```
                           chocolate fruity caramel peanutyalmondy nougat
Air Heads                          0      1       0              0      0
Caramel Apple Pops                 0      1       1              0      0
Chewey Lemonhead Fruit Mix         0      1       0              0      0
Chiclets                           0      1       0              0      0
Dots                               0      1       0              0      0
Dum Dums                           0      1       0              0      0
                           crispedricewafer hard bar pluribus sugarpercent
Air Heads                                 0    0   0        0        0.906
Caramel Apple Pops                        0    0   0        0        0.604
Chewey Lemonhead Fruit Mix                0    0   0        1        0.732
Chiclets                                  0    0   0        1        0.046
Dots                                      0    0   0        1        0.732
Dum Dums                                  0    1   0        0        0.732
                           pricepercent winpercent
Air Heads                         0.511   52.34146
Caramel Apple Pops                0.325   34.51768
Chewey Lemonhead Fruit Mix        0.511   36.01763
Chiclets                          0.325   24.52499
Dots                              0.511   42.27208
Dum Dums                          0.034   39.46056
```

How often does my favorite candy win?

winpercent is the percentage of people who choose a candy over another randomly chosen candy from the dataset

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

```
[1] 81.64291
```

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

```
candy["Sour Patch Kids", ]$winpercent
```

```
[1] 59.864
```

Q4. What is the winpercent for KitKat?

```
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
```

```
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	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
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?

`winpercent` column is on a 0:100 scale and all others appear to be 0:1

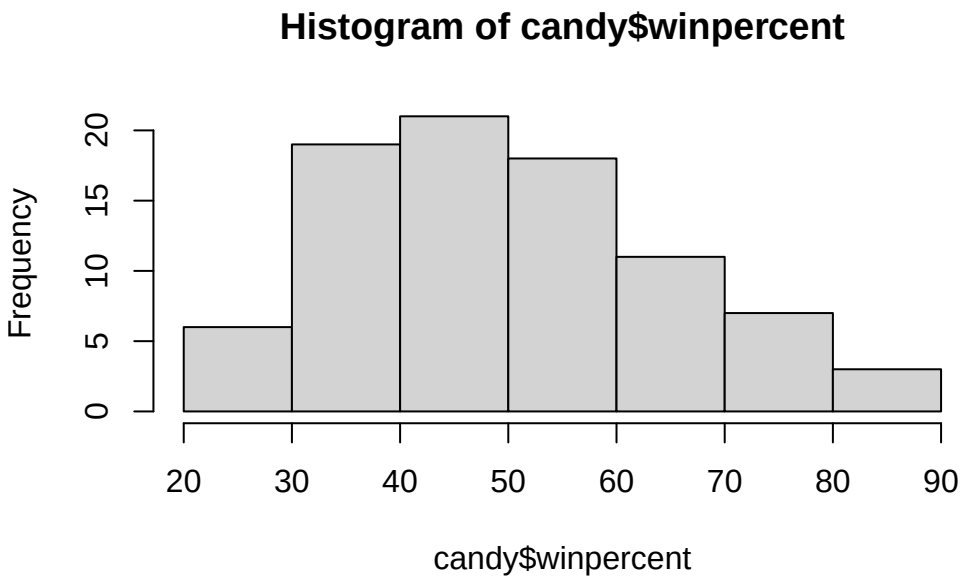
Q7. What do you think a zero and one represent for the candy$chocolate column?

A zero here means the candy is not classified as containing chocolate.

Q8. Plot a histogram of winpercent values

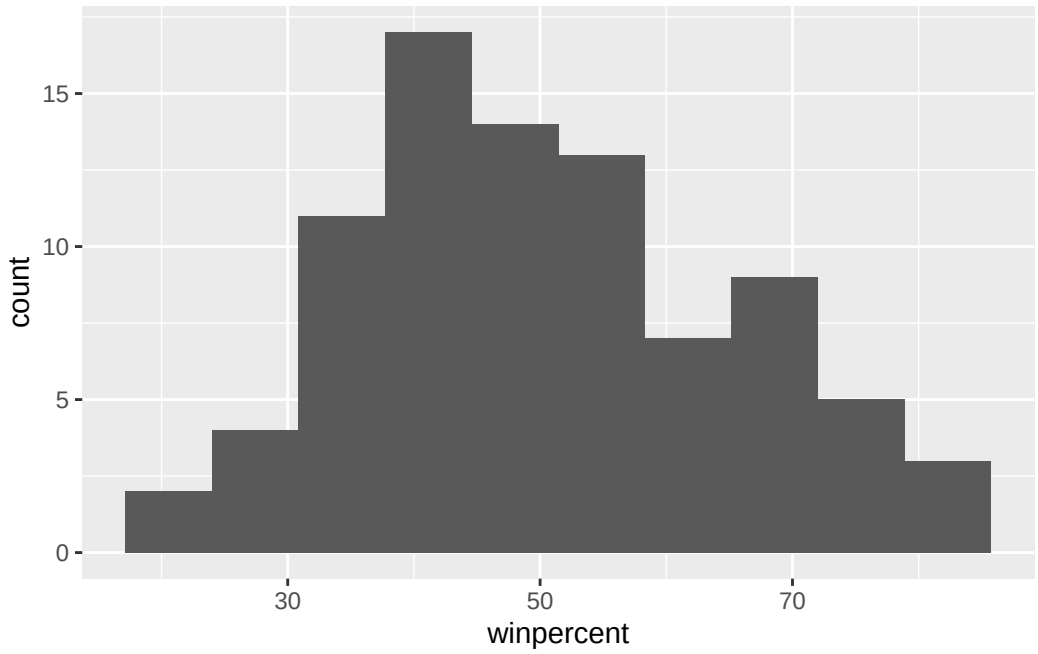
In base R graphics:

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



```
library(ggplot2)

ggplot(candy) +
  aes(winpercent) +
  geom_histogram(bins = 10)
```



Q9. Is the distribution of winpercent values symmetrical?

No

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

below 50%, with a median of 47

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

```
[1] 47.82975
```

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

```
[1] 50.31676
```

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

To answer this question, I will need to: - "subset" (aka "select", "filter") the candy dataset to just chocolate candy - get the winpercent files - calculate the mean of these,

Then do the same for fruity candy and compare.

```
mean(candy[candy$chocolate == 1,]$winpercent)
```

```
[1] 60.92153
```

```
#can also use as.logical(candy$chocolate) to get TRUE/FALSE values

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

```
[1] 44.11974
```

To break it down:

```
#Filter/select/subset to just chocolate rows
chocolate.candy <- candy[as.logical(candy$chocolate),]
fruity.candy <- candy[as.logical(candy$fruity),]

#Get their winpercent values
chocolate.winpercent <- chocolate.candy$winpercent
fruity.winpercent <- fruity.candy$winpercent

#Calculate their mean winpercent value
mean(chocolate.winpercent)
```

```
[1] 60.92153
```

```
mean(fruity.winpercent)
```

```
[1] 44.11974
```

The mean winpercent for chocolate candy is 60.92153, while the mean winpercent for fruity candy is 44.11974. Thus, chocolate candy is ranked higher.

Q12. Is this difference statistically significant?

```
  t.test(chocolate.winpercent, fruity.winpercent)
```

```
    Welch Two Sample t-test

data:  chocolate.winpercent and fruity.winpercent
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

There is a base R function called `sort()` for sorting vectors of input

```
  x <- c(5, 2, 10)

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

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

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

```
  order(x)
```

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

```
  x[ order(x) ]
```

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

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

I can order by `winpercent`

```
ord <- order(candy$winpercent)
head(candy[ord, ], 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
```

```
#This will order the candy from lowest winpercent to highest
```

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

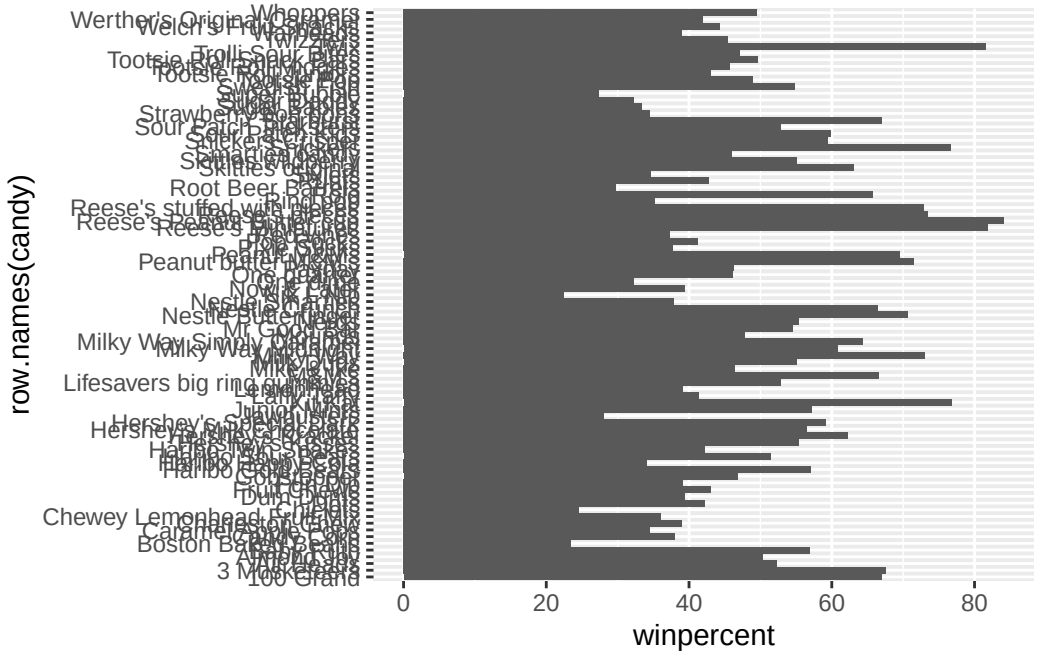
```
ord2 <- order(candy$winpercent, decreasing = TRUE)
head(candy[ord2,], 5)
```

```
                        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.

```
ggplot(candy) +
  aes(winpercent, row.names(candy)) +
  geom_col()
```

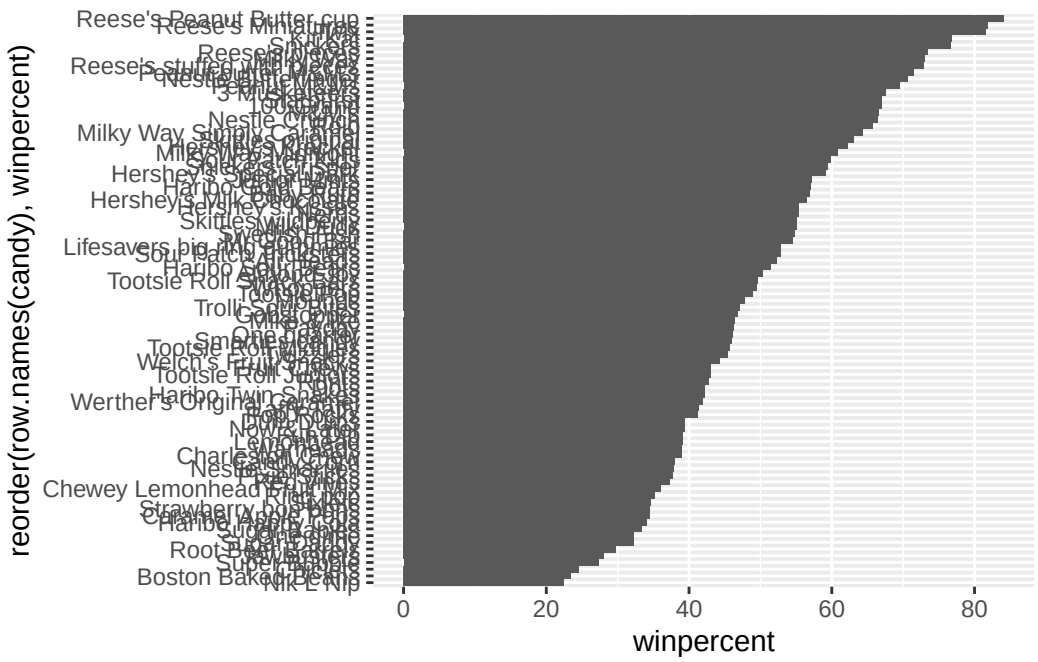



```
#We use geom_col(), geom_bar() computes stuff for you
```

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

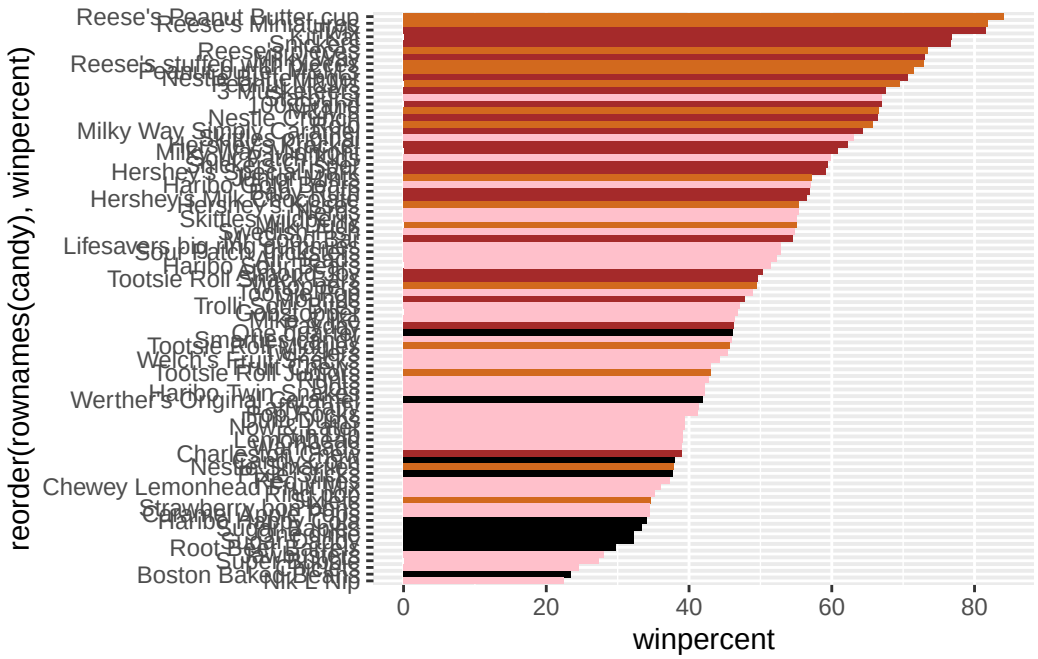
```
ggplot(candy) +
  aes(winpercent, reorder(row.names(candy), winpercent)) +
```

```
  geom_col()
```




```
#makes a black vector for each candy
my_cols=rep("black", nrow(candy))
#overwrites chocolate candy as a chocolate color (no longer black)
my_cols[as.logical(candy$chocolate)] = "chocolate"
#overwrites bars as brown
my_cols[as.logical(candy$bar)] = "brown"
#overwrites fruity candy as pink
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

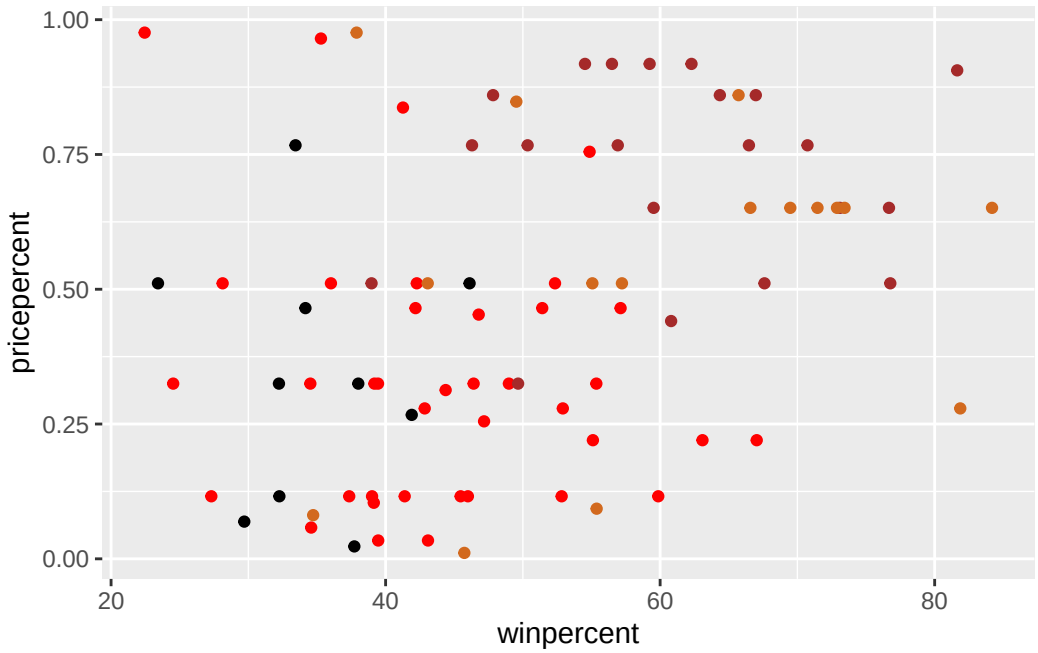
Taking a look at pricepercent

What is the best candy for the least money?

We can determine this by looking at winpercent vs pricepercent

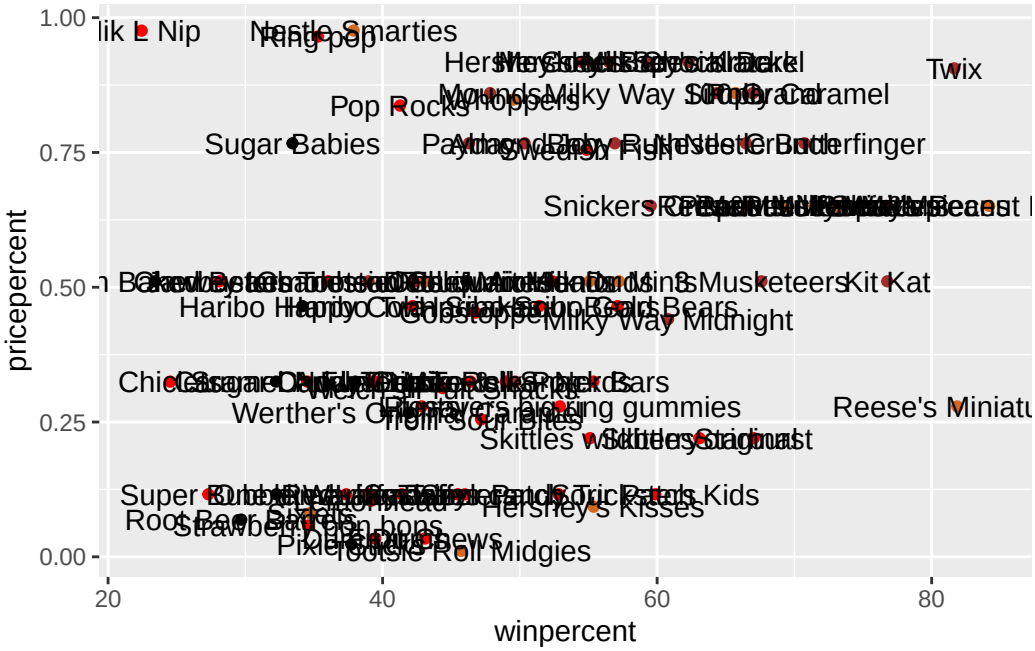
```
my_cols[as.logical(candy$fruity)] = "red"
```

```
# 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()
```

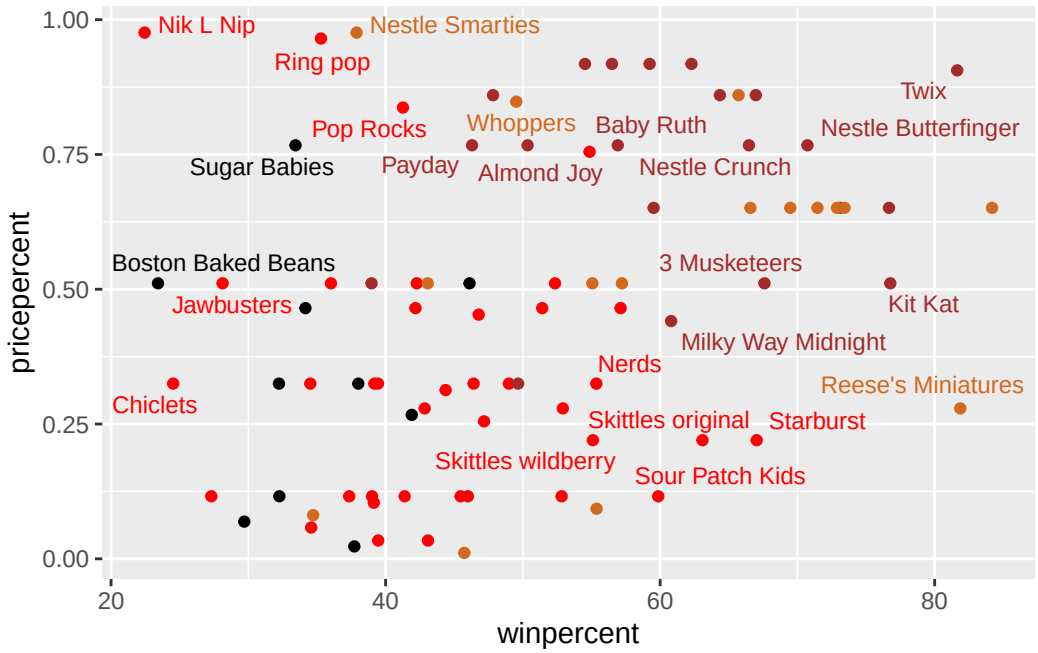


To deal with overlapping labels, I can use the **ggrepel** package

```
library(ggrepel)

ggplot(candy) +
  aes(winpercent, pricepercent, label= rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col = my_cols, size = 3.3, max.overlaps = 6)
```

```
Warning: ggrepel: 61 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



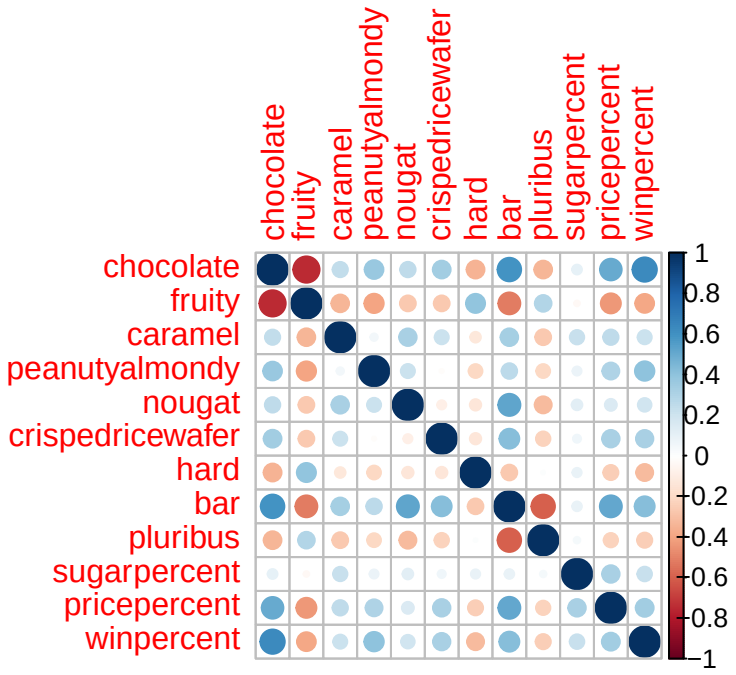
Exploring the correlation structure

Pearson correlation goes between -1 and +1, with zero indicating no correlation. Values close to 1 are very highly (anti) correlated.

```
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 + winpercent or chocolate + bar

Principal Component Analysis

The base 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
```

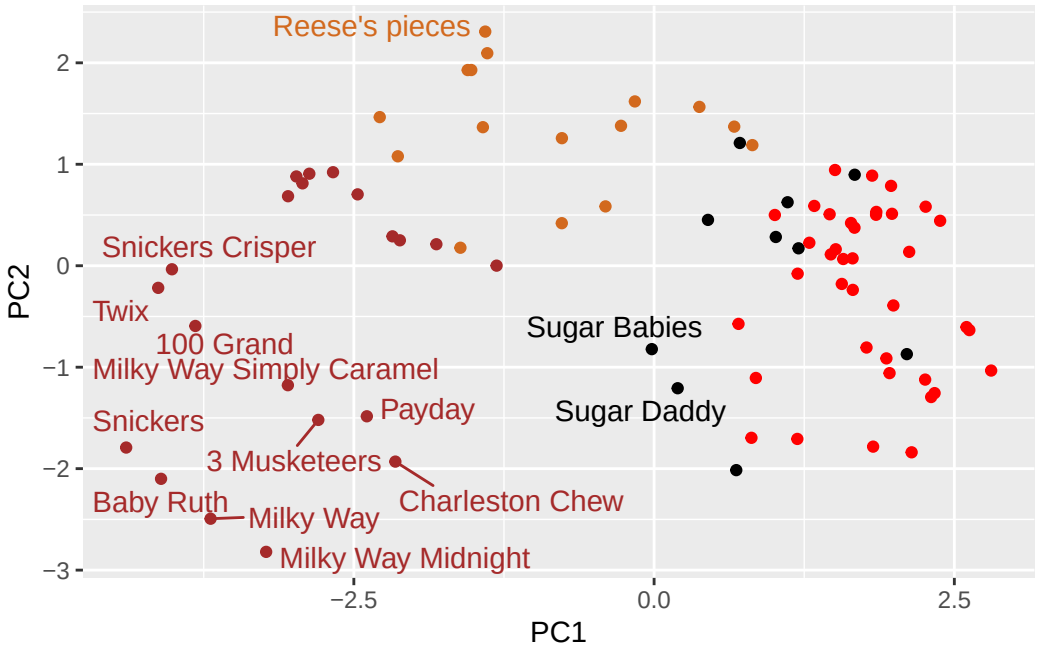
The main result of PCA - i.e. the new PC plot (projection of candy on our new PC axis) is contained in `pca$x`

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

p <- ggplot(pc) +
  aes(PC1, PC2, label = rownames(pc)) +
  geom_point(col = my_cols) +
  geom_text_repel(col = my_cols, max.overlaps = 5)

p
```

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

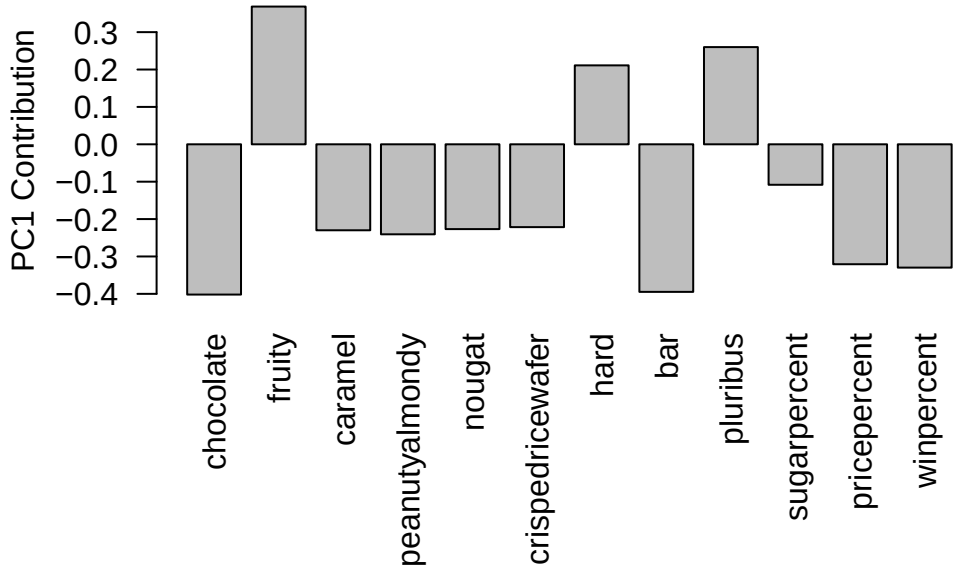


```
#library(plotly)

#ggplotly(p)
```

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

```
par(mar=c(8,4,2,2))
barplot(pca$rotation[,1], las=2, ylab="PC1 Contribution")
```



fruity, hard, pluribus are captured in PC1