Class 9

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Importing candy data

```
candy_file <- read.csv("candy-data.txt", 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
```

> Q how many chocolate candy types are in the data set?

37 of the candies are chocolate

```
length(grep('1', candy_file$chocolate))
```

```
[1] 37
```

> Q how many fruity candy types are in the data set?

38 of the candies are fruity

```
length(grep('1', candy_file$fruity))
```

```
[1] 38
```

> Q how many total candy?

85 different types of candies

```
nrow(candy_file)
```

```
[1] 85
```

> Q how many variables/dimesnsions are there

there are 12 different variables/candy types

```
ncol(candy_file)
```

```
[1] 12
```

Data exploration using the package skimr

calling only one function from a package

```
#library(skimr)

skimr::skim(candy_file)
```

Table 1: Data summary

Name	candy_file
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	

What is your favorite candy

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

```r
candy_file['Baby Ruth',]$winpercent
```

```
[1] 56.91455
```

Q What are the 5 least liked candies

```r
inds <- order(candy_file$winpercent)

head(candy_file[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"?

```r
candy_file['Kit Kat',]$winpercent
```

```
[1] 76.7686
```

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

```r
candy_file['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 winpercent column of the data set is on a diffenet scale than the rest of the data set

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

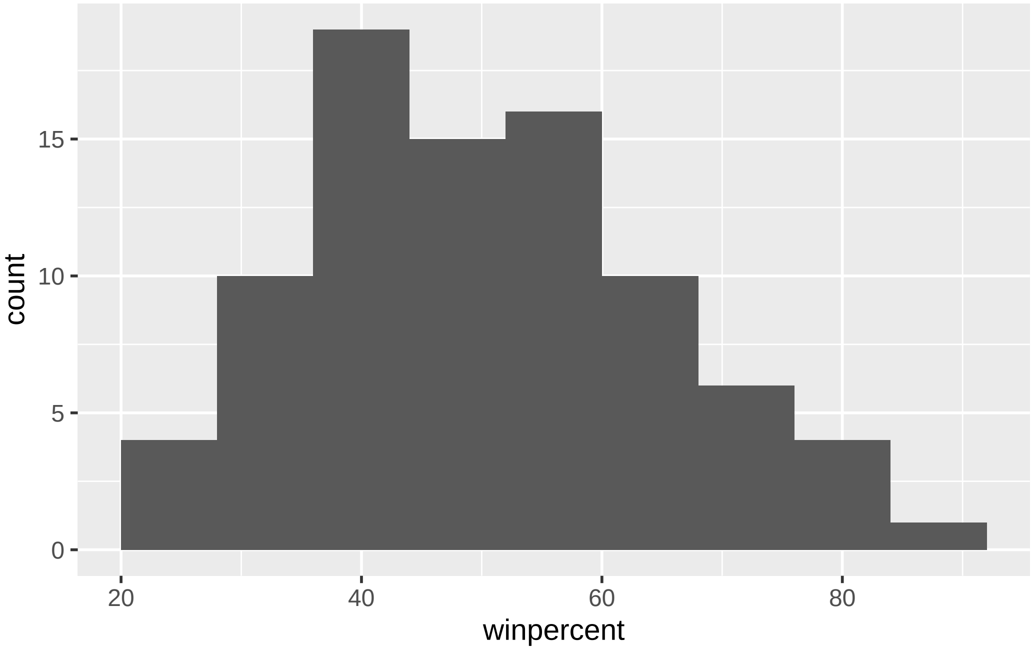
The zero means that the candy was not chosen and the 1 represents that the candy was chosen based on the randomly generated candy matchups

> Q8. Plot a histogram of winpercent values

```r
library(ggplot2)
```

```
Warning: package 'ggplot2' was built under R version 4.2.3
```

```r
ggplot(candy_file, aes(winpercent)) +
  geom_histogram(binwidth = 8)
```



Q9. Is the distribution of winpercent values symmetrical?

the distribution is not symetrical, it is left skewed >Q10. Is the center of the distribution above or below 50%?

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

-find all chocolate cady (subset) -get the winpercent values -summarice these values into on metric (mean)

```r
choc <- subset(candy_file$winpercent, candy_file$chocolate==1)
mean(choc)
```

```
[1] 60.92153
```

```r
fruity <- subset(candy_file$winpercent, candy_file$fruity==1)
mean(fruity)
```

```
[1] 44.11974
```

```r
t.test(choc,fruity)
```

```

	Welch Two Sample t-test

data:  choc and fruity
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 differnece is statistacally significant with a p-value of 2.87e-08

Overall Candy Rankings

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

```r
inds <- order(candy_file$winpercent)

head(candy_file[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?

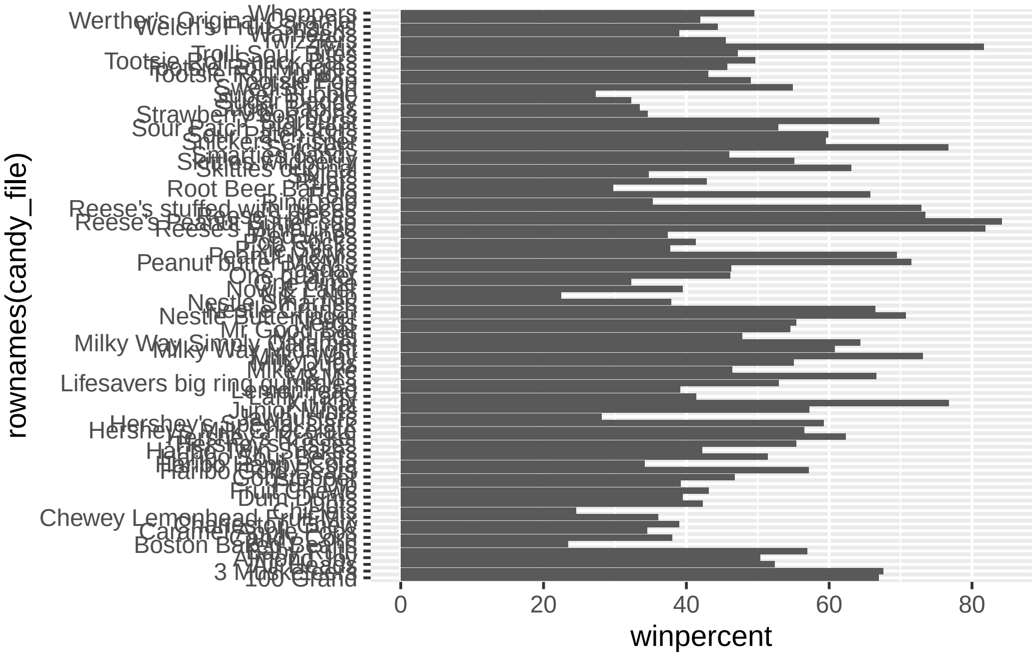
```
inds <- order(candy_file$winpercent)

tail(candy_file[inds,])
```

```
                          chocolate fruity caramel peanutyalmondy nougat
Reese's pieces                    1      0       0              1      0
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
Reese's pieces                           0    0   0        1        0.406
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
Reese's pieces                   0.651   73.43499
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.

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



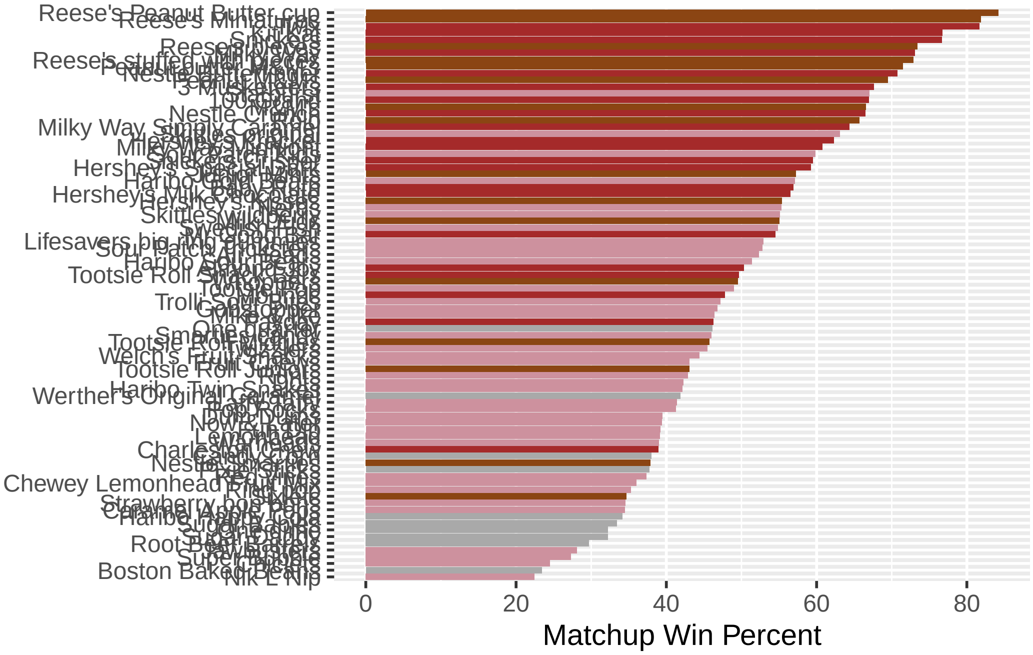
Q16. This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

creating color vector to color the graph based on the type of candies

```
my_cols=rep('darkgrey', nrow(candy_file))
my_cols[as.logical(candy_file$chocolate)] = "chocolate4"
my_cols[as.logical(candy_file$bar)] = "brown"
my_cols[as.logical(candy_file$fruity)] = "pink3"
```

plot was saved because the aspect ratio was bad for readability

```
ggplot(candy_file, aes(winpercent, reorder(rownames(candy_file),winpercent))) +
  geom_col(fill=my_cols) +
  labs(x='Matchup Win Percent', y=NULL)
```



```r
ggsave('barplot.png', height=10, width=7)
```

how to insert any image caption text can go in the square brackets adding a {} bracket with #fig, a hyperlink will be added with a link to the graph

Q17. What is the worst ranked chocolate candy?

Sixlets

Q18. What is the best ranked fruity candy?

Nik L Nip

Taking a look at pricepoint

```r
ggplot(candy_file, aes(x=winpercent, y=pricepercent, label=rownames(candy_file)))+
  geom_point(col=my_cols) +
  geom_text(col=my_cols)
```

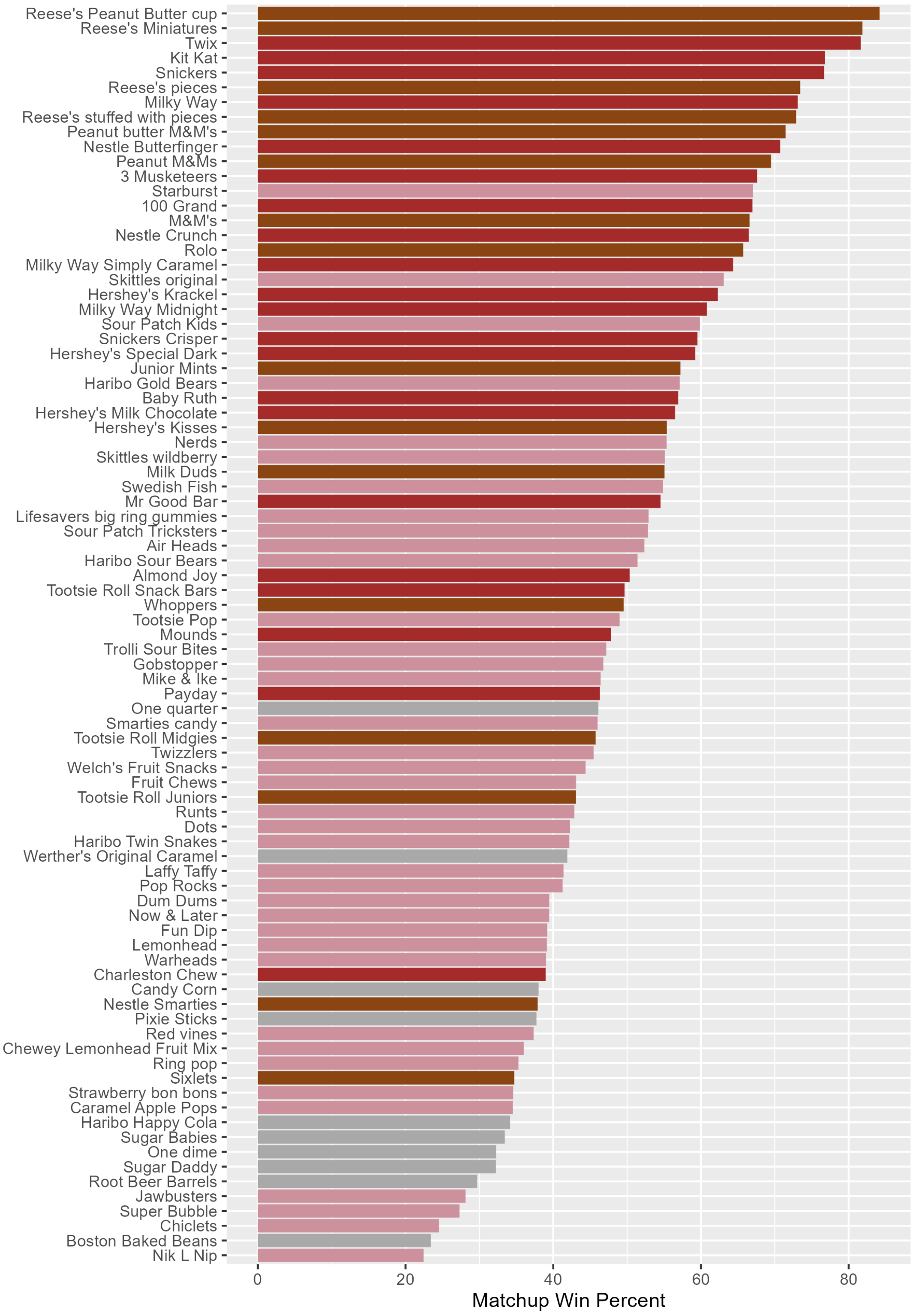
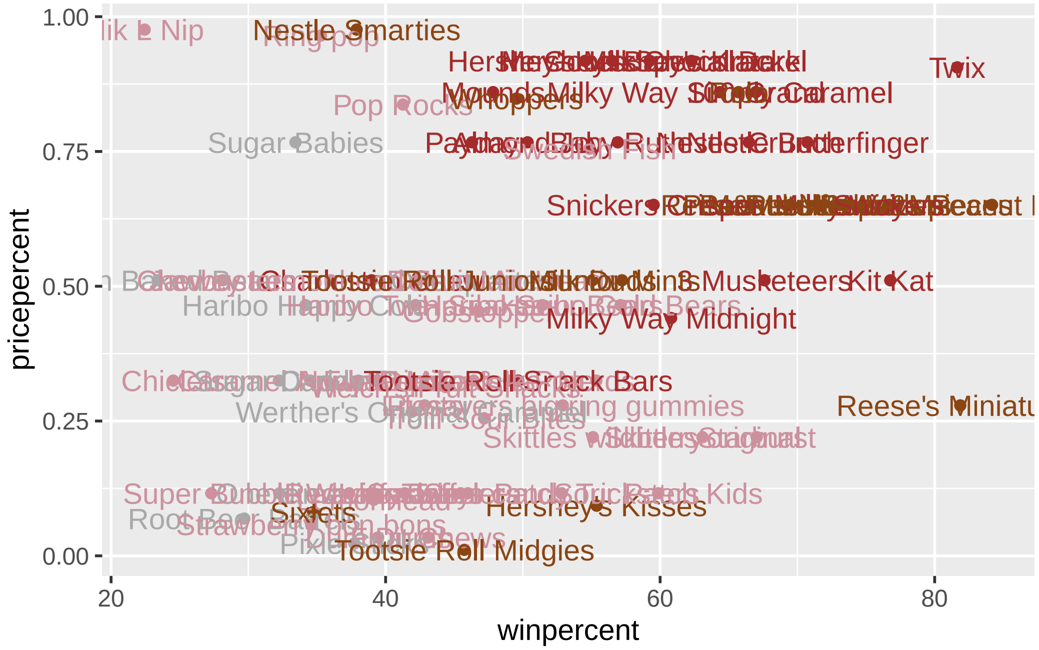


Figure 1: win percentage



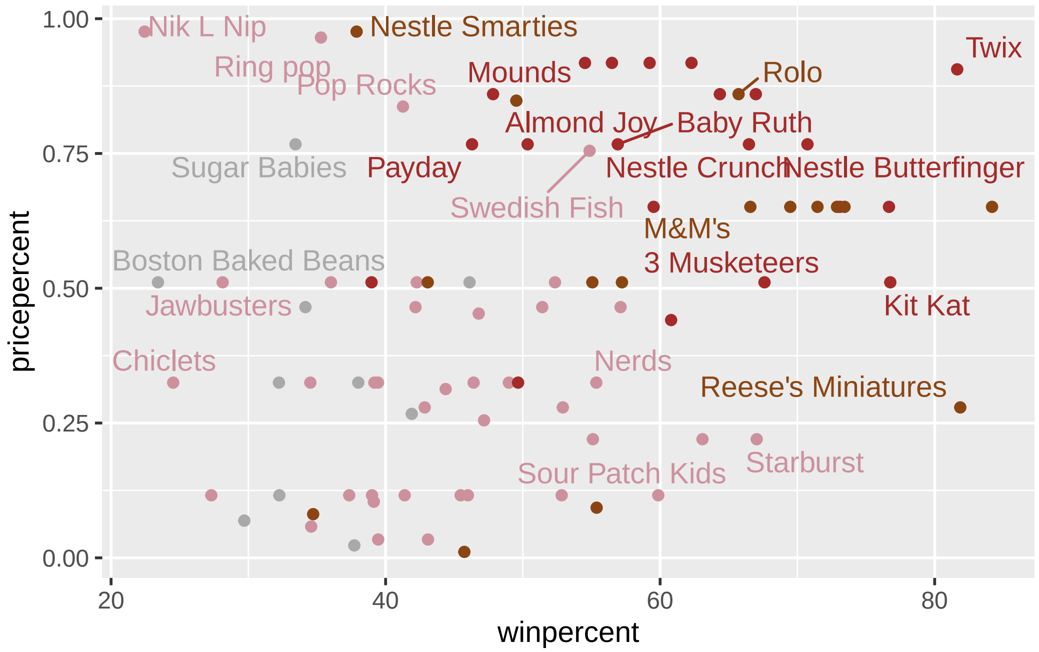
ggrepel package can be used to make point lables look nicer, geom_text will put in the labels but doesn't account for overlap

```
library(ggrepel)
```

```
Warning: package 'ggrepel' was built under R version 4.2.3
```

```
ggplot(candy_file, aes(x=winpercent, y=pricepercent, label=rownames(candy_file)))+
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, 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?

Reese’s miniatures

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

The least popular is the Nik L Nip

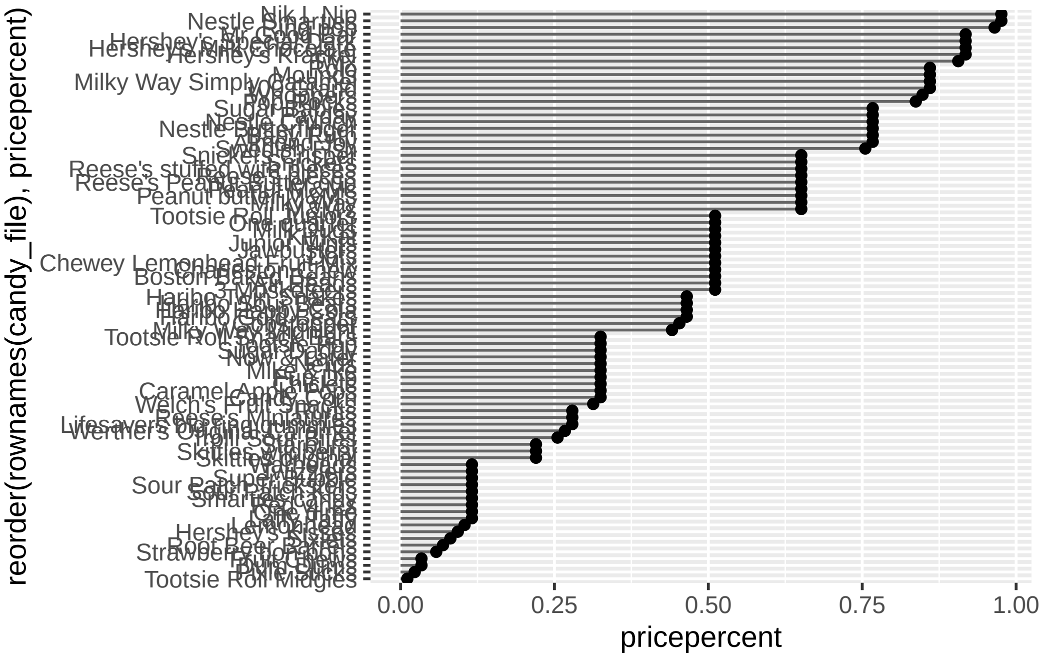
```
inds2 <- order(candy_file$pricepercent, decreasing=TRUE)

head(candy_file[inds2,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
```

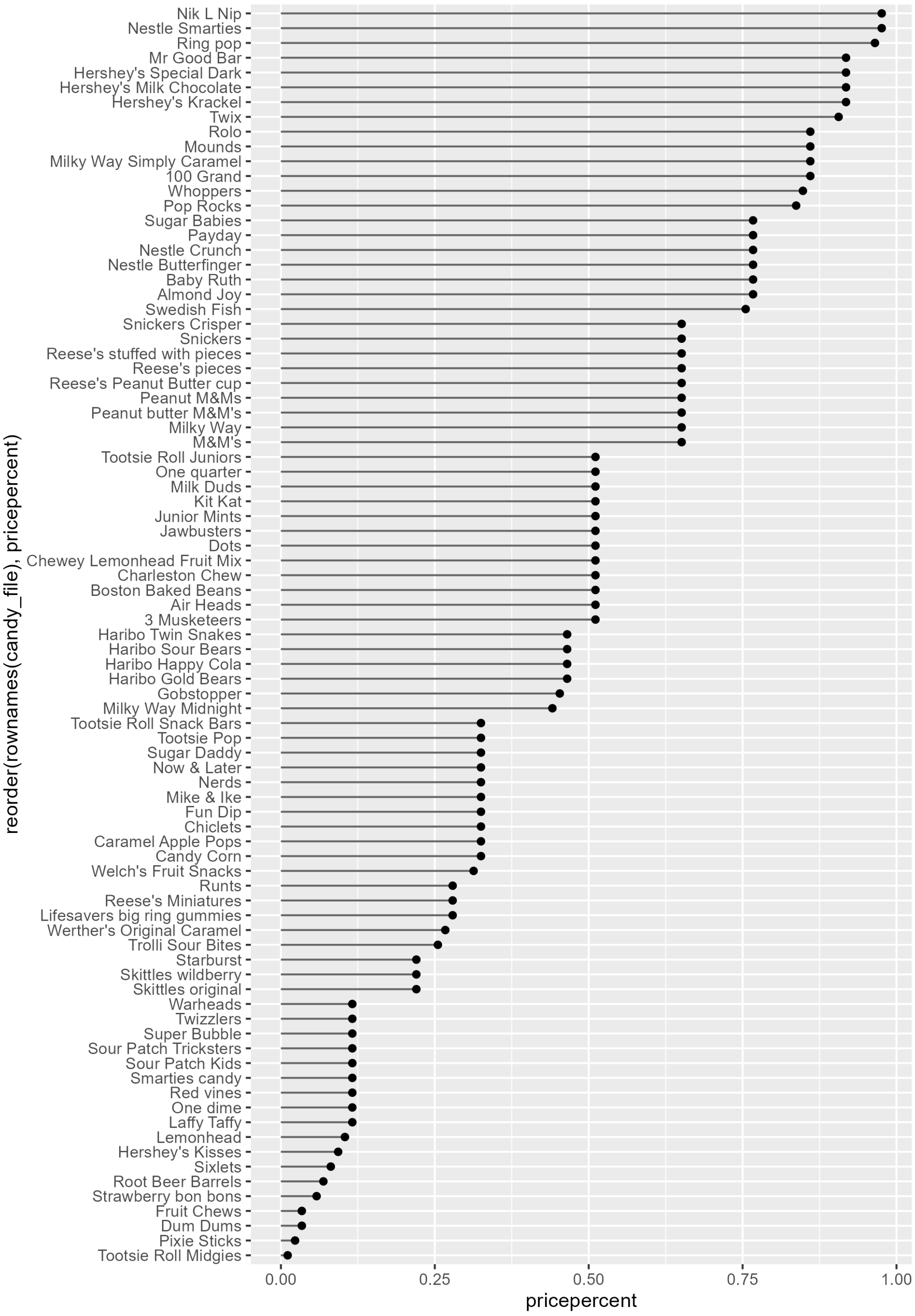
Q21. Make a barplot again with geom_col() this time using pricepercent and then improve this step by step, first ordering the x-axis by value and finally making a so called “dot chat” or “lollipop” chart by swapping geom_col() for geom_point() + geom_segment().

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



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

Because aspect ratio makes seeing the graph dificult, the plot is loaded in as an image


Nik L Nip
Nestle Smarties
Ring pop
Mr Good Bar
Hershey's Special Dark
Hershey's Milk Chocolate
Hershey's Krackel
Twix
Rolo
Mounds
Milky Way Simply Caramel
100 Grand
Whoppers
Pop Rocks
Sugar Babies
Payday
Nestle Crunch
Nestle Butterfinger
Baby Ruth
Almond Joy
Swedish Fish
Snickers Crisper
Snickers
Reese's stuffed with pieces
Reese's pieces
Reese's Peanut Butter cup
Peanut M&Ms
Peanut butter M&M's
Milky Way
M&M's
Tootsie Roll Juniors
One quarter
Milk Duds
Kit Kat
Junior Mints
Jawbusters
Dots
Chewey Lemonhead Fruit Mix
Charleston Chew
Boston Baked Beans
Air Heads
3 Musketeers
Haribo Twin Snakes
Haribo Sour Bears
Haribo Happy Cola
Haribo Gold Bears
Gobstopper
Milky Way Midnight
Tootsie Roll Snack Bars
Tootsie Pop
Sugar Daddy
Now & Later
Nerds
Mike & Ike
Fun Dip
Chiclets
Caramel Apple Pops
Candy Corn
Welch's Fruit Snacks
Runts
Reese's Miniatures
Lifesavers big ring gummies
Werther's Original Caramel
Trolli Sour Bites
Starburst
Skittles wildberry
Skittles original
Warheads
Twizzlers
Super Bubble
Sour Patch Tricksters
Sour Patch Kids
Smarties candy
Red vines
One dime
Laffy Taffy
Lemonhead
Hershey's Kisses
Sixlets
Root Beer Barrels
Strawberry bon bons
Fruit Chews
Dum Dums
Pixie Sticks
Tootsie Roll Midgies
reorder(rownames(candy_file), pricepercent)
0.00
0.25
0.50
0.75
1.00
pricepercent

Exploring Correlation

```r
library(corrplot)
```

```
Warning: package 'corrplot' was built under R version 4.2.2
```

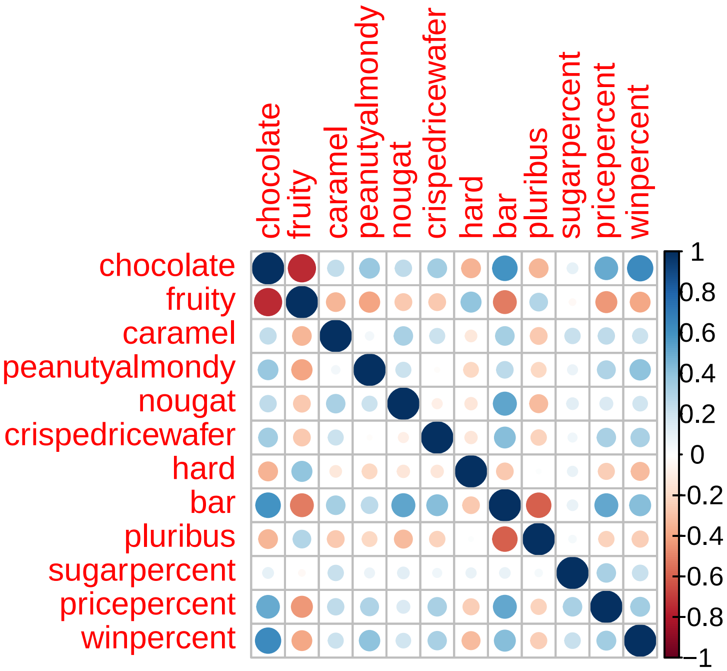
```
corrplot 0.92 loaded
```

```r
cij <- cor(candy_file)
```

```r
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
```

```r
corrplot(cij)
```



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

Chocolate and fruity are negatively correlated

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

chocolate highly correlates with bar and winpercent

PCA

PCA needs to be scaled - scale=TRUE

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

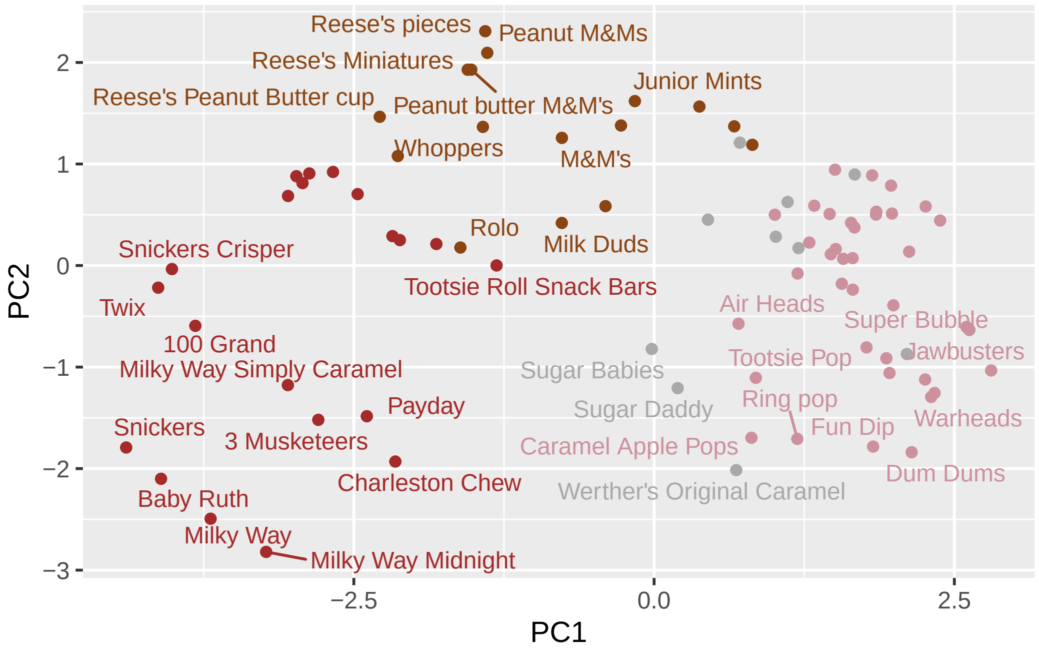
```
Importance of components:
                          PC1    PC2    PC3     PC4    PC5     PC6     PC7
Standard deviation     2.0788 1.1378 1.1092 1.07533 0.9518 0.81923 0.81530
Proportion of Variance 0.3601 0.1079 0.1025 0.09636 0.0755 0.05593 0.05539
Cumulative Proportion  0.3601 0.4680 0.5705 0.66688 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_result <- as.data.frame(pca$x)
```

```
ggplot(pca_result, aes(x=PC1,y=PC2,label=rownames(pca_result)))+
  geom_point(col=my_cols)+
  geom_text_repel(col=my_cols, max.overlaps = 7, size=3)
```

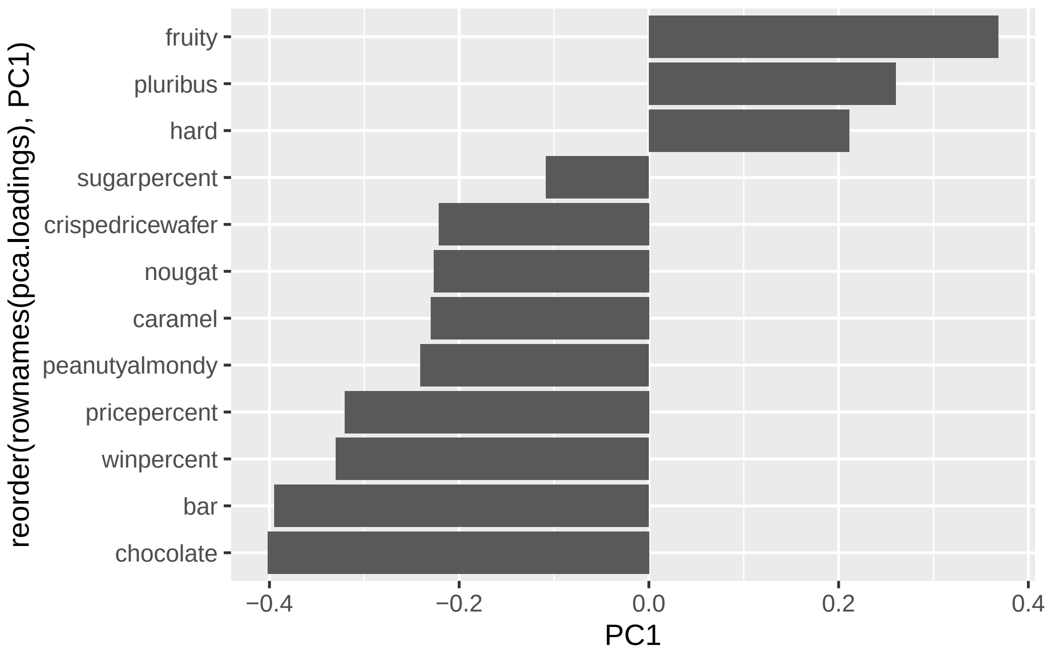
```
Warning: ggrepel: 51 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Loadings plot

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

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



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

The positive direction mostly picked up the fruity, pluribus, and hard candies. This makes sense because these three characteristics are commonly found together within fruity flavored candies