Class10

AUTHOR
Joe Kesler

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
```

There are 85 different candy types.

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

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

```
[1] 38
```

There are 38 fruity candies.

2.What is your favorite candy?

lets look at the variable called winpercent. It shows us who prefers this candy over another randomly chosen candy. Here's an example:

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

```
[1] 81.64291
```

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

My favorite candy is Haribo Sour Bears. Lets see its winpercent value:

```
candy["Haribo Sour Bears",]$winpercent
```

```
[1] 51.41243
```

Its win percent is only 51 :/

> Q4. What is the winpercent value for "Kit Kat"?

```
candy["Kit Kat",]$winpercent
```

```
[1] 76.7686
```

The people love kit kats

> Q5. What is the winpercent value for "Tootsie Roll Snack Bars"?

```
candy["Tootsie Roll Snack Bars",]$winpercent
```

```
[1] 49.6535
```

The people like tootsie rolls a lot more than I thought.

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

```
Warning: package 'skimr' was built under R version 4.1.3
```

```
skim(candy)
```

Data summary

Name	candy
Number of rows	85
Number of columns	12

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?

All the variables that end in “percent” seem to be on a different scale that is continuous. Meanwhile, the non “percent” scales are just between 0 and 1

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

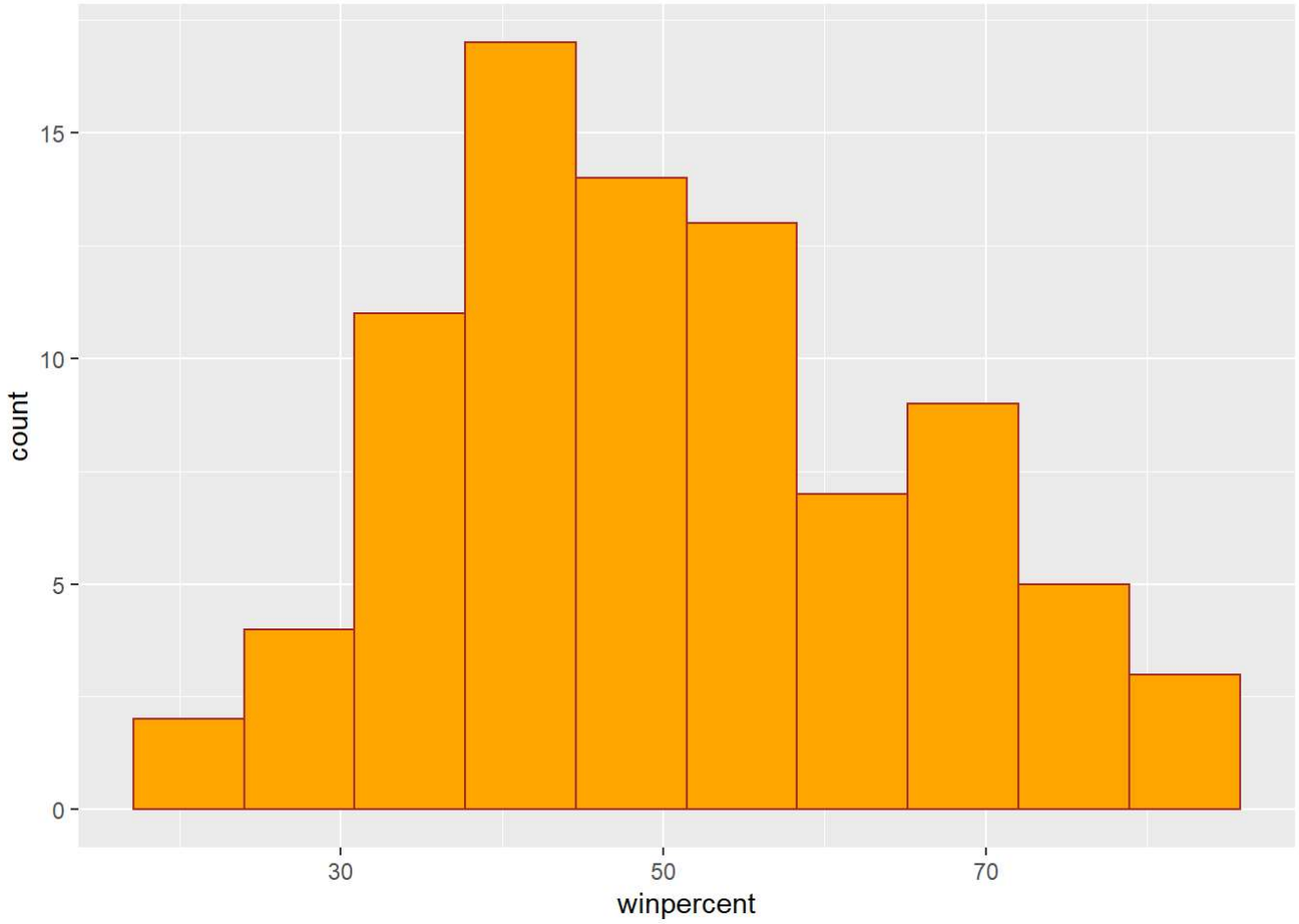
0 and 1 represent whether or not the candy fits within the category of the variable. 1 is yes it does fit, and 0 is no it doesn’t fit.

> Q8. Plot a histogram of winpercent values

```
library(ggplot2)
```

```
Warning: package 'ggplot2' was built under R version 4.1.3
```

```
ggplot(candy) +
  aes(winpercent) +
  geom_histogram(bins = 10, col = "brown", fill = "orange")
```



> Q9. Is the distribution of winpercent values symmetrical?

It looks like it is skewed to the right.

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

It is below 50%

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

```
chocolate.inds <- as.logical(candy$chocolate)
chocolate.wins <- candy[chocolate.inds,]$winpercent
```

```
fruity.inds <- as.logical(candy$fruity)
fruity.wins <- candy[fruity.inds,]$winpercent
```

```
mean(chocolate.wins)
```

```
[1] 60.92153
```

```
mean(fruity.wins)
```

```
[1] 44.11974
```

The people ON AVERAGE like the chocolate candy better.

> Q12. Is this difference statistically significant?

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

```
    Welch Two Sample t-test

data:  chocolate.wins and fruity.wins
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
```

It is significant because the p-value is so differnt. People prefer chocolate.

3. Overall candy rankings

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

```
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
```

You can see the 5 least liked above

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

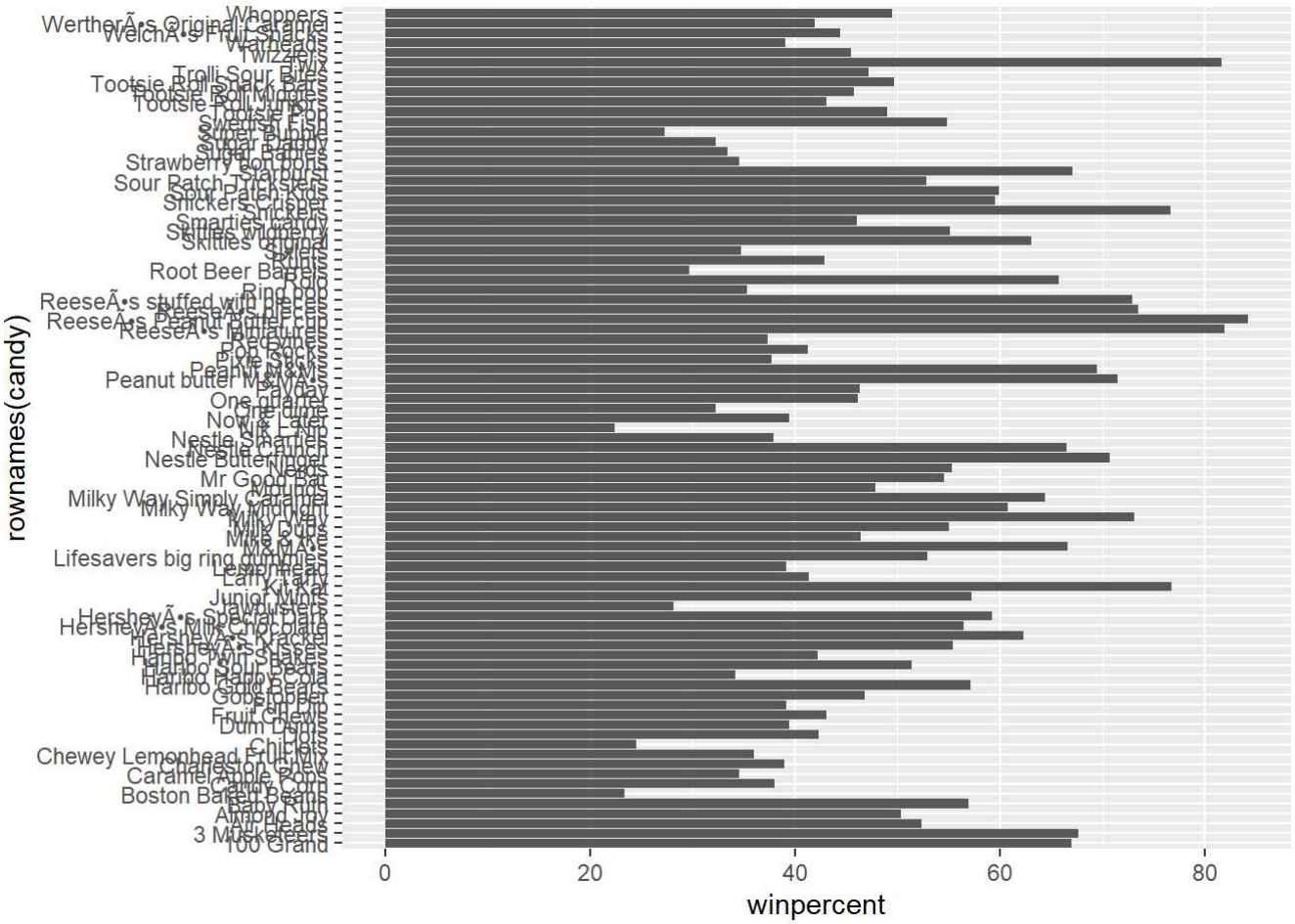
```
tail(candy[order(candy$winpercent),], n=5)
```

```
                         chocolate fruity caramel peanutyalmondy nougat
Snickers                         1      0       1              1      1
Kit Kat                          1      0       0              0      0
Twix                             1      0       1              0      0
ReeseÃ•s Miniatures              1      0       0              1      0
ReeseÃ•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
ReeseÃ•s Miniatures                      0    0   0        0        0.034
ReeseÃ•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
ReeseÃ•s Miniatures              0.279   81.86626
ReeseÃ•s Peanut Butter cup       0.651   84.18029
```

You can see the five most liked above.

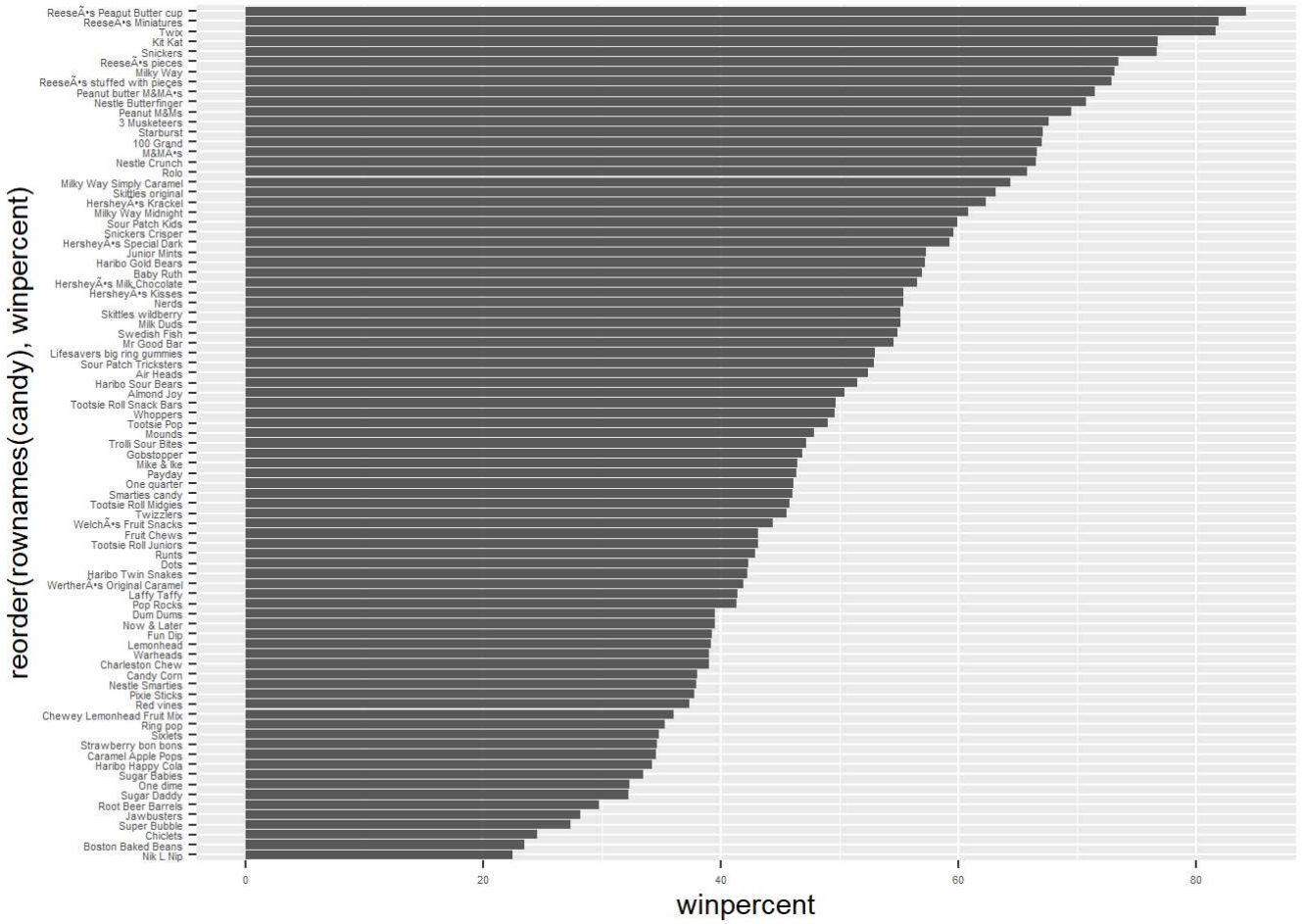
> Q15. Make a first barplot of candy ranking based on winpercent values.

```
library(ggplot2)

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



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

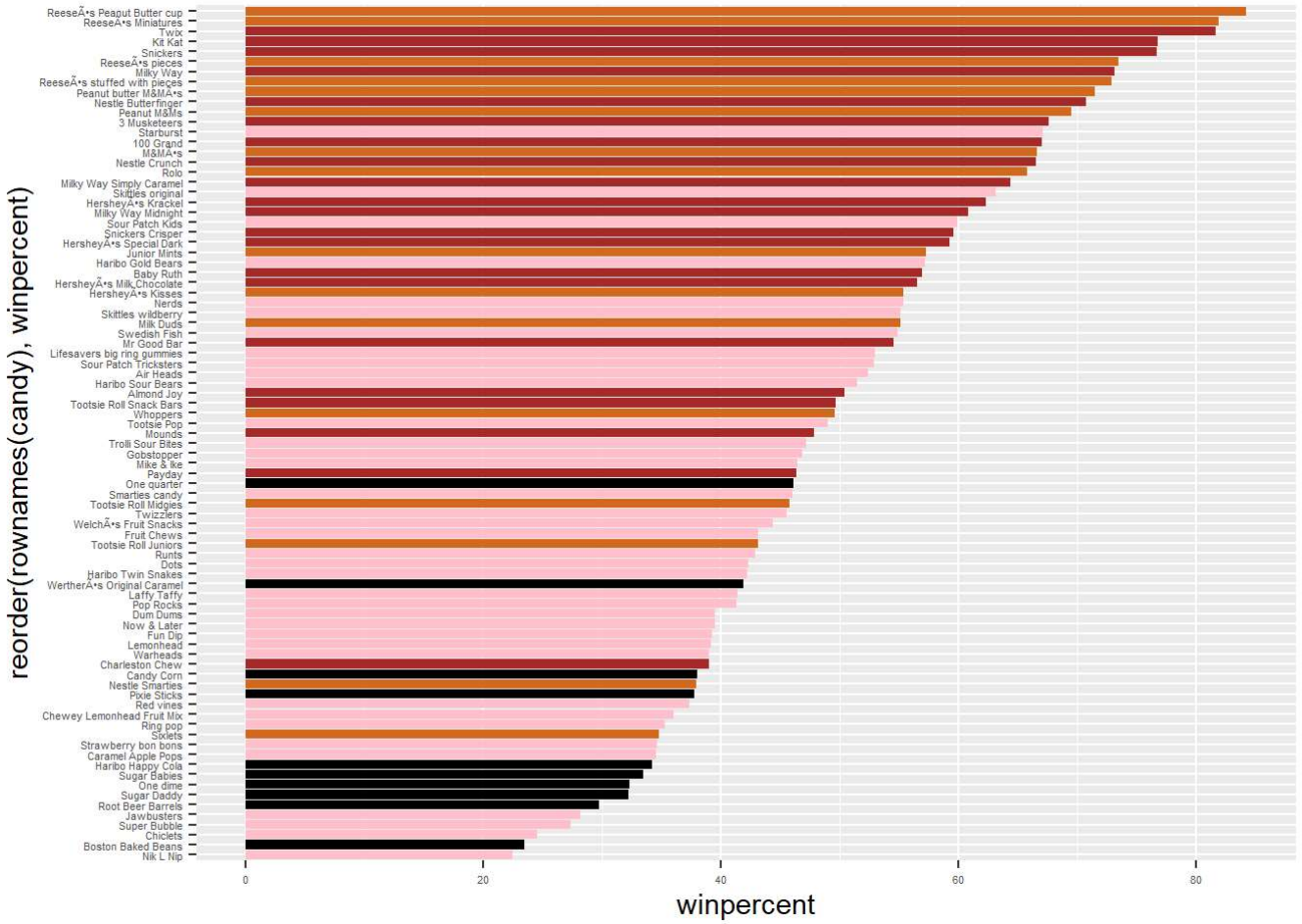
```
ggplot(candy)+
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col() +
  theme(axis.text = element_text(size = 4))
```



Now lets add color.

```
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) +
  theme(axis.text = element_text(size = 4))
```



> Q17. What is the worst ranked chocolate candy?

Sixlets is the worst ranked chocolate candy

> Q18. What is the best ranked fruity candy?

Starburst is the best ranked fruity candy.

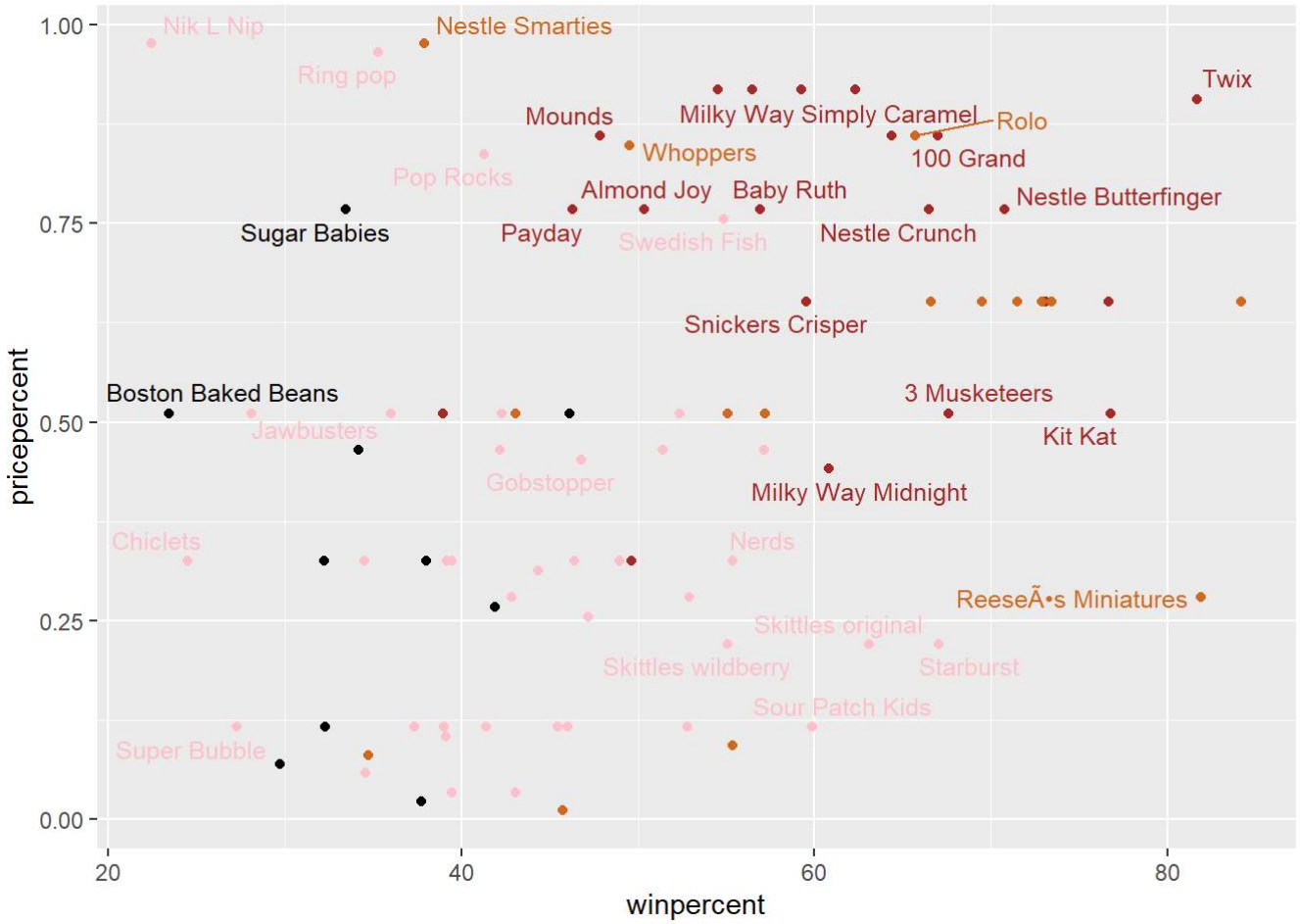
4. Taking a look at pricepercent

```
library(ggrepel)
```

```
Warning: package 'ggrepel' was built under R version 4.1.3
```

```
# 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?

looking at the graph, it seems to be reeses miniatures.

> Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular?

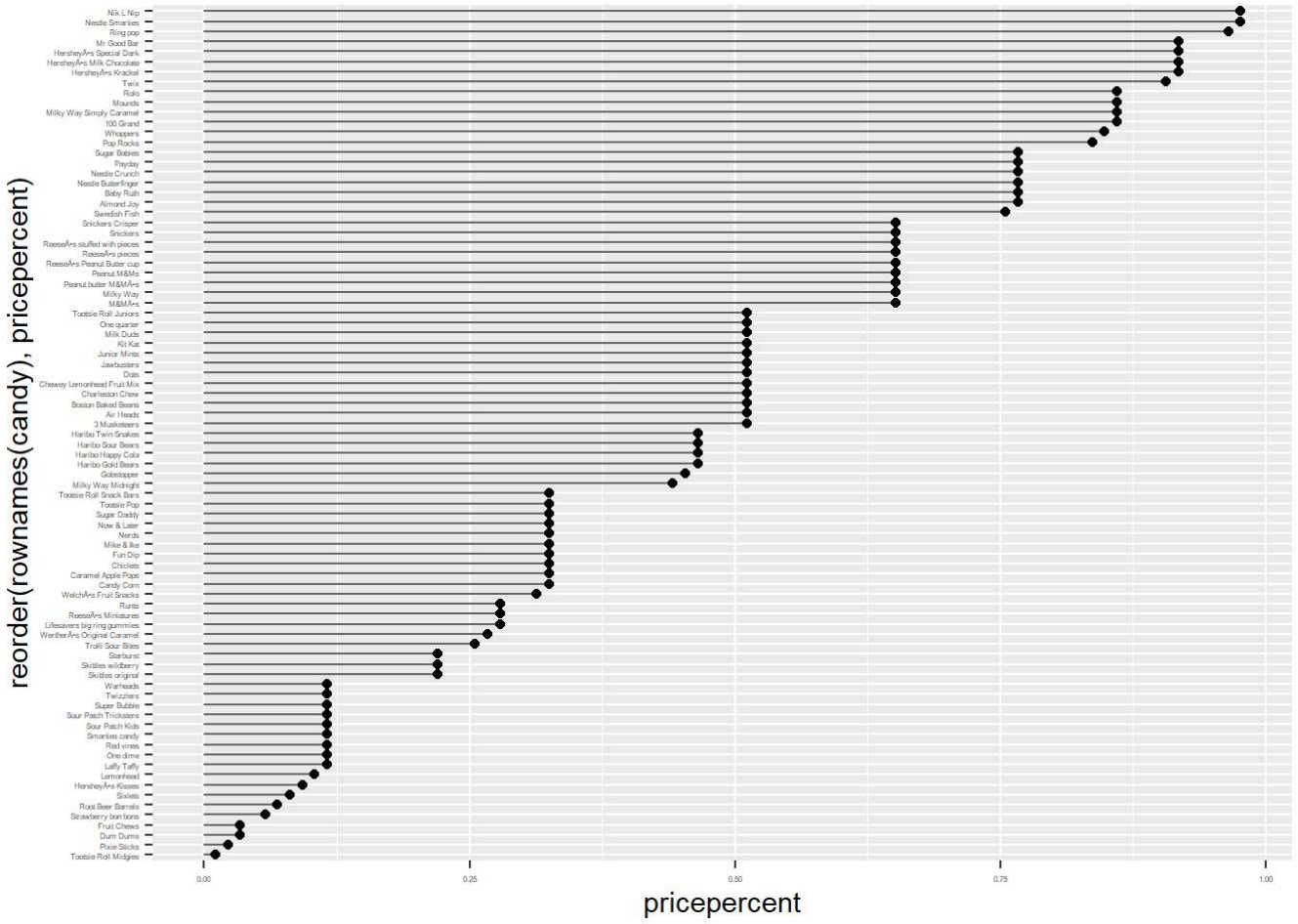
```
ord <- order(candy$pricepercent, decreasing = TRUE)
head( candy[ord,c(11,12)], n=5 )
```

	pricepercent	winpercent
Nik L Nip	0.976	22.44534
Nestle Smarties	0.976	37.88719
Ring pop	0.965	35.29076
HersheyÃ•s Krackel	0.918	62.28448
HersheyÃ•s Milk Chocolate	0.918	56.49050

The top 5 most expensive in the dataset can be seen above. The least popular of these 5 is Nik L Nip

> 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().

```
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 = element_text(size = 3))
```

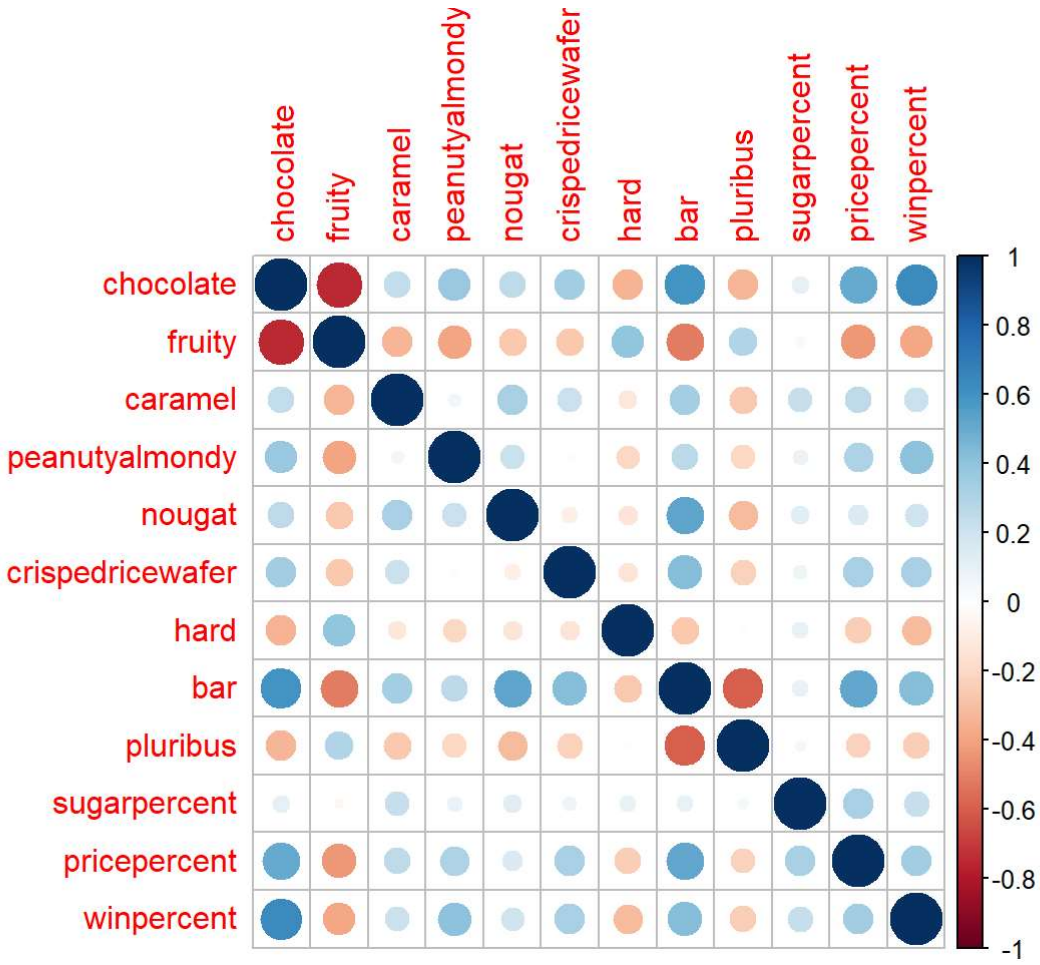



```
library(corrplot)
```

```
Warning: package 'corrplot' was built under R version 4.1.3
```

```
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 fruity are super anti-correlated. Also bar and pluribus are super anti-correlated

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

Chocolate and winpercent are very highly correlated. Bar and chocolate are also extremely correlated.

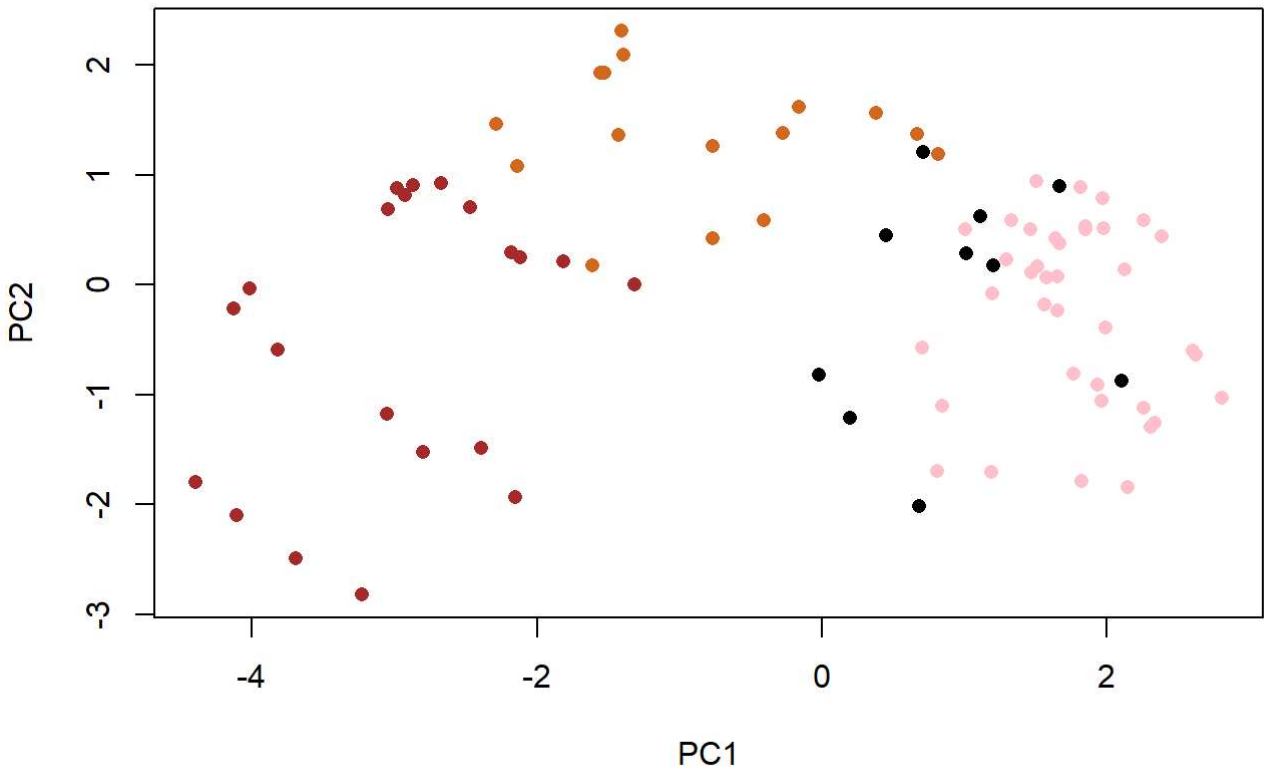
6. PCA

```
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
```

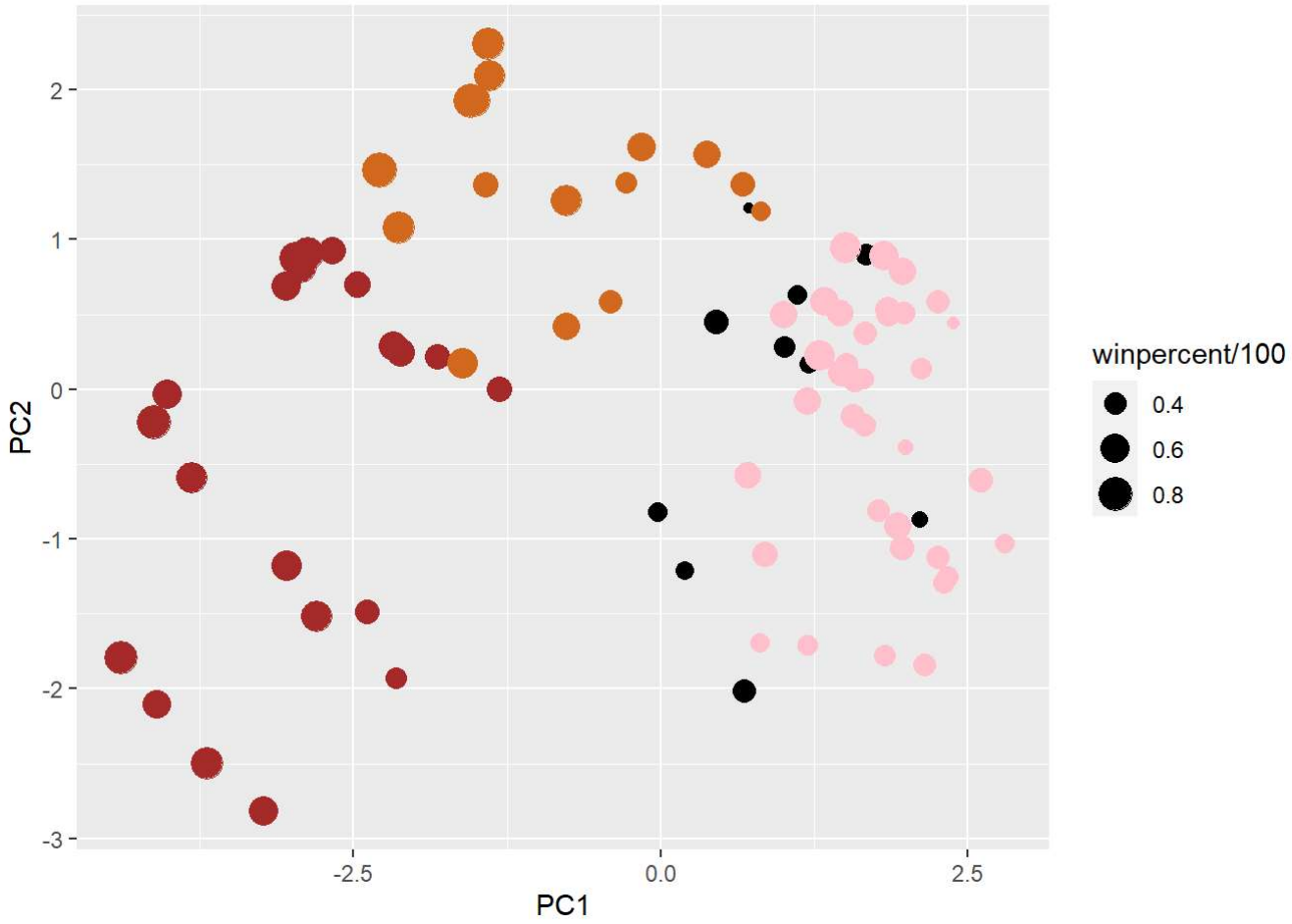
```
plot(pca$x[,1:2], col=my_cols, pch=16)
```



The above graph is the PCA for our candies. Lets make this prettier using ggplot though.

```
my_data <- cbind(candy, pca$x[,1:3])
```

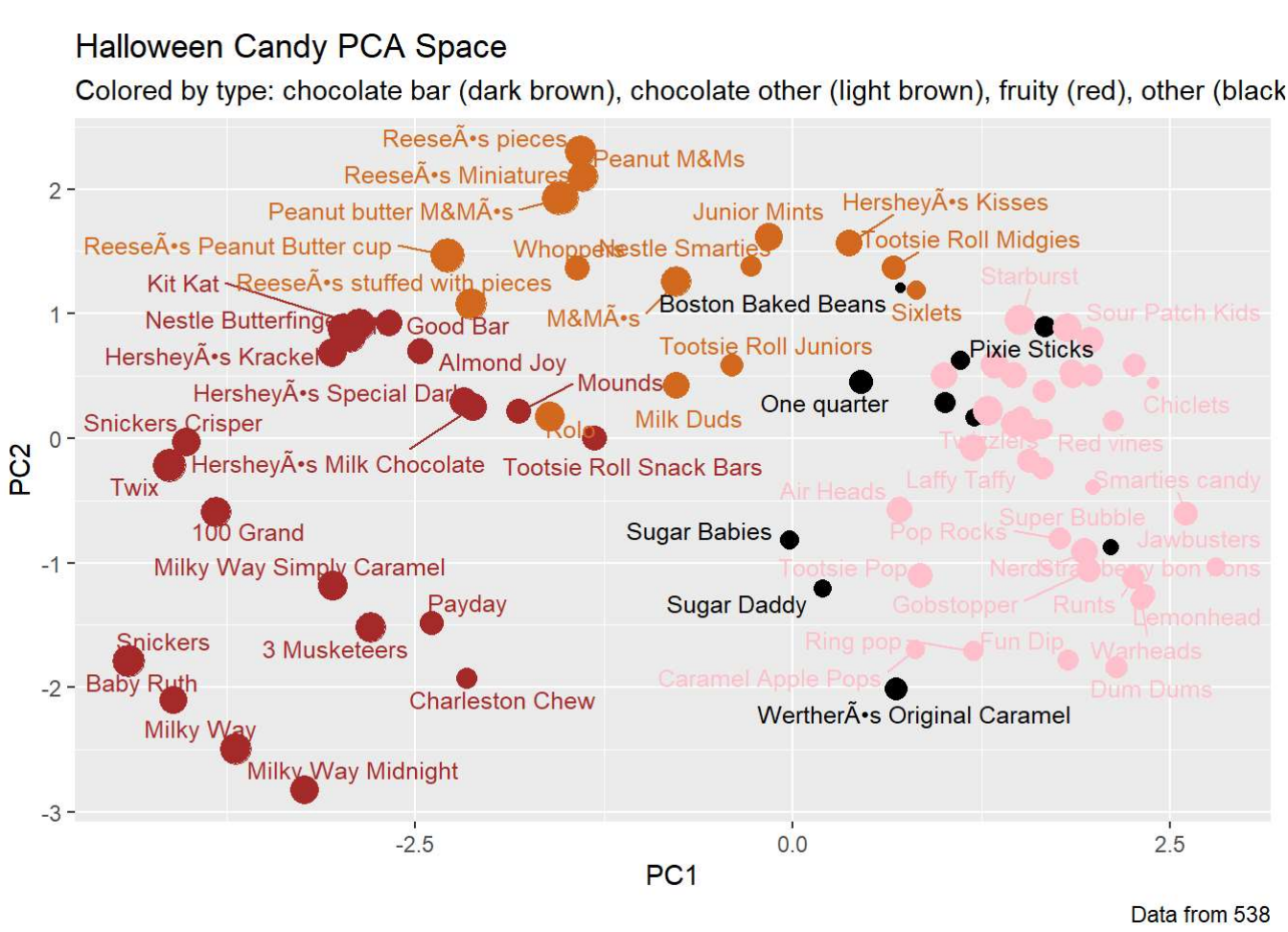
```
p <- ggplot(my_data) +
        aes(x=PC1, y=PC2,
            size=winpercent/100,
            text=rownames(my_data),
            label=rownames(my_data)) +
        geom_point(col=my_cols)

p
```



Lets put in some non overlapping candy names using ggrepel

```
library(ggrepel)

p + geom_text_repel(size=3.3, col=my_cols, max.overlaps = 10)  +
  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: 21 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```

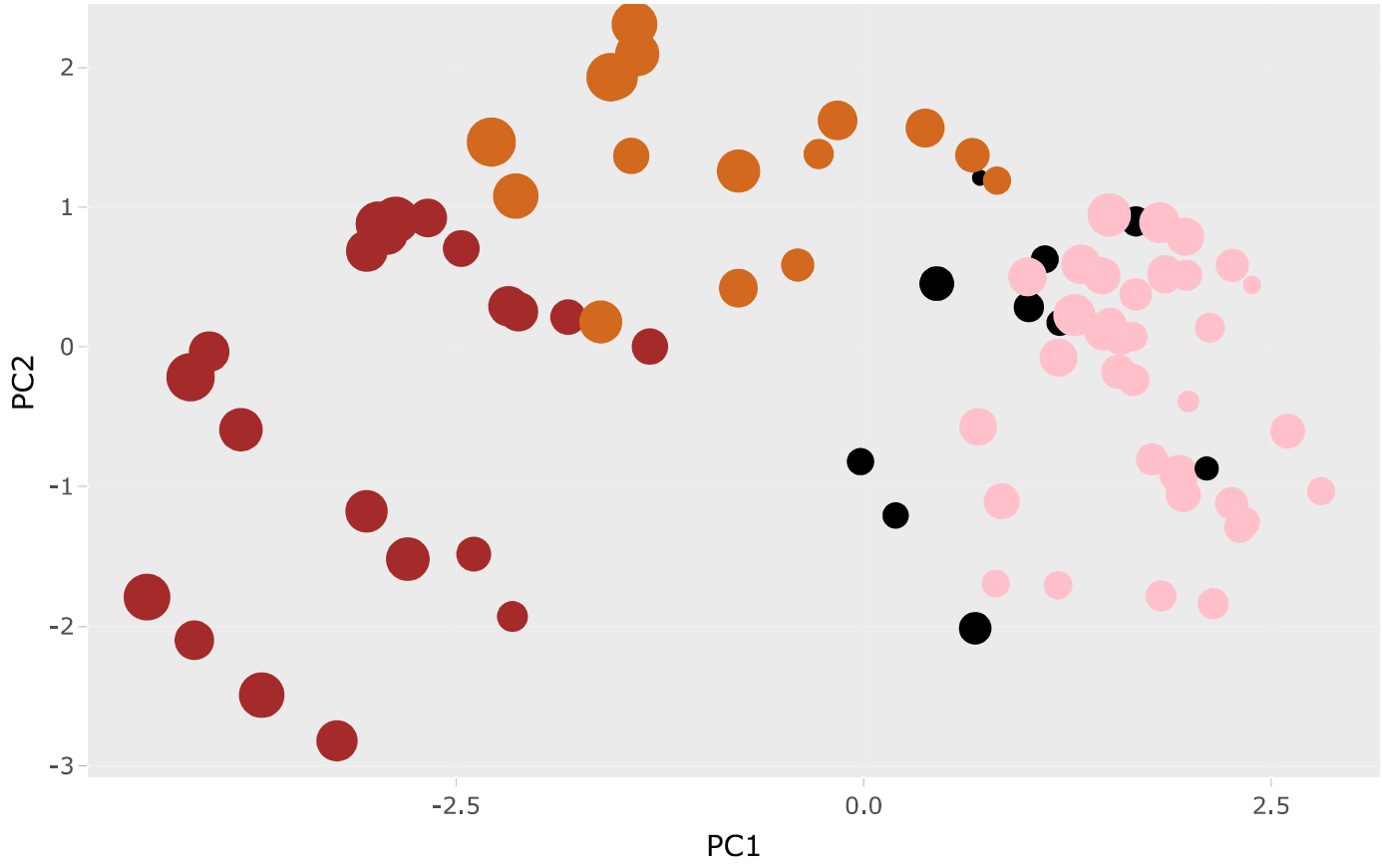



```
library(plotly)
```

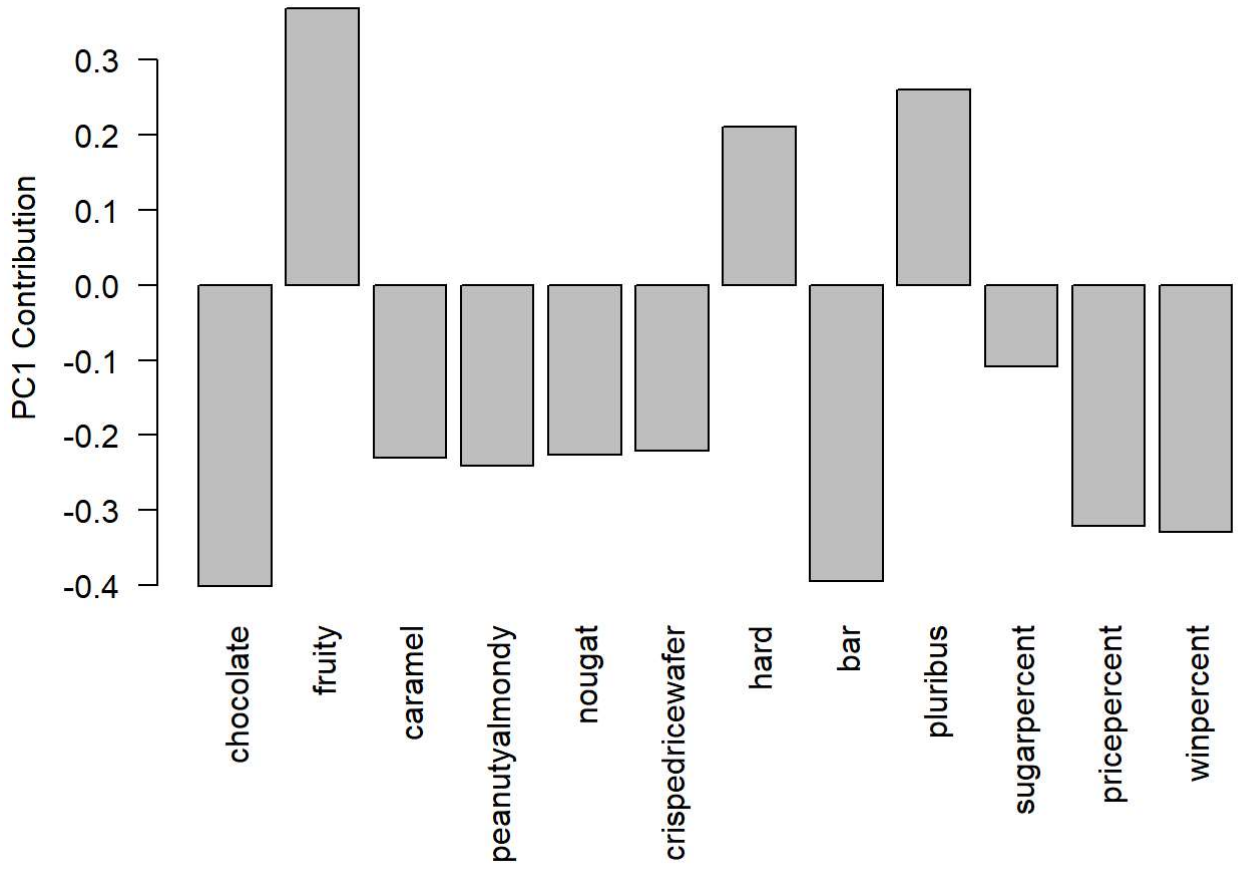
```
Warning: package 'plotly' was built under R version 4.1.3
```

```

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 all send candies in the PC1 positive direction. this all makes sense because they are all correlated as can be seen in the correlation graph. Also just when you think about from a how candies are packaged point of view, it makes sense.