Halloween_Mini_Project

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Halloween Mini-Project

In this project, we will explore FiveThirtyEight’s Halloween Candy dataset.

1. Importing Candy Data

```
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?

```
# number of different candy types based on rows
nrow(candy)
```

```
[1] 85
```

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

```
# total sum for each colum
colSums(candy)
```

```
       chocolate           fruity          caramel   peanutyalmondy 
          37.000           38.000           14.000           14.000 
          nougat crispedricewafer             hard              bar 
           7.000            7.000           15.000           21.000 
        pluribus     sugarpercent     pricepercent       winpercent 
          44.000           40.685           39.855         4276.925 
```

There are 38 fruity candy types.

2. What is your favorite candy?

One of the most interesting variables in the dataset is `winpercent`. For a given candy this value is the percentage of people who prefer this candy over another randomly chosen candy from the dataset. Higher values indicate a more popular candy.

```
# winpercent value for Twix
candy["Twix", ]$winpercent
```

```
[1] 81.64291
```

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

```
candy["Skittles original", ]$winpercent
```

```
[1] 63.08514
```

> - **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
```

Side-note: the skimr::skim() function

There is a useful `skim()` function in the **skimr** package that can help give you a quick overview of a given dataset. Let's install this package and try it on our candy data.

```
library("skimr")
skim(candy)
```

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.

Chocolate and candy are on a different scale than the majority of the other columns.

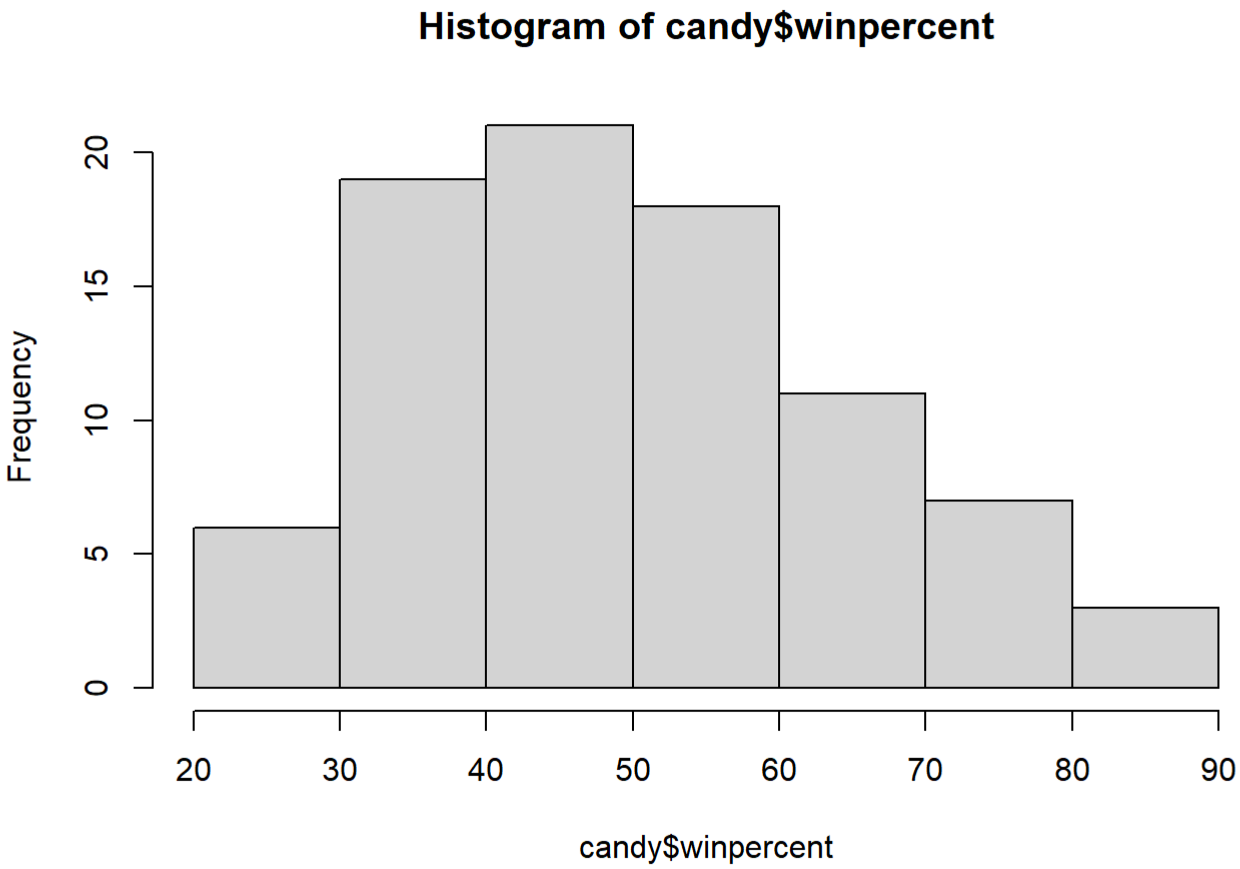
> - **Q7**. What do you think a zero and one represent for the `candy$chocolate` column?

zero is the sum of NA and NULL (i.e. missing) values.
one is the sum of not NA and NULL (i.e. missing values.

A good place to start any exploratory analysis is with a histogram. You can do this most easily with the base R function `hist()`. Alternatively, you can use `ggplot()` with `geom_hist()`. Either works well in this case and (as always) its your choice.

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

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



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

No.

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

```
[1] 50.31676
```

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

```
[1] 47.82975
```

> - **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 is higher ranked with a winpercent mean of 60.92 compared to fruity with a winpercent mean of 44.12.

```
# use logical vectors to access the coresponding candy rows
candy_chocolate <- candy$winpercent[as.logical(candy$chocolate)]
candy_fruity <- candy$winpercent[as.logical(candy$fruity)]

mean(candy_chocolate)
```

```
[1] 60.92153
```

```
mean(candy_fruity)
```

```
[1] 44.11974
```

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

Yes since p-value, 2.214e-08, is less than the 0.05 level of significance.

```
# two sample t-test for chocolate and fruity
t.test(candy_chocolate, candy_fruity, var.equal = TRUE)
```

```

	Two Sample t-test

data:  candy_chocolate and candy_fruity
t = 6.2766, df = 73, p-value = 2.214e-08
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 11.46678 22.13680
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?

```r
# using dplyr package
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
```

```r
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
```

```r
# using base R package
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?

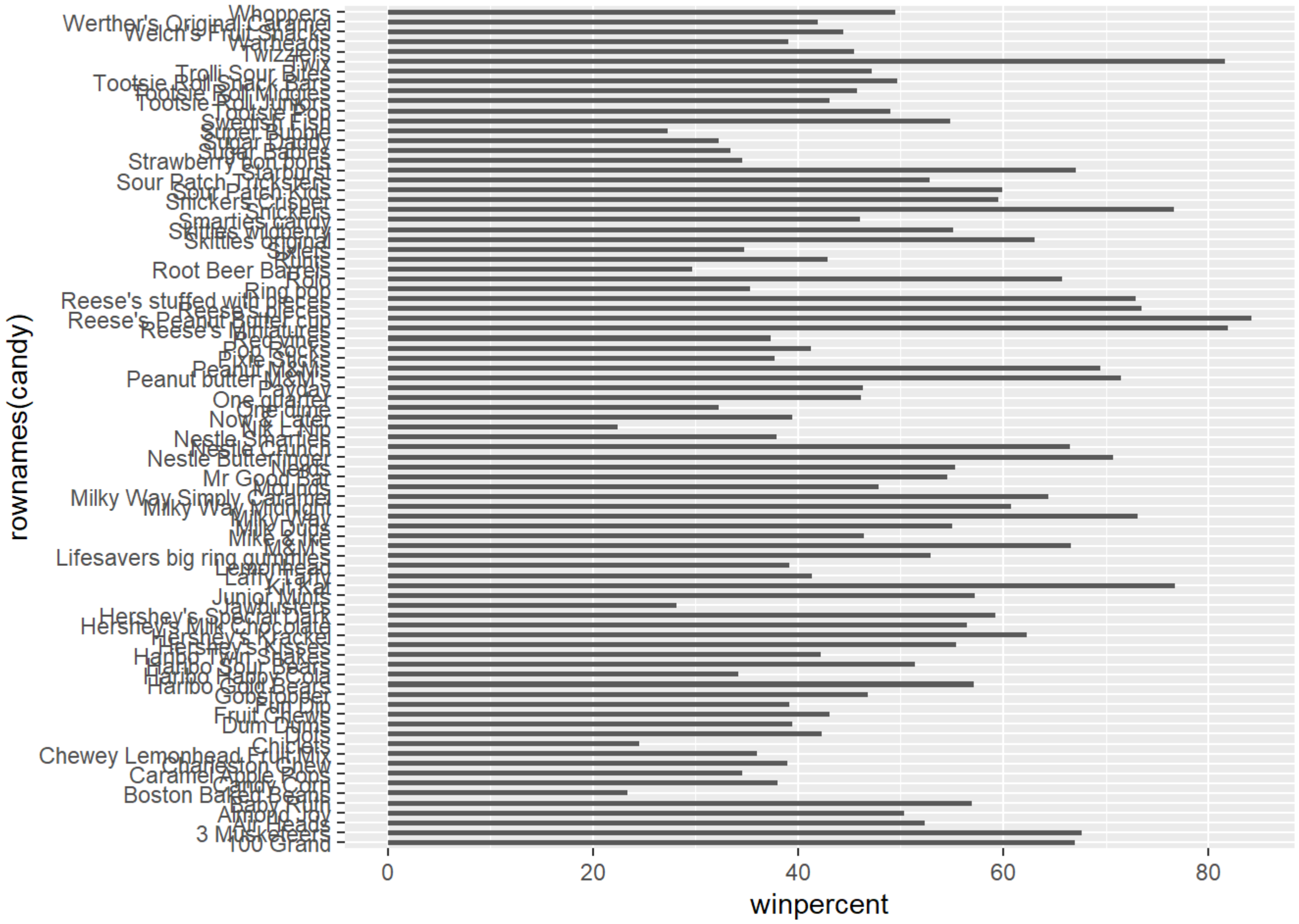
```
candy %>% arrange(winpercent) %>% tail(5)
```

```
                          chocolate fruity caramel peanutyalmondy nougat
Snickers                          1      0       1              1      1
Kit Kat                           1      0       0              0      0
Twix                              1      0       1              0      0
Reese's Miniatures                1      0       0              1      0
Reese's Peanut Butter cup         1      0       0              1      0
                          crispedricewafer hard bar pluribus sugarpercent
Snickers                                 0    0   1        0        0.546
Kit Kat                                  1    0   1        0        0.313
Twix                                     1    0   1        0        0.546
Reese's Miniatures                       0    0   0        0        0.034
Reese's Peanut Butter cup                0    0   0        0        0.720
                          pricepercent winpercent
Snickers                         0.651   76.67378
Kit Kat                          0.511   76.76860
Twix                             0.906   81.64291
Reese's Miniatures               0.279   81.86626
Reese's Peanut Butter cup        0.651   84.18029
```

To examine more of the dataset in this vain we can make a barplot to visualize the overall rankings.

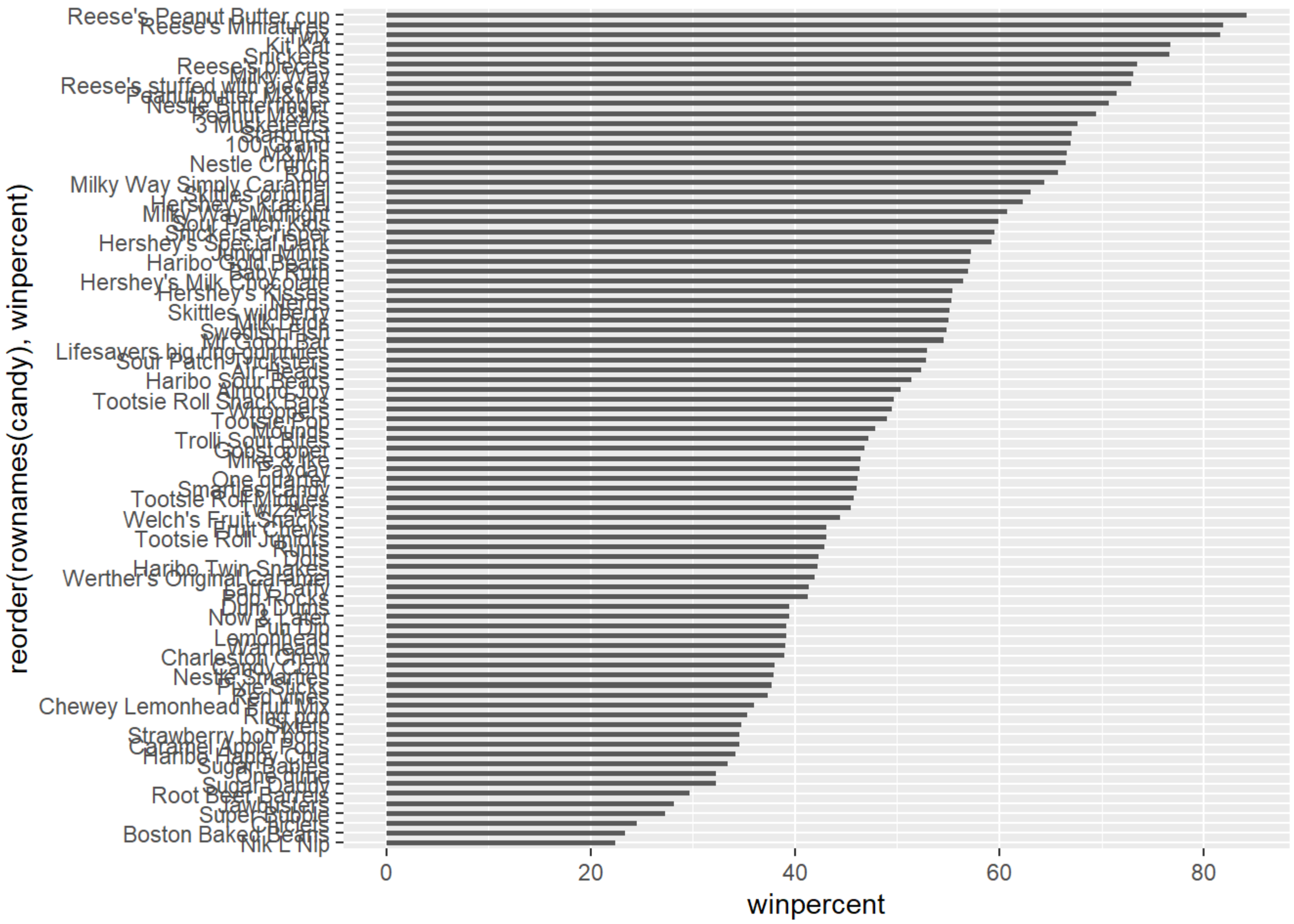
> - **Q15**. Make a first barplot of candy ranking based on `winpercent` values.

```
library(ggplot2)

ggplot(candy) +
  aes(winpercent, rownames(candy)) +
   geom_bar(stat="identity", width=0.5)
```



> - **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_bar(stat="identity", width=0.5)
```

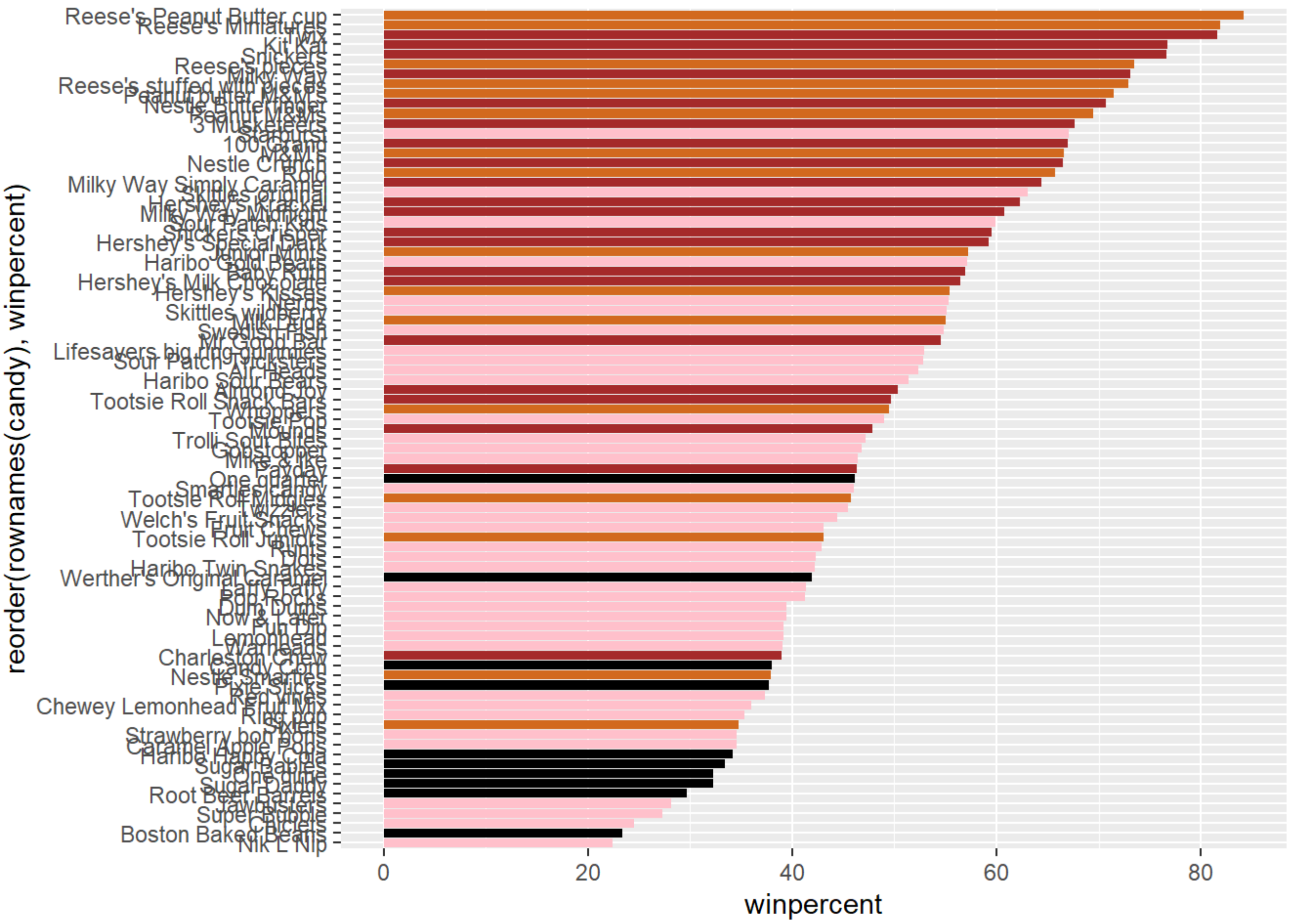


Let's setup a color vector (that signifies candy type) that we can then use for some future plots. We start by making a vector of all black values (one for each candy). Then we overwrite chocolate (for chocolate candy), brown (for candy bars) and red (for fruity candy) values.

```
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()`. Experement to see what happens if you use `col=mycols`.

```
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?

Starbursts.

4. Taking a look at Pricepercent

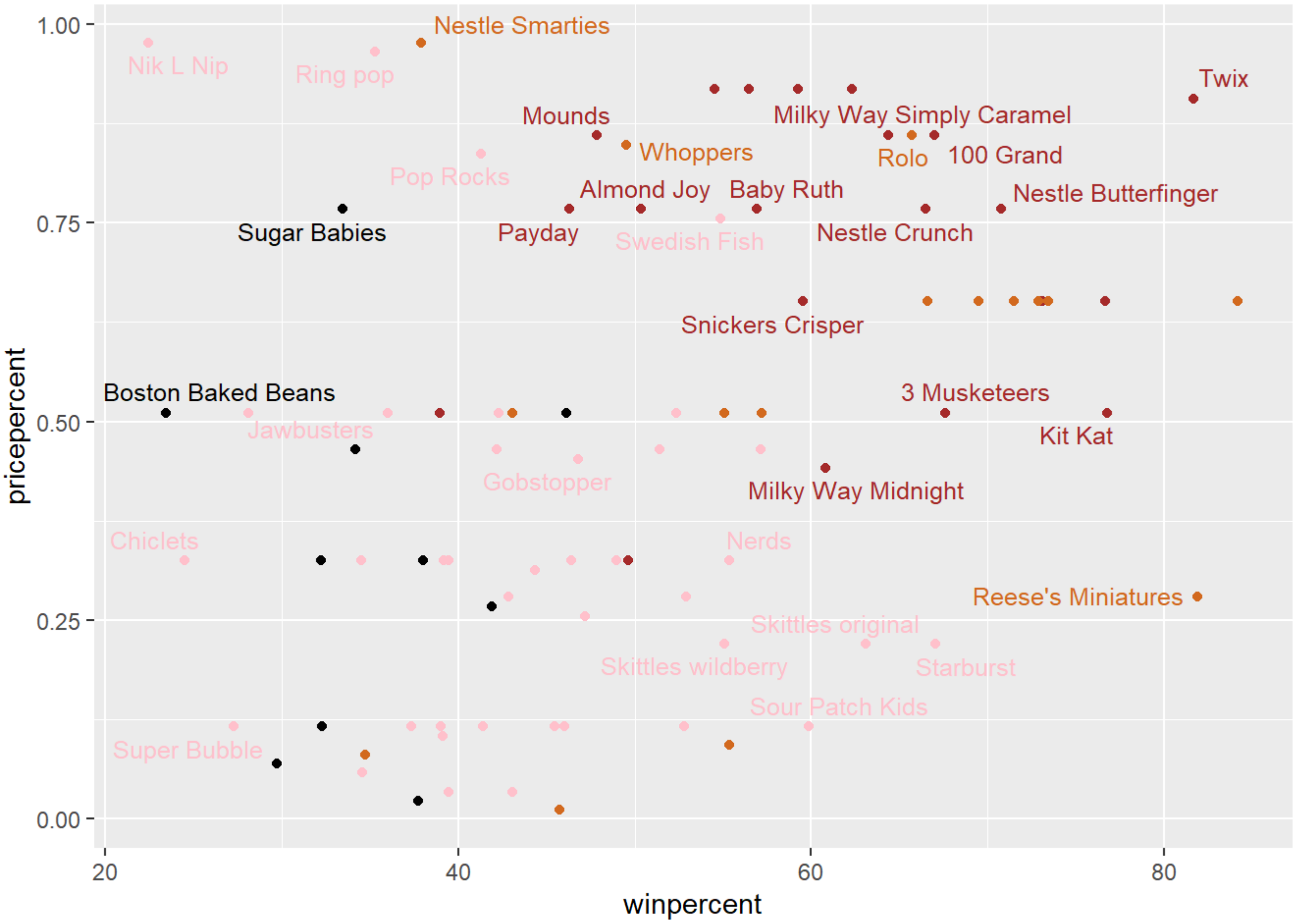
What about value for money? What is the the best candy for the least money? One way to get at this would be to make a plot of `winpercent` vs the `pricepercent` variable.

To this plot we will add text labels so we can more easily identify a given candy. There is a regular `geom_label()` that comes with ggplot2. However, as there are quite a few candys in our dataset lots of these labels will be overlapping and hard to read. To help with this we can use the `geom_text_repel()` function from the **ggrepel** package.

```
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 = 5)
```

```
Warning: ggrepel: 53 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?

Chocolate 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
```

```
ord
```

```
 [1] 45 63 56 24 25 26 41 80  1 39 40 57 85 50  6  7 43 44 47 71 74 33 34 37 48
[26] 53 54 55 65 66  2  4  5  8 11 12 14 27 28 29 36 76 19 20 21 22 18 38  9 10
[51] 13 17 35 42 46 72 75 78 83 32 52 59 84 79 61 62 69  3 30 51 64 67 68 73 81
[76] 82 31 23 60 58 70 15 16 49 77
```

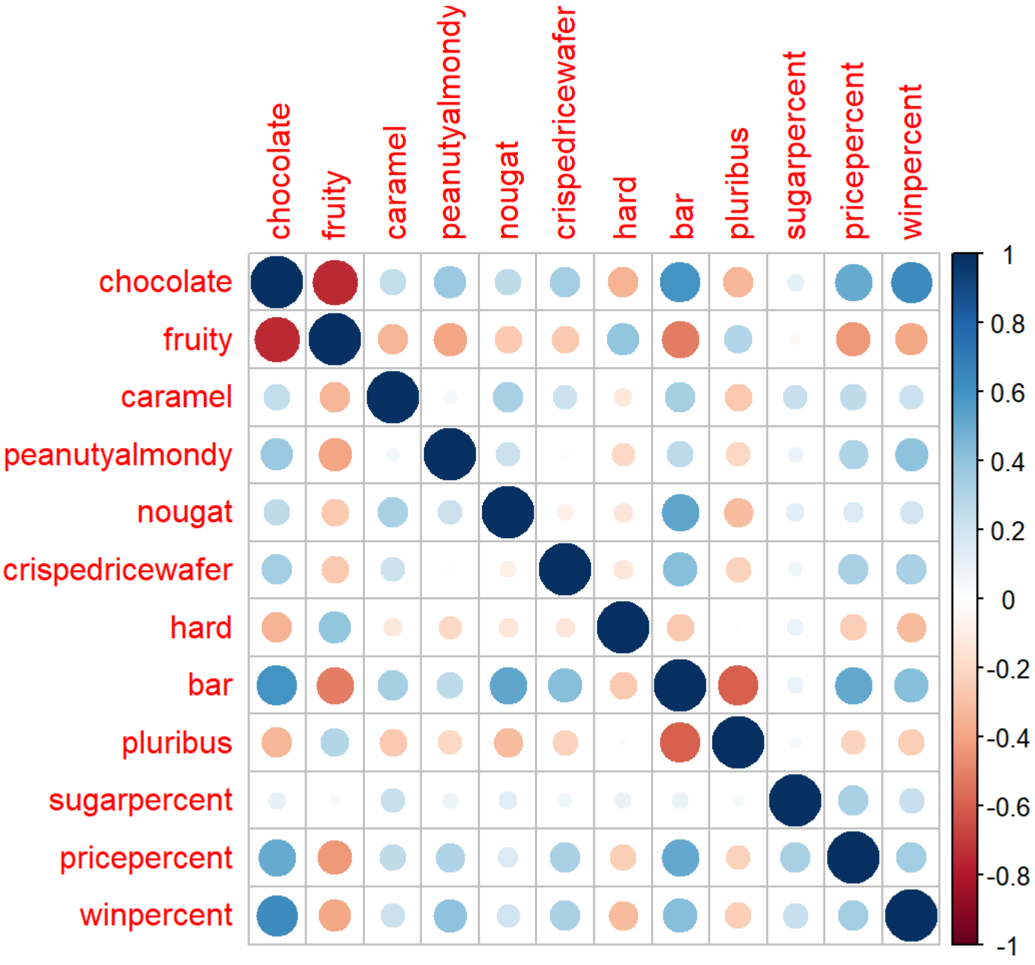
5. Exploring the Correlation Structure

We'll use correlation and view the results with the **corrplot** package to plot a correlation matrix.

```
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 fruity.

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

Chocolate bar.

6. Principal Component Analysis

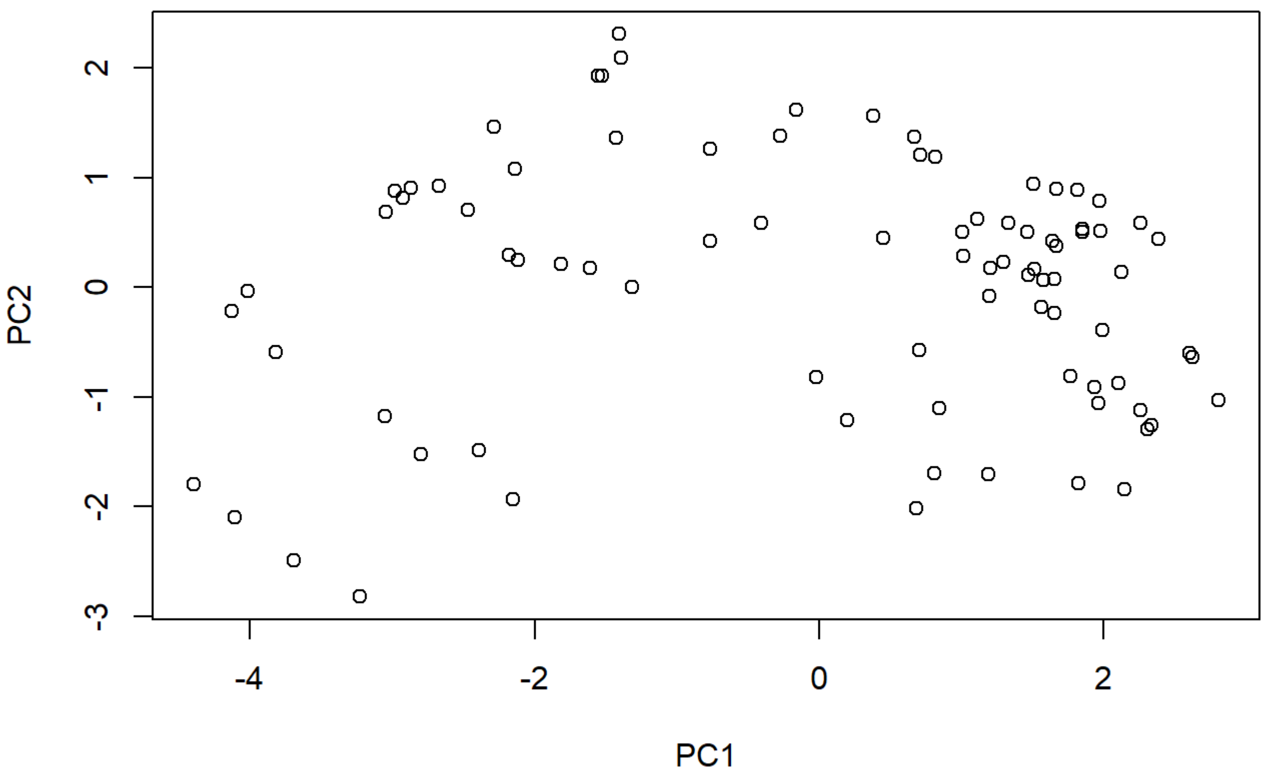
Let's apply PCA using the `prcom()` function to our candy dataset remembering to set the `scale=TRUE` argument.

```
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
```

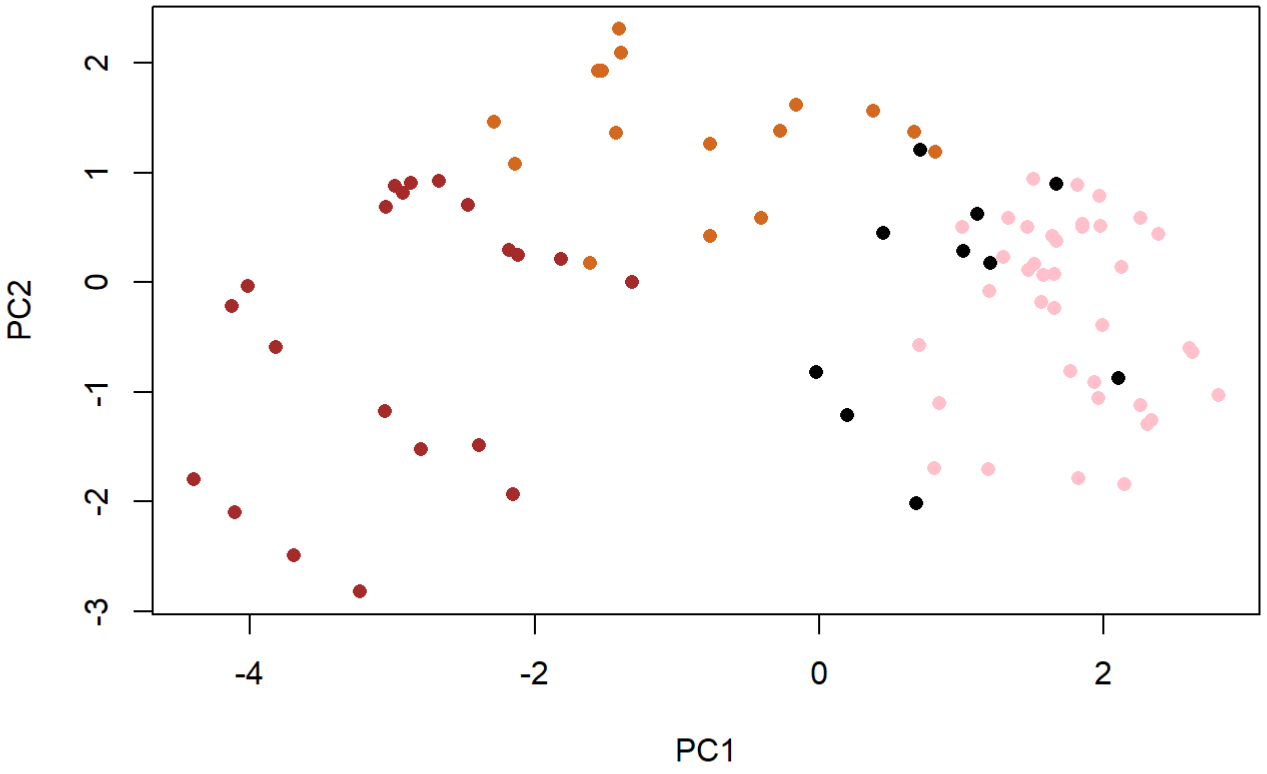
Now we can plot our main PCA score plot of PC1 vs PC2.

```
plot(pca$x[,1], pca$x[,2], xlab="PC1", ylab="PC2")
```



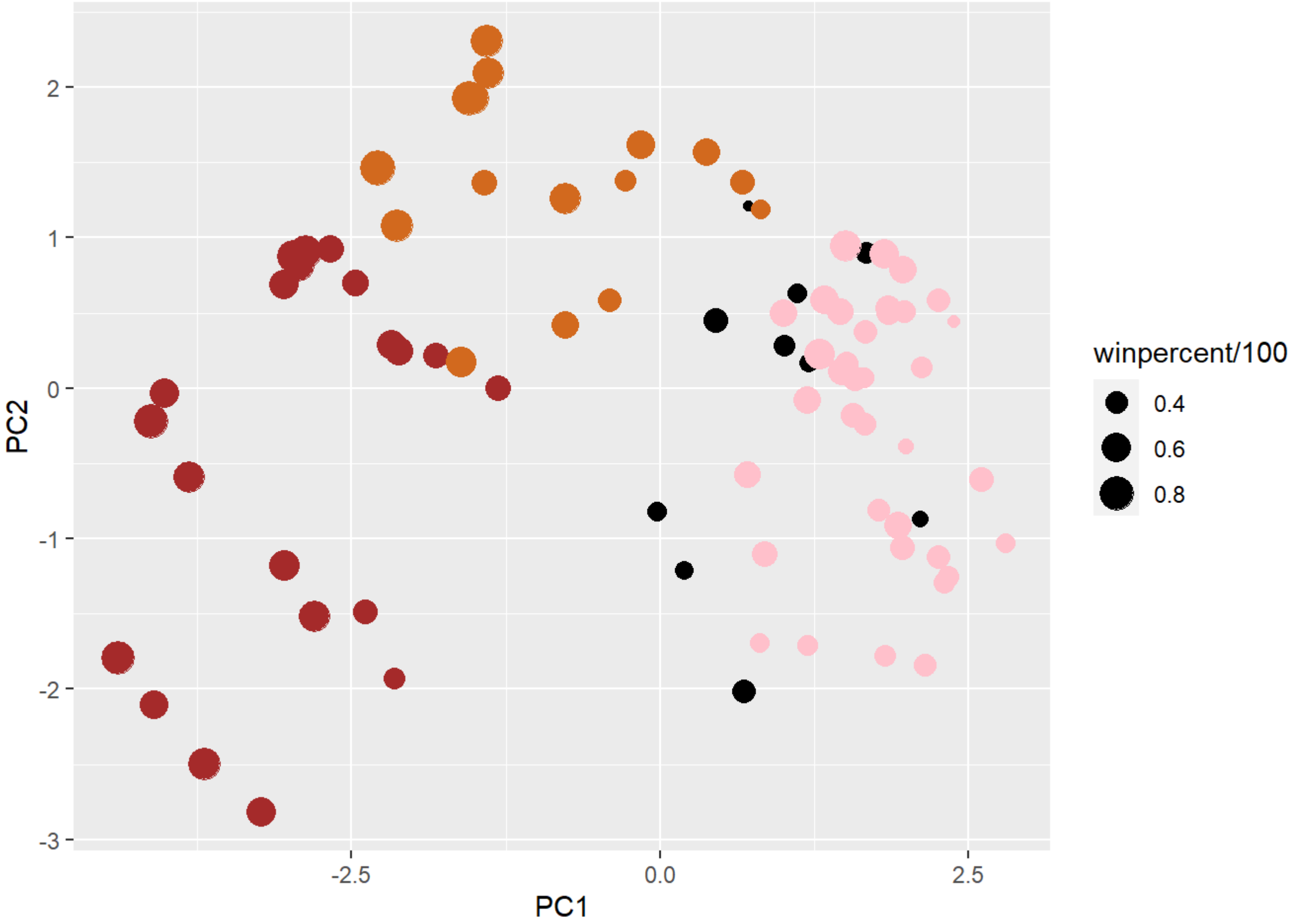
We can change the plotting character and add some color:

```
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])
```

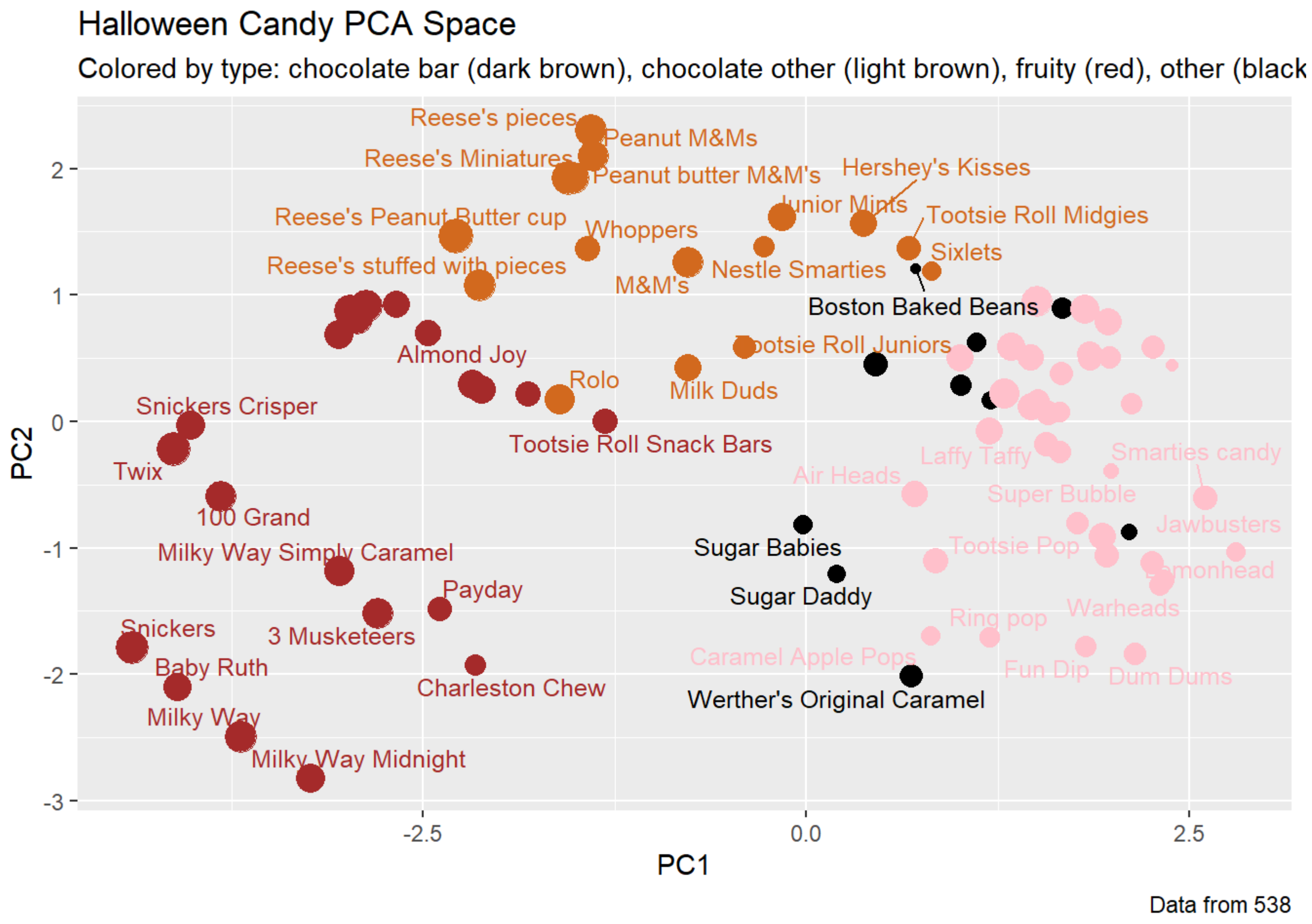
```
p <- ggplot(my_data) + 
        aes(x=PC1, y=PC2, 
            size=winpercent/100,  
            text=rownames(my_data),
            label=rownames(my_data)) + 
        geom_point(col=my_cols)

p
```



Again we can use the **ggrepel** package and the function `ggrepel::geom_text_repel()` to label up the plot with non overlapping candy names like. We will also add a title and subtitle like so:

```
library(ggrepel)

p + geom_text_repel(size=3.3, col=my_cols, max.overlaps = 7)  +
  theme(legend.position = "none") +
  labs(title="Halloween Candy PCA Space",
       subtitle="Colored by type: chocolate bar (dark brown), chocolate other (light brown), frui
       caption="Data from 538")
```

```
Warning: ggrepel: 40 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```

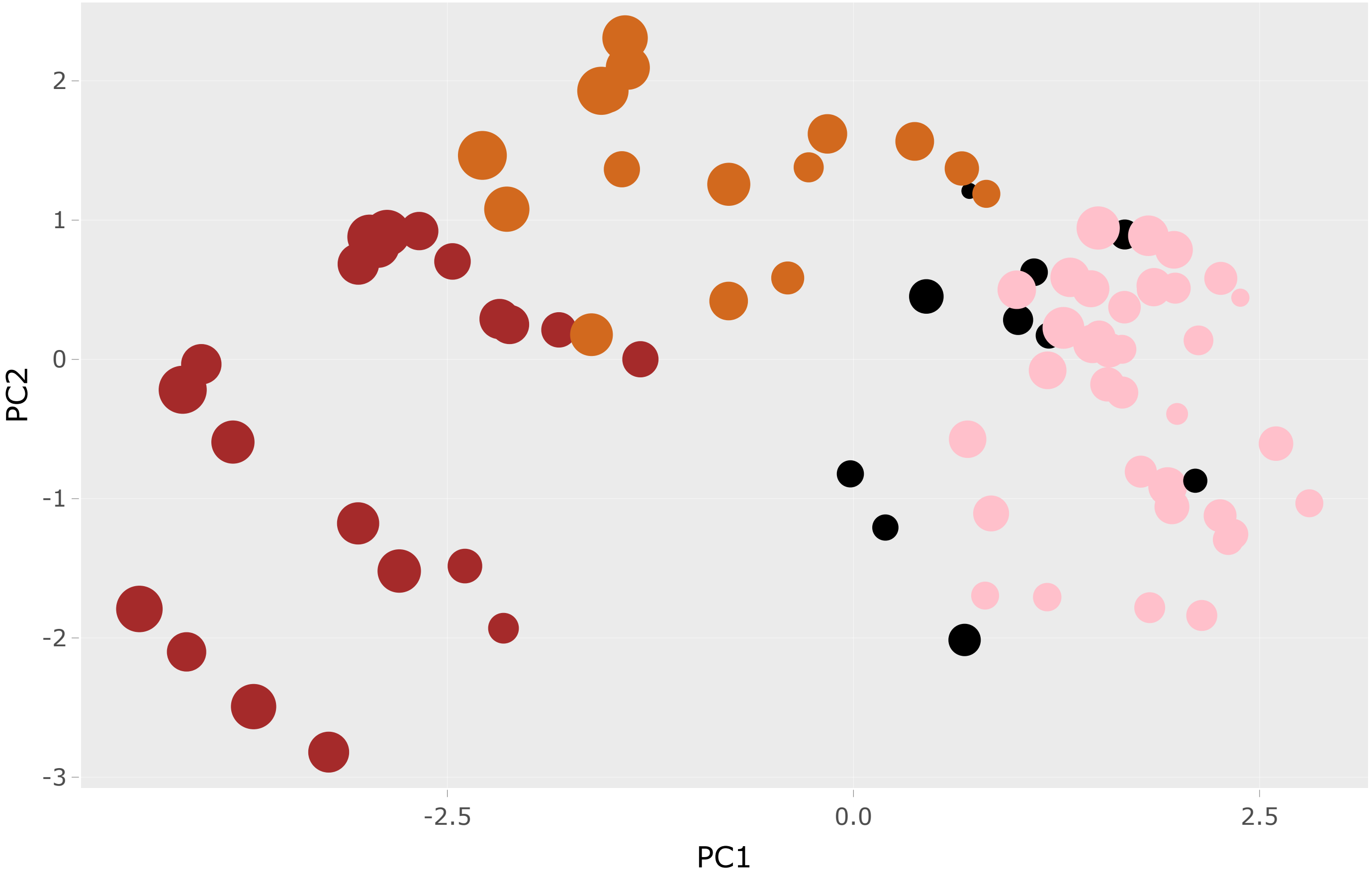


If you want to see more candy labels you can change the `max.overlaps` value to allow more overlapping labels or pass the ggplot object `p` to **plotly** like so to generate an interactive plot that you can mouse over to see labels:

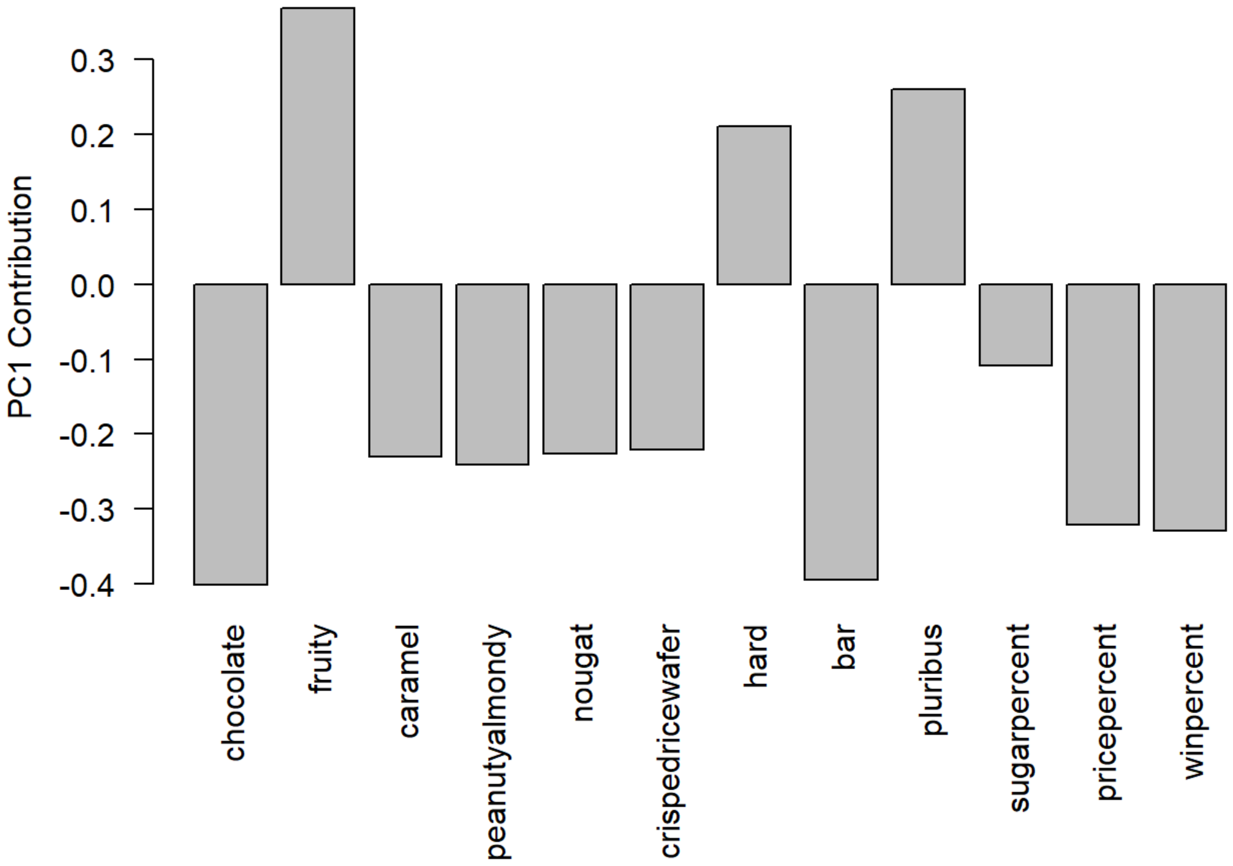
```
library(plotly)
```

```
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, hard and pluribus. Use this makes sense because most fruity candy are hard and packaged in a bag or box of multiple candies.