class 9 halloween mini project

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here we analyze a candy data set from the 538 website. This is a CSV file from their GitHub repository.

Data Import

```
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?

```
nrow(candy)
```

```
[1] 85
```

> Q2.how many fruity candy types are in the dataset?

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

```
[1] 38
```

data exploration

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

```
candy["M&M", ]$winpercent
```

```
[1] 66.57458
```

> 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
```

> 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
```

```
library("skimr")
skim(candy)
```

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	▂▇▇▅▂

```
skimr::skim(candy)
```

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?

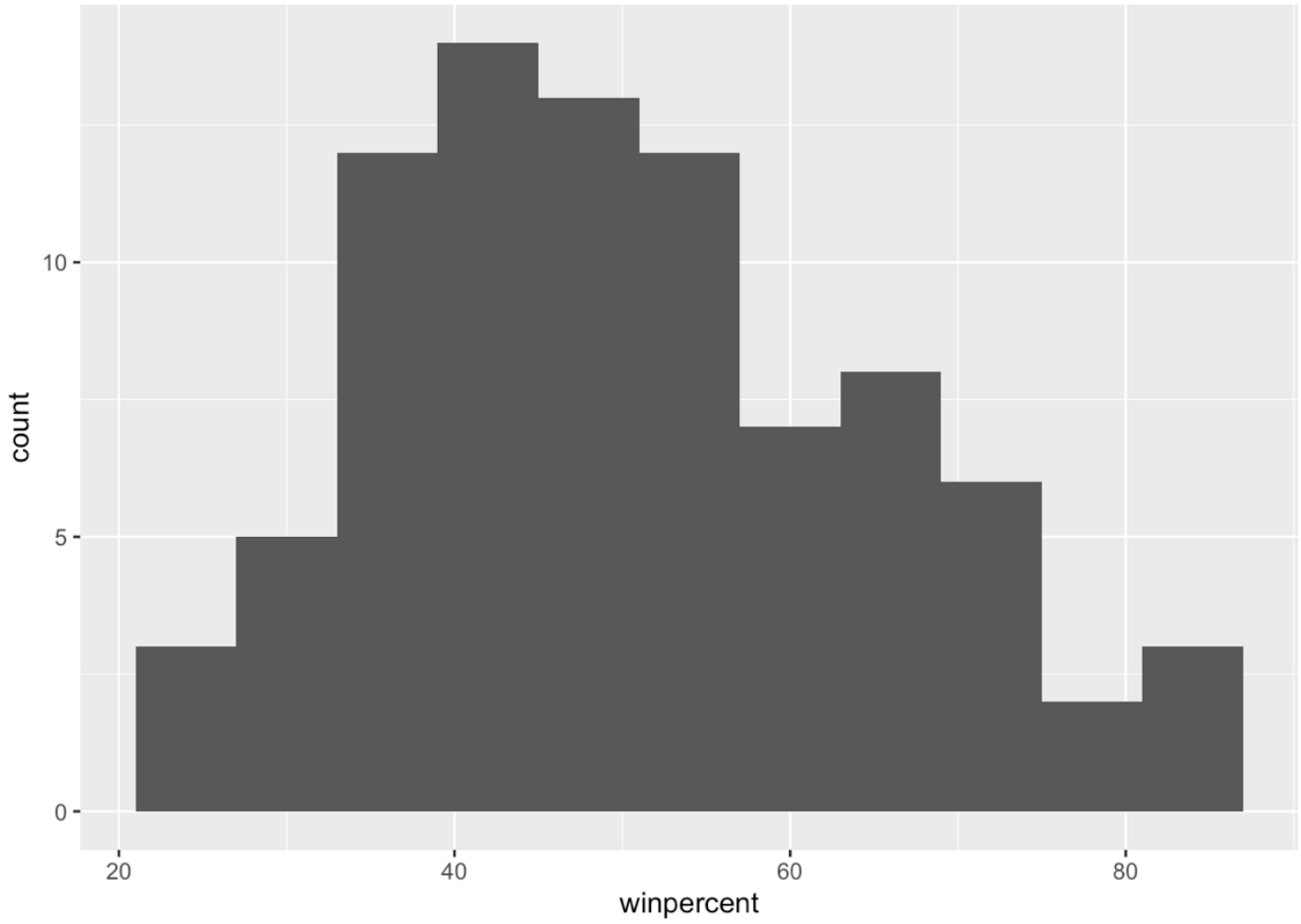
By looking at the columns, I think that winpercent is on a different scale.

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

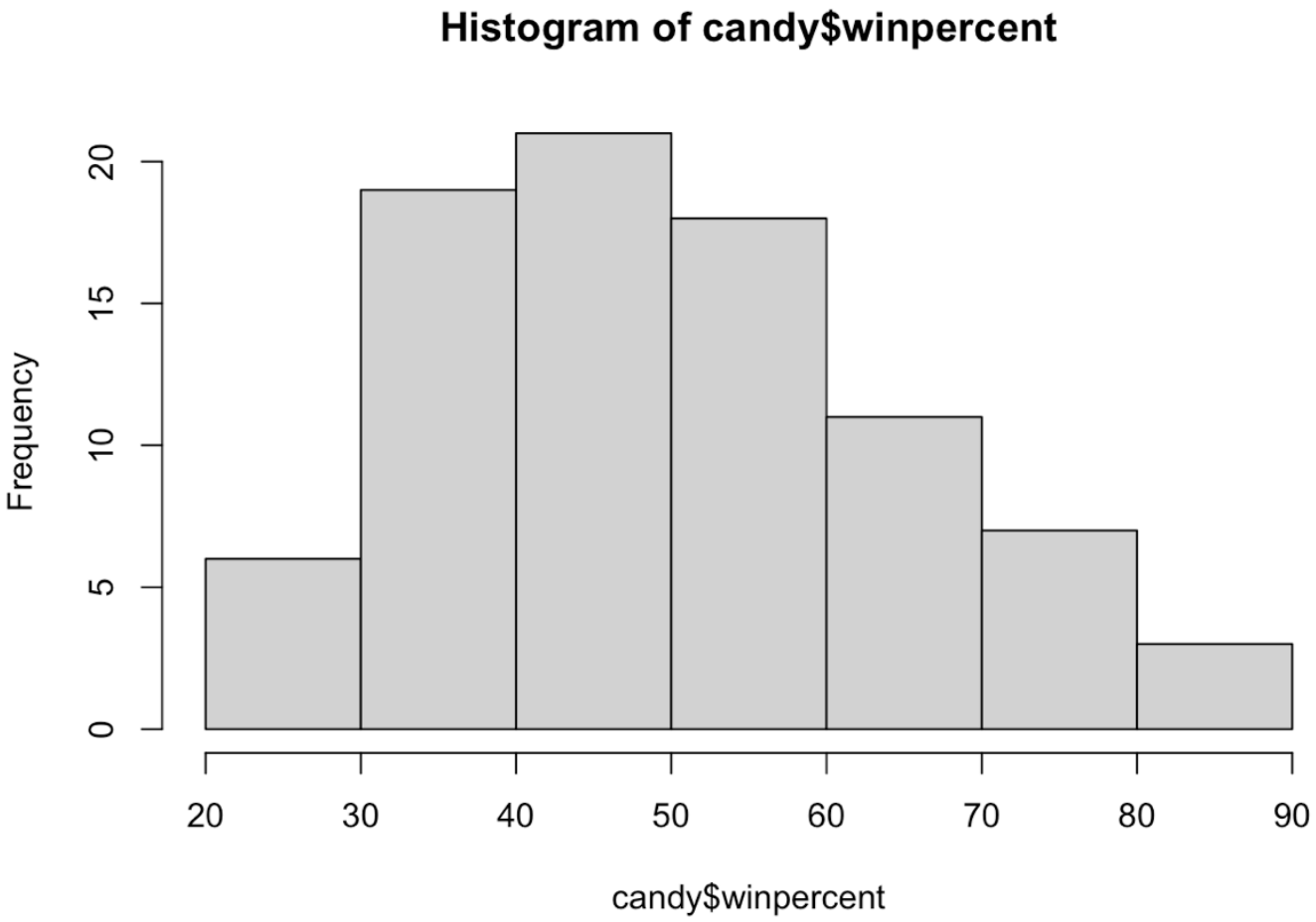
ONe represents the chocolate itself and zero represents if the given brand is chocolate.

> Q8. Plot a histogram of winpercent values

```
library(ggplot2)
ggplot(candy) +
  aes(winpercent) +
  geom_histogram(binwidth=6)
```



```
hist(candy$winpercent, breaks=8)
```



> Q9.is the distribution of winpercent values symmetrical?

No,not symmetrical the values are skewed left

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

It is below 50%

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

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

```
[1] 60.92153
```

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

```
[1] 44.11974
```

chocolate is ranked higher.

> Q12. Is this difference statistically significant?

```
x <- candy$winpercent[as.logical(candy$chocolate)]
y <- candy$winpercent[as.logical(candy$fruit)]
t.test(x,y)
```

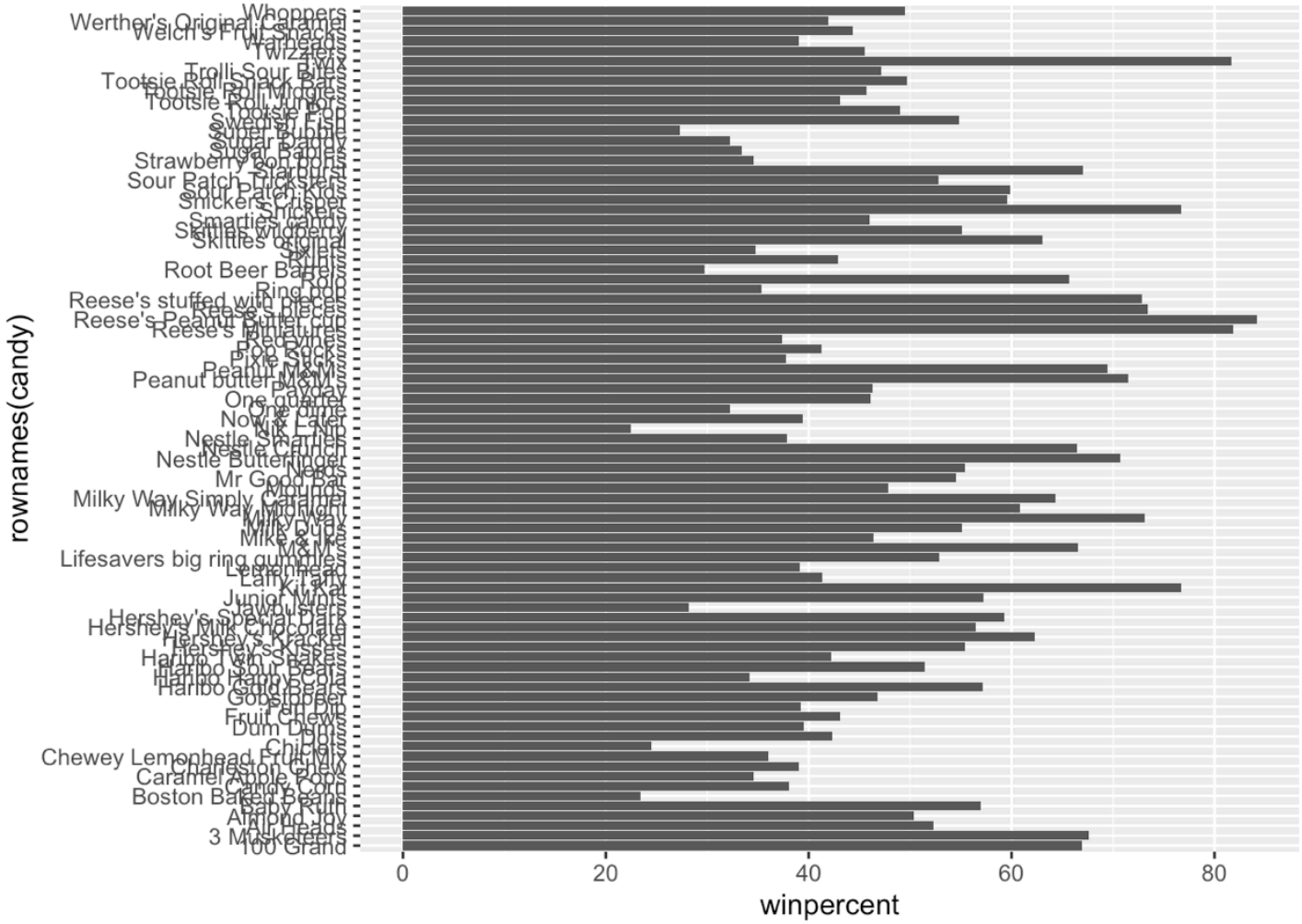
```
    Welch Two Sample t-test

data:  x and y
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
```

yes, statistically significant.

> Q13. What are the five least liked candy types in this set? Q14. What are the top 5 all time favorite candy types out of this set?

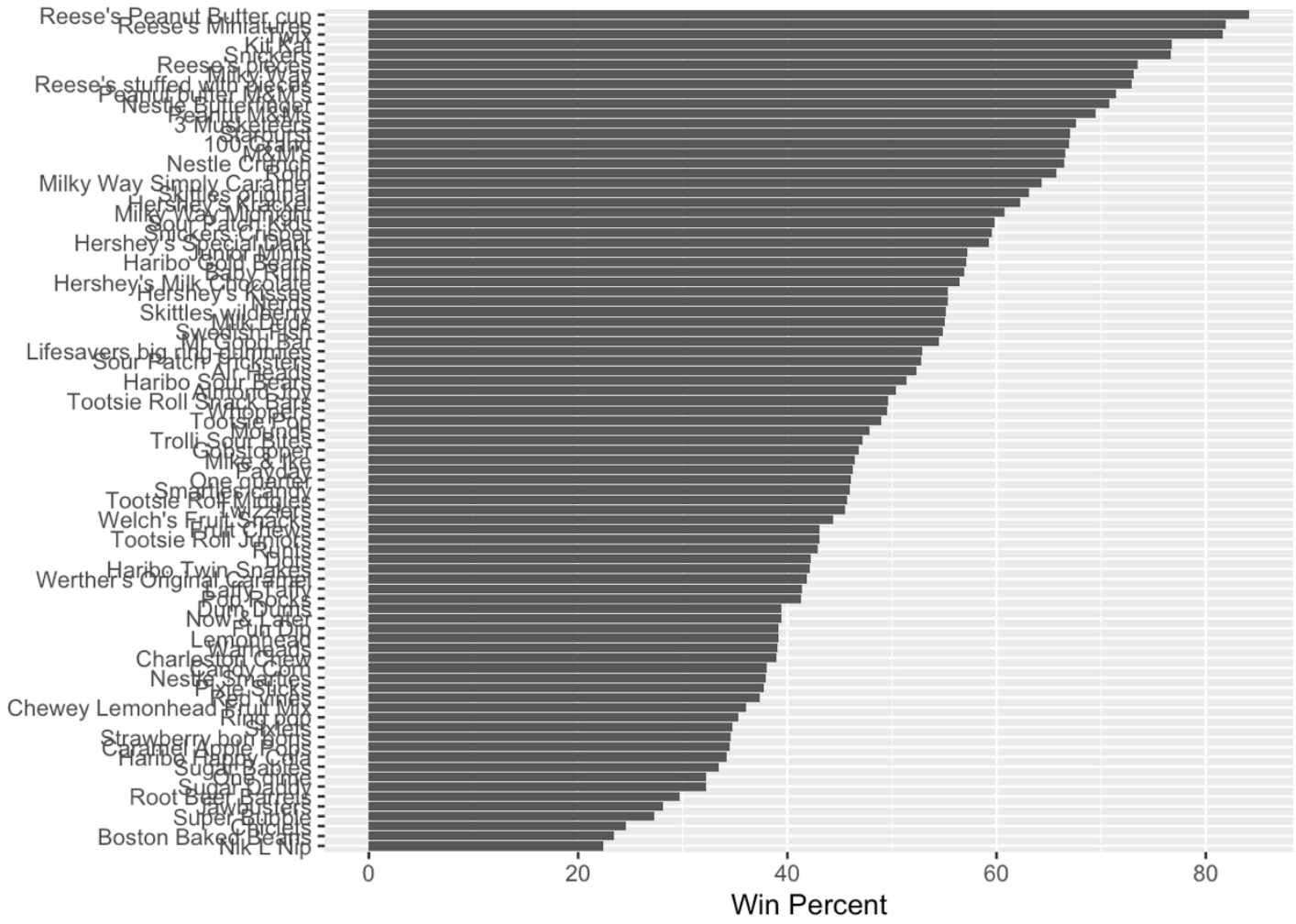
> Q15. Make a bar plot

```
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() +
  labs(x="Win Percent", y=NULL)
```




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

You can insert any image.

[A plot with better aspect ratio]

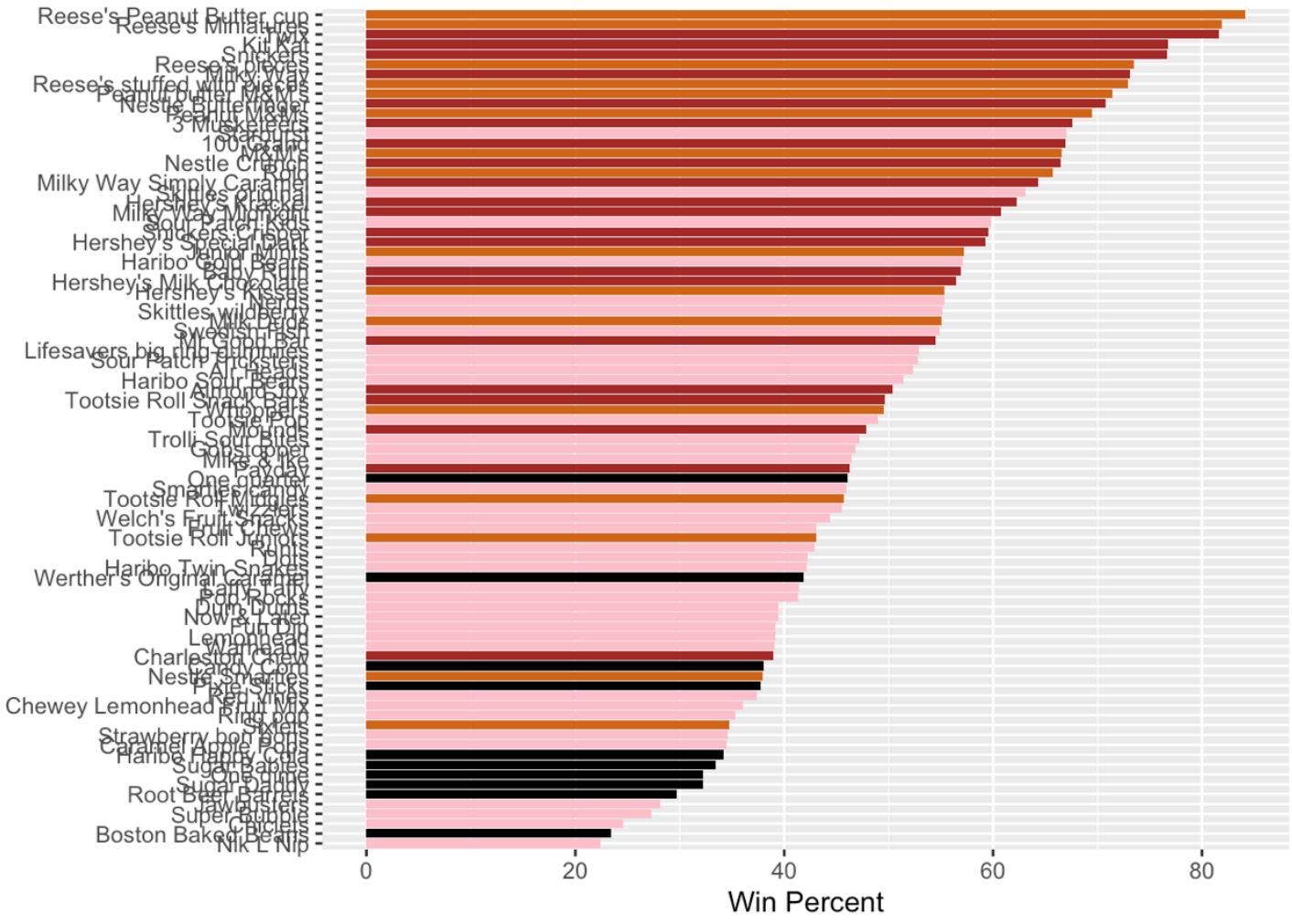
Add some color.

```
my_cols <- rep("black", nrow(candy))
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"
my_cols
```

```
 [1] "brown"     "brown"     "black"     "black"     "pink"      "brown"
 [7] "brown"     "black"     "black"     "pink"      "brown"     "pink"
```

```
 [13] "pink"      "pink"      "pink"      "pink"      "pink"      "pink"
 [19] "pink"      "black"     "pink"      "pink"      "chocolate" "brown"
 [25] "brown"     "brown"     "pink"      "chocolate" "brown"     "pink"
 [31] "pink"      "pink"      "chocolate" "chocolate" "pink"      "chocolate"
 [37] "brown"     "brown"     "brown"     "brown"     "brown"     "pink"
 [43] "brown"     "brown"     "pink"      "pink"      "brown"     "chocolate"
 [49] "black"     "pink"      "pink"      "chocolate" "chocolate" "chocolate"
 [55] "chocolate" "pink"      "chocolate" "black"     "pink"      "chocolate"
 [61] "pink"      "pink"      "chocolate" "pink"      "brown"     "brown"
 [67] "pink"      "pink"      "pink"      "pink"      "black"     "black"
 [73] "pink"      "pink"      "pink"      "chocolate" "chocolate" "brown"
 [79] "pink"      "brown"     "pink"      "pink"      "pink"      "black"
 [85] "chocolate"
```

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



> Q17. What is the worst ranked chocolate candy?

sixlets

> Q18. What is the best ranked fruity candy?

starburst

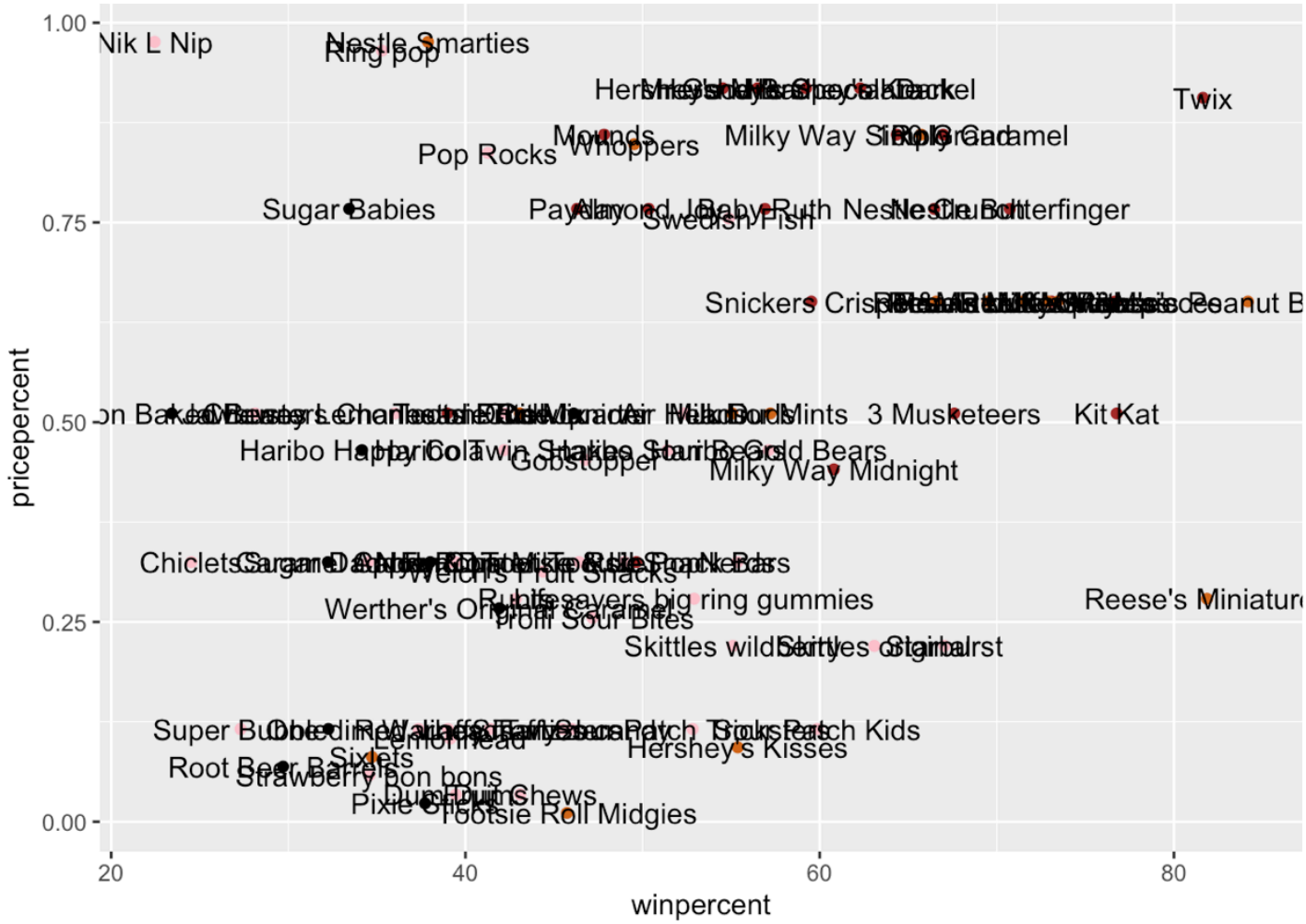
Taking a look at pricepercent

```
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
```

to see what is a good candy in terms of winpercent and pricepercent, we can make a plot of winpercent vs the pricepercent variable and then see the best candy for the least amount of money

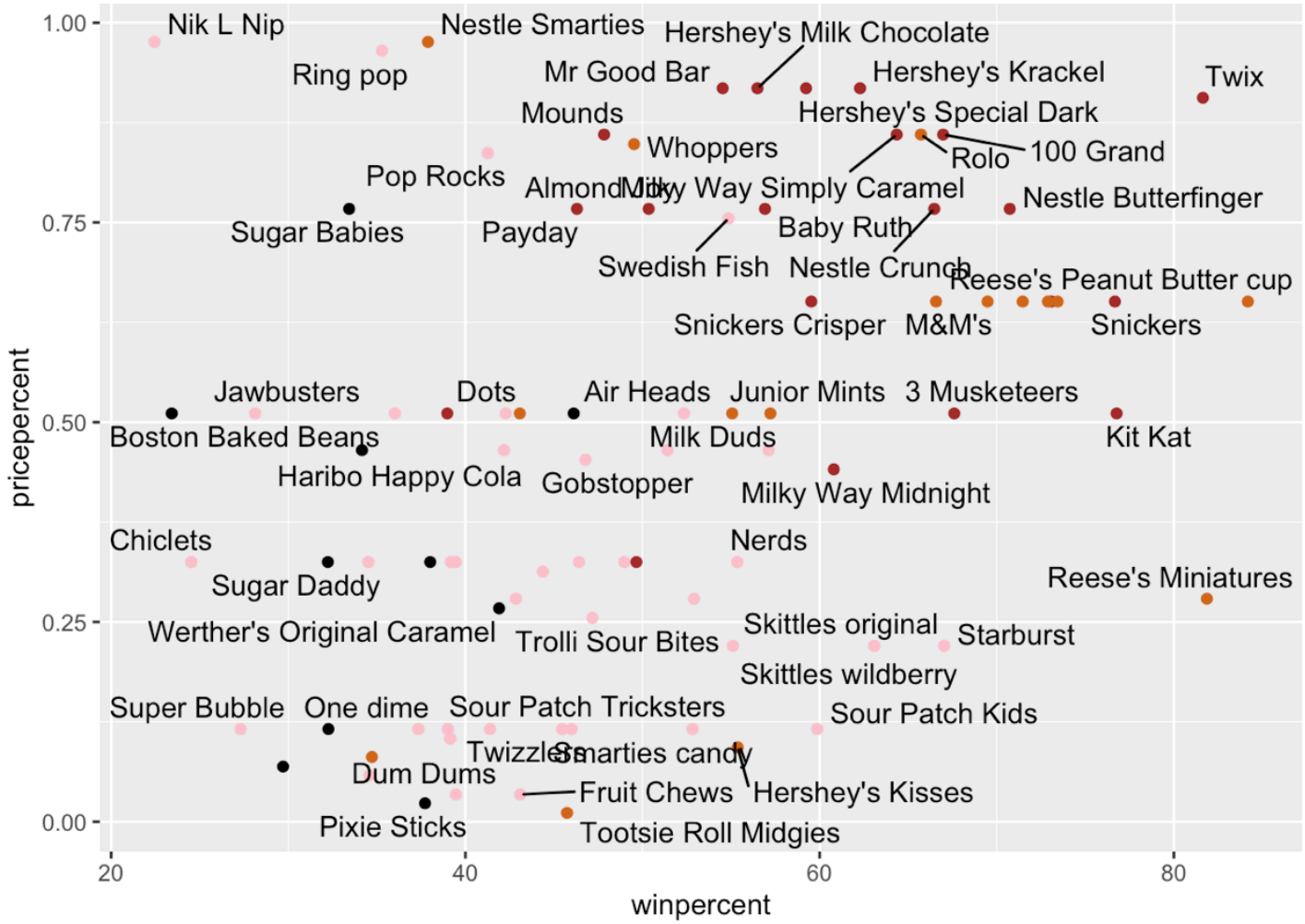
```
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text()
```



to avoid the overplotting of all these labels, we can use an add on package called ggrepel

```
library(ggrepel)

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

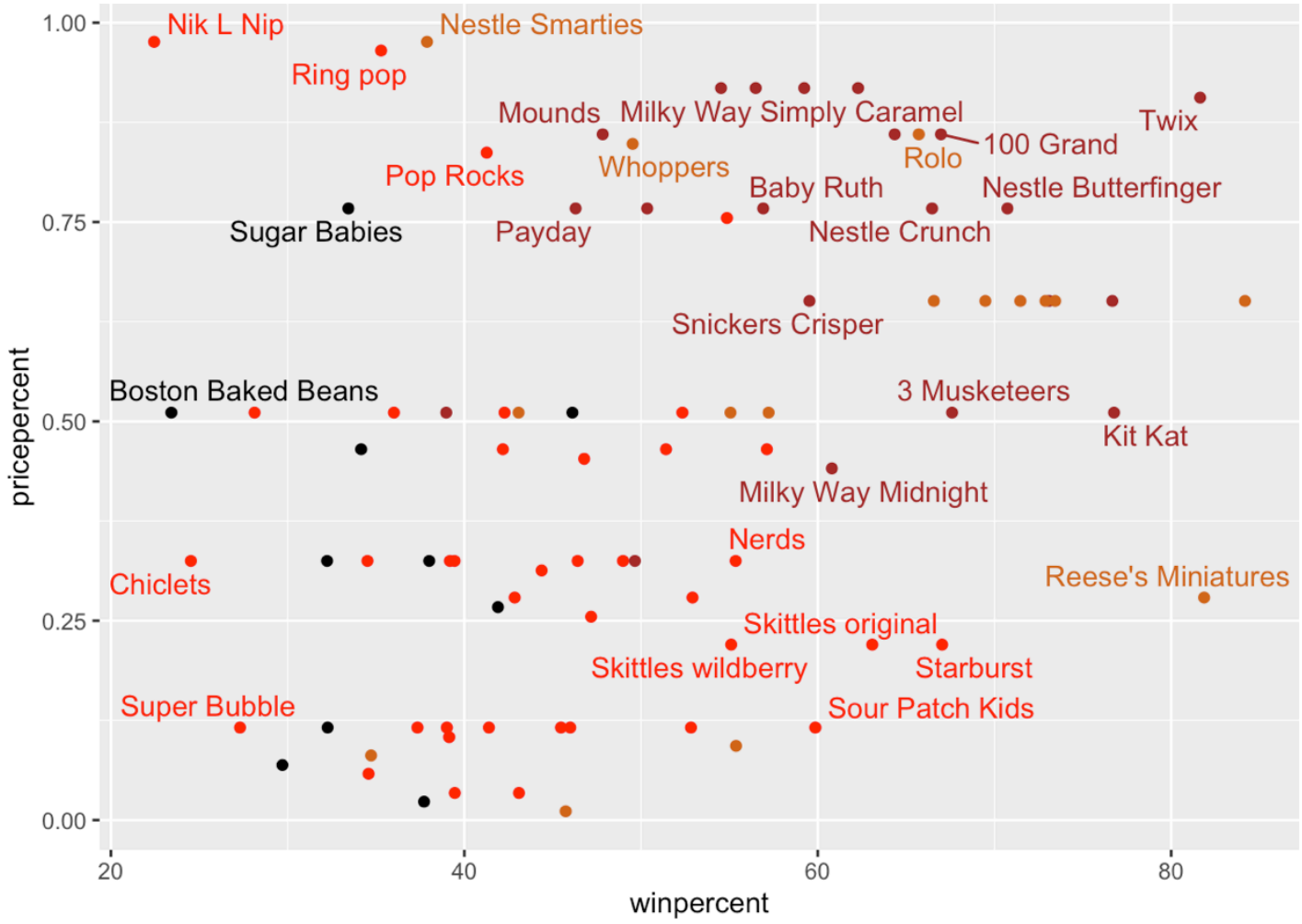
```
Warning: ggrepel: 29 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Play with the max.overlaps parameter to `geom_text_repel()`

```
# Too hard to see pink
my_cols[as.logical(candy$fruity)] = "red"

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

```
Warning: ggrepel: 57 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



> 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 )
```

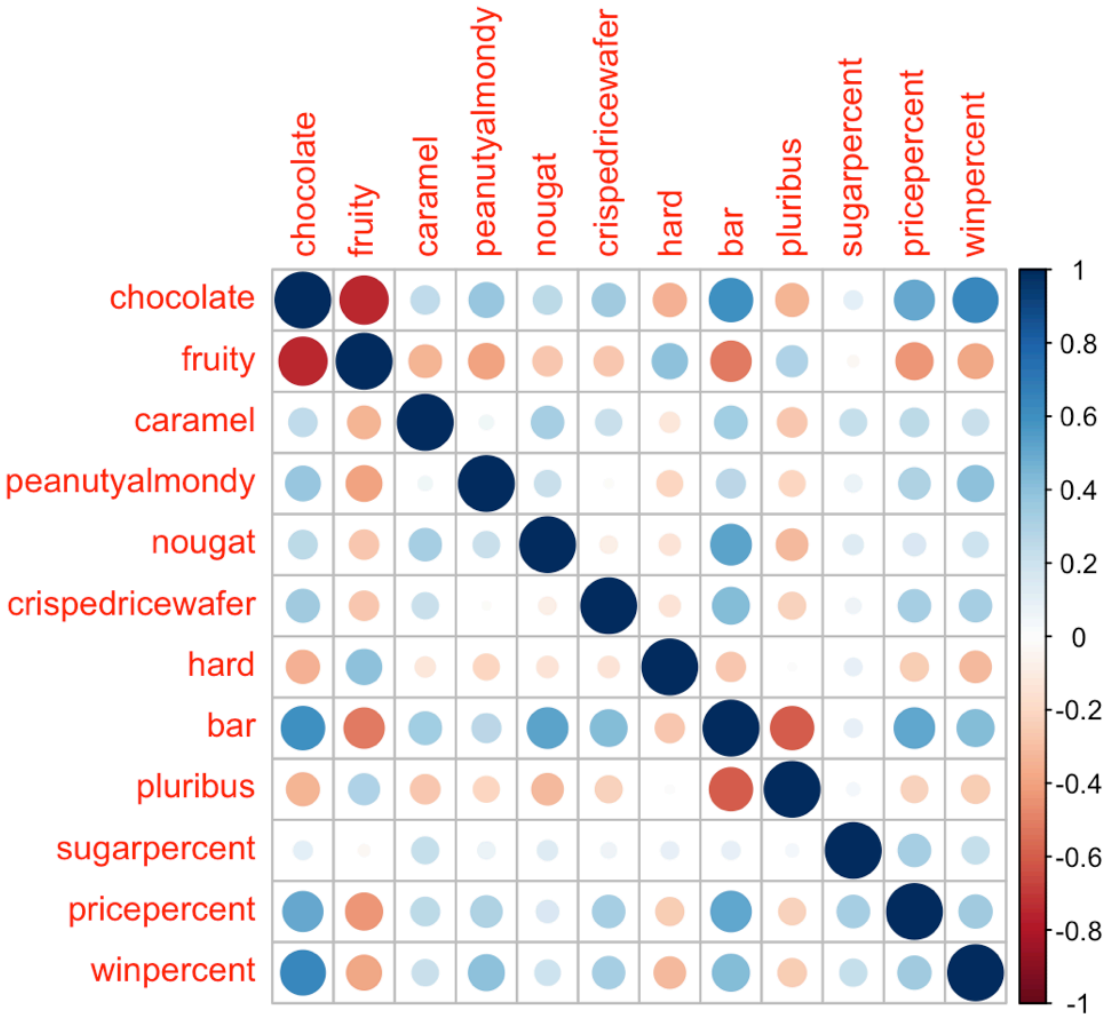
```
                      pricepercent winpercent
Nik L Nip                    0.976   22.44534
Nestle Smarties              0.976   37.88719
Ring pop                     0.965   35.29076
Hershey's Krackel            0.918   62.28448
Hershey's Milk Chocolate     0.918   56.49050
```

5 Exploring the correlation structure

```
library(corrplot)
```

```
corrplot 0.92 loaded
```

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



On to PCA

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

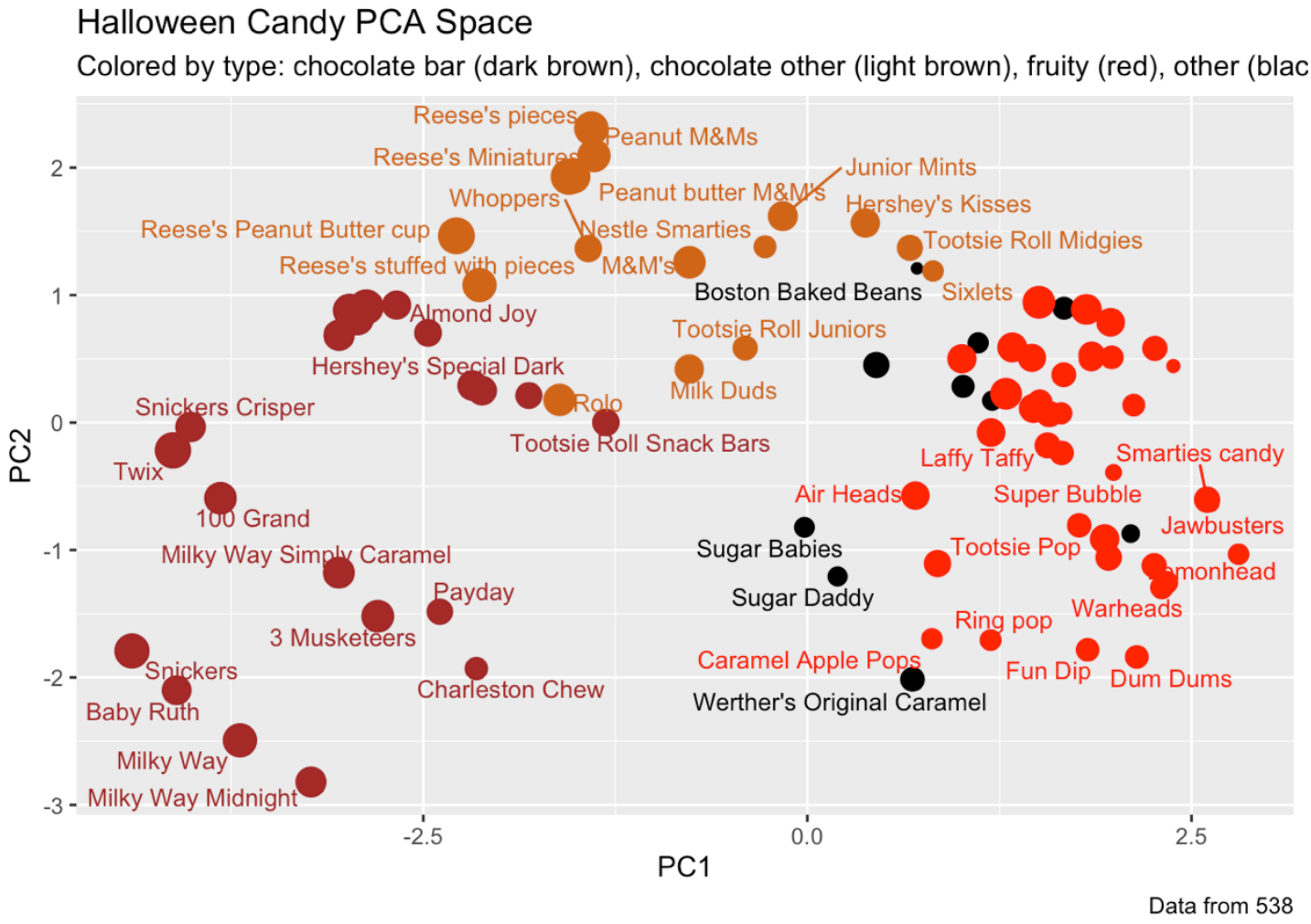
```
pca <- prcomp(candy, scale=TRUE)
summary(pca)
```

```
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
```

Plot my main PCA score with ggplot

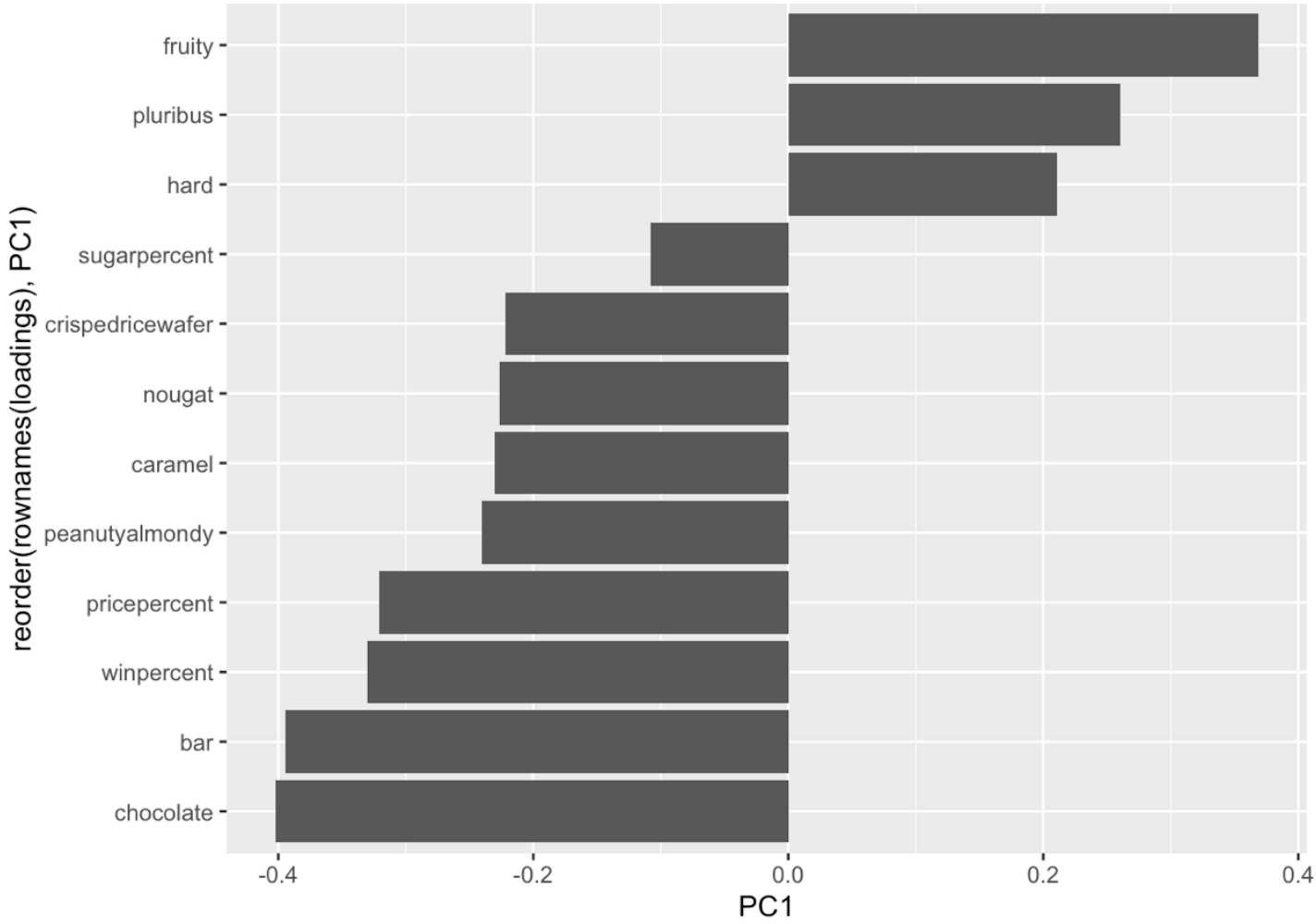
```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])

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 + 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
       caption="Data from 538")
```

```
Warning: ggrepel: 39 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?

PC1 exhibits a strong correlation with positive attributes, particularly highlighting characteristics such as fruity, pluribus, and hard. The logical implication here is that it is more sensible to expect the coexistence of hard and fruity confections in a grouped (pluribus) manner.