Class 9: Halloween Mini-Project

Raquel Gonzalez (A16207442)

Here we analyze a candy dataset from the 538 website. This is a CSV file from their GitHub repository.

Data Import

```r
candy <- read.csv("candy-data.csv", 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?

```r
nrow(candy)
```

```
[1] 85
```

There are 85 different candy types in this dataset

> Q2: How many fruity candy types are in the dataset?

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

```
[1] 38
```

There are 38 fruity candy types in the dataset.

Data Exploration

> Q3: What is your favorite candy in the dataset and what is its `winpercent` value?

```r
candy["Sour Patch Kids",]$winpercent
```

```
[1] 59.864
```

My favorite candy is Sour Patch Kids. Its win percent is 59.86%.

> Q4: What is the `winpercent` value for "Kit Kat"

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

```
[1] 76.7686
```

The win percent for Kit Kat is 76.77%

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

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

```
[1] 49.6535
```

The win percent for Tootsie Roll Snack Bars is 49.65%

> Q: What is the least liked candy in the dataset - lowest winpercent?

```
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
```

The least liked candy is Nik L Nip with a win percent of 22.45%

```
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?

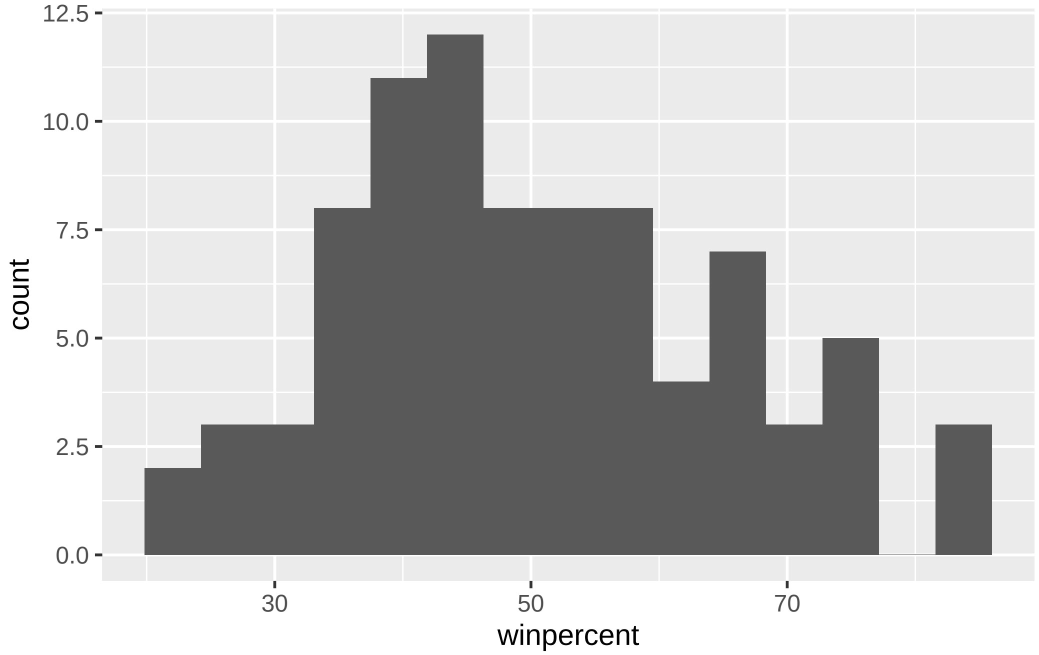
The row `winpercent` looks to be on a different scale (much larger) to the majority of the other columns in the dataset.

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

Zero and One represent True/False values. The candy gets a zero if it is not chocolate (false) and a one if it is chocolate (true).

> Q8: Plot a histogram of winpercent values

```r
library(ggplot2)
ggplot(candy, aes(winpercent)) +
  geom_histogram(bins = 15)
```



Q9: Is the distribution of win percent values symmetrical?

The distribution of win percent values is skewed.

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

The center of distribution is below 50%

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

First, find all chocolate candy and their $winpercent values.

Next, summarize these values into one number.

Then, do the same for fruity candy and compare the numbers.

```
mean(candy$winpercent[as.logical(candy$chocolate)])
```

```
[1] 60.92153
```

```
mean(candy$winpercent[as.logical(candy$fruity)])
```

```
[1] 44.11974
```

On average, chocolate candy is ranked higher than fruity candy (60.92% > 44.12%).

> Q12: Is this difference statistically significant?

```r
t.test(candy$winpercent[as.logical(candy$chocolate)],candy$winpercent[as.logical(candy$fru
```

```
	Welch Two Sample t-test

data:  candy$winpercent[as.logical(candy$chocolate)] and candy$winpercent[as.logical(candy$fr
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 
```

These results are statistically 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
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
```

```r
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 top 5 least liked candies are Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, and Jawbusters.

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

```r
candy %>%
  arrange(winpercent) %>%
  tail(5)
```

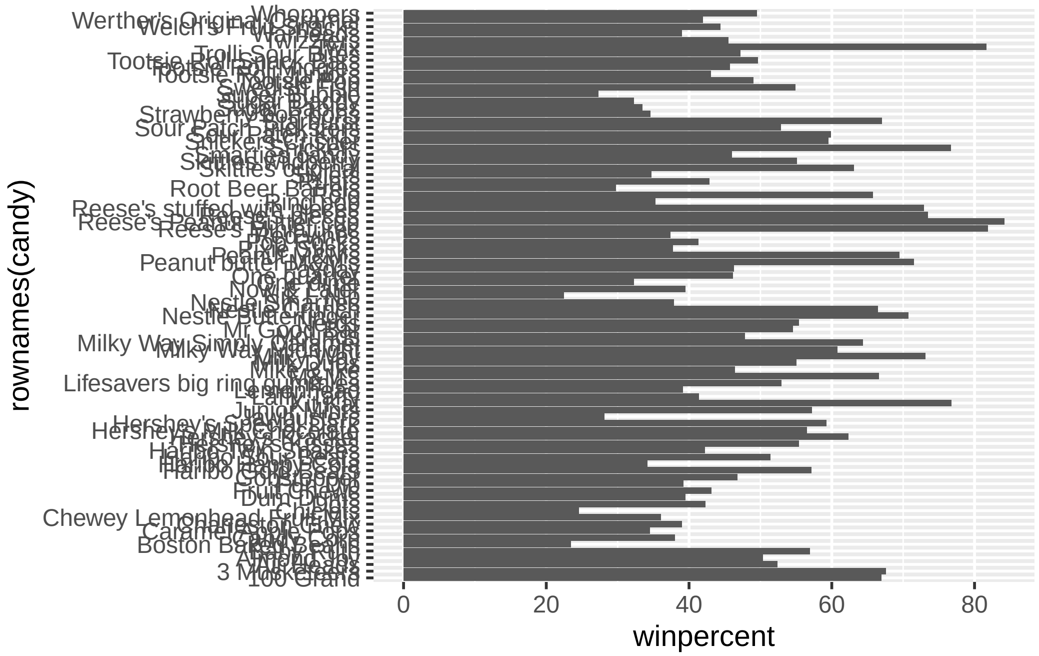
```
                          chocolate fruity caramel peanutyalmondy nougat
Snickers                          1      0       1              1      1
Kit Kat                           1      0       0              0      0
Twix                              1      0       1              0      0
Reese's 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
```

The top 5 all time favorite candy types are Reese's Peanut Butter Cup, Reese's Miniatures, Twix, Kit Kat, and Snickers.

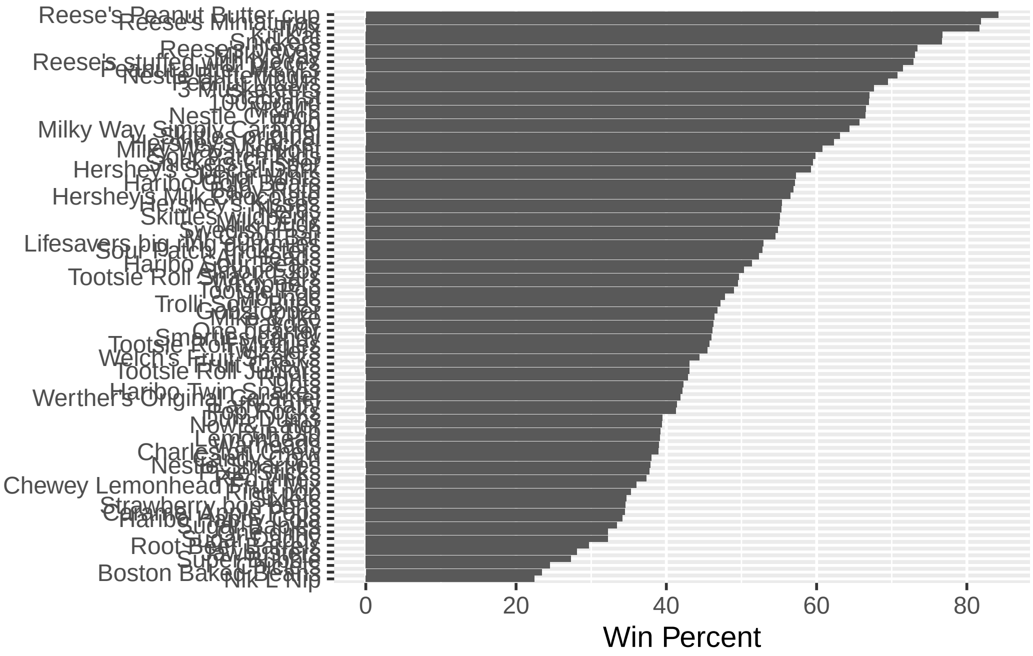
> Q15: Make a first barplot of candy ranking based on winpercent values.

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

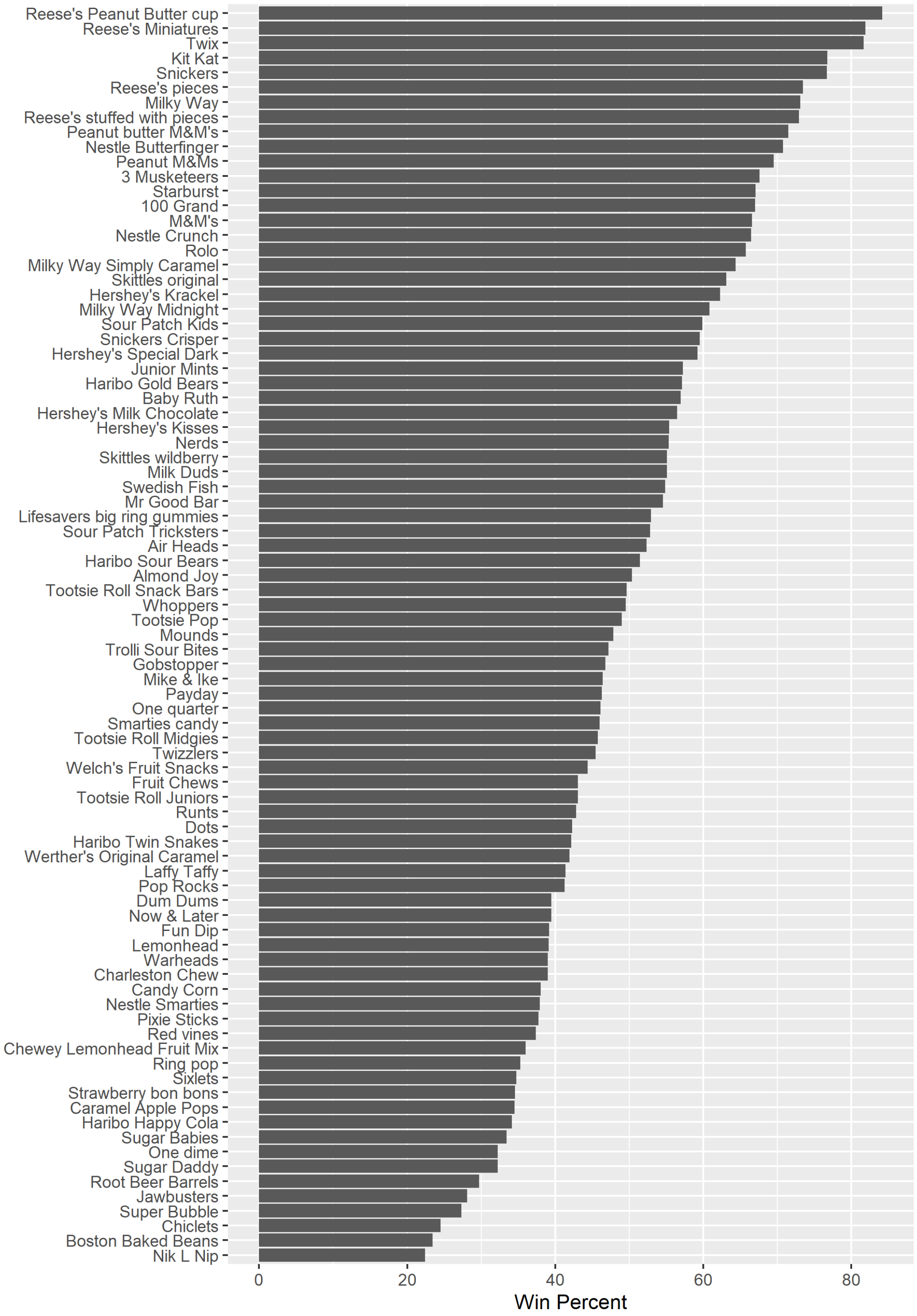


> Q16: This is very ugly, use the `reorder()` function to get the bars sorted by `winpercent`?

```r
ggplot(candy, aes(winpercent, reorder(rownames(candy), winpercent))) +
  geom_col() +
  labs(x = "Win Percent", y = NULL)
```



```r
# Still ugly. Can we adjust the labels so we can read them better?
ggsave('barplot1.png', width = 7, height = 10)
```

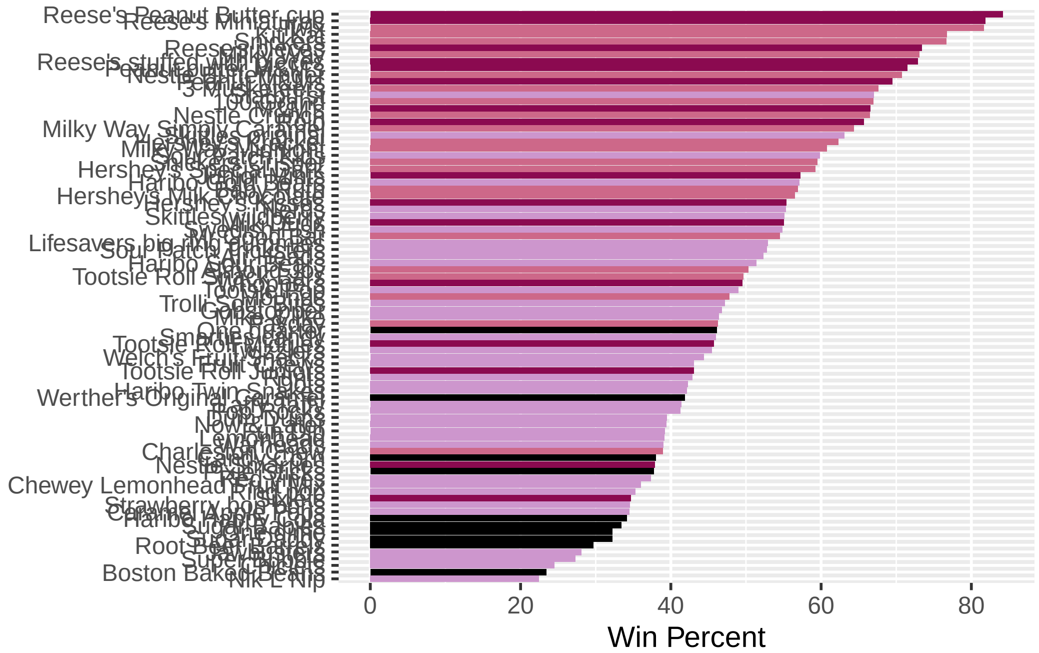

Reese's Peanut Butter cup
Reese's Miniatures
Twix
Kit Kat
Snickers
Reese's pieces
Milky Way
Reese's stuffed with pieces
Peanut butter M&M's
Nestle Butterfinger
Peanut M&Ms
3 Musketeers
Starburst
100 Grand
M&M's
Nestle Crunch
Rolo
Milky Way Simply Caramel
Skittles original
Hershey's Krackel
Milky Way Midnight
Sour Patch Kids
Snickers Crisper
Hershey's Special Dark
Junior Mints
Haribo Gold Bears
Baby Ruth
Hershey's Milk Chocolate
Hershey's Kisses
Nerds
Skittles wildberry
Milk Duds
Swedish Fish
Mr Good Bar
Lifesavers big ring gummies
Sour Patch Tricksters
Air Heads
Haribo Sour Bears
Almond Joy
Tootsie Roll Snack Bars
Whoppers
Tootsie Pop
Mounds
Trolli Sour Bites
Gobstopper
Mike & Ike
Payday
One quarter
Smarties candy
Tootsie Roll Midgies
Twizzlers
Welch's Fruit Snacks
Fruit Chews
Tootsie Roll Juniors
Runts
Dots
Haribo Twin Snakes
Werther's Original Caramel
Laffy Taffy
Pop Rocks
Dum Dums
Now & Later
Fun Dip
Lemonhead
Warheads
Charleston Chew
Candy Corn
Nestle Smarties
Pixie Sticks
Red vines
Chewey Lemonhead Fruit Mix
Ring pop
Sixlets
Strawberry bon bons
Caramel Apple Pops
Haribo Happy Cola
Sugar Babies
One dime
Sugar Daddy
Root Beer Barrels
Jawbusters
Super Bubble
Chiclets
Boston Baked Beans
Nik L Nip
0
20
40
60
80
Win Percent

You can insert any image using this markdown syntax. `![](barplot1.png)`

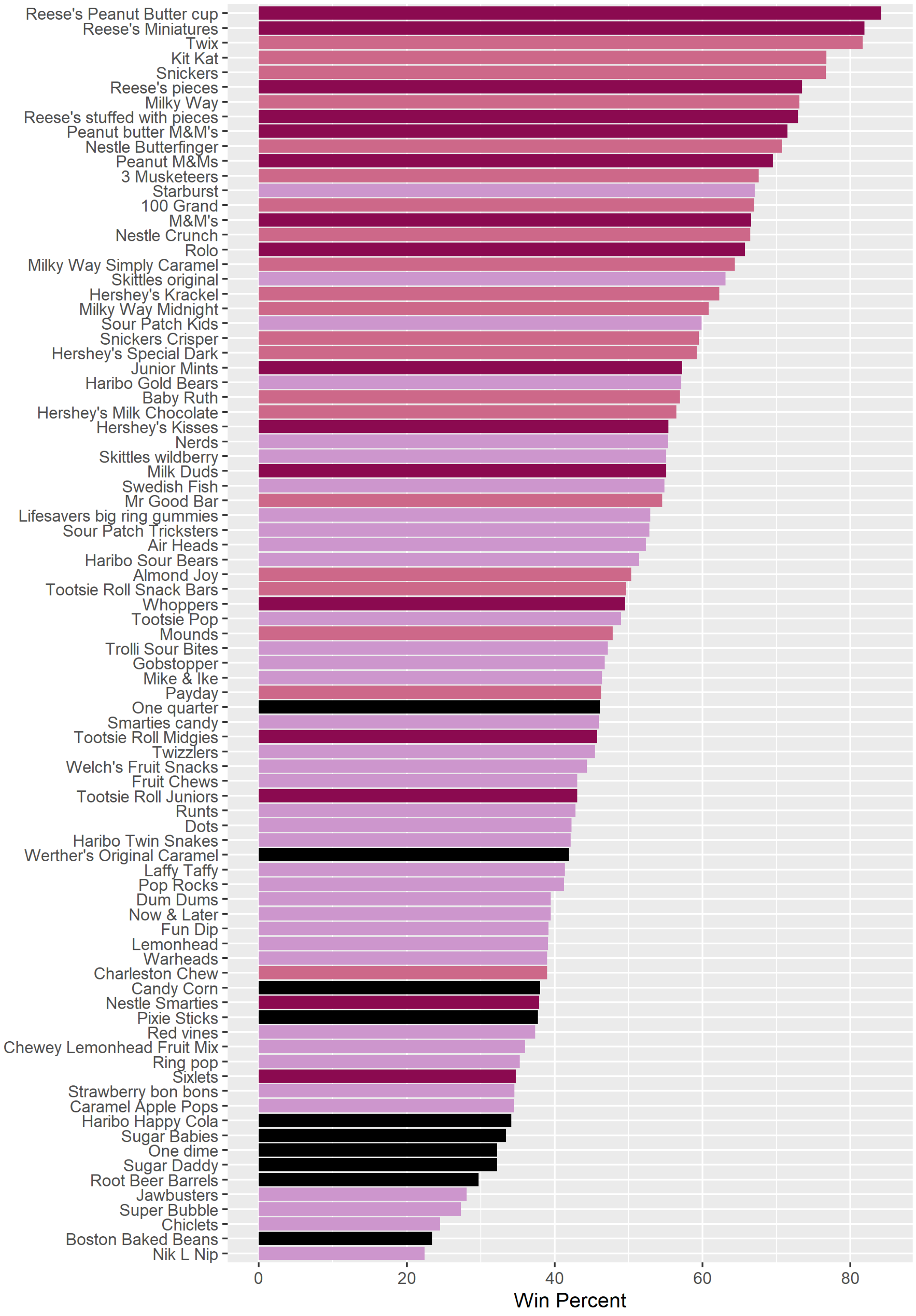
Now let's add color to our ggplot. We need to make a custom color vector.

```
# Start with an all black vector of colors.
my_cols <- rep("black", nrow(candy))
my_cols[as.logical(candy$chocolate)] = "deeppink4"
my_cols[as.logical(candy$bar)] = "palevioletred3"
my_cols[as.logical(candy$fruity)] = "plum3"
```

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



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


Reese's Peanut Butter cup
Reese's Miniatures
Twix
Kit Kat
Snickers
Reese's pieces
Milky Way
Reese's stuffed with pieces
Peanut butter M&M's
Nestle Butterfinger
Peanut M&Ms
3 Musketeers
Starburst
100 Grand
M&M's
Nestle Crunch
Rolo
Milky Way Simply Caramel
Skittles original
Hershey's Krackel
Milky Way Midnight
Sour Patch Kids
Snickers Crisper
Hershey's Special Dark
Junior Mints
Haribo Gold Bears
Baby Ruth
Hershey's Milk Chocolate
Hershey's Kisses
Nerds
Skittles wildberry
Milk Duds
Swedish Fish
Mr Good Bar
Lifesavers big ring gummies
Sour Patch Tricksters
Air Heads
Haribo Sour Bears
Almond Joy
Tootsie Roll Snack Bars
Whoppers
Tootsie Pop
Mounds
Trolli Sour Bites
Gobstopper
Mike & Ike
Payday
One quarter
Smarties candy
Tootsie Roll Midgies
Twizzlers
Welch's Fruit Snacks
Fruit Chews
Tootsie Roll Juniors
Runts
Dots
Haribo Twin Snakes
Werther's Original Caramel
Laffy Taffy
Pop Rocks
Dum Dums
Now & Later
Fun Dip
Lemonhead
Warheads
Charleston Chew
Candy Corn
Nestle Smarties
Pixie Sticks
Red vines
Chewey Lemonhead Fruit Mix
Ring pop
Sixlets
Strawberry bon bons
Caramel Apple Pops
Haribo Happy Cola
Sugar Babies
One dime
Sugar Daddy
Root Beer Barrels
Jawbusters
Super Bubble
Chiclets
Boston Baked Beans
Nik L Nip
0
20
40
60
80
Win Percent

> Q17: What is the worst ranked chocolate candy?

The worst ranked chocolate candy is Sixlets.

> Q18: What is the best ranked fruity candy?

The best ranked fruity candy is Starburst.

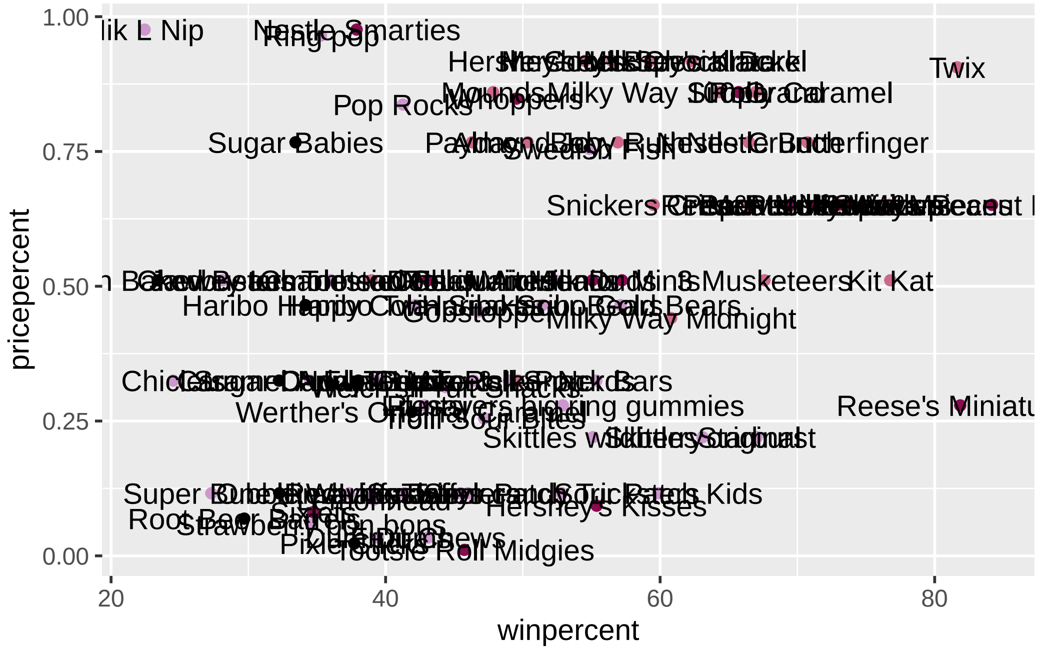
Taking a look at pricepercent

```
candy$pricepercent
```

```
 [1] 0.860 0.511 0.116 0.511 0.511 0.767 0.767 0.511 0.325 0.325 0.511 0.511
[13] 0.325 0.511 0.034 0.034 0.325 0.453 0.465 0.465 0.465 0.465 0.093 0.918
[25] 0.918 0.918 0.511 0.511 0.511 0.116 0.104 0.279 0.651 0.651 0.325 0.511
[37] 0.651 0.441 0.860 0.860 0.918 0.325 0.767 0.767 0.976 0.325 0.767 0.651
[49] 0.023 0.837 0.116 0.279 0.651 0.651 0.651 0.965 0.860 0.069 0.279 0.081
[61] 0.220 0.220 0.976 0.116 0.651 0.651 0.116 0.116 0.220 0.058 0.767 0.325
[73] 0.116 0.755 0.325 0.511 0.011 0.325 0.255 0.906 0.116 0.116 0.313 0.267
[85] 0.848
```

if we want to see what is a good candy to buy in terms of winpercent and pricepercent, we can plot these two variables and then see the best candy for the least amount of money.

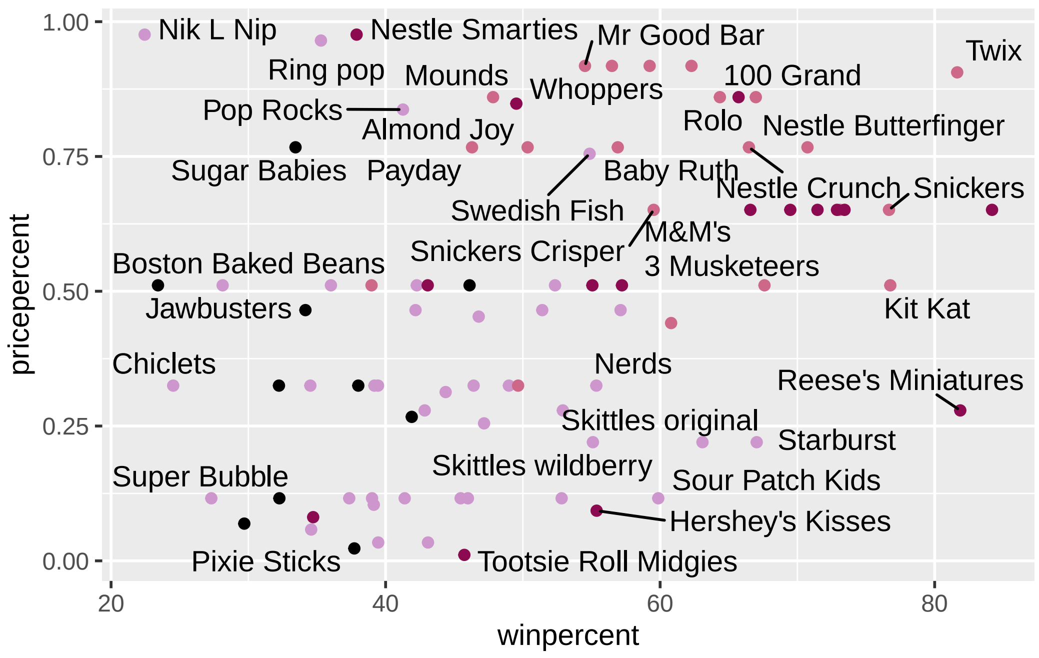
```
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text()
```



To avoid the overplotting of all these labels we can use an add on package called ggrepl.

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

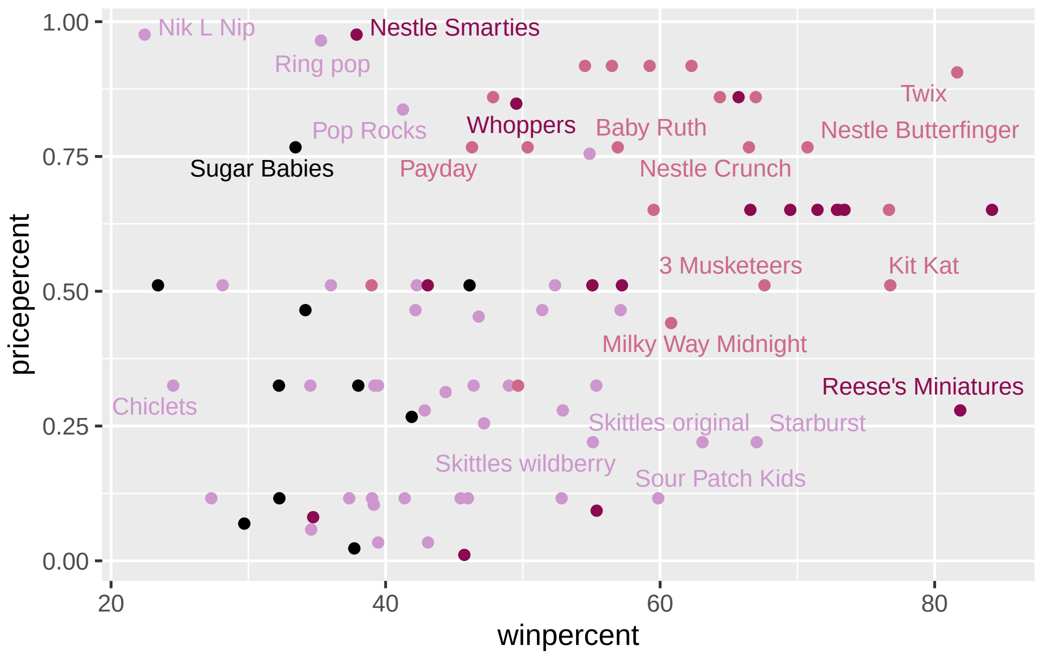
```
Warning: ggrepel: 50 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Play with the `max.overlaps` parameter on `geom_text_repel`.

```
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(max.overlaps=5, col=my_cols, size = 3.3)
```

```
Warning: ggrepel: 65 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 have the highest `winpercent` for the lowest `pricepercent`.

> 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
```

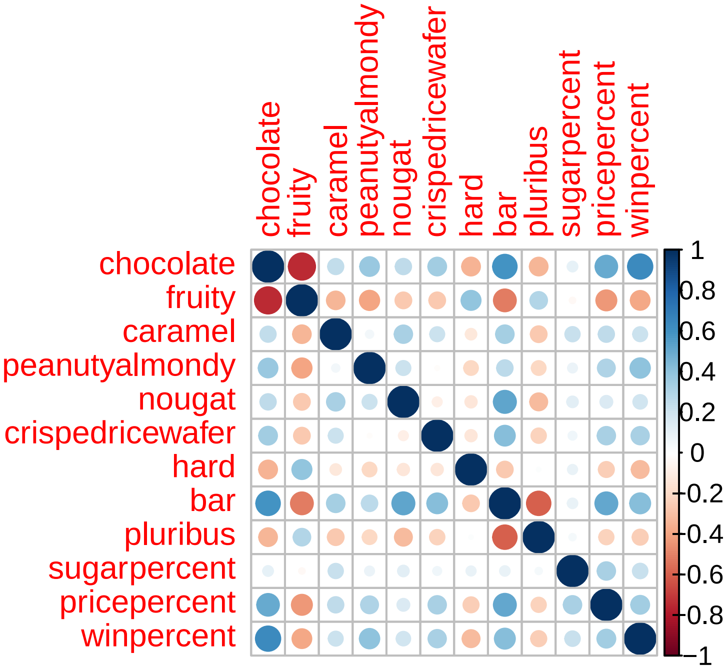
The top 5 most expensive candies are Nik L Nip, Nestle Smarties, Ring pop, Hershey's Krackel, and Hershey's Milk Chocolate. The least popular of these is Nik L Nip.

5 Exploring the correlation structure.

```
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 are two variables that are anticorrelated.

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

Chocolate and winpercent are the two variables that are the most positively correlated.

On to PCA

The main function for this is called `prcom()` and here we know we need to scale our data with the `scale=TRUE` argument.

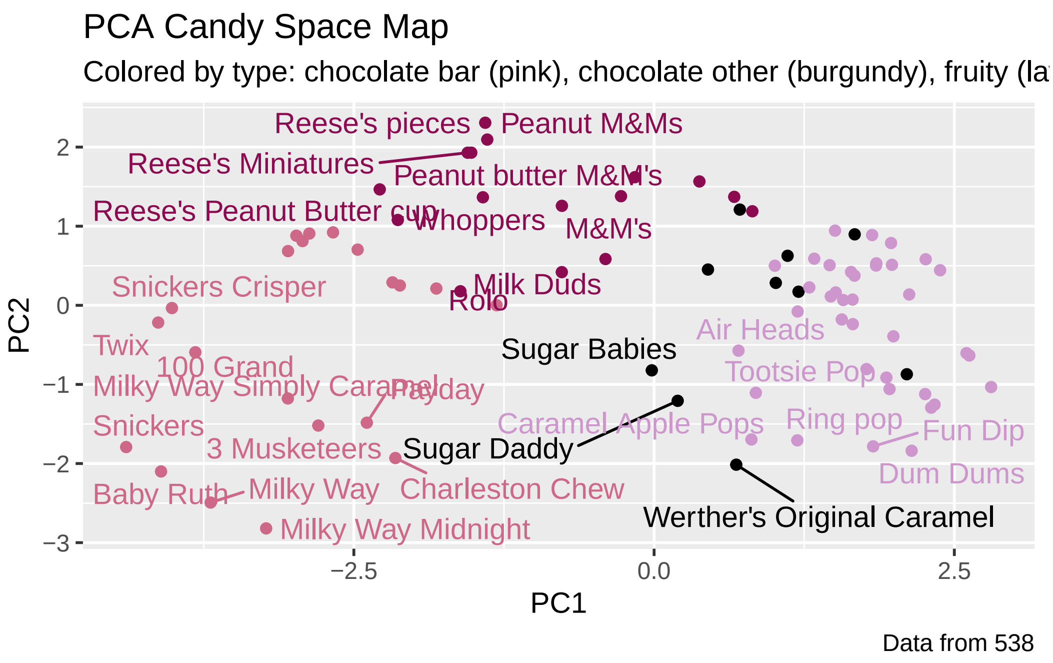
```
pca <- prcomp(candy, scale=TRUE)
summary(pca)
```

```
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
```

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

```
ggplot(my_data) +
  aes(PC1, PC2, label = rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols) +
  labs(title="PCA Candy Space Map", subtitle = "Colored by type: chocolate bar (pink), cho
```

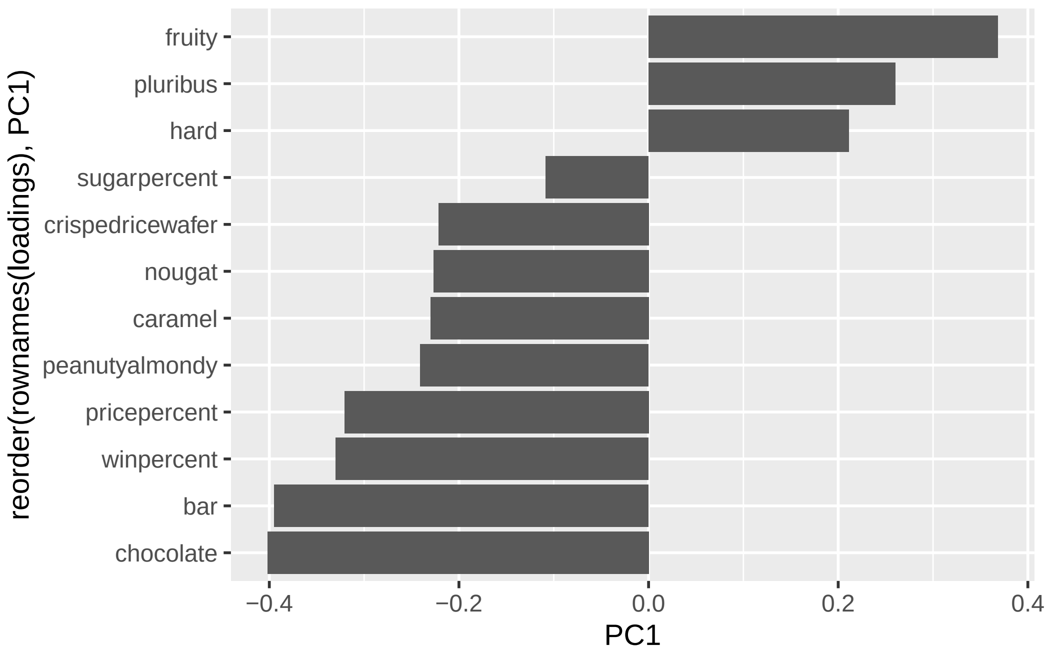
```
Warning: ggrepel: 56 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Loadings Plot

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

ggplot(loadings) +
  aes(PC1, reorder(rownames(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 fruity, pluribus, and hard variables are picked up strongly by PC1 in the positive direction. This makes sense, as these variables are all correlated with each other, whereas the remaining variables in the negative direction are all correlated with each other.