Class 10: Halloween Candy

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5/5/23

Importing Candy Data

```
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
```

- **Q1**. How many different candy types are in this dataset? **85**

```
dim(candy)
```

```
[1] 85 12
```

- **Q2**. How many fruity candy types are in the dataset? **38**

```
sum(candy["fruity"])
```

```
[1] 38
```

Finding Favorite Candy

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

```
[1] 81.64291
```

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

```
candy["Hershey's Kisses", ]$winpercent
```

```
[1] 55.37545
```

- **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
```

Using the skimr package:

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

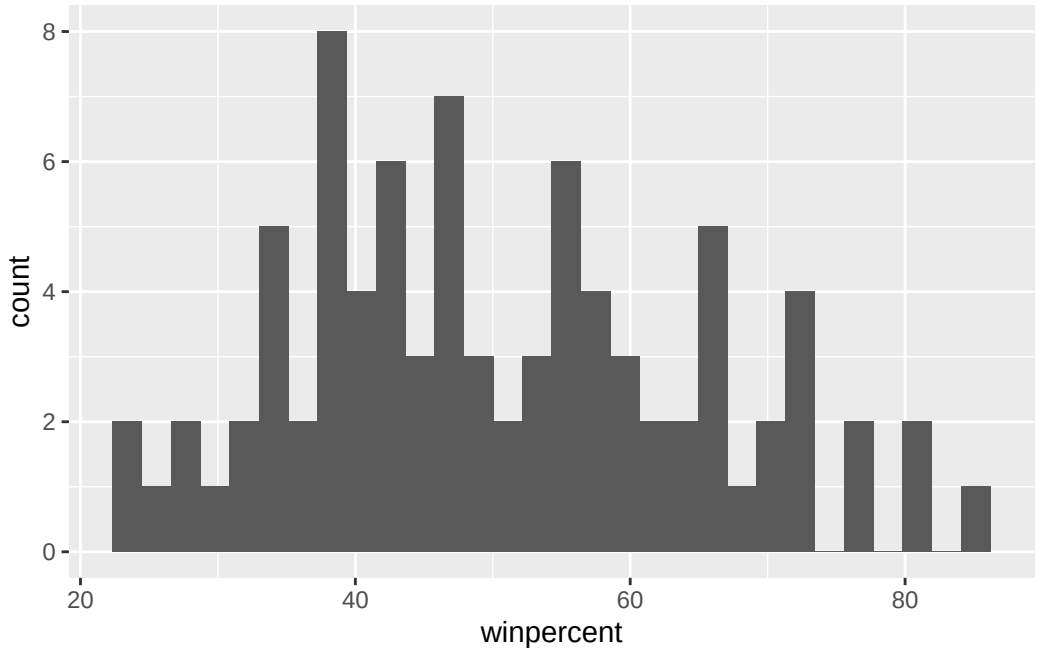
- **Q6**. Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset? **winpercent is on a different scale as it goes from 0 to 100, all the others only range form 0 to 1.**
- **Q7**. What do you think a zero and one represent for the `candy$chocolate` column? **0 indicates that the candy does not have chocolate and the 1 means that it does.**

Graphing Data

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

```
library(ggplot2)

ggplot(candy, aes(winpercent, binwidth = 30)) +
  geom_histogram()
```

```
`stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



- **Q9**. Is the distribution of `winpercent` values symmetrical? **No, it is skewed to the right**
- **Q10**. Is the center of the distribution above or below 50%? **Below 50%**
- **Q11**. On average is chocolate candy higher or lower ranked than fruit candy? **Chocolate is ranked higher**

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

```
[1] 60.92153
```

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

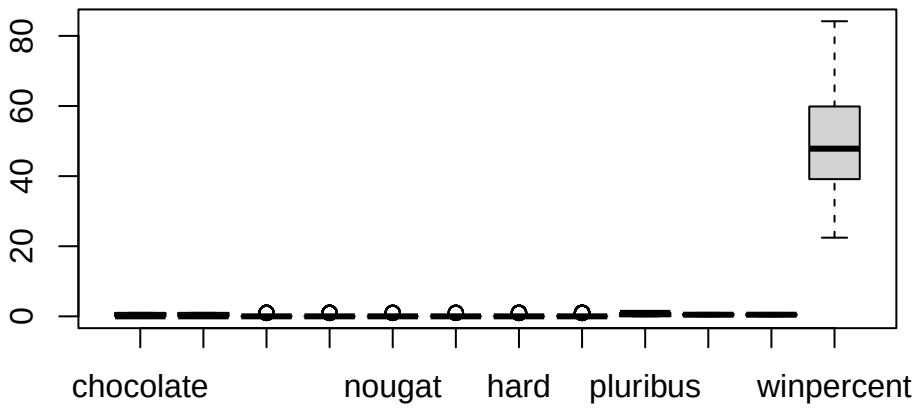
```
[1] 44.11974
```

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

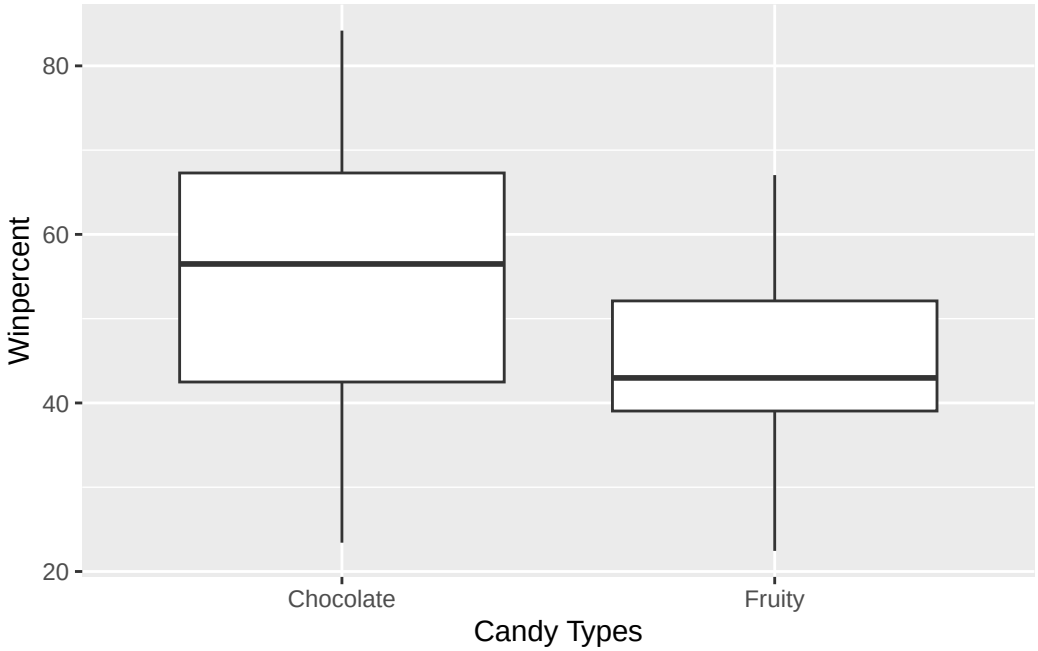
```
choc_fruit <- t.test(candy$winpercent[as.logical(candy$chocolate)],candy$winpercent[as.log
choc_fruit
```

```
    Welch Two Sample t-test

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

```
boxplot(candy)
```




```
t_nums <- factor(candy$chocolate)
t_nums <- factor(candy$fruity)
levels(t_nums) <- list(Chocolate = "0", Fruity = "1")

candy_box <- ggplot(candy) +
  aes(t_nums, winpercent) +
  geom_boxplot()

candy_box + labs(y= "Winpercent", x = "Candy Types")
```



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
```

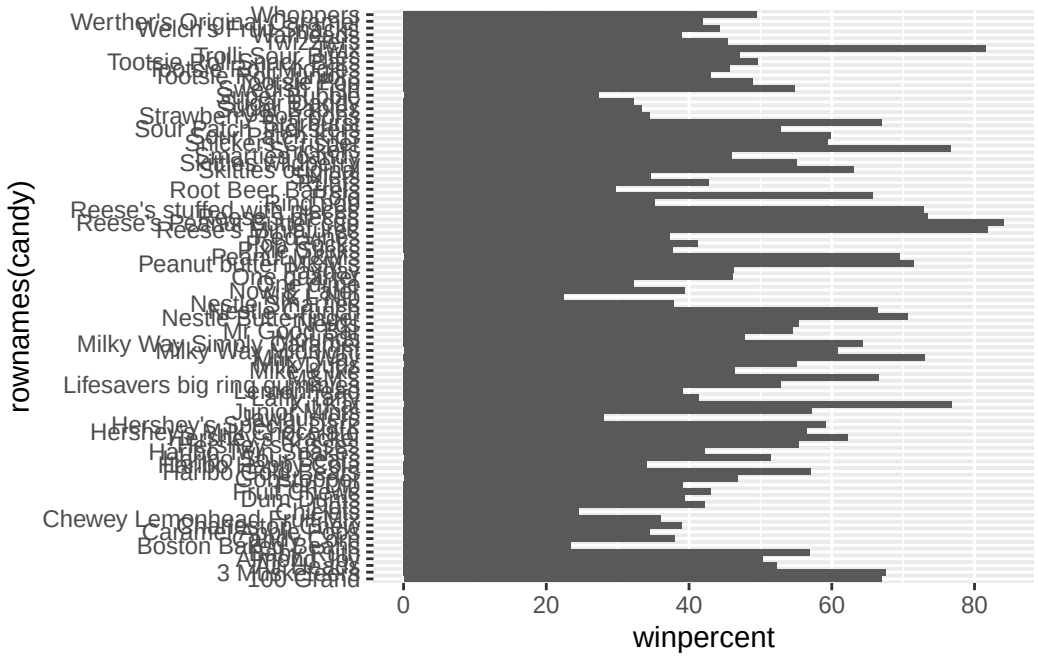
- **Q14**. What are the top 5 all time favorite candy types out of this set?

```
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
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
```

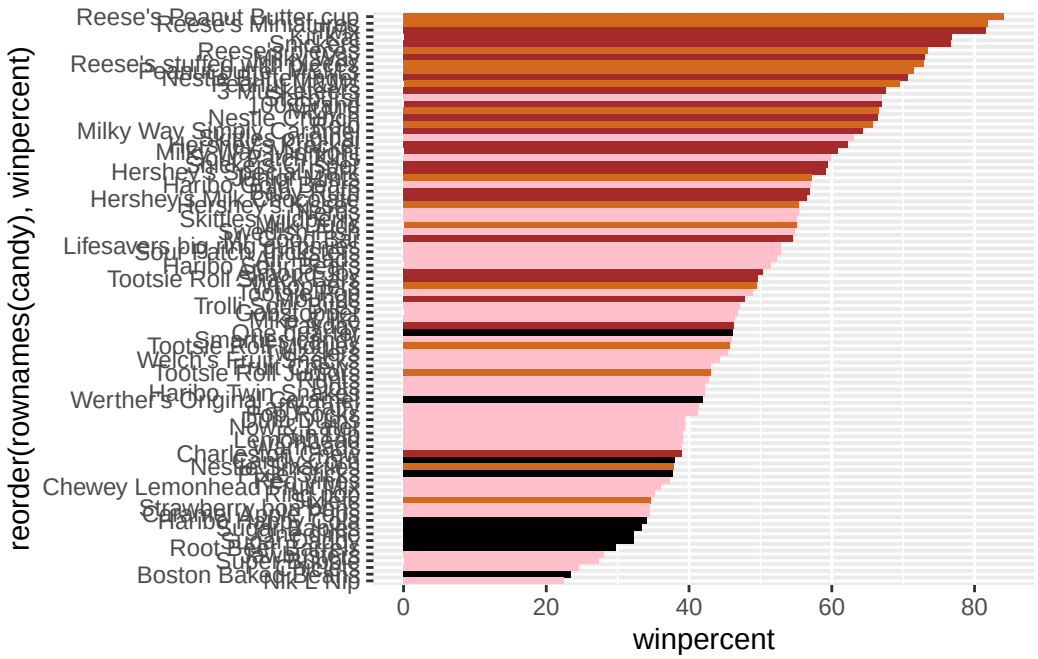
- **Q15**. Make a first barplot of candy ranking based on `winpercent` values.

```
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`?

```
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)
```

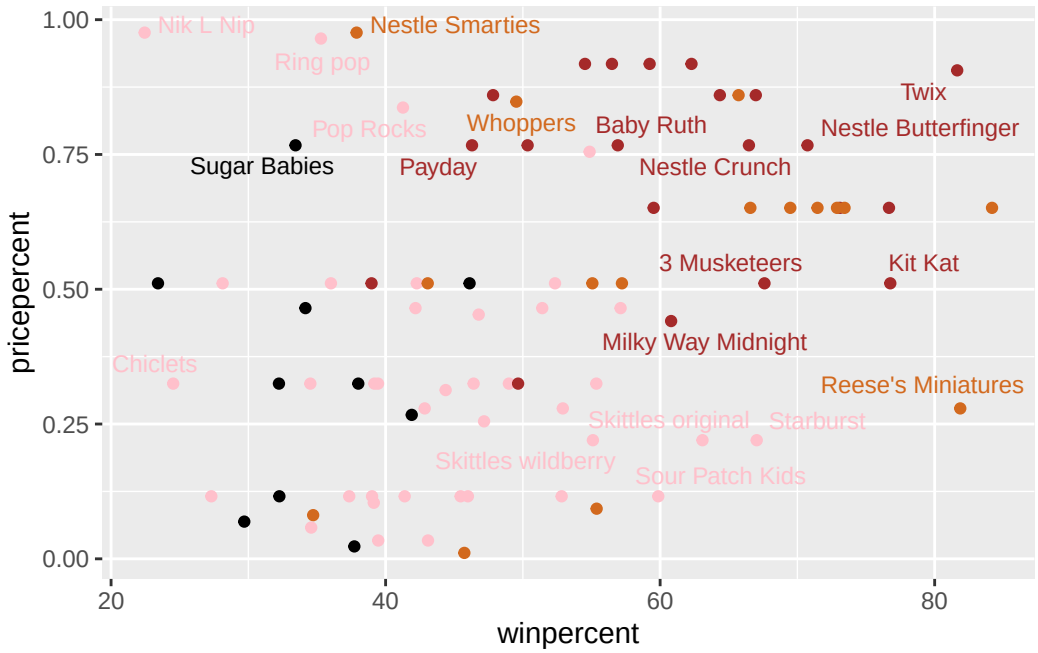


- **Q17**. What is the worst ranked chocolate candy? **Sixlets**
- **Q18**. What is the best ranked fruity candy? **Starburst**

Exploring pricepercent

```
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 = 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**

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

```
                         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
```

- **Q20**. What are the top 5 most expensive candy types in the dataset and of these which is the least popular? **Nik L Nip**

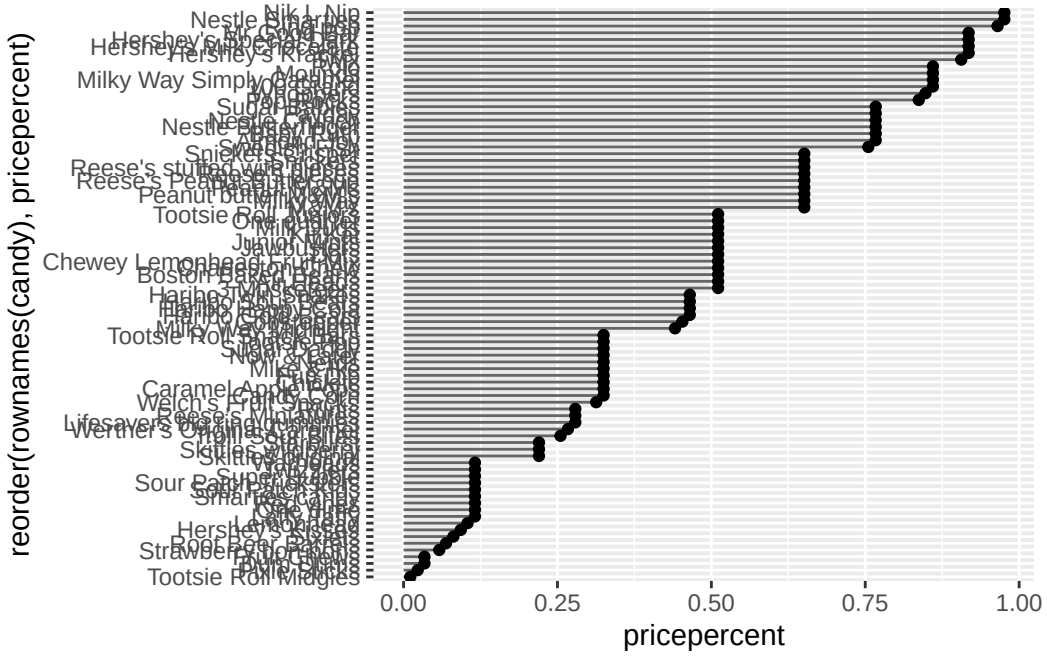
```
ord <- order(candy$pricepercent, decreasing = TRUE)
head( candy[ord,c(11,12)], n=5 )
```

```
                    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
```

- **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()
```

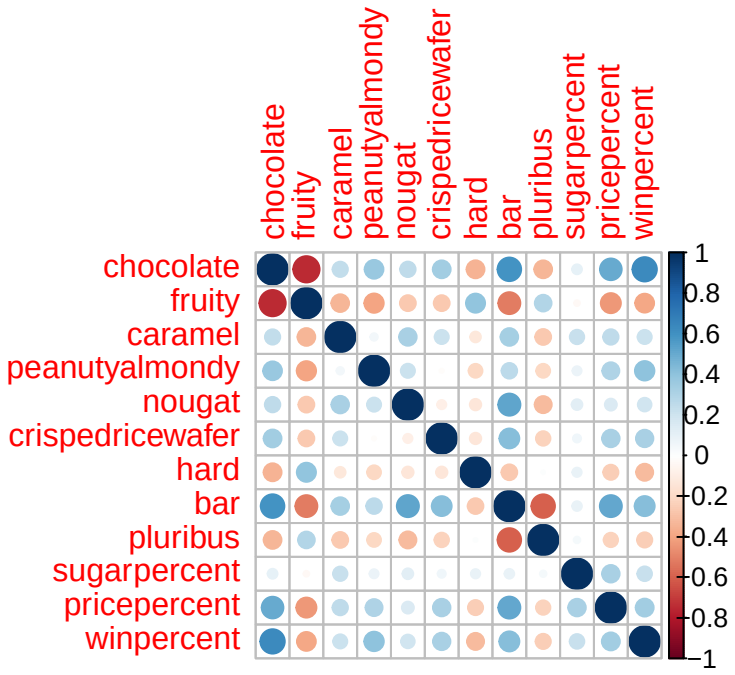


Correlation Structures

```
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 fruity**
- **Q23**. Similarly, what two variables are most positively correlated? **Chocolate and bar or chocolate and winpercent**

Principal Component Analysis

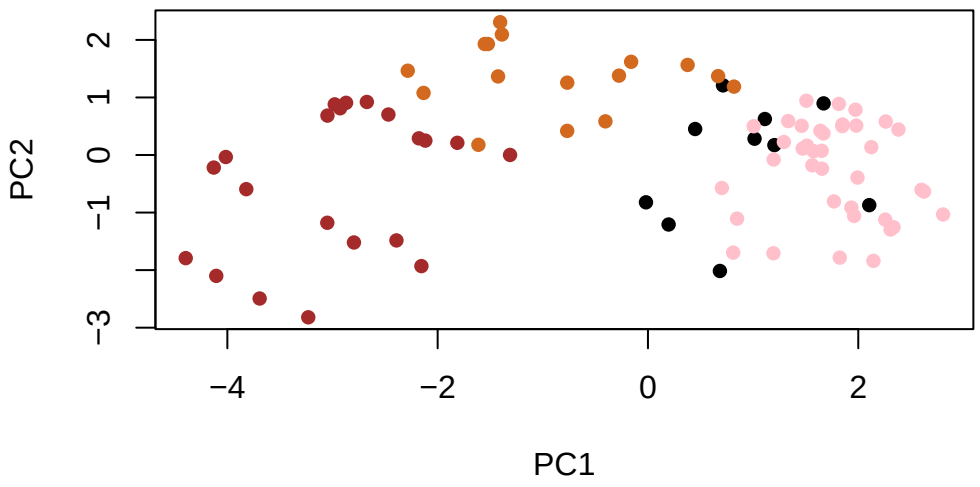
```
pca <- prcomp(candy, scale = T)
summary(pca)
```

```
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
```

Base Plotting PCA results:

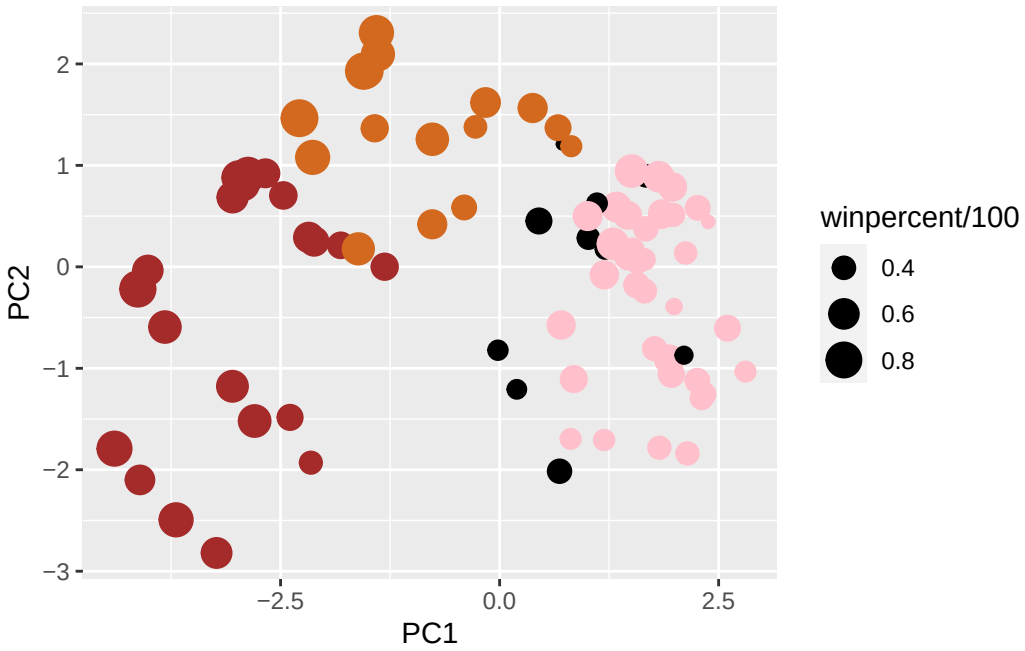
```
plot(pca$x[,1:2], col=my_cols, pch=16)
```



Using ggplot for PCA results:

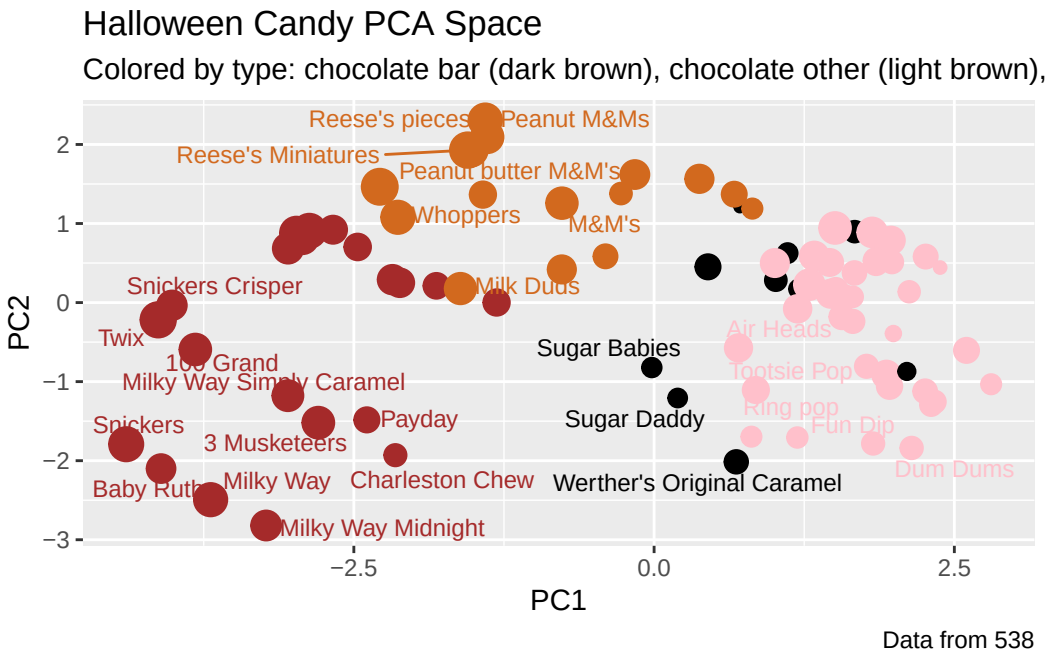
```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])

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
```



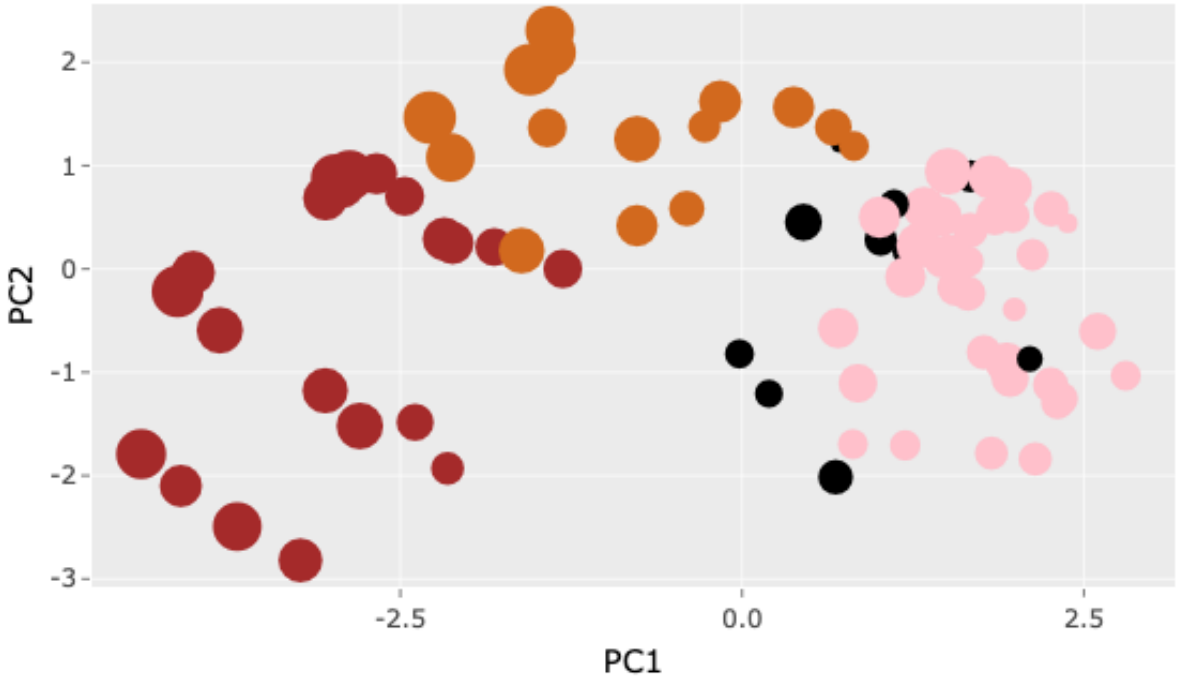

```
library(ggrepel)

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: 59 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



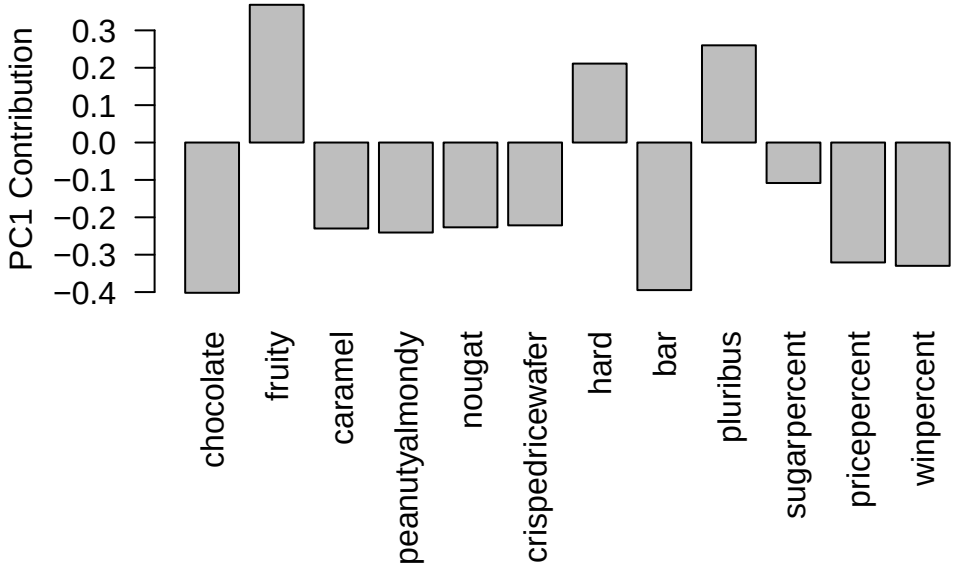
Generating interactive plots:

```
#library(plotly)

#ggplotly(p)
#Could not export as pdf due to this interactive graph, attached png of graph below.
```



PCA contributions plot:

```
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 are first picked up and this makes sense as PCA1 shows the highest variance among the variables.**