class09HalloweenCandyProject

Nashed A16631132

```
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? 85

```
nrow(candy)
```

```
[1] 85
```

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

```
[1] 38
```

> Q2. How many fruity candy types are in the data set? 38

I can convert the 1 and 0 values to be TRUE or FLASE and use that to extract the type of candy I want. For example the chocolate candy....

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

```
                            chocolate fruity caramel peanutyalmondy nougat
100 Grand                           1      0       1              0      0
3 Musketeers                        1      0       0              0      1
Almond Joy                          1      0       0              1      0
Baby Ruth                           1      0       1              1      1
Charleston Chew                     1      0       0              0      1
Hershey's Kisses                    1      0       0              0      0
Hershey's Krackel                   1      0       0              0      0
Hershey's Milk Chocolate            1      0       0              0      0
Hershey's Special Dark              1      0       0              0      0
Junior Mints                        1      0       0              0      0
Kit Kat                             1      0       0              0      0
Peanut butter M&M's                 1      0       0              1      0
M&M's                               1      0       0              0      0
Milk Duds                           1      0       1              0      0
Milky Way                           1      0       1              0      1
Milky Way Midnight                  1      0       1              0      1
Milky Way Simply Caramel            1      0       1              0      0
Mounds                              1      0       0              0      0
Mr Good Bar                         1      0       0              1      0
Nestle Butterfinger                 1      0       0              1      0
Nestle Crunch                       1      0       0              0      0
Peanut M&Ms                         1      0       0              1      0
Reese's Miniatures                  1      0       0              1      0
Reese's Peanut Butter cup           1      0       0              1      0
Reese's pieces                      1      0       0              1      0
Reese's stuffed with pieces         1      0       0              1      0
Rolo                                1      0       1              0      0
Sixlets                             1      0       0              0      0
Nestle Smarties                     1      0       0              0      0
Snickers                            1      0       1              1      1
Snickers Crisper                    1      0       1              1      0
Tootsie Pop                         1      1       0              0      0
Tootsie Roll Juniors                1      0       0              0      0
Tootsie Roll Midgies                1      0       0              0      0
Tootsie Roll Snack Bars             1      0       0              0      0
Twix                                1      0       1              0      0
Whoppers                            1      0       0              0      0
                            crispedricewafer hard bar pluribus sugarpercent
100 Grand                                  1    0   1        0        0.732
3 Musketeers                               0    0   1        0        0.604
Almond Joy                                 0    0   1        0        0.465
Baby Ruth                                  0    0   1        0        0.604
Charleston Chew                            0    0   1        0        0.604
Hershey's Kisses                           0    0   0        1        0.127
Hershey's Krackel                          1    0   1        0        0.430
Hershey's Milk Chocolate                   0    0   1        0        0.430
Hershey's Special Dark                     0    0   1        0        0.430
Junior Mints                               0    0   0        1        0.197
Kit Kat                                    1    0   1        0        0.313
Peanut butter M&M's                        0    0   0        1        0.825
M&M's                                      0    0   0        1        0.825
Milk Duds                                  0    0   0        1        0.302
Milky Way                                  0    0   1        0        0.604
Milky Way Midnight                         0    0   1        0        0.732
Milky Way Simply Caramel                   0    0   1        0        0.965
Mounds                                     0    0   1        0        0.313
Mr Good Bar                                0    0   1        0        0.313
Nestle Butterfinger                        0    0   1        0        0.604
Nestle Crunch                              1    0   1        0        0.313
Peanut M&Ms                                0    0   0        1        0.593
Reese's Miniatures                         0    0   0        0        0.034
Reese's Peanut Butter cup                  0    0   0        0        0.720
Reese's pieces                             0    0   0        1        0.406
Reese's stuffed with pieces                0    0   0        0        0.988
Rolo                                       0    0   0        1        0.860
Sixlets                                    0    0   0        1        0.220
Nestle Smarties                            0    0   0        1        0.267
Snickers                                   0    0   1        0        0.546
Snickers Crisper                           1    0   1        0        0.604
Tootsie Pop                                0    1   0        0        0.604
Tootsie Roll Juniors                       0    0   0        0        0.313
Tootsie Roll Midgies                       0    0   0        1        0.174
Tootsie Roll Snack Bars                    0    0   1        0        0.465
Twix                                       1    0   1        0        0.546
Whoppers                                   1    0   0        1        0.872
                            pricepercent winpercent
100 Grand                          0.860   66.97173
```

```
3 Musketeers                       0.511   67.60294
Almond Joy                         0.767   50.34755
Baby Ruth                          0.767   56.91455
Charleston Chew                    0.511   38.97504
Hershey's Kisses                   0.093   55.37545
Hershey's Krackel                  0.918   62.28448
Hershey's Milk Chocolate           0.918   56.49050
Hershey's Special Dark             0.918   59.23612
Junior Mints                       0.511   57.21925
Kit Kat                            0.511   76.76860
Peanut butter M&M's                0.651   71.46505
M&M's                              0.651   66.57458
Milk Duds                          0.511   55.06407
Milky Way                          0.651   73.09956
Milky Way Midnight                 0.441   60.80070
Milky Way Simply Caramel           0.860   64.35334
Mounds                             0.860   47.82975
Mr Good Bar                        0.918   54.52645
Nestle Butterfinger                0.767   70.73564
Nestle Crunch                      0.767   66.47068
Peanut M&Ms                        0.651   69.48379
Reese's Miniatures                 0.279   81.86626
Reese's Peanut Butter cup          0.651   84.18029
Reese's pieces                     0.651   73.43499
Reese's stuffed with pieces        0.651   72.88790
Rolo                               0.860   65.71629
Sixlets                            0.081   34.72200
Nestle Smarties                    0.976   37.88719
Snickers                           0.651   76.67378
Snickers Crisper                   0.651   59.52925
Tootsie Pop                        0.325   48.98265
Tootsie Roll Juniors               0.511   43.06890
Tootsie Roll Midgies               0.011   45.73675
Tootsie Roll Snack Bars            0.325   49.65350
Twix                               0.906   81.64291
Whoppers                           0.848   49.52411
```

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

```
candy["3 Musketeers", ]$winpercent
```

```
[1] 67.60294
```

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
```

```
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

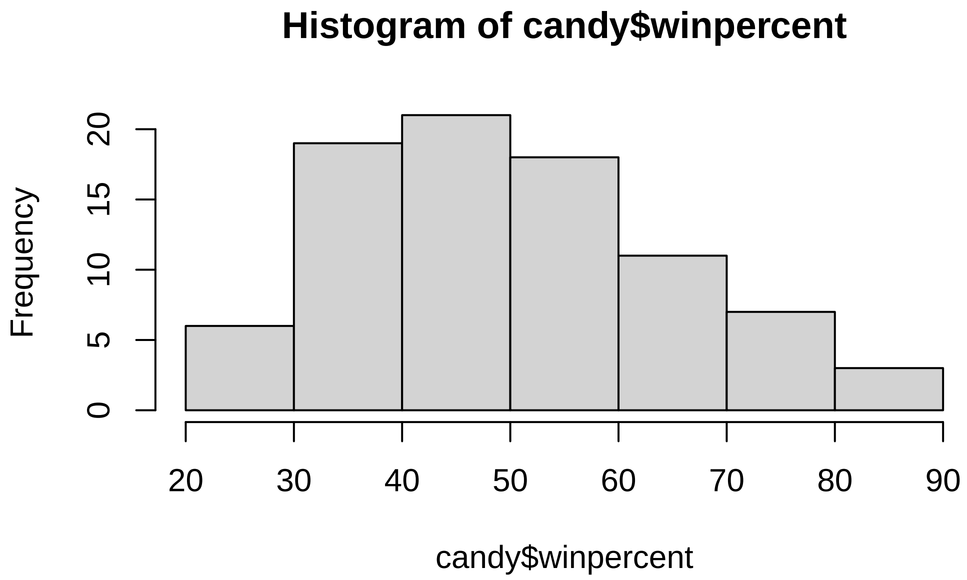
skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
chocolate	0	1	0.44	0.50	0.00	0.00	0.00	1.00	1.00	
fruity	0	1	0.45	0.50	0.00	0.00	0.00	1.00	1.00	
caramel	0	1	0.16	0.37	0.00	0.00	0.00	0.00	1.00	
peanutyalmondy	0	1	0.16	0.37	0.00	0.00	0.00	0.00	1.00	
nougat	0	1	0.08	0.28	0.00	0.00	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	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
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	

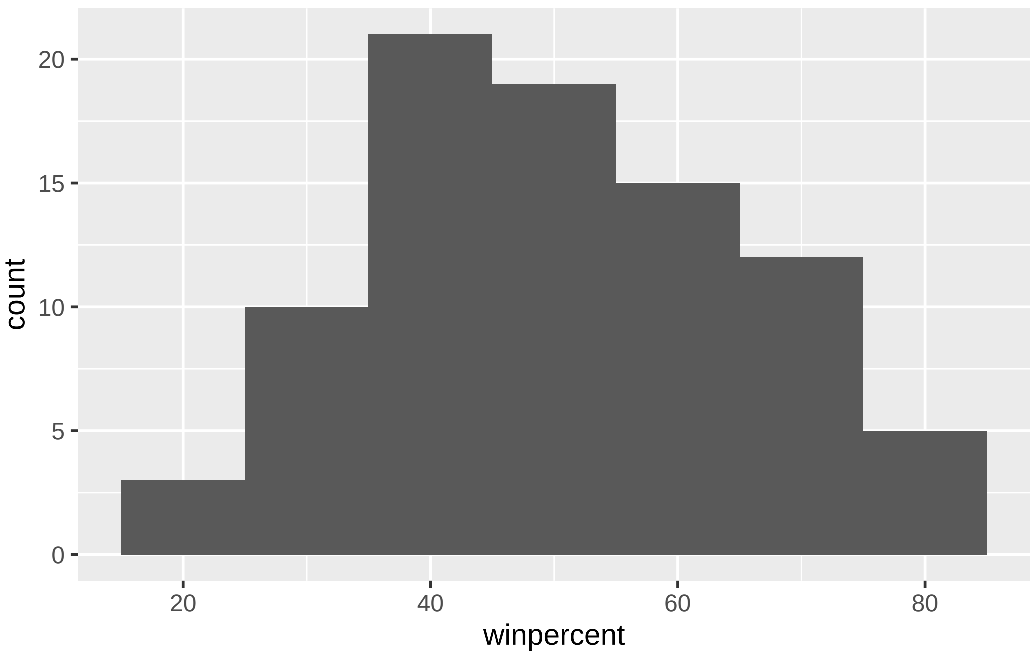
Q6. Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset? Winpercent seems to be on a different scale and has very different values than the other valuables and is not in the 0-1 range. Q7. What do you think a zero and one represent for the candy$chocolate column? 0 is false and 1 true.

Q8. Plot a histogram of winpercent values

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



```
library(ggplot2)
ggplot(candy) +
  aes(winpercent) +
  geom_histogram(binwidth=10)
```



Q9. Is the distribution of winpercent values symmetrical? No, it is not very symmetrical and is skewed.

Q10. Is the center of the distribution above or below 50%? The center of the distribution is below 50% and is skewed to the right.

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

```
 [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
```

```
fruit.inds <- as.logical(candy$fruit)
fruit.win <- candy[fruit.inds, "winpercent"]
fruit.win
```

```
 [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
```

```
mean(choc.win)
```

```
[1] 60.92153
```

```
mean(fruit.win)
```

```
[1] 44.11974
```

> Q11. On average is chocolate candy higher or lower ranked than fruit candy? On average, chocolate is higher ranked than fruit candy and has a higher average.

```
t.test(choc.win, fruit.win)
```

```

	Welch Two Sample t-test

data:  choc.win and fruit.win
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 
```

> Q12. Is this difference statistically significant? The p-value is very small so we can reject the null hypothesis that there is no difference in the means, and conclude that there is a significant difference.

```
mycols <- rep("gray", nrow(candy))
#mycols[2:5] <- "red"
mycols[as.logical(candy$chocolate)] <-"chocolate"
mycols[as.logical(candy$fruit)] <-"pink"
mycols
```

```
 [1] "chocolate" "chocolate" "gray"      "gray"      "pink"      "chocolate"
 [7] "chocolate" "gray"      "gray"      "pink"      "chocolate" "pink"
[13] "pink"      "pink"      "pink"      "pink"      "pink"      "pink"
[19] "pink"      "gray"      "pink"      "pink"      "chocolate" "chocolate"
[25] "chocolate" "chocolate" "pink"      "chocolate" "chocolate" "pink"
[31] "pink"      "pink"      "chocolate" "chocolate" "pink"      "chocolate"
[37] "chocolate" "chocolate" "chocolate" "chocolate" "chocolate" "pink"
[43] "chocolate" "chocolate" "pink"      "pink"      "gray"      "chocolate"
[49] "gray"      "pink"      "pink"      "chocolate" "chocolate" "chocolate"
[55] "chocolate" "pink"      "chocolate" "gray"      "pink"      "chocolate"
[61] "pink"      "pink"      "chocolate" "pink"      "chocolate" "chocolate"
[67] "pink"      "pink"      "pink"      "pink"      "gray"      "gray"
[73] "pink"      "pink"      "pink"      "chocolate" "chocolate" "chocolate"
[79] "pink"      "chocolate" "pink"      "pink"      "pink"      "gray"
[85] "chocolate"
```

Q13. What are the five least liked candy types in this set? Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, Jawbusters

```
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
```

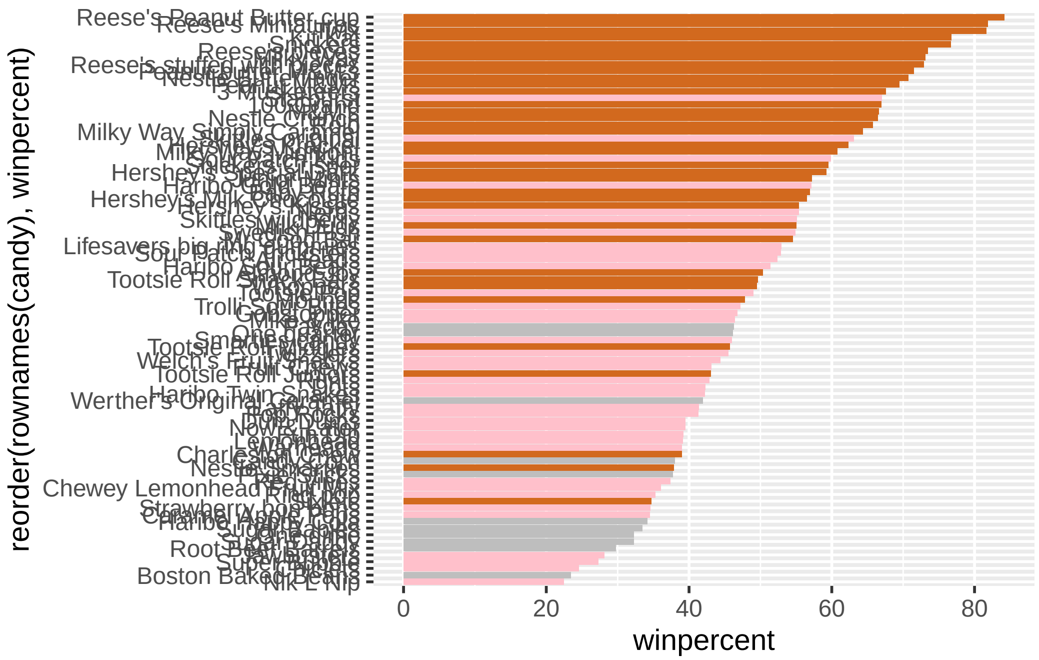
Q14. What are the top 5 all time favorite candy types out of this set? Reeses Peanut Butter Cup, Reeses Miniatures, Twix, Kit Kat, Snickers

```
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
```

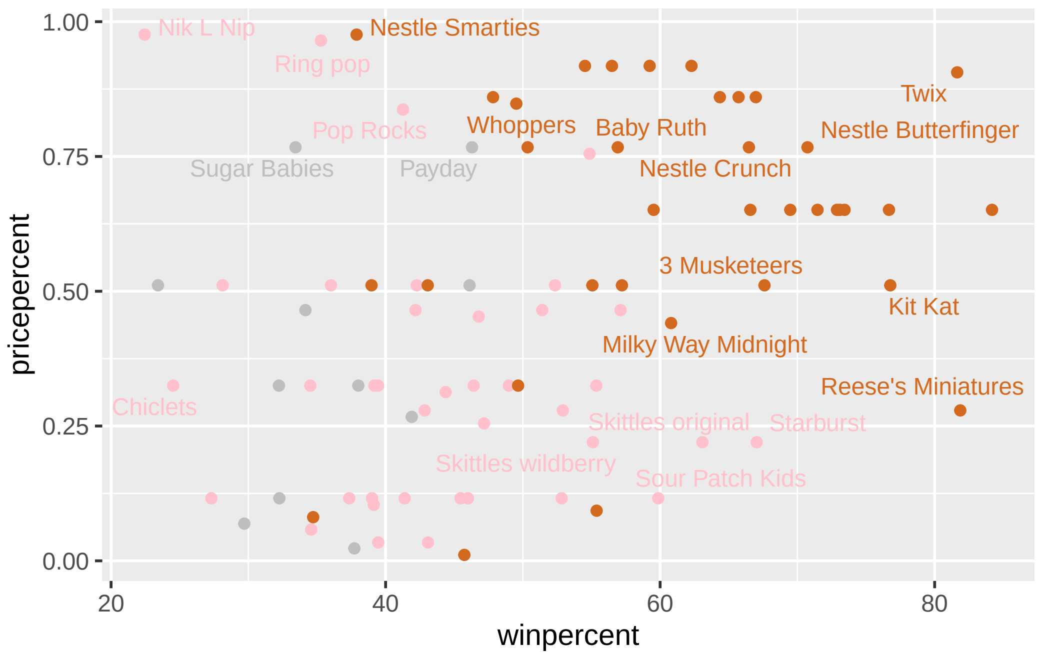
> Q15. Make a first barplot of candy ranking based on winpercent values. Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

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



```
library(ggrepel)

# How about a plot of price vs win
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=mycols) +
  geom_text_repel(col=mycols, size=3.3, max.overlaps = 5)
```

```
Warning: ggrepel: 65 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Q17. What is the worst ranked chocolate candy? Nik L Nip Q18. What is the best ranked fruity candy? Reeses Peanut Butter Cup

```
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
```

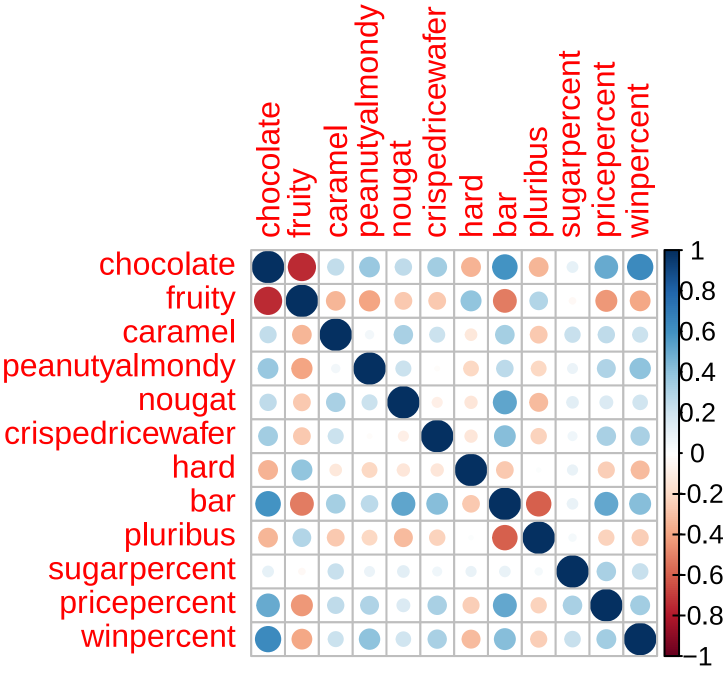
Q19. Which candy type is the highest ranked in terms of winpercent for the least money - i.e. offers the most bang for your buck? Reeses miniatures

Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular? The top 5 most expensive candy typea are Nik L Nip, Nestle Smarties, Ring pop, Hershey's Krackel, Hershey's Milk Chocolate and the least popular one is Nik L Nip.

```
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

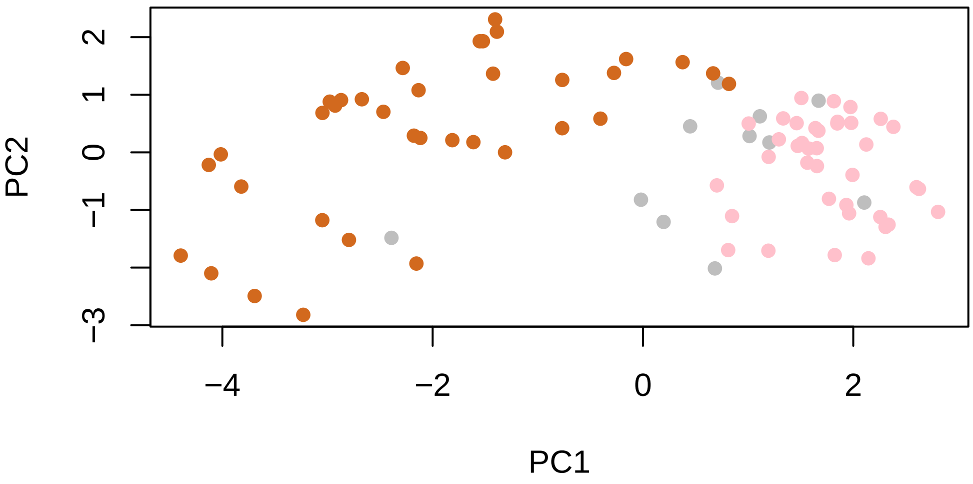
Q23. Similarly, what two variables are most positively correlated? winpercent and chocolate

```
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=mycols, pch=16)
```

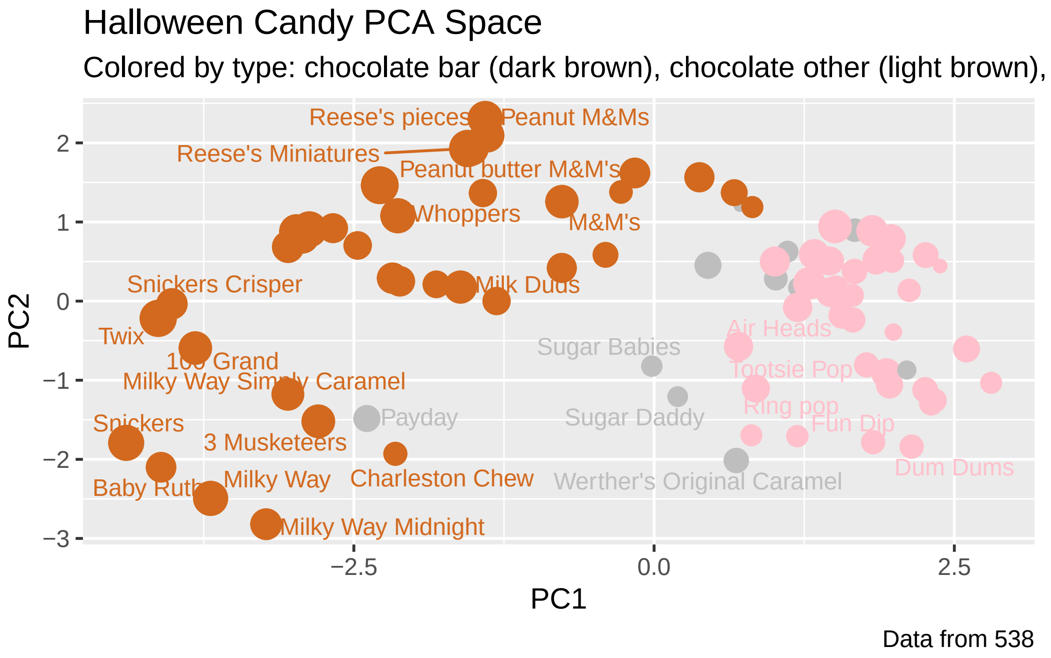


```
my_data <- cbind(candy, pca$x[,1:3])
p <- ggplot(my_data) +
        aes(x=PC1, y=PC2,
            size=winpercent/100,
            text=rownames(my_data),
            label=rownames(my_data)) +
        geom_point(col=mycols)
```

```
library(ggrepel)
p + geom_text_repel(size=3.3, col=mycols, 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
```

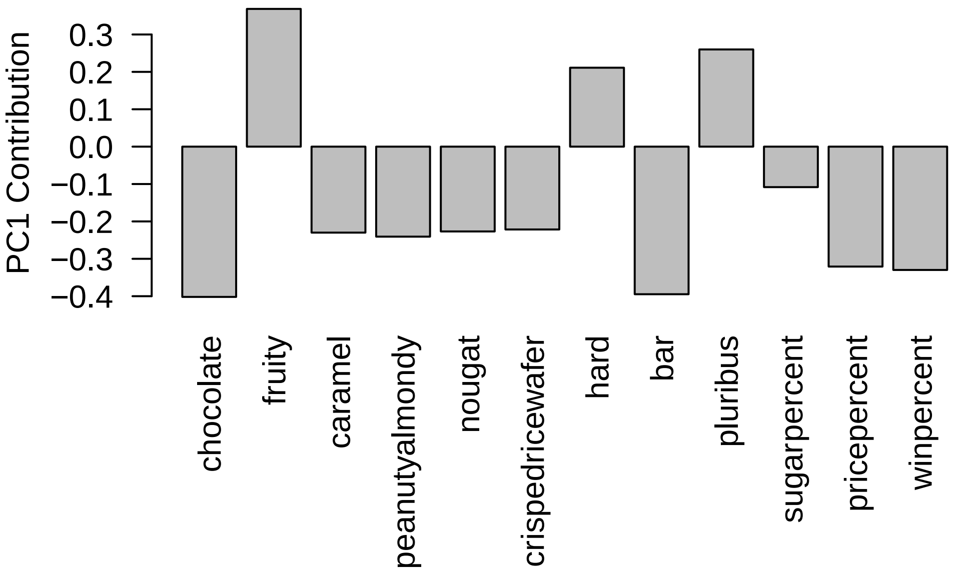


```r
library(plotly)
```

```

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
```

```
#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 because I would expect that fruit candy would come in a bag or box of multiple candies.