Class 09: Mini Project (Candy)

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Today we will analyze some data from about 538 typical halloween candy.

Our first job is to get the data into R.

```
candy_file<- read.csv("candy-data.csv", row.names =1)
head(candy_file)
```

```
             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
```

```
candy<- candy_file
```

Q. How many chocolate candy types are in this dataset?

```
sum(candy$chocolate)
```

```
[1] 37
```

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

There are 9 types of candy.

```
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
```

Q2. How many fruit candy are there?

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

```
[1] 38
```

Q. How many total candy?

```
nrow(candy)
```

```
[1] 85
```

Q. How many variables/dimensions are there?

```
ncol(candy)
```

```
[1] 12
```

```
dim(candy)
```

```
[1] 85 12
```

Skimr package allows for a peak/report of your dataset.

```
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	

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

```
candy["Haribo Gold Bears",]$winpercent
```

```
[1] 57.11974
```

Q. What are the five least liked candy's in the dataset?

```
inds <- order(candy$winpercent)

head(candy[inds,])
```

```
                  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
Root Beer Barrels         0      0       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
Root Beer Barrels                0    1   0        1        0.732        0.069
                  winpercent
Nik L Nip           22.44534
Boston Baked Beans  23.41782
Chiclets            24.52499
Super Bubble        27.30386
Jawbusters          28.12744
Root Beer Barrels   29.70369
```

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
```

Q6. Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset?

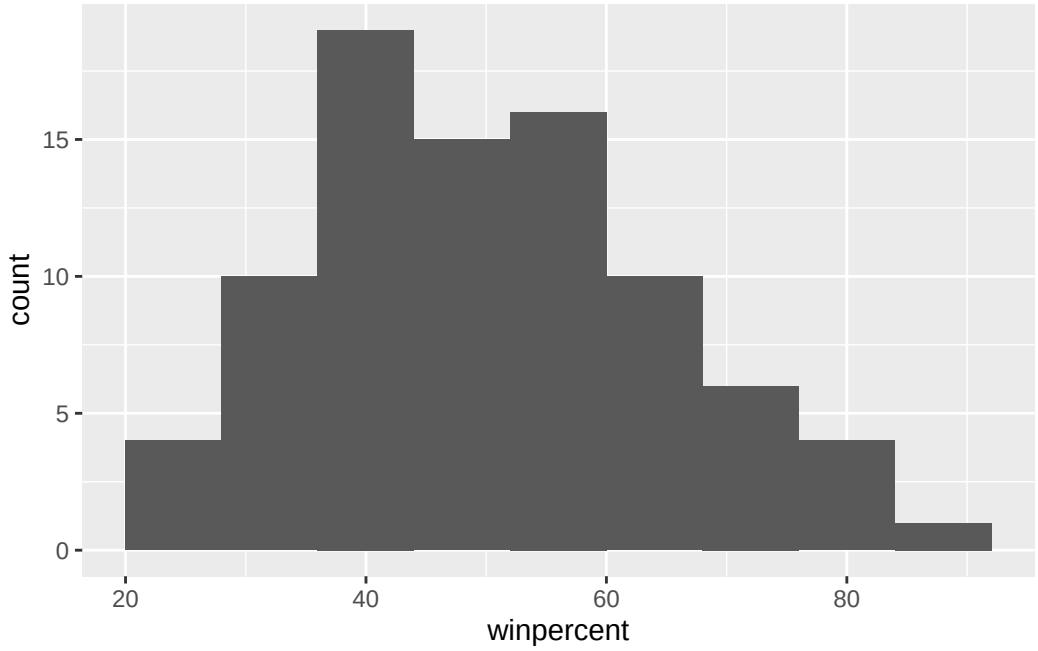
The last 3 columns are all percent values compared to the logical values within the candy types.

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

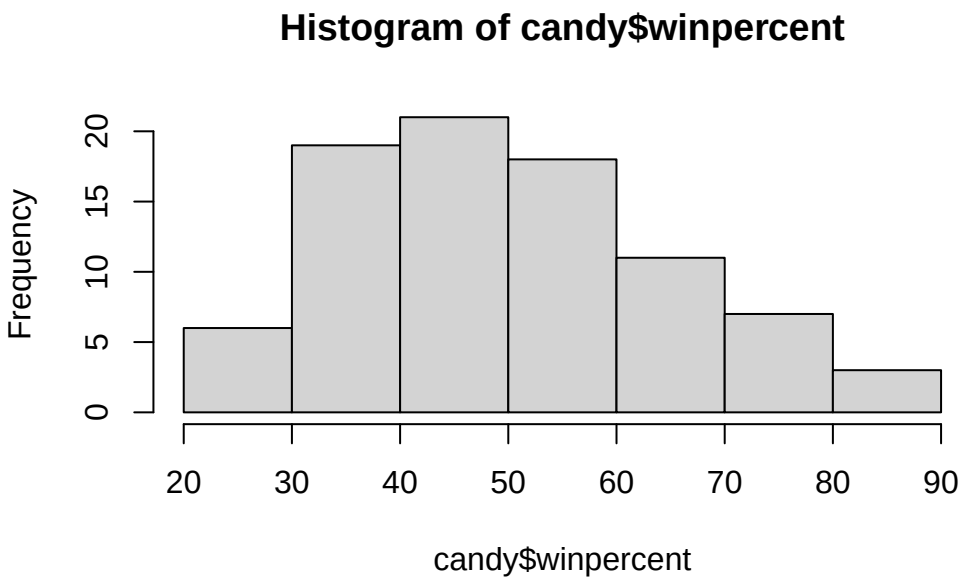
It represents whether that particular candy has chocolate in it or not. (1 is yes, 0 is no)

Q8. Plot a histogram of winpercent values

```
library(ggplot2)
ggplot(candy)+
  aes(winpercent)+
  geom_histogram(binwidth=8)
```




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



Q9. Is the distribution of winpercent values symmetrical?

No it is skewed to the left. > Q10. Is the center of the distribution above or below 50%?

The center of the distribution is below 50% > Q11. On average is chocolate candy higher or lower ranked than fruit candy?

First find all chocolate candy and all fruit candy. Take the mean of the winpercent values. Compare.

```
chocolate<- subset(candy,chocolate == 1)
fruity <- subset(candy,fruity == 1)

choco_mean <-mean(chocolate$winpercent)
fruity_mean <- mean(fruity$winpercent)
```

Q12. Is this difference statistically significant?

Yes it is.

```
t.test(chocolate$winpercent,fruity$winpercent)
```

```
    Welch Two Sample t-test

data:  chocolate$winpercent and fruity$winpercent
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
```

Overall candy rankings

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

```
head(candy[inds,])
```

```
                  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
Root Beer Barrels         0      0       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
Root Beer Barrels                0    1   0        1        0.732        0.069
                  winpercent
Nik L Nip           22.44534
Boston Baked Beans  23.41782
Chiclets            24.52499
Super Bubble        27.30386
Jawbusters          28.12744
Root Beer Barrels   29.70369
```

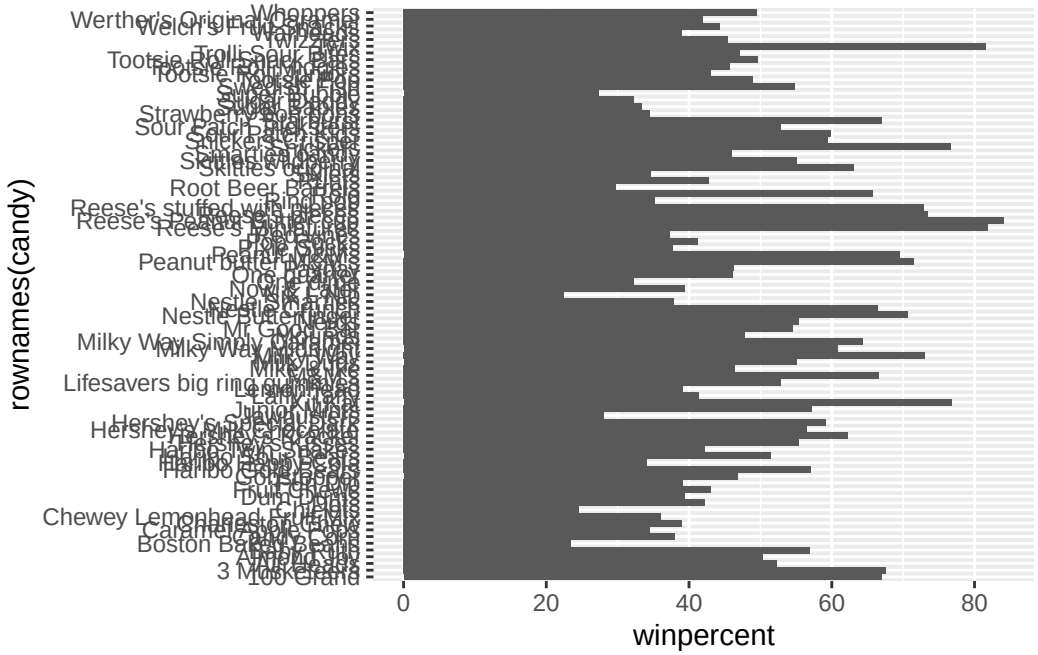
Q14. What are the top 5 all time favorite candy types out of this set?

```
inds_2 <- rev(inds)
head(candy[inds_2,])
```

```
                         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
Reese's pieces                    1      0       0              1      0
                         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
Reese's pieces                           0    0   0        1        0.406
                         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
Reese's pieces                   0.651   73.43499
```

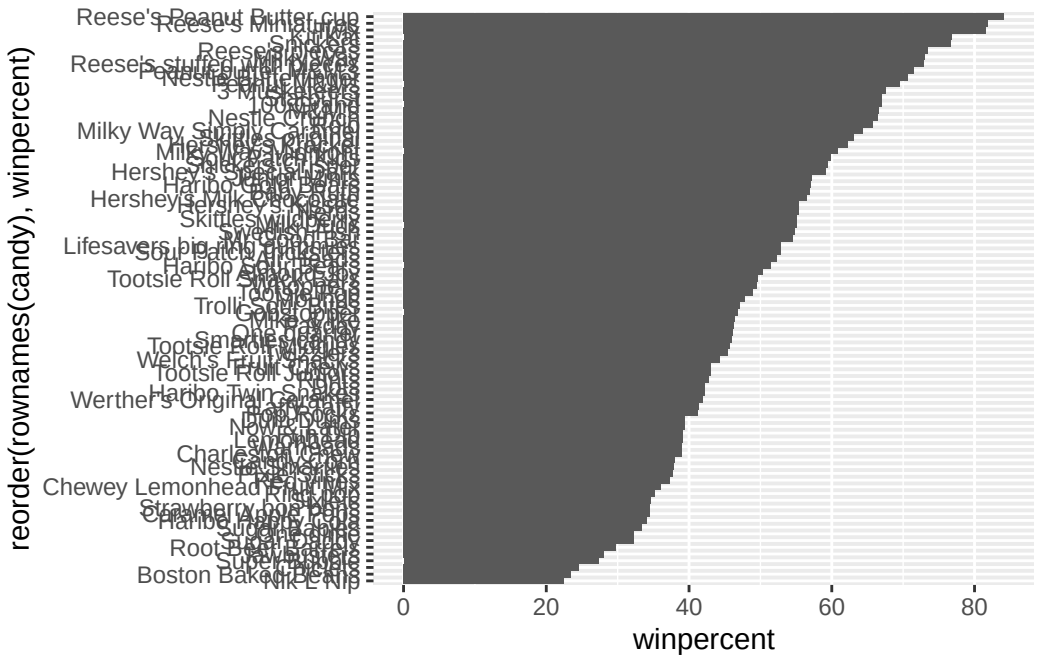
Q15. Make a first barplot of candy ranking based on winpercent values.

```
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()
```




```
ggsave("barplot1.png", height =10, width =7)
```

We can now insert any image using markdown syntax. This is ! followed by square brackets and then normal parenthesis.

Figure 1

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col() +
  labs(x = "Match-up Win percent", y = NULL)
```

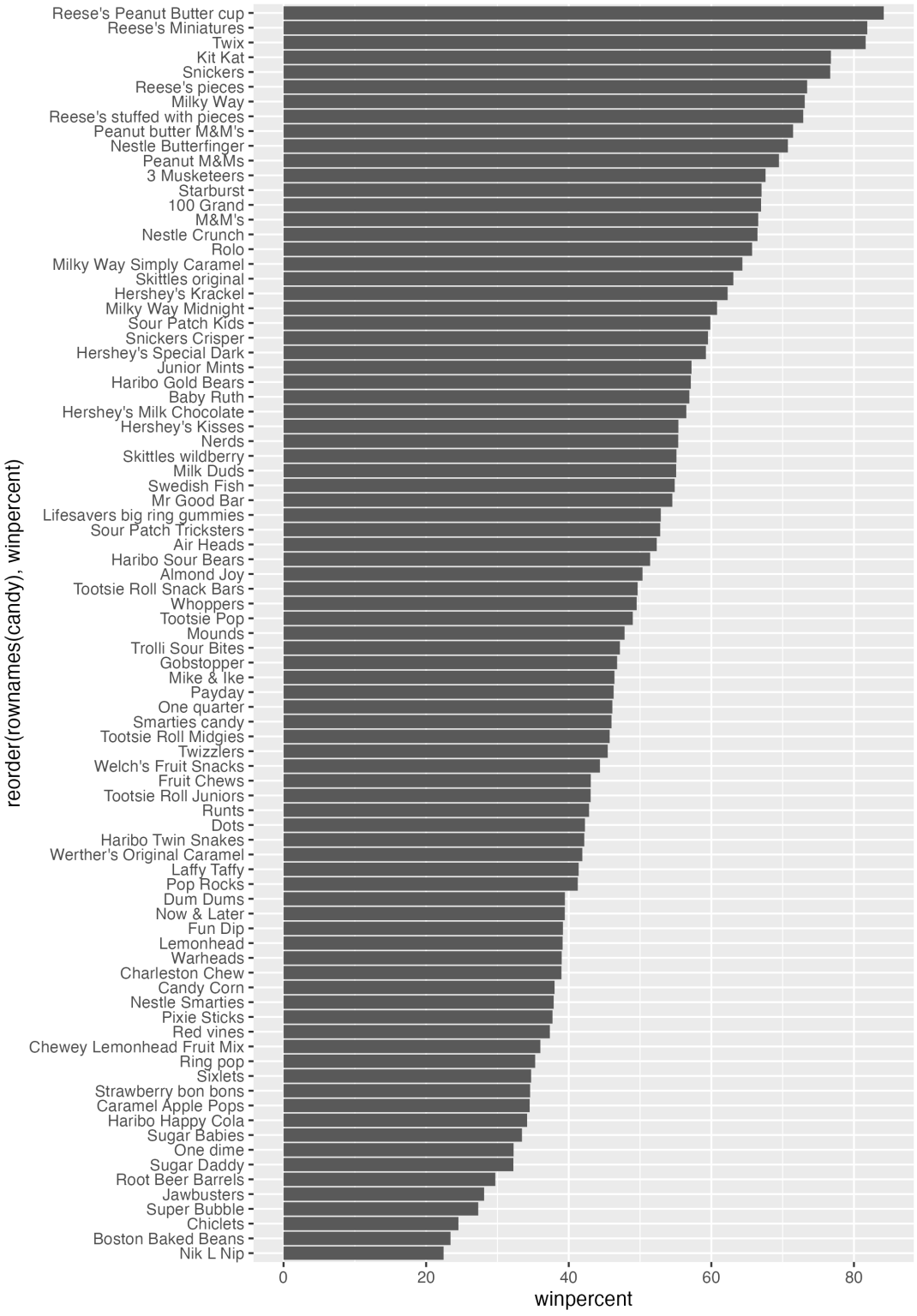
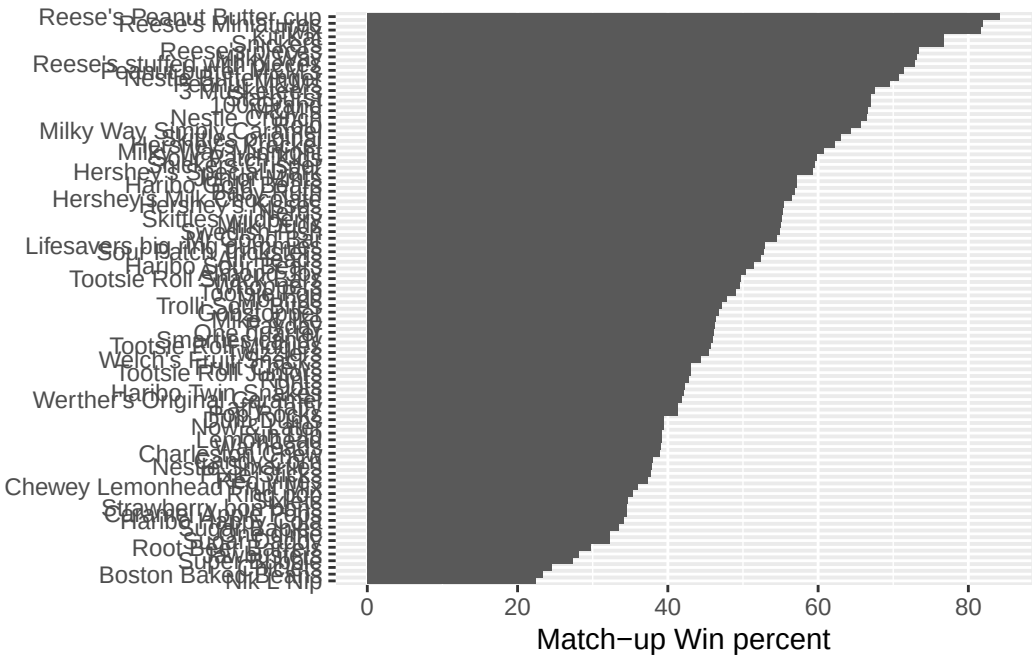
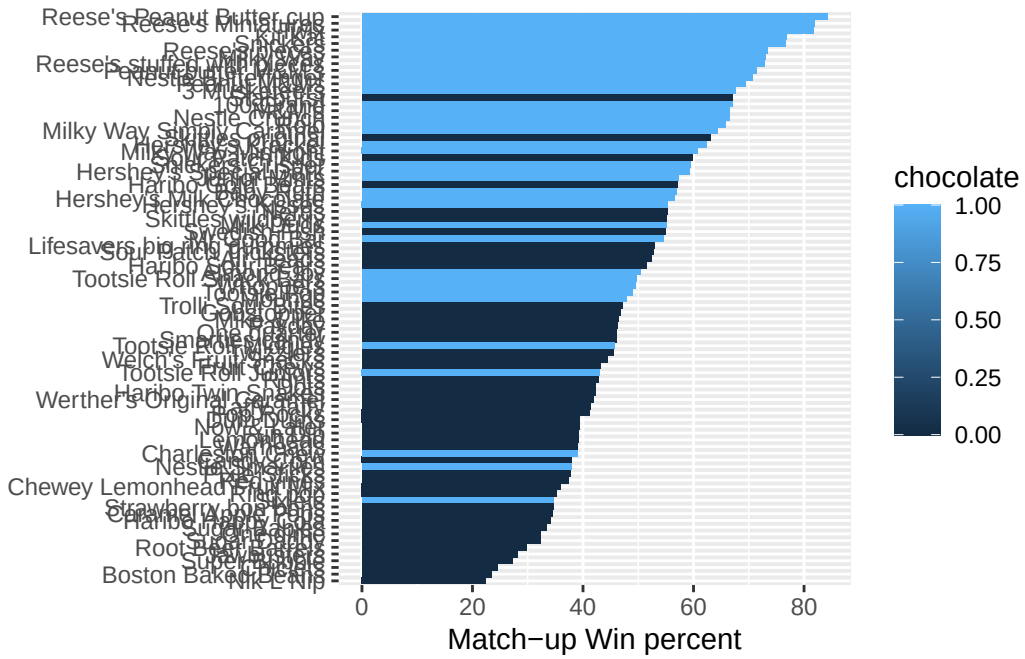


Figure 1: A dull plot

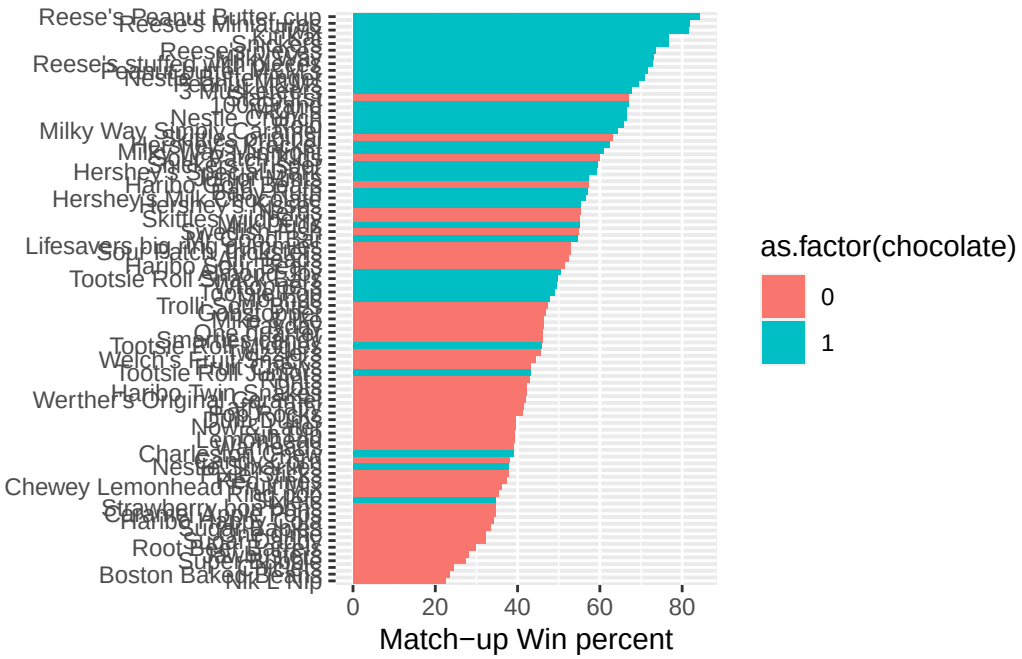


Lets add some color.

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent), fill = chocolate) +
  geom_col() +
  labs(x = "Match-up Win percent", y = NULL)
```




```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent), fill = as.factor(chocolate)) +
  geom_col() +
  labs(x = "Match-up Win percent", y = NULL)
```



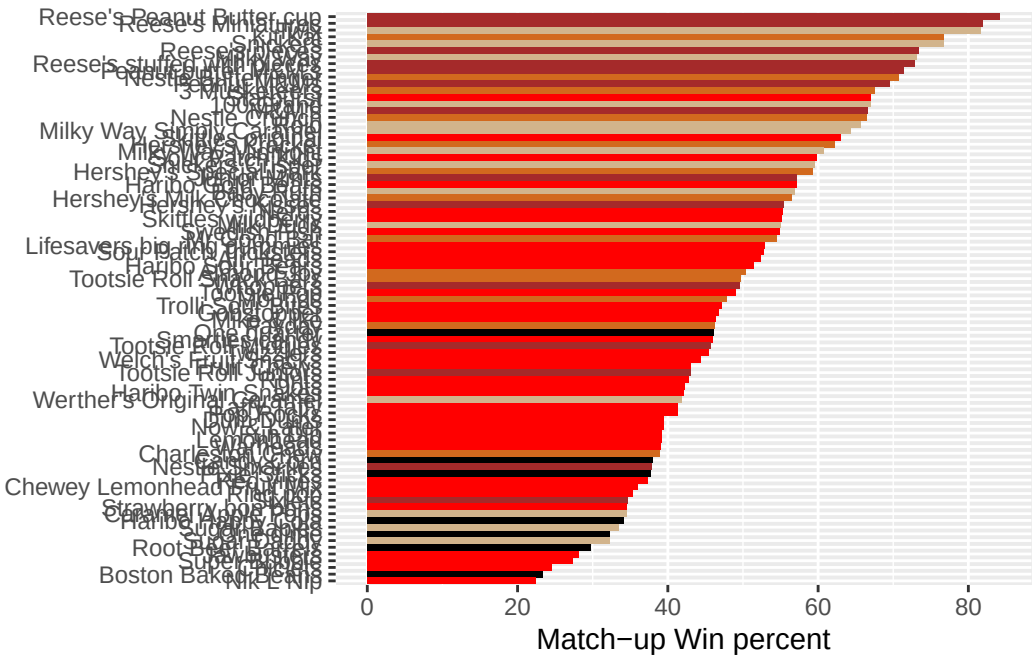
We need to make our own color vactor with the colors we like.

```
#you need this default vector set to every value within dataset and then we manually rewri
my_cols <- rep("black", nrow(candy))

my_cols[ as.logical(candy$chocolate) ] <- "brown"
my_cols[ as.logical(candy$fruity) ] <- "red"
my_cols[ as.logical(candy$bar) ] <- "chocolate"
my_cols[ as.logical(candy$caramel) ] <- "tan"
```

Because we mapped my_cols to our dataset, we cannot set the aesthetic in the typical aes() portion of ggplot. It needs to go to the geom_()

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy), winpercent)) +
  geom_col(fill=my_cols) +
  labs(x = "Match-up Win percent", y = NULL)
```




```
ggsave("barplot2.png", height =10, width =7)
```

As shown in Figure 2 there is terrible colors choices.

Q17. What is the worst ranked chocolate candy?

The worst chocolate candy is Sixlets. > Q18. What is the best ranked fruity candy?

The worst fruity candy is Nik L Nip.

#Take a look at pricepercent Lets make a plot of winpercent vs pricepercent. the original idea with this is to show what is the best candy for your money.

```
ggplot(candy) +
  aes(winpercent, pricepercent, label =rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text(col=my_cols)
```

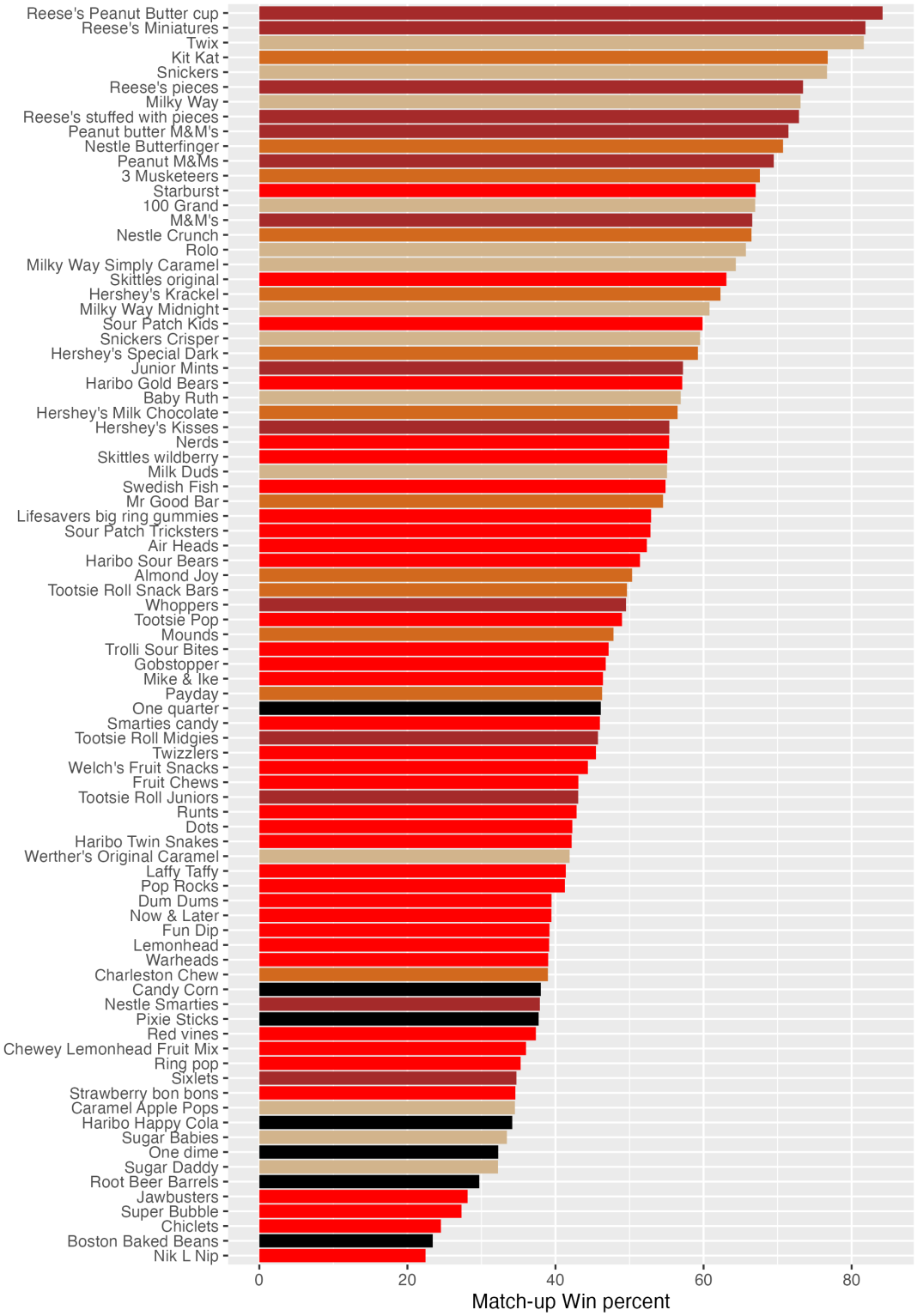
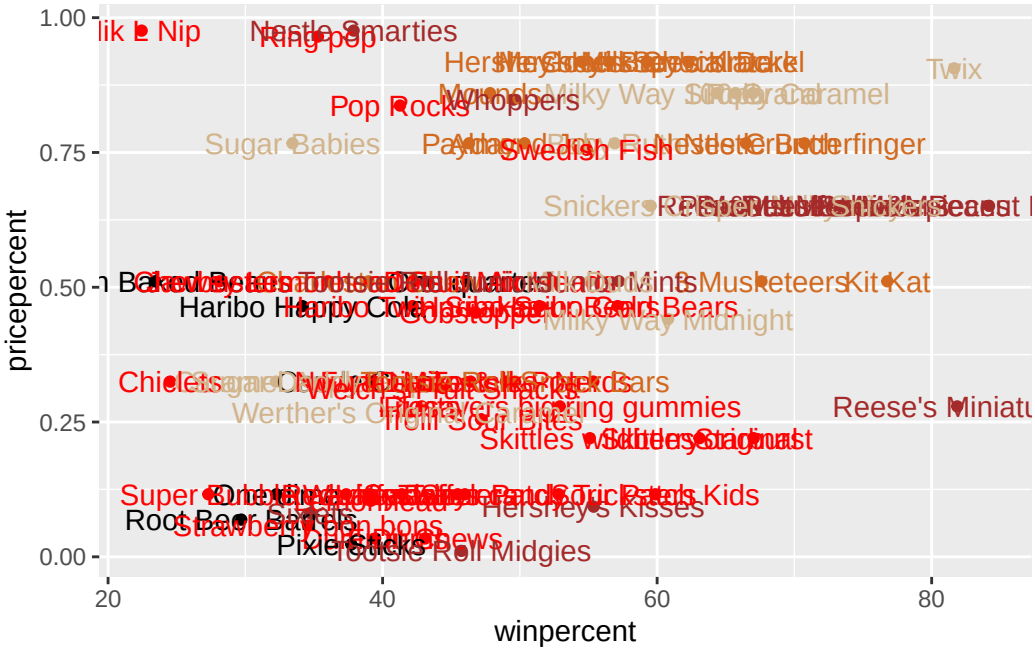


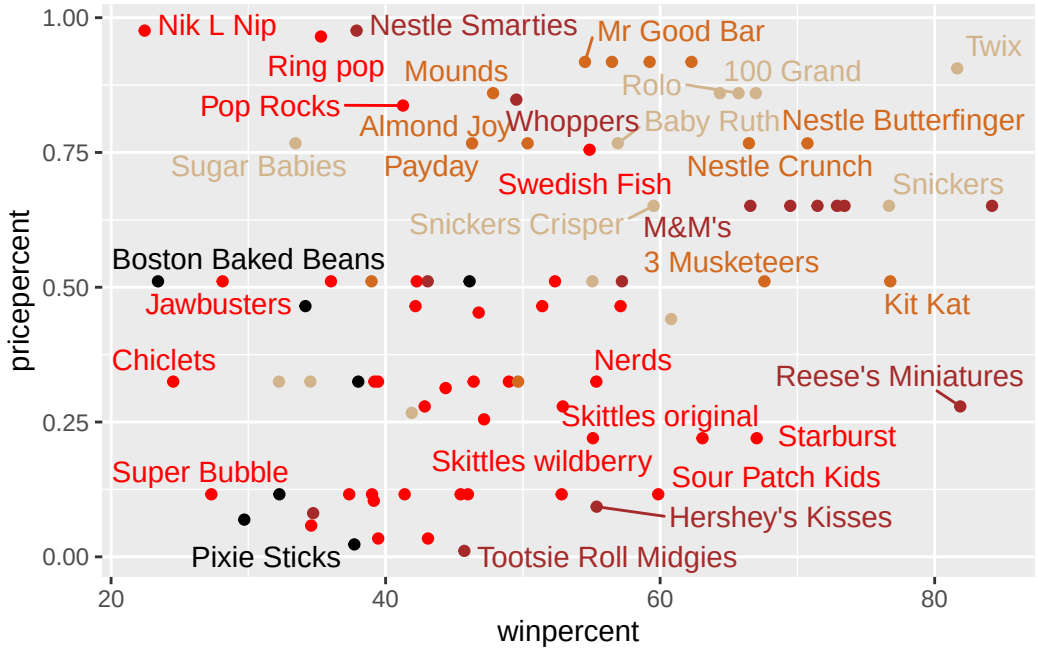
Figure 2: This is where you can put caption text



These labels suck so lets try making a new one using ggrepel.

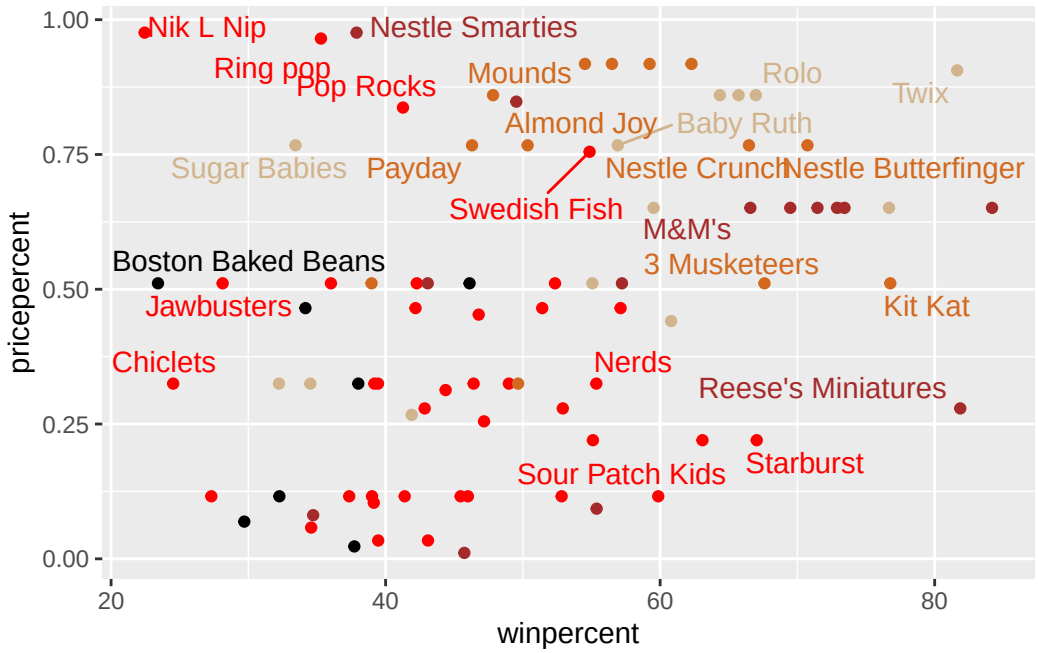
```
library(ggrepel)
ggplot(candy) +
  aes(winpercent, pricepercent, label =rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols)
```

```
Warning: ggrepel: 50 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```




```
library(ggrepel)
ggplot(candy) +
  aes(winpercent, pricepercent, label =rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, size = 4, max.overlaps = 8)
```

```
Warning: ggrepel: 61 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?

Reece's miniatures are the best bang for your buck. Highest win percent but still low pricepercent. However, using the code below, you would pick tootsie roll midgies.

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

```
                    pricepercent winpercent
Tootsie Roll Midgies        0.011   45.73675
Pixie Sticks                0.023   37.72234
Dum Dums                    0.034   39.46056
Fruit Chews                 0.034   43.08892
Strawberry bon bons         0.058   34.57899
```

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

```
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
```

##explore the correlation within the candy data.

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

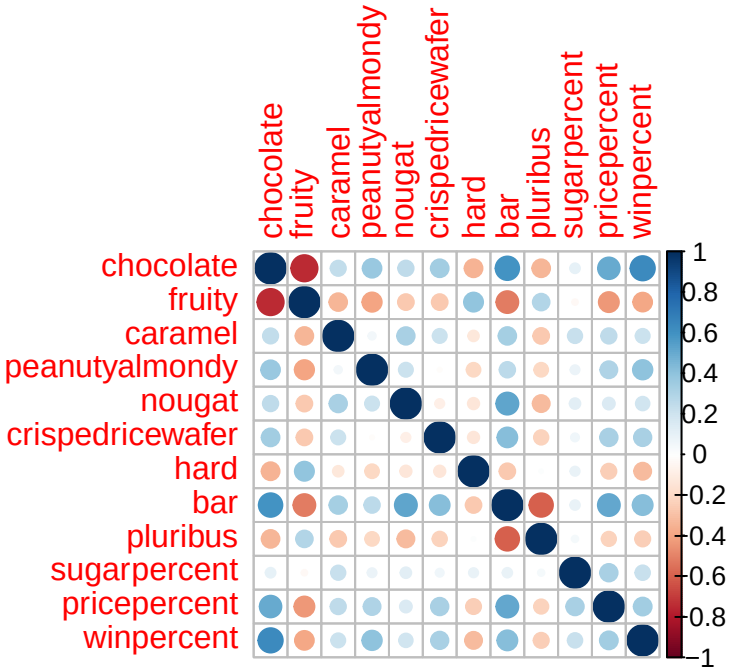
```
head(cij)
```

```
                  chocolate     fruity     caramel peanutyalmondy      nougat
chocolate         1.0000000 -0.7417211  0.24987535     0.37782357  0.25489183
fruity           -0.7417211  1.0000000 -0.33548538    -0.39928014 -0.26936712
caramel           0.2498753 -0.3354854  1.00000000     0.05935614  0.32849280
peanutyalmondy    0.3778236 -0.3992801  0.05935614     1.00000000  0.21311310
nougat            0.2548918 -0.2693671  0.32849280     0.21311310  1.00000000
crispedricewafer  0.3412098 -0.2693671  0.21311310    -0.01764631 -0.08974359
                  crispedricewafer       hard        bar   pluribus sugarpercent
chocolate              0.34120978 -0.3441769  0.5974211 -0.3396752   0.10416906
fruity                -0.26936712  0.3906775 -0.5150656  0.2997252  -0.03439296
caramel                0.21311310 -0.1223551  0.3339600 -0.2695850   0.22193335
peanutyalmondy        -0.01764631 -0.2055566  0.2604196 -0.2061093   0.08788927
nougat                -0.08974359 -0.1386750  0.5229764 -0.3103388   0.12308135
crispedricewafer       1.00000000 -0.1386750  0.4237509 -0.2246934   0.06994969
                  pricepercent winpercent
chocolate            0.5046754  0.6365167
fruity              -0.4309685 -0.3809381
caramel              0.2543271  0.2134163
peanutyalmondy       0.3091532  0.4061922
nougat               0.1531964  0.1993753
crispedricewafer     0.3282654  0.3246797
```

```
library(corrplot)
```

```
corrplot 0.92 loaded
```

```
corrplot(cij)
```



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

Chocolate and Fruity is anti-correlated. > Q23. Similarly, what two variables are most positively correlated?

Chocolate and winpercent or bar are positively correlated.

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

```
$names
[1] "sdev"     "rotation" "center"   "scale"    "x"

$class
[1] "prcomp"
```

```
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
```

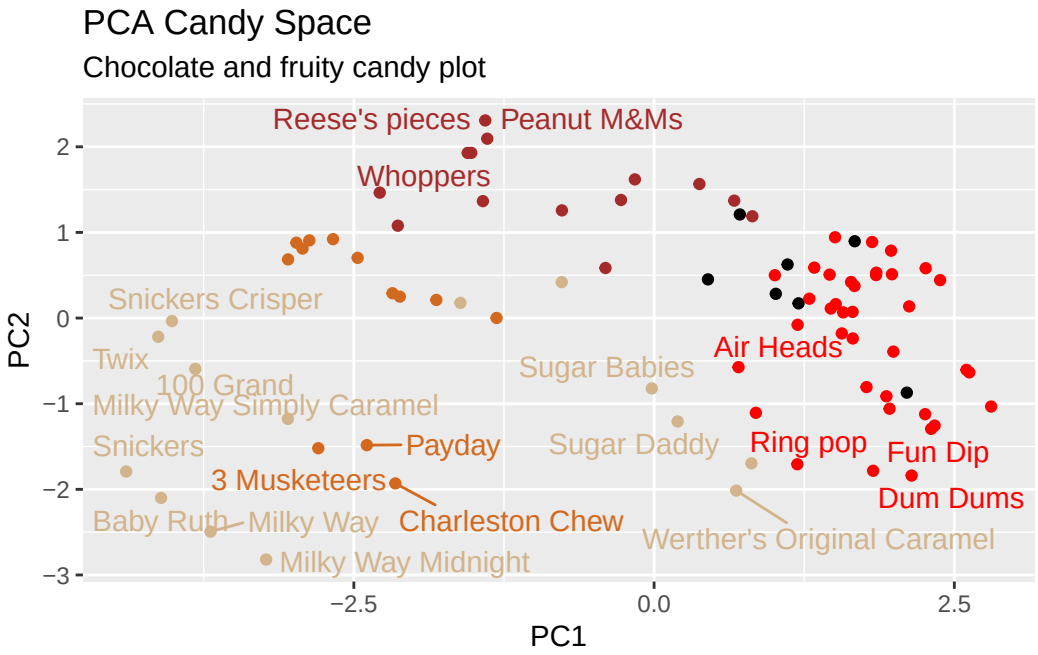
```
pc.score.results<- as.data.frame(pca$x)
head(pc.score.results)
```

```
                    PC1        PC2        PC3        PC4         PC5
100 Grand    -3.8198617 -0.5935788 -2.1863087 -2.3715957 -0.66236243
3 Musketeers -2.7960236 -1.5196062  1.4121986  0.6994387 -0.16006665
One dime      1.2025836  0.1718121  2.0607712 -1.2006782 -0.26977985
One quarter   0.4486538  0.4519736  1.4764928 -1.0017714 -0.05093737
Air Heads     0.7028992 -0.5731343 -0.9293893  0.4124566  0.33108524
Almond Joy   -2.4683383  0.7035501  0.8581089  0.5724974  1.43200435
                   PC6        PC7        PC8        PC9        PC10
100 Grand    -0.54521840 -0.1434056  0.5772242  0.3791482 -0.15409954
3 Musketeers  0.38258842  2.0215553 -1.5025750  0.0238327 -0.15523907
One dime      0.09495053 -0.7722007  0.1556221 -0.4539890 -0.94378362
One quarter   0.42835404 -0.5908920  0.3591344 -0.6388898  0.09557965
Air Heads     0.18879160  0.9680808  1.0123933 -1.3830122 -0.57372349
Almond Joy    1.02227348 -0.6660460  0.6082613 -0.1390599 -0.31277870
                   PC11        PC12
100 Grand     0.1419038  0.06469883
3 Musketeers -0.5179272 -0.18394717
One dime     -0.5158708 -0.51074779
One quarter  -0.9867194 -0.95827191
Air Heads    -0.5144537  0.04429924
Almond Joy    1.0611487  0.18893471
```

```
ggplot(pc.score.results) +
  aes(PC1,PC2, label =rownames(pc.score.results))+
  geom_point(col = my_cols)+
  geom_text_repel(col = my_cols, max.overlaps = 8)+
  labs(title="PCA Candy Space",
```

```
        subtitle = "Chocolate and fruity candy plot")
```

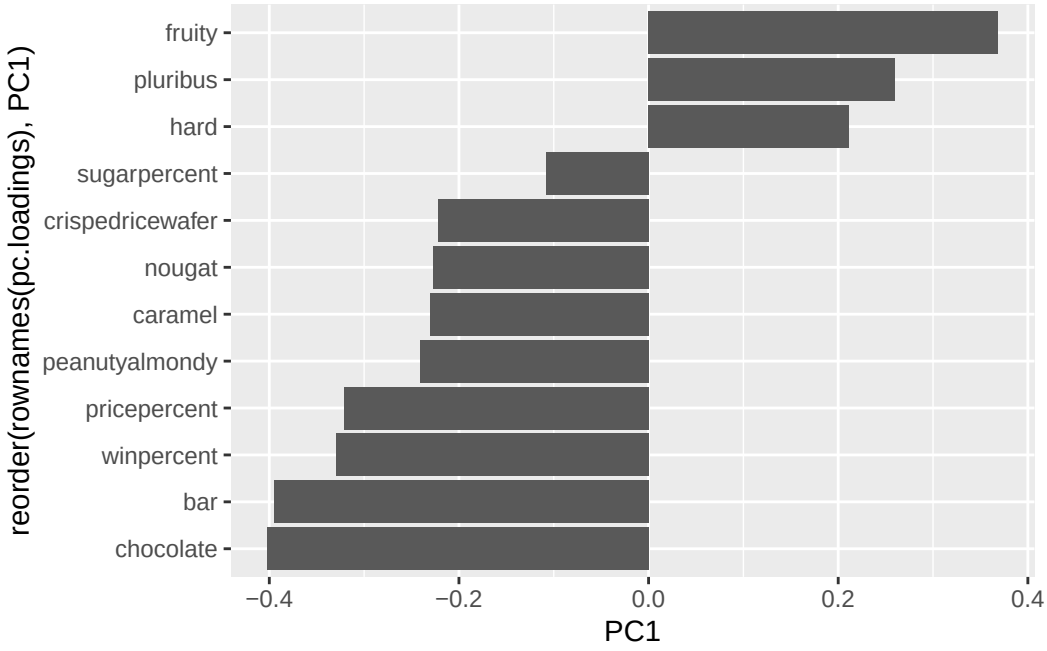
```
Warning: ggrepel: 64 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



#Loading plots

```
pc.loadings <-as.data.frame(pca$rotation)

ggplot(pc.loadings) +
  aes(PC1, reorder(rownames(pc.loadings),PC1)) +
  geom_col()
```



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

Fruit, pluribus, and hard are all correlated together (right half) vs Chocolate and the other factors (left half) are correlated with the most correlated from bottom up.