class10

```
url <- "https://raw.githubusercontent.com/fivethirtyeight/data/master/candy-power-ranking/
candy_file <- read.csv(url)

candy = data.frame(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?

```
ncol(candy)
```

```
[1] 12
```

12.

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

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

```
[1] 38
```

38.

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

Almond Joy! 50.34755. See below.

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

76.7686

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

49.6535

```
# for twix; example
candy["Twix", ]$winpercent
```

```
[1] 81.64291
```

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

```
[1] 50.34755
```

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

```
[1] 76.7686
```

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

```
[1] 49.6535
```

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 insanely high compared to all of the other variables.

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

0-not chocolate, 1-is chocolate.

```
#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	

Q8. Plot a histogram of winpercent values

See below.

Q9. Is the distribution of winpercent values symmetrical?

Not really? There are multiple modes asymmetrically peaking on the graph, and the data is not evenly scattered on either side.

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

Below. Data ranges from 0-90 on display, and majority of data is below 50.

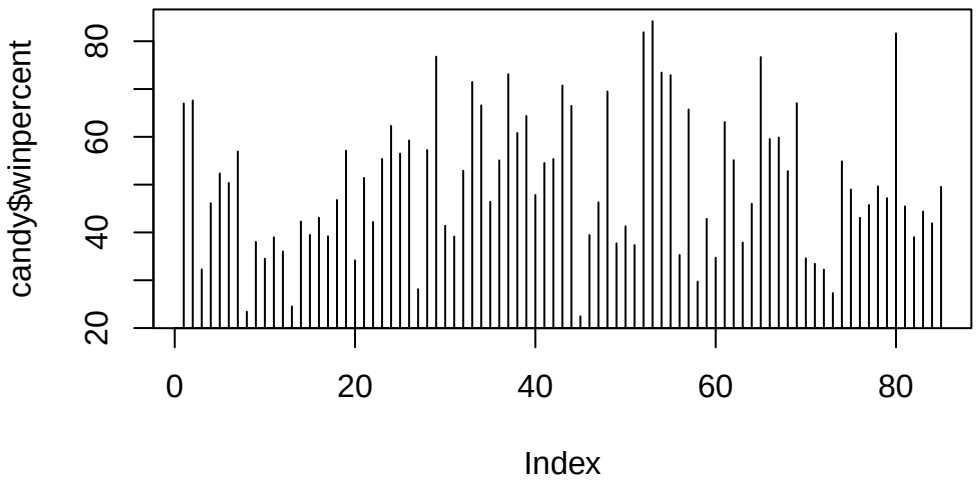
Q11. On average is chocolate candy higher or lower ranked than fruit candy?

Chocolate is higher ranked.

Q12. Is this difference statistically significant?

Yes. p-value = 2.871e-08 «< 0.05

```
plot(x=candy$winpercent, type="h")
```




```
fruitLogical <- candy$winpercent[as.logical(candy$fruity)]
chocLogical <- candy$winpercent[as.logical(candy$chocolate)]
mean(fruitLogical)
```

```
[1] 44.11974
```

```
mean(chocLogical)
```

```
[1] 60.92153
```

```
t.test(fruitLogical, chocLogical)
```

```
    Welch Two Sample t-test

data:  fruitLogical and chocLogical
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:
```

```
 -22.15795 -11.44563
sample estimates:
mean of x mean of y
 44.11974  60.92153
```

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

Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, Jawbusters. See below.

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

Reese's Peanut Butter Cups, Reese's Miniatures, Twix, Kit Kat, Snickers.

```
head(candy[order(candy$winpercent, decreasing=FALSE),], 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
```

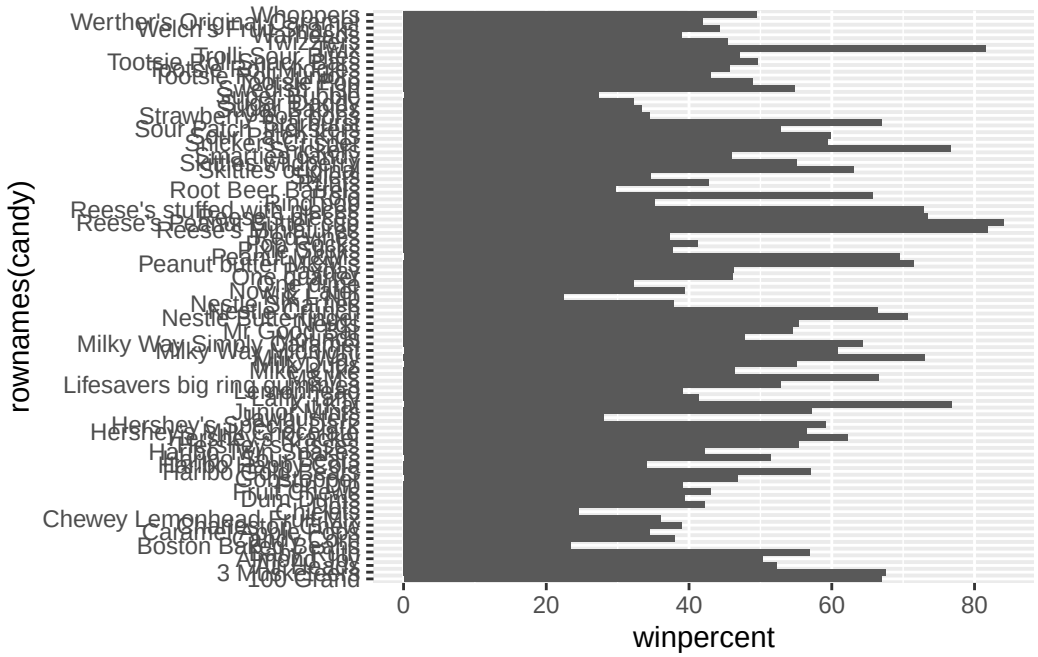
```
head(candy[order(candy$winpercent, decreasing=TRUE),], n=5)
```

```
                        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
```

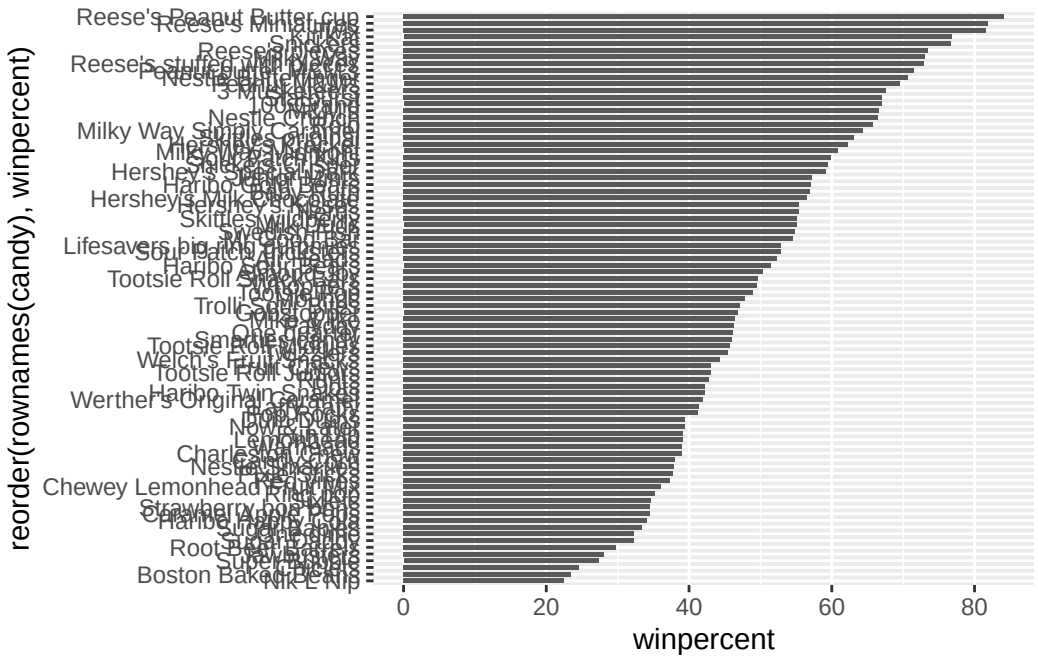
Q15. Make a first barplot of candy ranking based on winpercent values.

```
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(width=0.7)
```




```
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"
```

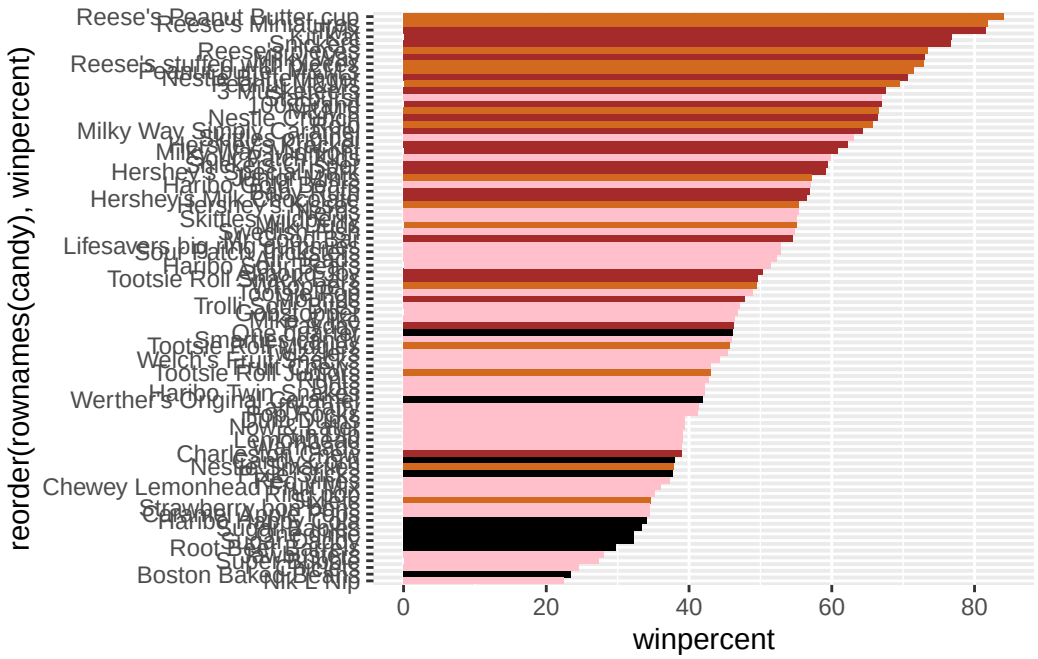
Q17. What is the worst ranked chocolate candy?

Charleston Chew

Q18. What is the best ranked fruity candy?

Starburst

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




```
#install.packages("ggrepel")
library(ggrepel)
```

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?

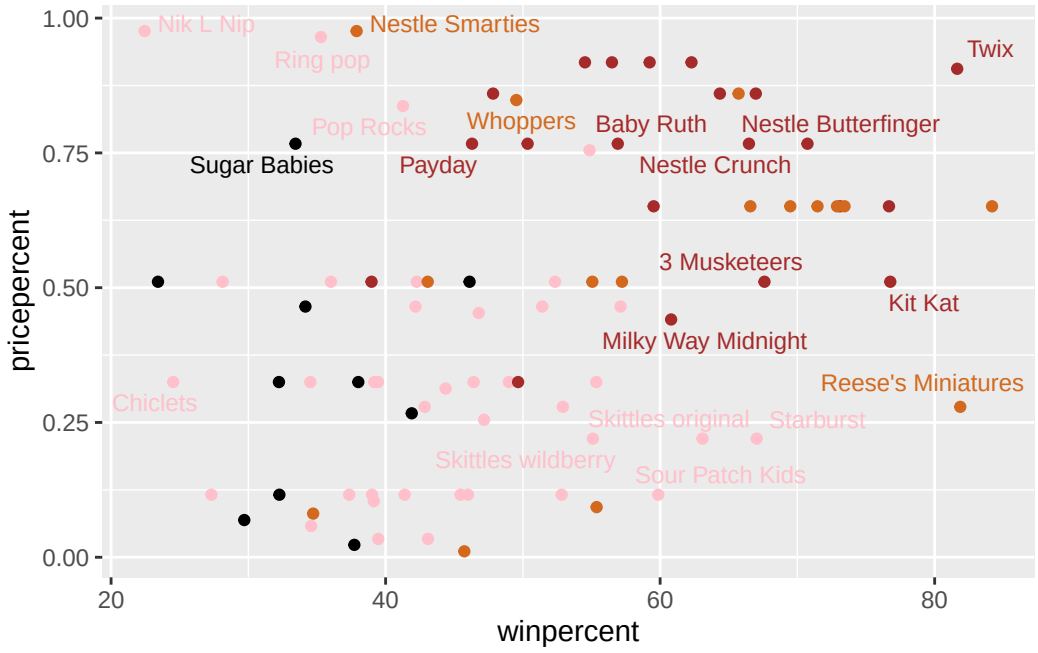
Reese's miniatures

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

Nik L Nip

```
# 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
```

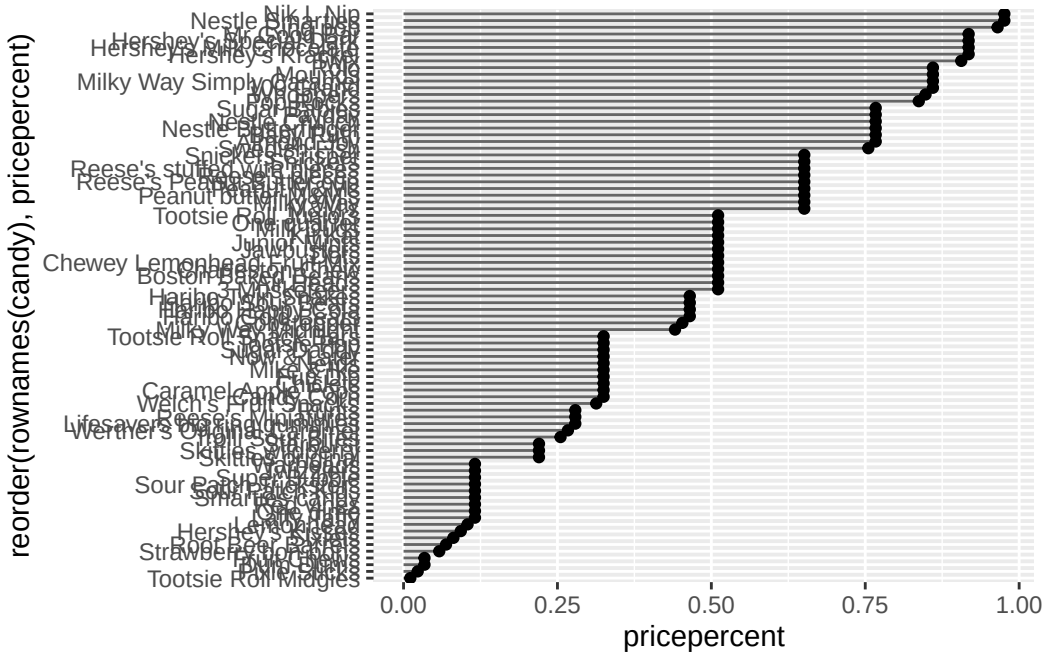



```r
ord <- order(candy$pricepercent, decreasing = TRUE)
head( candy[ord,c(11,12)], n=5 )
```

```
                      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()
```



Q22. Examining this plot what two variables are anti-correlated (i.e. have minus values)?

Chocolate and fruity. See below.

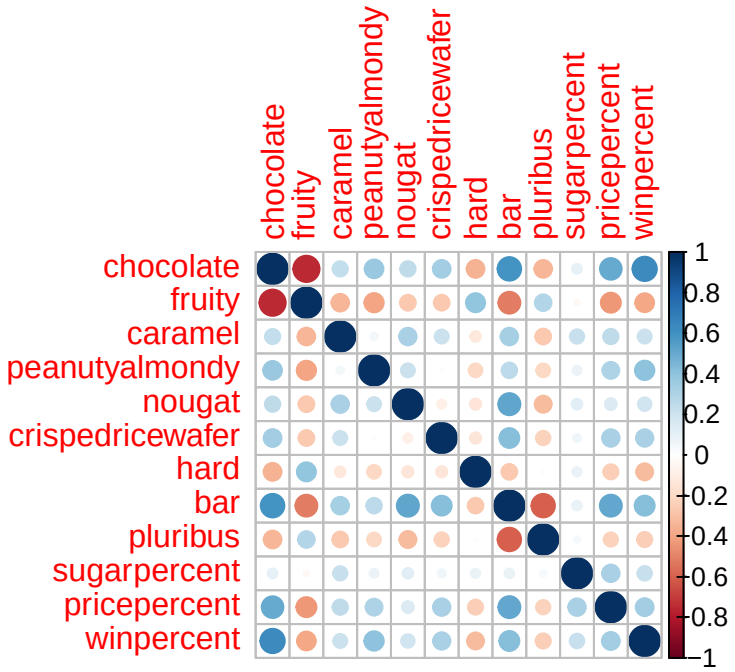
Q23. Similarly, what two variables are most positively correlated?

Chocolate and bar (and winpercent with chocolate)

```
#install.packages("corrplot")
library(corrplot)
```

```
corrplot 0.92 loaded
```

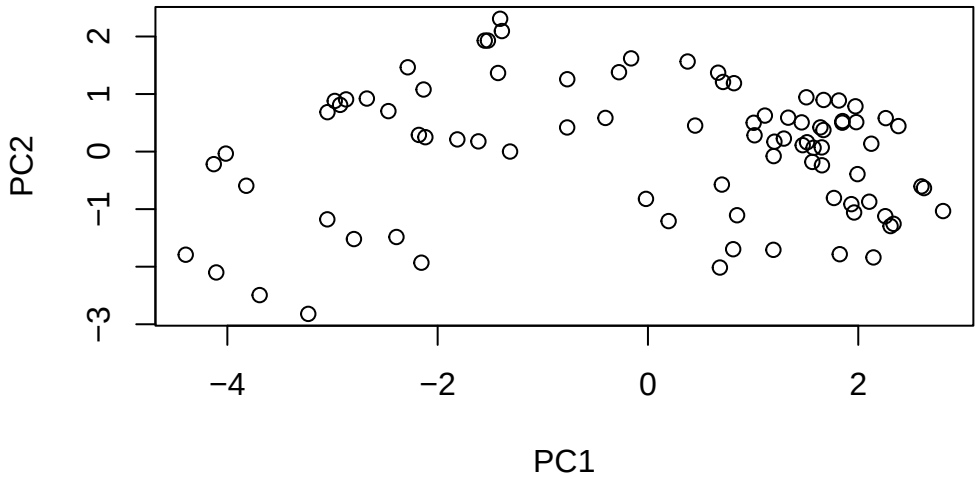
```
cij <- cor(candy)
corrplot(cij)
```



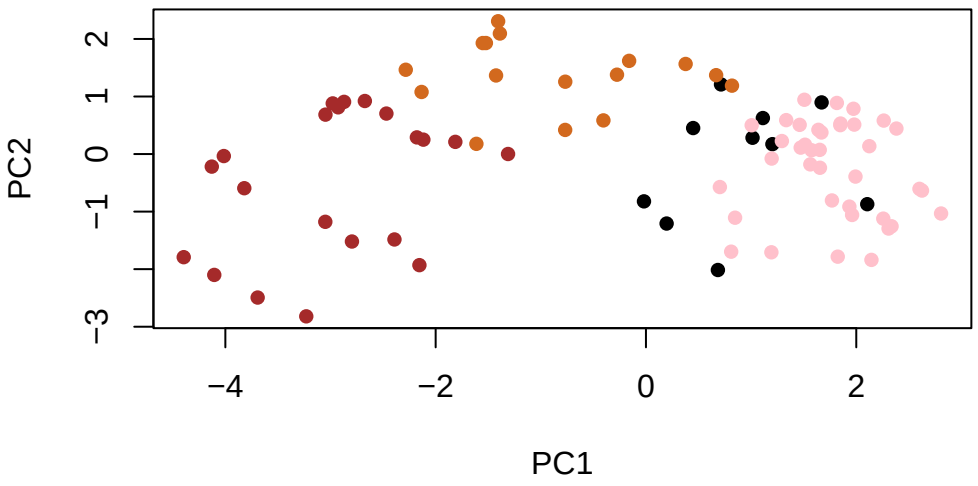

```
pca <- prcomp(candy, scale=TRUE)
summary(pca)
```

```
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
```

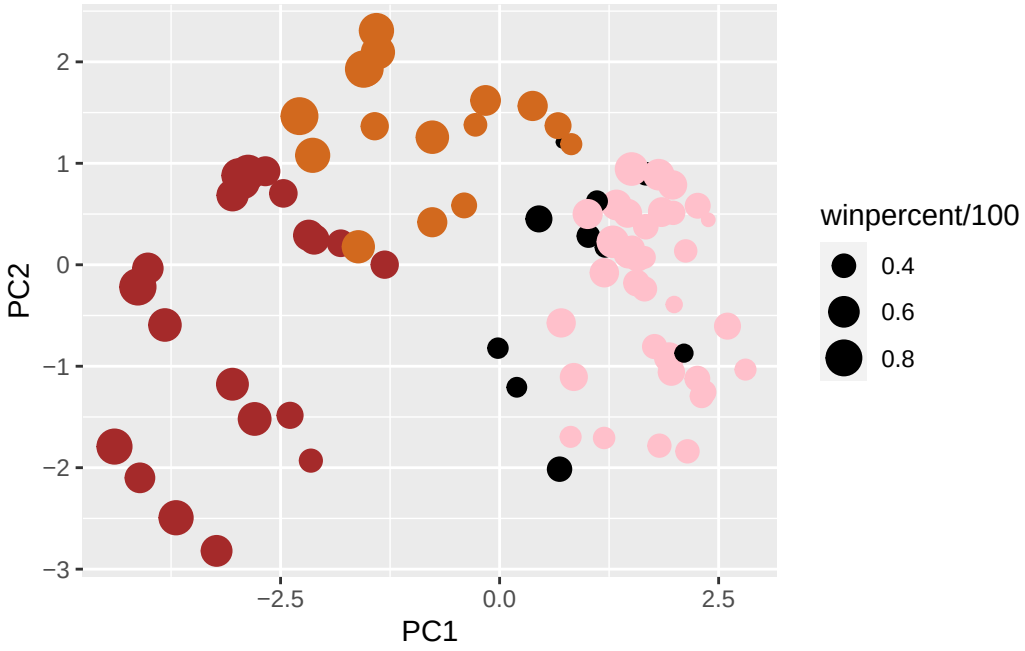
```r
plot(pca$x[,1:2])
```




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



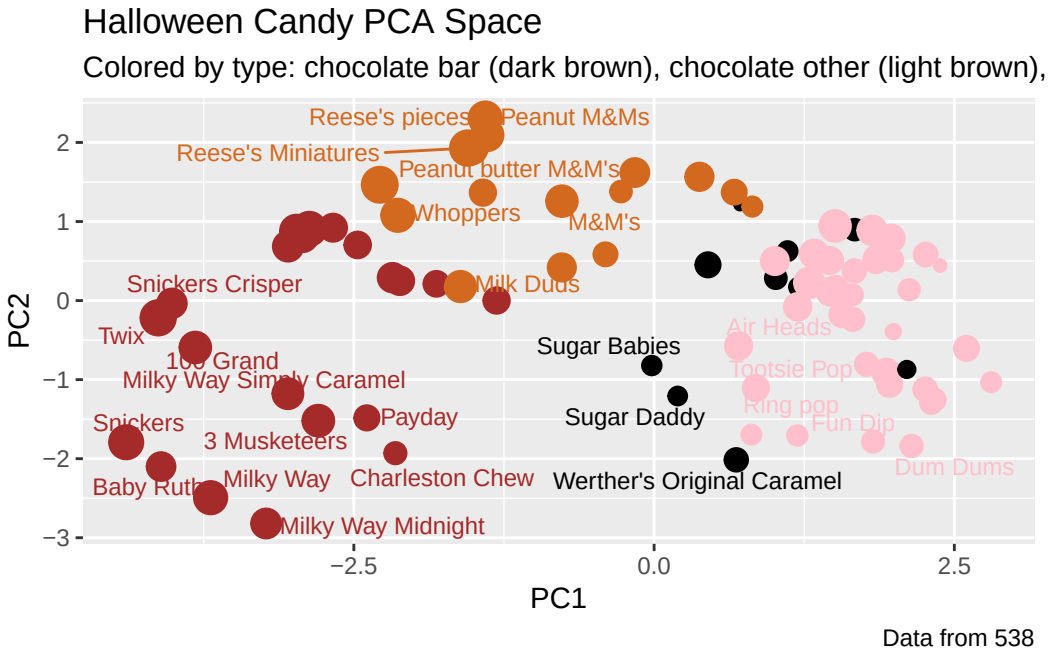

```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])
p <- ggplot(my_data) +
        aes(x=PC1, y=PC2,
            size=winpercent/100,
            text=rownames(my_data),
            label=rownames(my_data)) +
        geom_point(col=my_cols)
p
```




```
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
```

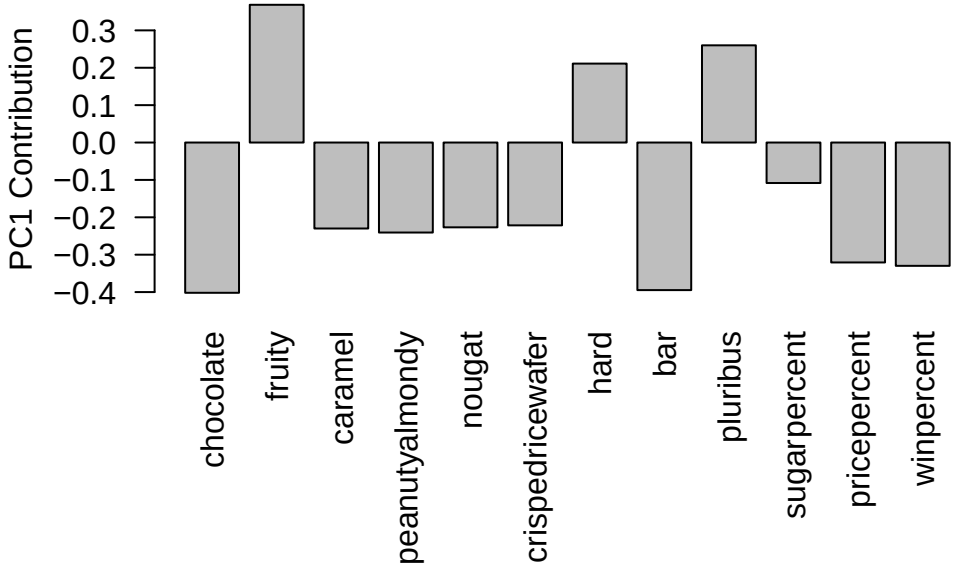



```
#install.packages("plotly")
#library(plotly)
#ggplotly(p)
```

Q24. What original variables are picked up strongly by PC1 in the positive direction? Do these make sense to you?

Fruity, hard, and pluribus. These do make sense, since fruity candies do tend to be hard and come in packages of multiple candies, which are a better price per individual candy (compared to a single chocolate bar)

```
par(mar=c(8,4,2,2))
barplot(pca$rotation[,1], las=2, ylab="PC1 Contribution")
```


PC1 Contribution
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
−0.4
chocolate
fruity
caramel
peanutyalmondy
nougat
crispedricewafer
hard
bar
pluribus
sugarpercent
pricepercent
winpercent