Class09 - Candy Project

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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
```

```
nrow(candy)
```

```
[1] 85
```

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

```
[1] 38
```

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

85

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

38

```
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
```

```
candy %>%
  filter(row.names(candy)=="Twix") %>%
  select(winpercent)
```

```
     winpercent
Twix   81.64291
```

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

```
[1] 81.64291
```

Q3. What is your favorite candy (other than Twix) in the dataset and what is it's winpercent value?

```
candy["Air Heads", ]$winpercent
```

```
[1] 52.34146
```

Air Head win percent = 52.34146

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

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

```
[1] 76.7686
```

76.7686

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

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

```
[1] 49.6535
```

49.6535

```
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?

Yes, Win percent seems to be on a different scale, all the other values are between 0 and 1 but winpercent is much larger.

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

```
candy$chocolate
```

```
 [1] 1 1 0 0 0 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 0 1 1 0 0 0 1 1 0 1 1 1
[39] 1 1 1 0 1 1 0 0 0 1 0 0 0 1 1 1 1 0 1 0 0 1 0 0 1 0 1 1 0 0 0 0 0 0 0 0 1 1
[77] 1 1 0 1 0 0 0 0 1
```

```
table(candy$chocolate)
```

```
 0  1
48 37
```

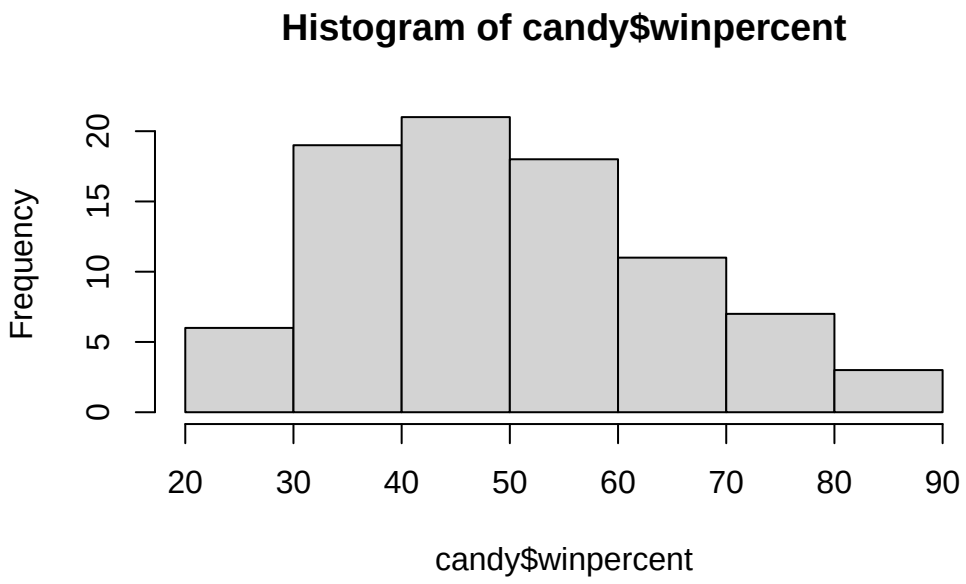
I think 0 means the candy doesnt contain chocolate and 1 the candy does contain chocolate.

Exploratory analysis

Q8. Plot a histogram of winpercent values

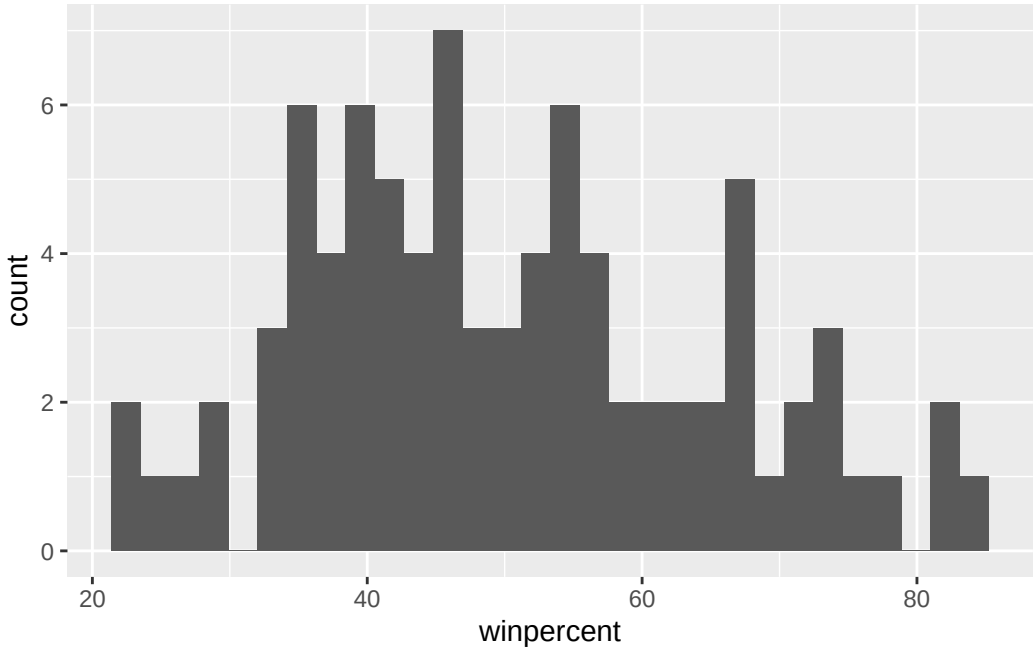
Base R:

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



ggplot:

```
library(ggplot2)
ggplot(candy,aes(winpercent)) + geom_histogram(bins=30)
```



Q9. Is the distribution of winpercent values symmetrical?

No, the distribution seems to be right skewed.

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

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

```
[1] 47.82975
```

median of winpercent = 47.82975 seems to be below 50%

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

```
chocwin<-candy$winpercent[as.logical(candy$chocolate)]
fruitwin<-candy$winpercent[as.logical(candy$fruity)]

mean(chocwin)
```

```
[1] 60.92153
```

```
mean(fruitwin)
```

```
[1] 44.11974
```

mean of chocolate win percent = 60.92153 mean of fruity win percent = 44.11974

on average chocolate is higher ranked than fruity.

Q12. Is this difference statistically significant?

```
t.test(chocwin,fruitwin)
```

```
    Welch Two Sample t-test

data:  chocwin and fruitwin
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
```

p value = 2.871e-08 which is less than 0.05 so it is considered significant.

Overall Candy Rankings

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

```
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
```

the 5 least liked candy types are 1) Nik L Nip 2) Boston Bakes beans 3) Chiclets 4) Super Bubble 5) Jawbusters

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

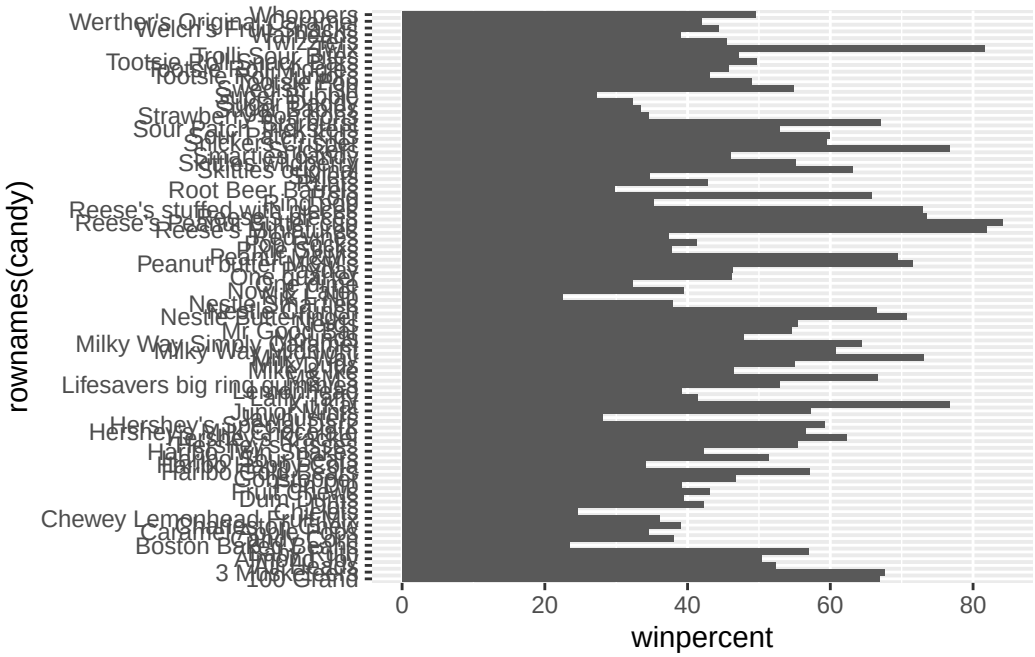
```
candy %>% arrange(desc(winpercent)) %>% head(5)
```

```
                         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
```

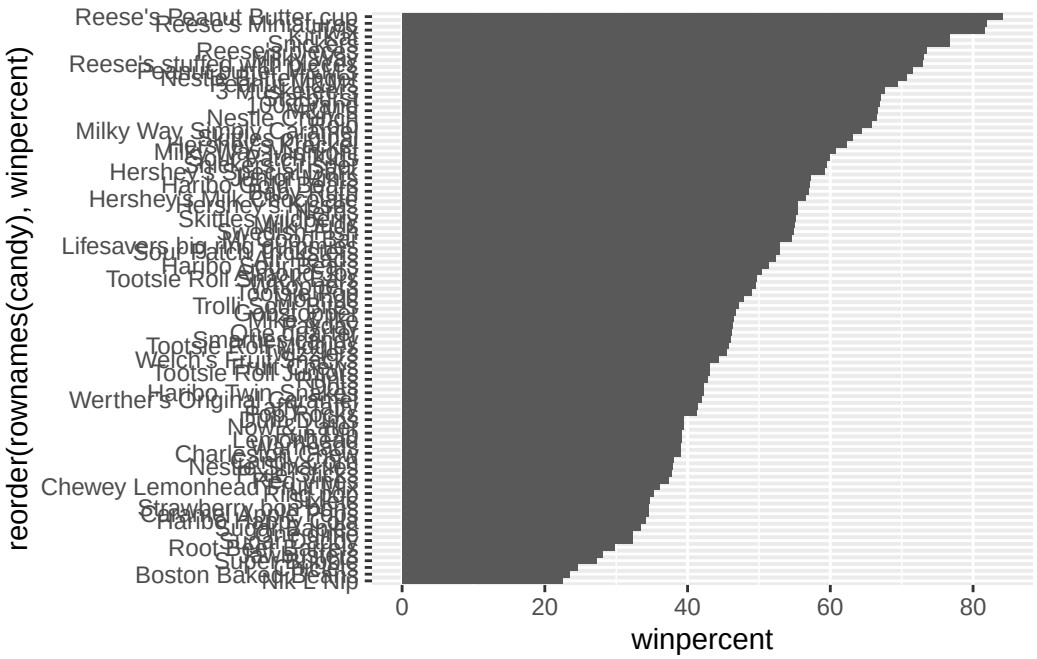
The top 5 all time favorite candy types are 1) Reese's Peanut Butter cup 2) Reese's Miniatures 3) Twix 4) Kit Kat 5) Snickers

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

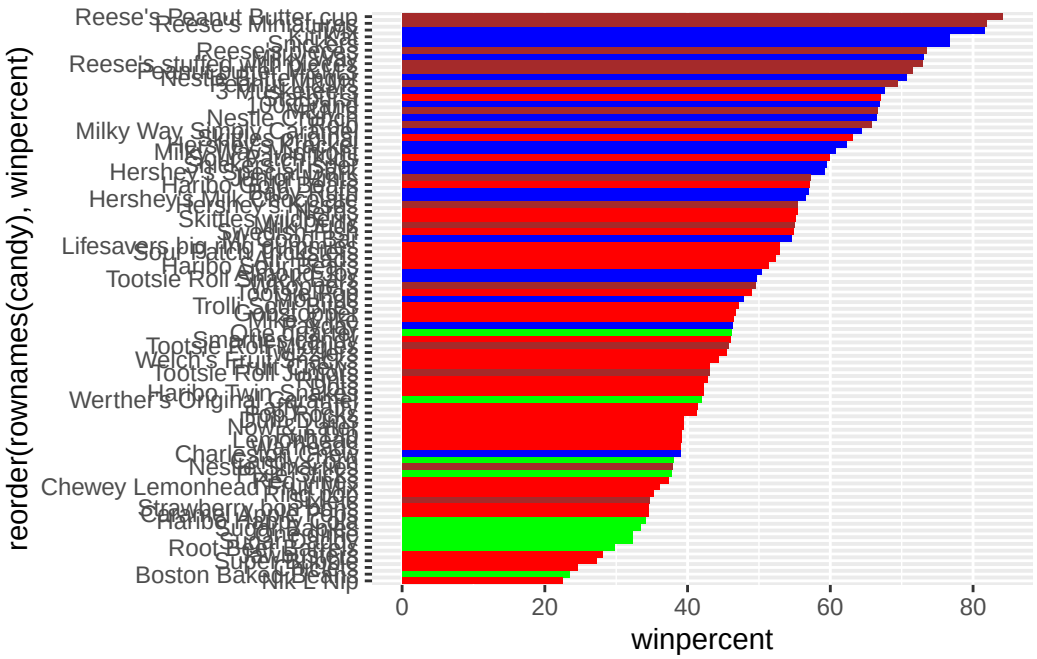
```
ggplot(candy) +
  aes(winpercent, rownames(candy),winpercent) +
  geom_col()
```




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




```
my_cols=rep("green", nrow(candy))
my_cols[as.logical(candy$chocolate)] = "brown"
my_cols[as.logical(candy$bar)] = "blue"
my_cols[as.logical(candy$fruity)] = "red"

ggplot(candy) +
  aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_col(fill=my_cols)
```



Q17. What is the worst ranked chocolate candy?

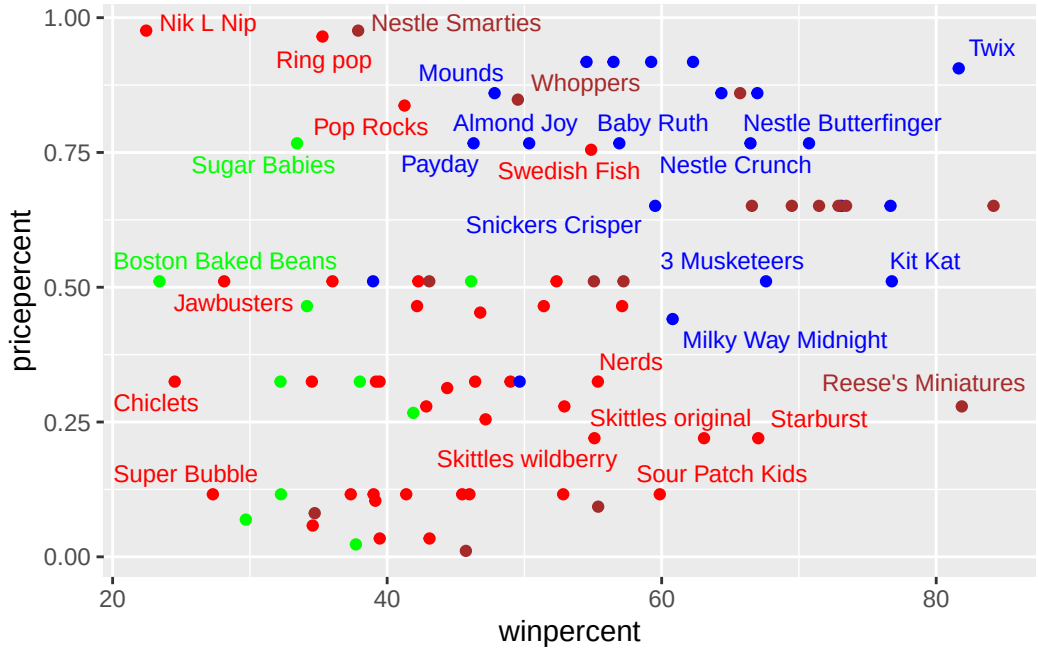
Sixlets

Q18. What is the best ranked fruity candy?

Starbursts

```
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 = 7)
```

```
Warning: ggrepel: 57 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



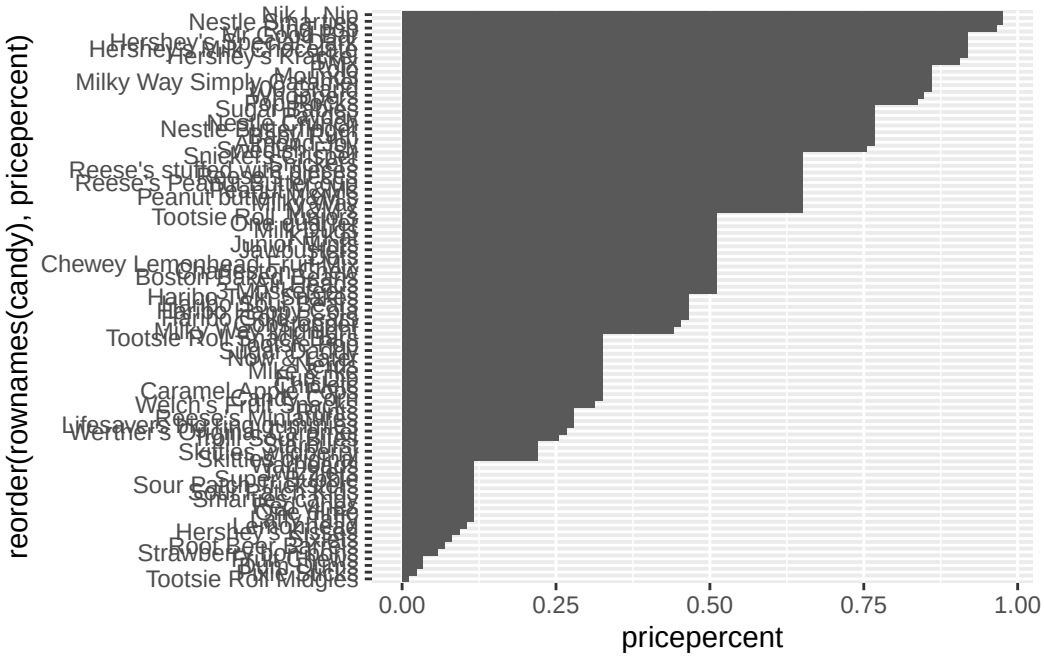
Q19. Which candy type is the highest ranked in terms of winpercent for the least money - i.e. offers the most bang for your buck?

Reese's Miniatures

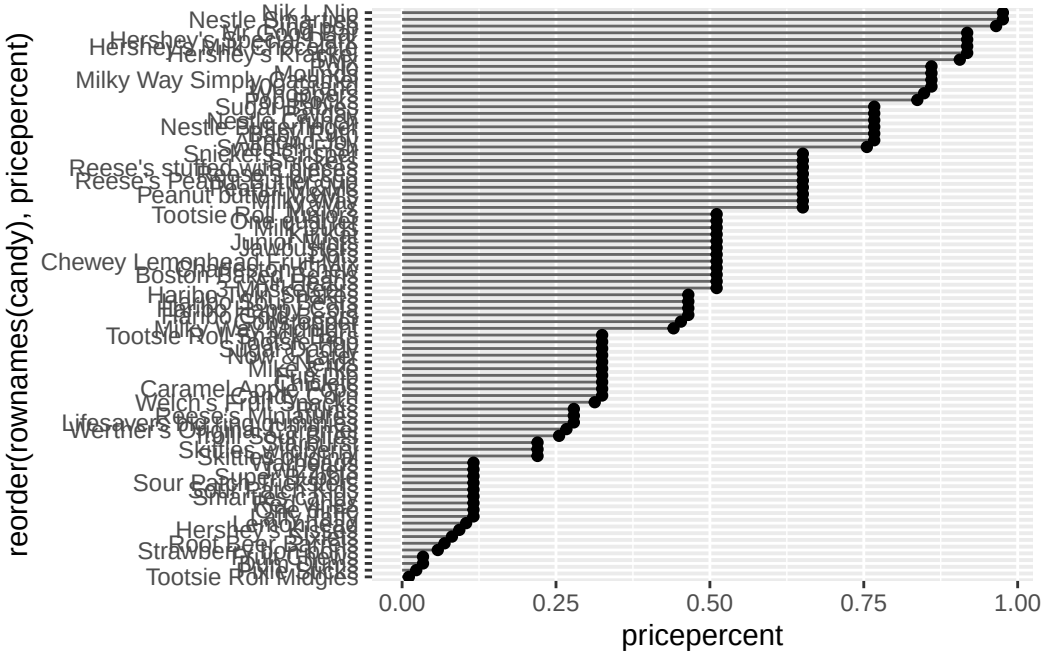
Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular?

Nik L Nip

```
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_col()
```




```
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_segment(aes(yend = reorder(rownames(candy), pricepercent),
                   xend = 0), col="gray40") +
    geom_point()
```

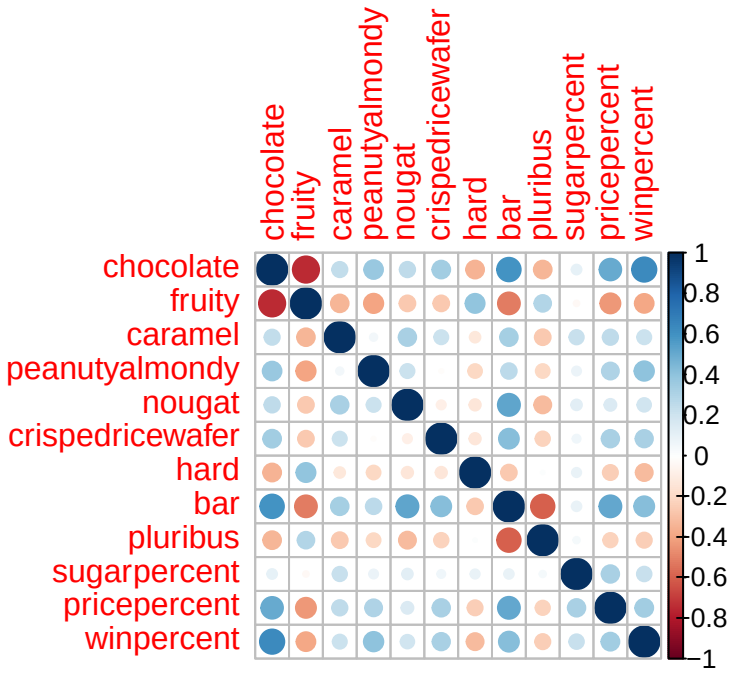


6 Exploring the coorelation structure

```
library(corrplot)
```

```
corrplot 0.95 loaded
```

```
cij <- cor(candy)
corrplot(cij)
```



Principal Component Analysis

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 win percent

```
pca <- prcomp(candy,scale=TRUE)


summary(pca)
```

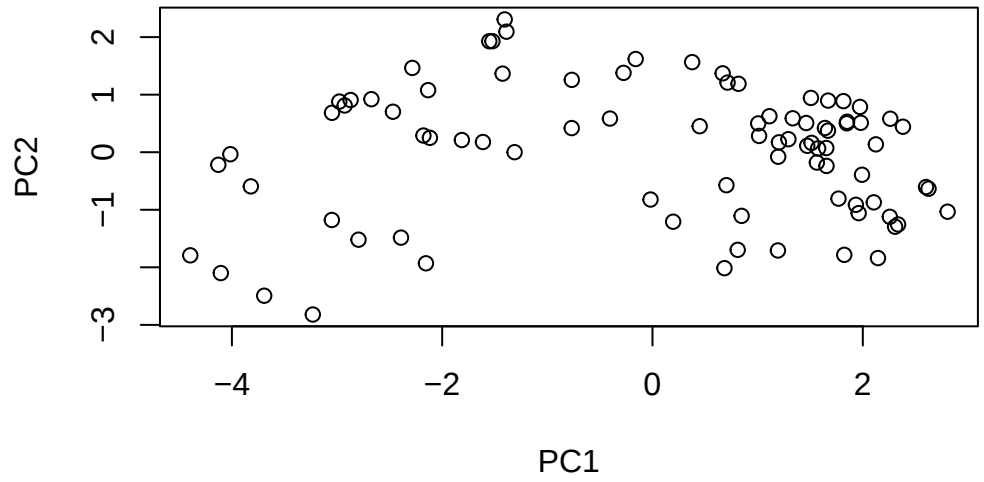
```
Importance of components:
                          PC1    PC2    PC3     PC4    PC5     PC6     PC7
Standard deviation     2.0788 1.1378 1.1092 1.07533 0.9518 0.81923 0.81530
Proportion of Variance 0.3601 0.1079 0.1025 0.09636 0.0755 0.05593 0.05539
Cumulative Proportion  0.3601 0.4680 0.5705 0.66688 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
```

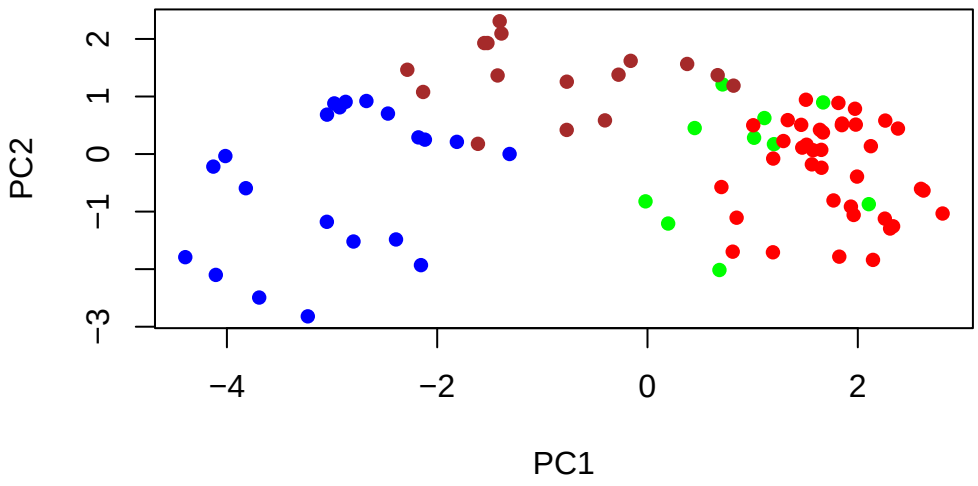
```
pca$rotation[,1]
```

```
       chocolate            fruity          caramel   peanutyalmondy
      -0.4019466         0.3683883        -0.2299709        -0.2407155
          nougat crispedricewafer             hard              bar
      -0.2268102        -0.2215182         0.2111587        -0.3947433
        pluribus     sugarpercent     pricepercent       winpercent
       0.2600041        -0.1083088        -0.3207361        -0.3298035
```

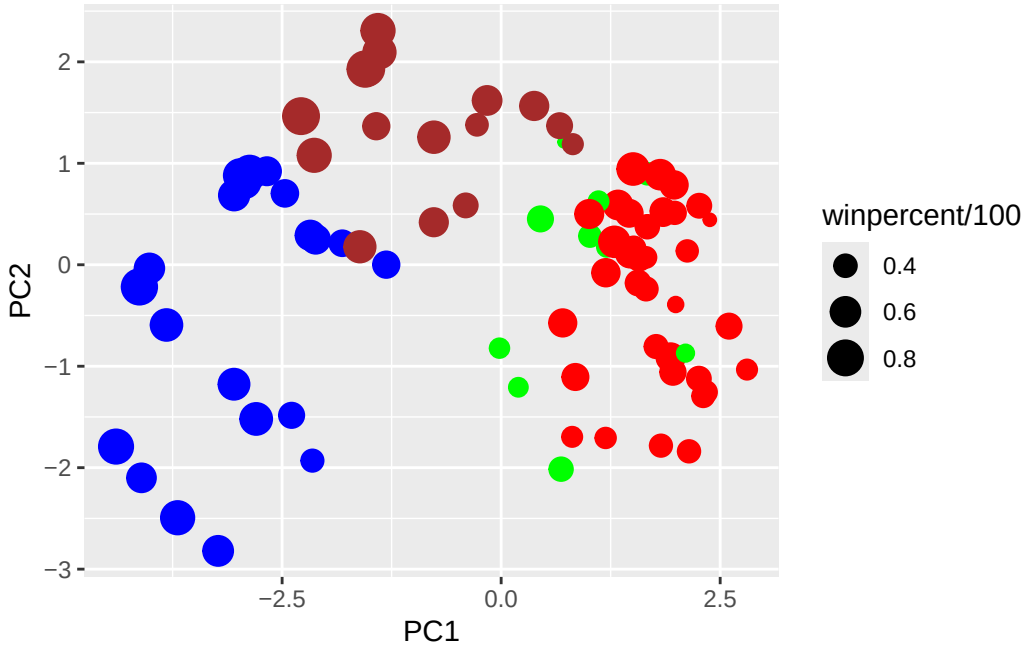
```
plot(pca$x[,1:2])
```




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

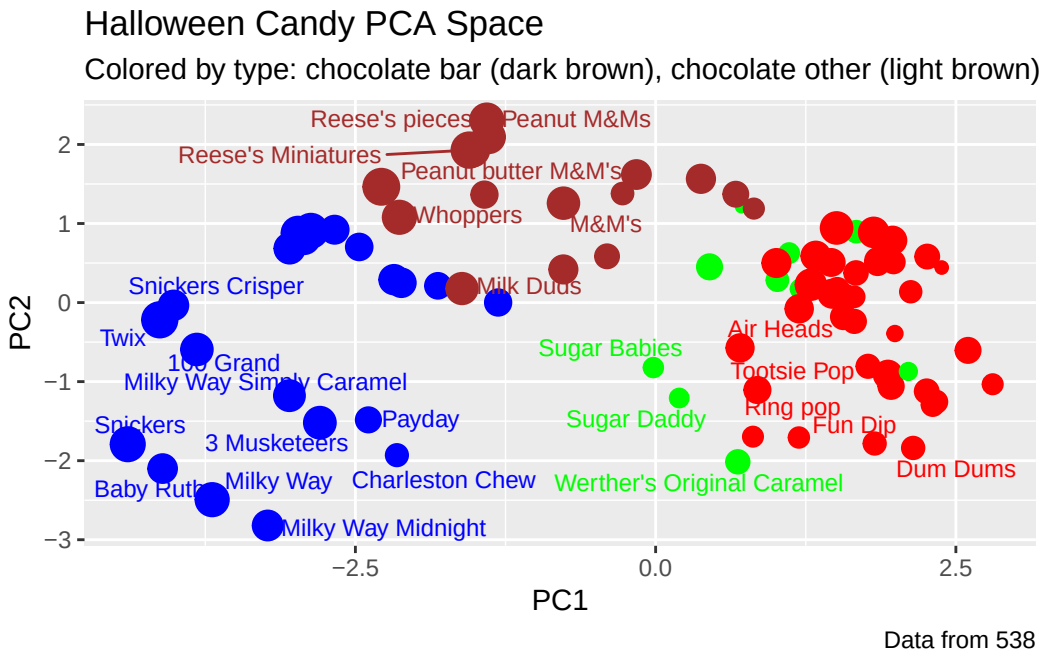



```
my_data <- cbind(candy, pca$x[,1:3])

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
```



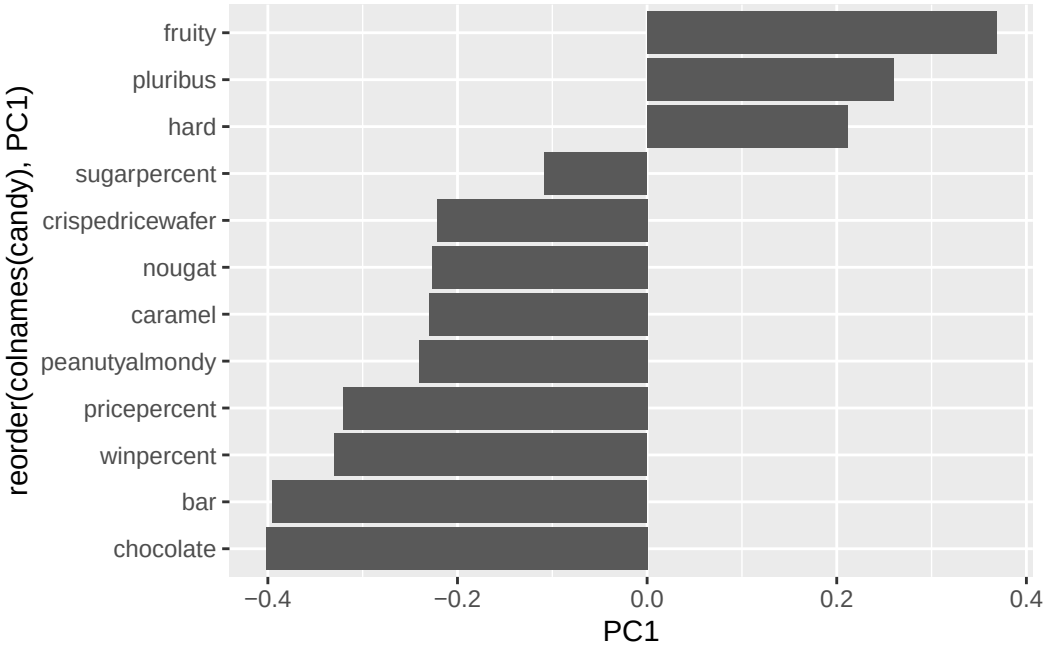

```
library(ggrepel)

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
```



Q24. Complete the code to generate the loadings plot above. What original variables are picked up strongly by PC1 in the positive direction? Do these make sense to you? Where did you see this relationship highlighted previously?

```
ggplot(pca$rotation) +
  aes(PC1, reorder(colnames(candy), PC1)) +
  geom_col()
```



In the positive direction fruity, Sugar percent, Crispedricewafer are seen in the positive direction this makes sense as we saw this previously in the scatter plot. This makes sense to be as we can see choclate, bar and other variables that were negatively cooreleated to fruity in the negative direction.

Summary

> Q25. Based on your exploratory analysis, correlation findings, and PCA results, what combination of characteristics appears to make a "winning" candy? How do these different analyses (visualization, correlation, PCA) support or complement each other in reaching this conclusion?

The combination of characteristics that make something appear to be a "winning candy" would be that they are chocolate, they are a bar, and have a high price percent. The bar plot of candy ranking based on win percent values showed that bar and chocolate candy were clearly stronger than Fruity and others. price percent vs Win percent graph showed that Bar and chocolate items were both winners and more highly priced.the PCA graphs showed us the positive correlation between Chocolate, Bar, Win percent and pricepercent, which were negatively correlated with fruity, pluribus and hard.

Optional extension questions

Q26. Are popular candies more expensive? In other words: is price significantly different between "winners" and "losers"? List both average values and a P-value along with your answer.

```
losers = candy[which(candy$winpercent < 50),]

winners = candy[which(candy$winpercent >= 50),]

#losers %>% arrange(pricepercent)

#winners %>% arrange(pricepercent)

t.test(winners,losers)
```

```
    Welch Two Sample t-test

data:  winners and losers
t = 2.267, df = 751.43, p-value = 0.02367
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.2860267 3.9814219
sample estimates:
mean of x mean of y
 5.619883  3.486159
```

Yes, price significantly effects the difference between winners and losers.