Class 10

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1. Importing candy data

We first need to import data from the FiveThirtyEight GitHub repo and read it using 'read.csv'

```
candy_file <- "https://raw.githubusercontent.com/fivethirtyeight/data/master/candy-power-r

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
```

'nrow()' will provide us with the number of rows with tells us the number of cansy types.

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

```
nrow (candy)
```

```
[1] 85
```

85 candy types

'table()' can help us narrow down the responses to a specific variable.

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

```
table(candy$fruity)
```

```
 0  1
47 38
```

38 fruity candy types

2. What is your favorite candy?

We can find the winpercent value using 'candy["chosen candy",]$winpercent'

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

```
candy["Almond Joy", ]$winpercent
```

```
[1] 50.34755
```

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
```

Now let's install the skimr::skim() function.

```
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	

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 winpercent for p100

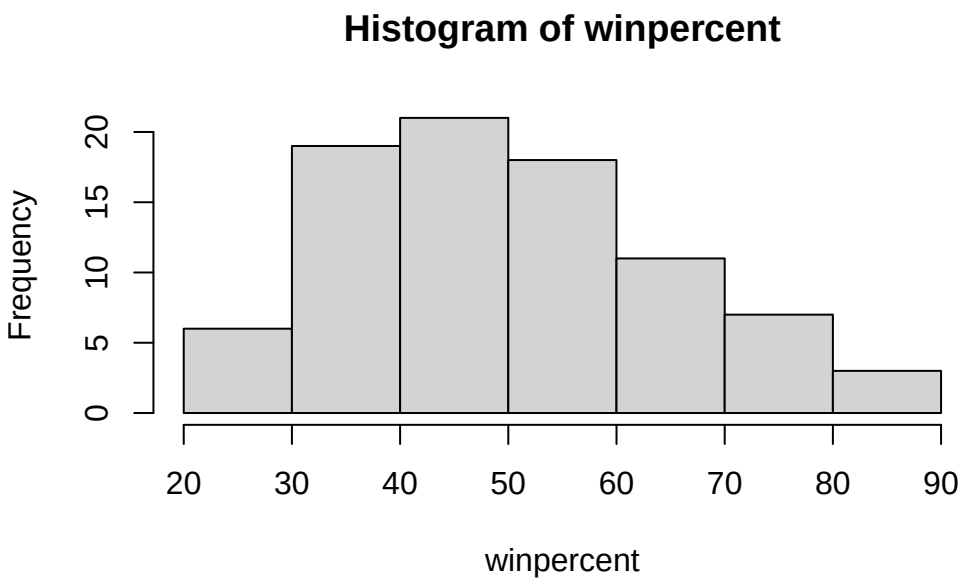
Q7. What do you think a zero and one represent for the candy$chocolate column?

zero represents no chocolate and one represents chocolate

We can create a histogram using 'hist()' to start an exploratory analysis.

Q8. Plot a histogram of winpercent values

```
winpercent <- candy$winpercent
hist(winpercent)
```



Q9. Is the distribution of winpercent values symmetrical?

almost symmetrical slightly skewed to the right

```
candy$winpercent[as.logical(candy$chocolate)]
```

```
 [1] 66.97173 67.60294 50.34755 56.91455 38.97504 55.37545 62.28448 56.49050
 [9] 59.23612 57.21925 76.76860 71.46505 66.57458 55.06407 73.09956 60.80070
[17] 64.35334 47.82975 54.52645 70.73564 66.47068 69.48379 81.86626 84.18029
[25] 73.43499 72.88790 65.71629 34.72200 37.88719 76.67378 59.52925 48.98265
[33] 43.06890 45.73675 49.65350 81.64291 49.52411
```

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

```
 [1] 52.34146 34.51768 36.01763 24.52499 42.27208 39.46056 43.08892 39.18550
 [9] 46.78335 57.11974 51.41243 42.17877 28.12744 41.38956 39.14106 52.91139
[17] 46.41172 55.35405 22.44534 39.44680 41.26551 37.34852 35.29076 42.84914
```

```
[25] 63.08514 55.10370 45.99583 59.86400 52.82595 67.03763 34.57899 27.30386
[33] 54.86111 48.98265 47.17323 45.46628 39.01190 44.37552
```

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

below

We can use 'as.logical()' to translate the data into a logical vector. The 'mean()' function will give the average.

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

chocolate is higher ranked

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

```
[1] 60.92153
```

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

```
[1] 44.11974
```

Q12. Is this difference statistically significant?

yes this difference is statistically significant

```
t.test(candy$winpercent[as.logical(candy$chocolate)], candy$winpercent[as.logical(candy$fr
```

```
    Welch Two Sample t-test

data:  candy$winpercent[as.logical(candy$chocolate)] and candy$winpercent[as.logical(candy$fi
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
```

3. Overall candy rankings

We can use the 'head()' and 'order()' function to sort the dataset by winpercent.

```
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
```

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

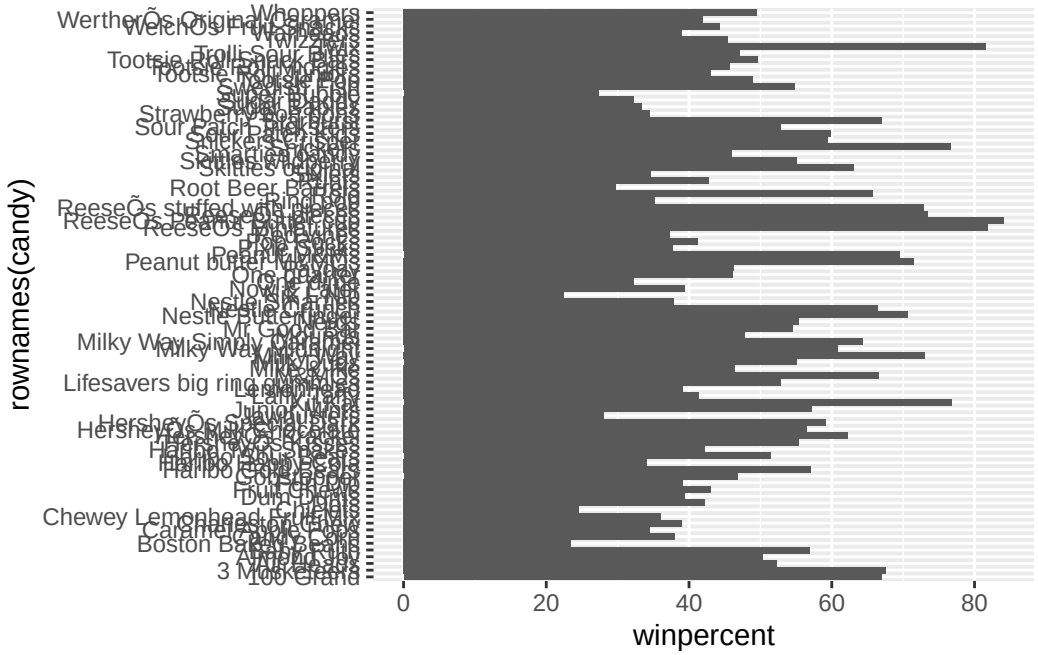
Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, and Jawbusters

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

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

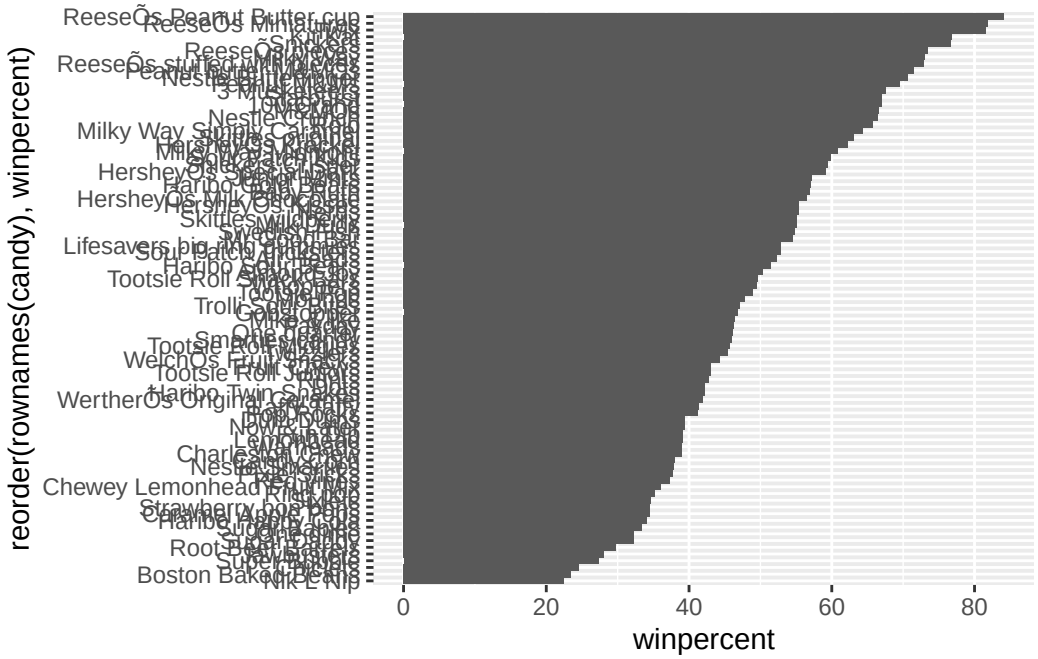
Q15. Make a first barplot of candy ranking based on winpercent values.

```
library(ggplot2)
ggplot(candy) +
  aes(winpercent, rownames(candy)) +
  geom_bar(stat="identity")
```



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

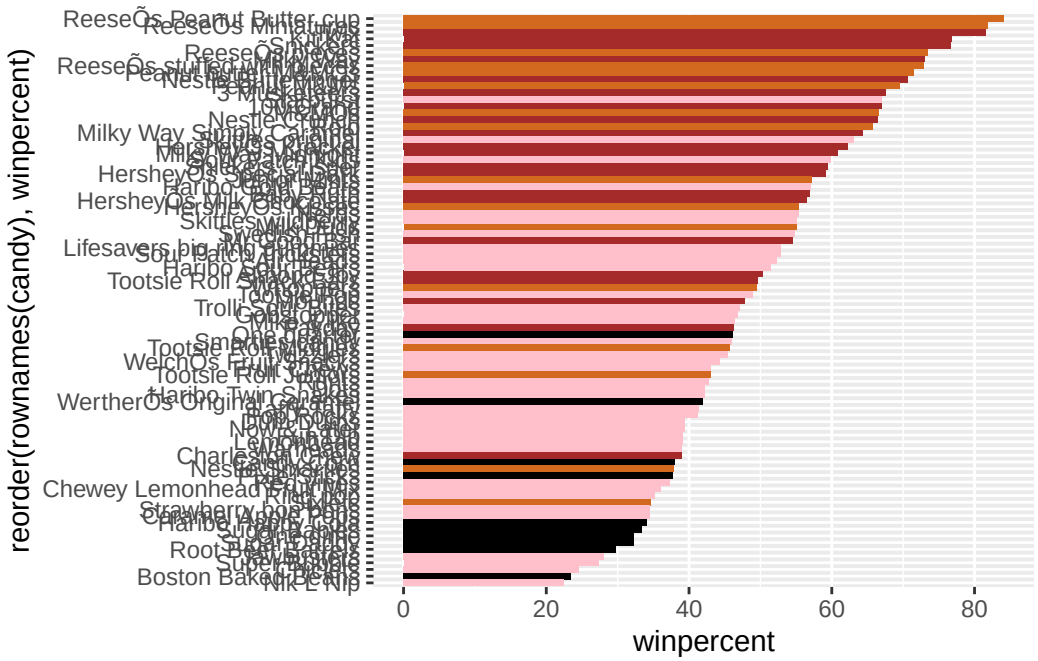
```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_bar(stat="identity")
```



Let's add some 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)
```



Q17. What is the worst ranked chocolate candy?

sixlets

Q18. What is the best ranked fruity candy?

starburst

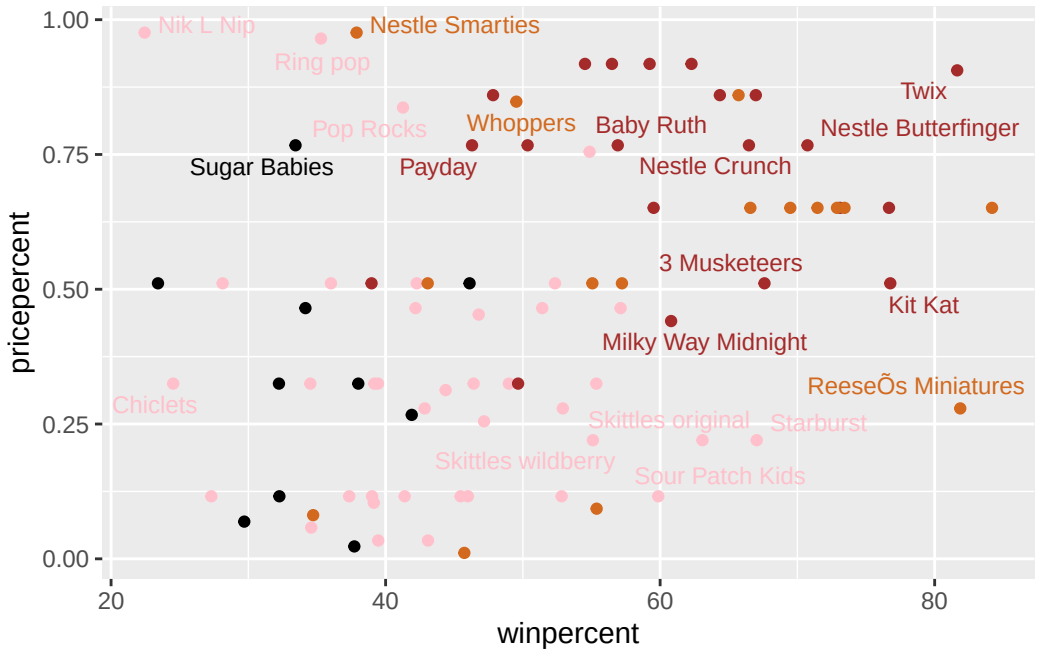
4. Taking a look at pricepercent

Let's take a look at the pricepercent variable compared to the winpercent variable.

```
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: 65 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?

Nik L Nip, Nestle Smarties, Ring pop, Hershey;s Krackel, and Hershey's Milk Chocolate. Nik L Nip is the least popular of these.

```
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
HersheyÕs Krackel                 0.918   62.28448
HersheyÕs Milk Chocolate          0.918   56.49050
```

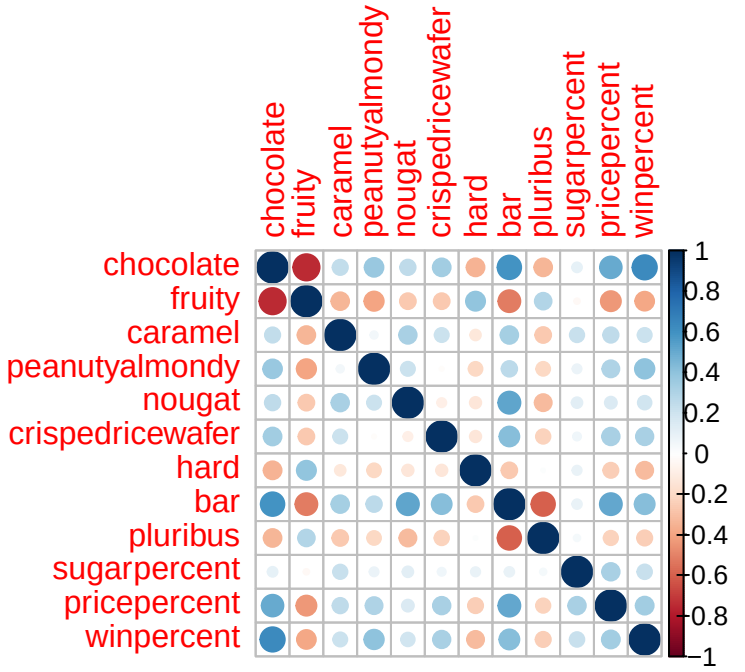
5. Exploring the correlation structure

We can install corrplot to see how the variables interact.

```
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 and chocolate

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

chocolate and winpercent

6. Principal component analysis

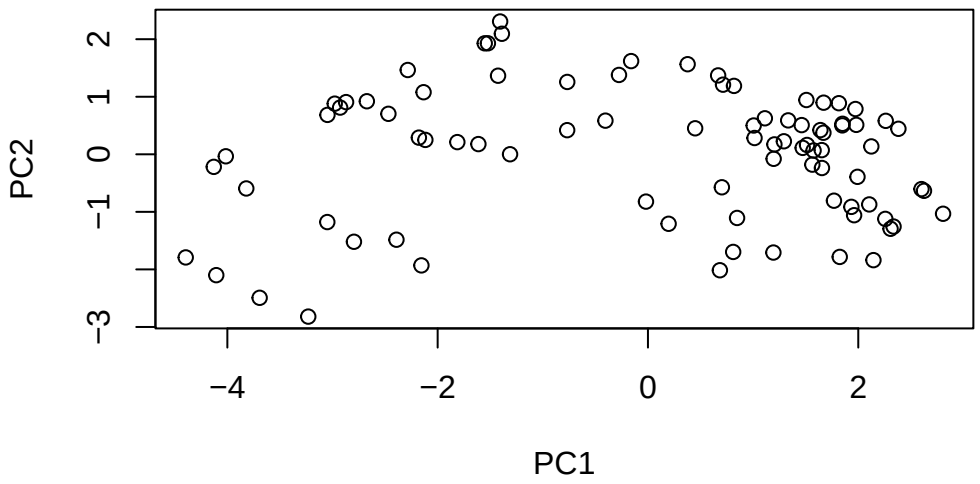
Let's use the 'prcomp()' function to apply PCA.

```
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
```

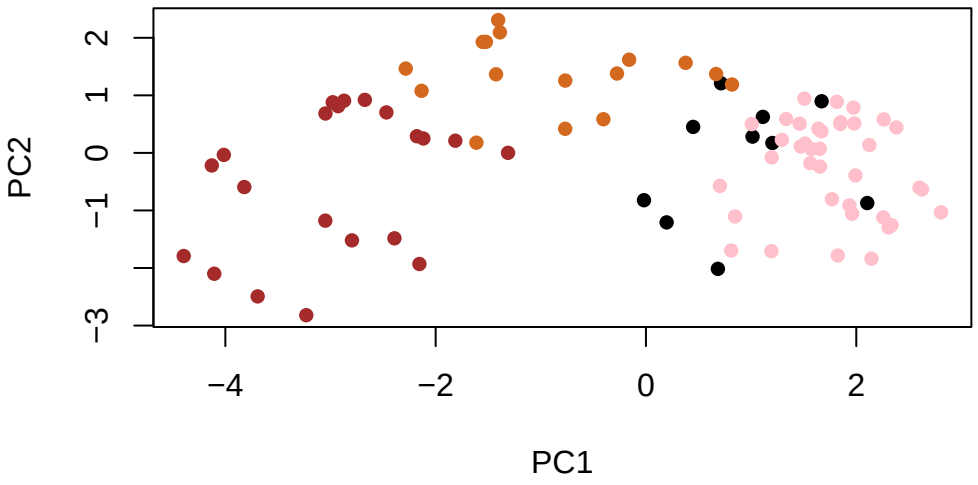
Now we can plot our main PCA score plot of PC1 vs PC2.

```
plot(pca$x[,1:2])
```



Let's add some color.

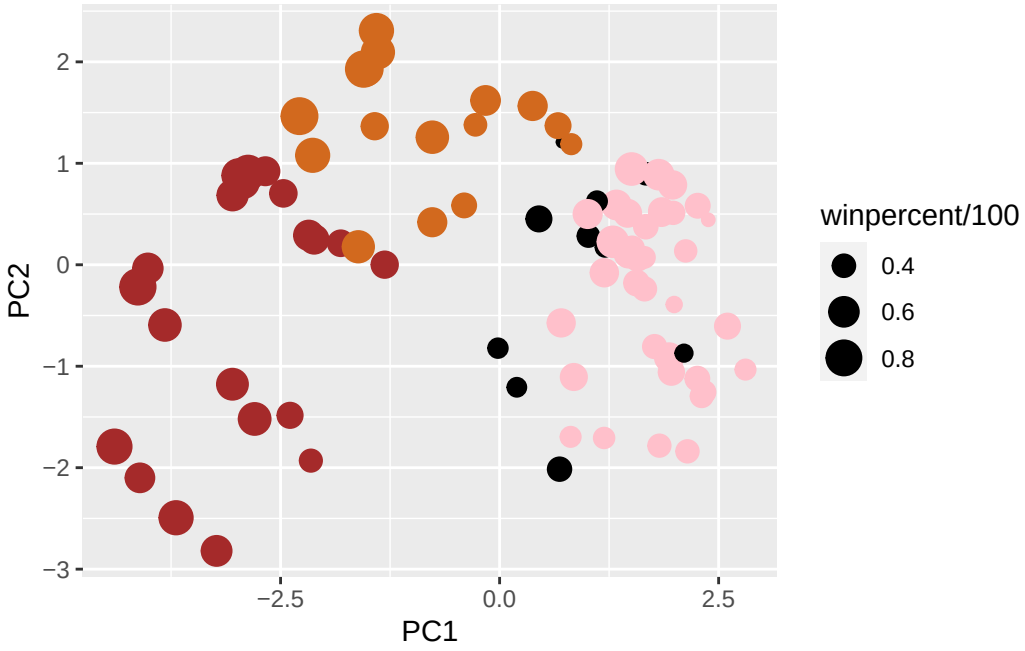
```
plot(pca$x[,1:2], col=my_cols, pch=16)
```



Using ggplot will generate a neater plot.

```
# 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
```

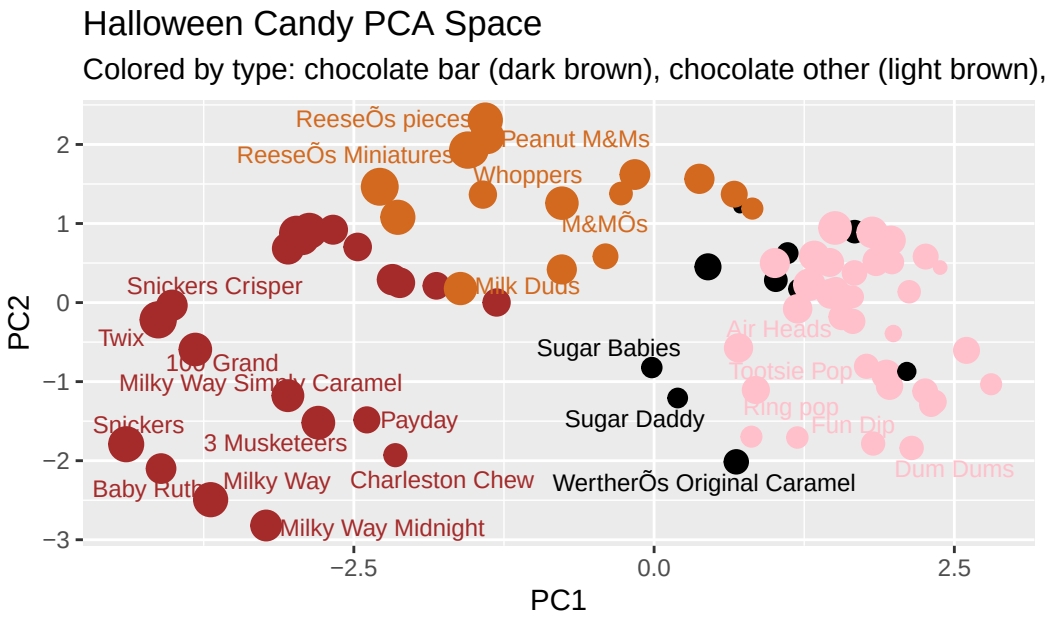


Let's label the plot with 'greppel'.

```
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
       caption="Data from 538")
```

```
Warning: ggrepel: 60 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```




```
library(plotly)
```

```
Attaching package: 'plotly'
```

```
The following object is masked from 'package:ggplot2':

    last_plot
```

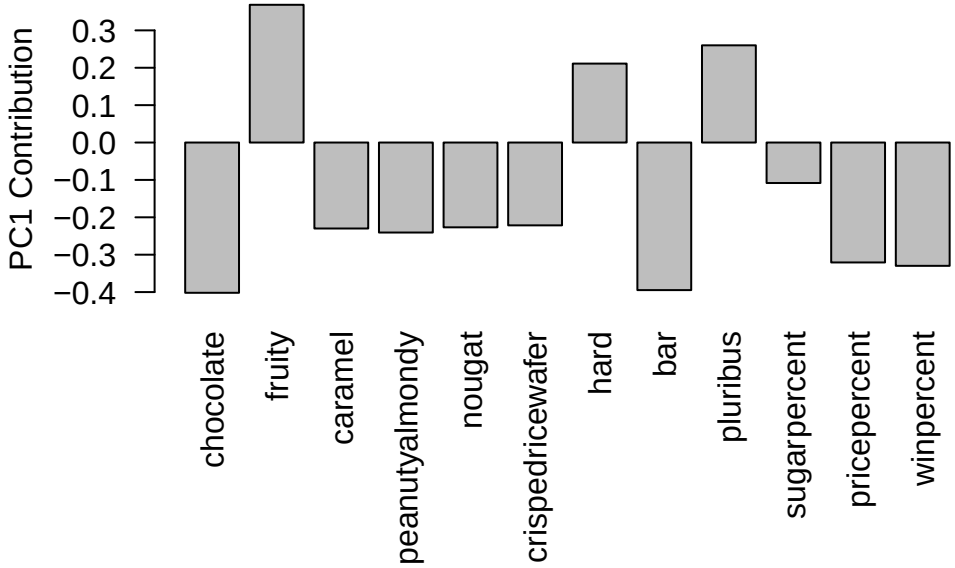
```
The following object is masked from 'package:stats':

    filter
```

```
The following object is masked from 'package:graphics':

    layout
```

```
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, pluribus