Lab9: Halloween Mini Project

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Import Data

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

```
             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
```

Data Exploration

> Q.1 How many different candies are in the dataset?

There are 85 candies in this dataset.

> Q.2 How many fruity candies are in the dataset?

There are 38 fruity candies in the dataset.

My favorite candy is Kit Kat.

```
candy_df["Kit Kat",]
```

```
        chocolate fruity caramel peanutyalmondy nougat crispedricewafer hard
Kit Kat         1      0       0              0      0                1    0
        bar pluribus sugarpercent pricepercent winpercent
Kit Kat   1        0        0.313        0.511    76.7686
```

> Q.3/Q.4 What is your favorite candy and what is its winpercent? What is Kit Kat's winpercent?

Kit Kat has a winpercent of 76.7686

> Q.5 What is "Tootsie Roll Snack Bars" winpercent?

Tootsie Roll Snack Bars have a winpercent of 49.653503

```
skimr::skim(candy_df)
```

Table 1: Data summary

Name	candy_df
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	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
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	

> Q.6 Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset?

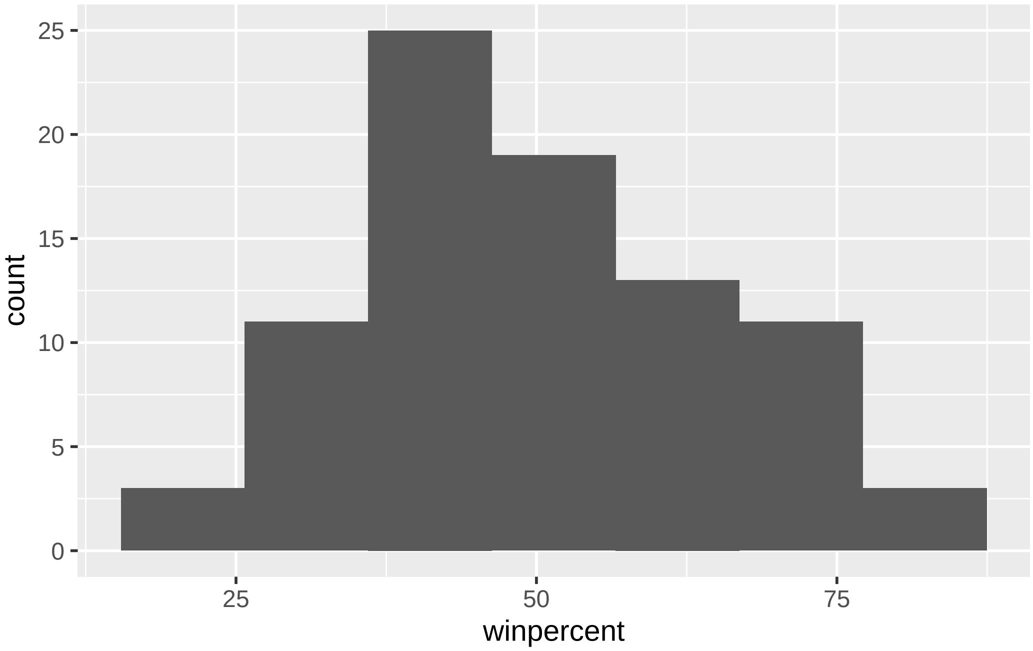
The sugar percent, price percent, and winpercent seem to be on a different scale

> Q.7 What do you think a zero and one represent for the candy$chocolate column?

Zeros represent the candy is not chocolate based and 1 means it is.

> Q.8 Plot a histogram of winpercent values

```r
library(ggplot2)
ggplot(candy_df) + aes(x=winpercent) + geom_histogram(bins=7)
```



> Q.9 Is the distribution of winpercent values symmetrical?

The distribution is not symmetrical

Q.10 Is the center above or below 50%?

Below 50%

Q.11 On average is chocolate candy higher or lower ranked than fruit candy?

```
chocolate_win <- mean(candy_df[candy_df$chocolate == 1,]$winpercent)
fruit_win <- mean(candy_df[candy_df$fruity == 1,]$winpercent)
```

Chocolate is ranked higher with an average winpercent 60.9215294 while fruity candies are only ranked with an average winpercent 44.1197414

Q.12 Is this difference statistically significant

```
chocolate_df <- candy_df[candy_df$chocolate == 1,]
fruity_df <- candy_df[candy_df$fruity == 1,]

ttest <- t.test(chocolate_df$winpercent, fruity_df$winpercent)
ttest
```

```

    Welch Two Sample t-test

data:  chocolate_df$winpercent and fruity_df$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 
```

Since the t-test had a p-value 2.8713778×10^{-8} the difference is statistically significant.

Q.13 What are the five least liked candy types in this set?

```
candy_df <- candy_df[order(candy_df$winpercent), ]
row.names(head(candy_df, n=5))
```

```
[1] "Nik L Nip"          "Boston Baked Beans" "Chiclets"          
[4] "Super Bubble"       "Jawbusters"        
```

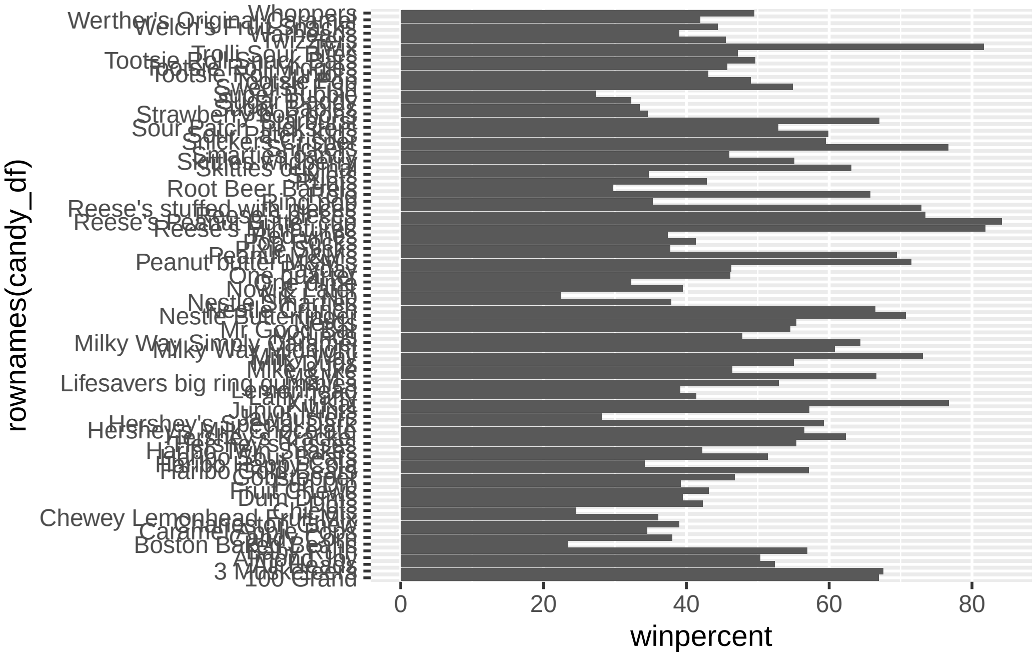
Q.14 What are the top 5 all time favorite candy types out of this set?

```
row.names(tail(candy_df, n=5))
```

```
[1] "Snickers"                         "Kit Kat"
[3] "Twix"                             "Reese's Miniatures"
[5] "Reese's Peanut Butter cup"
```

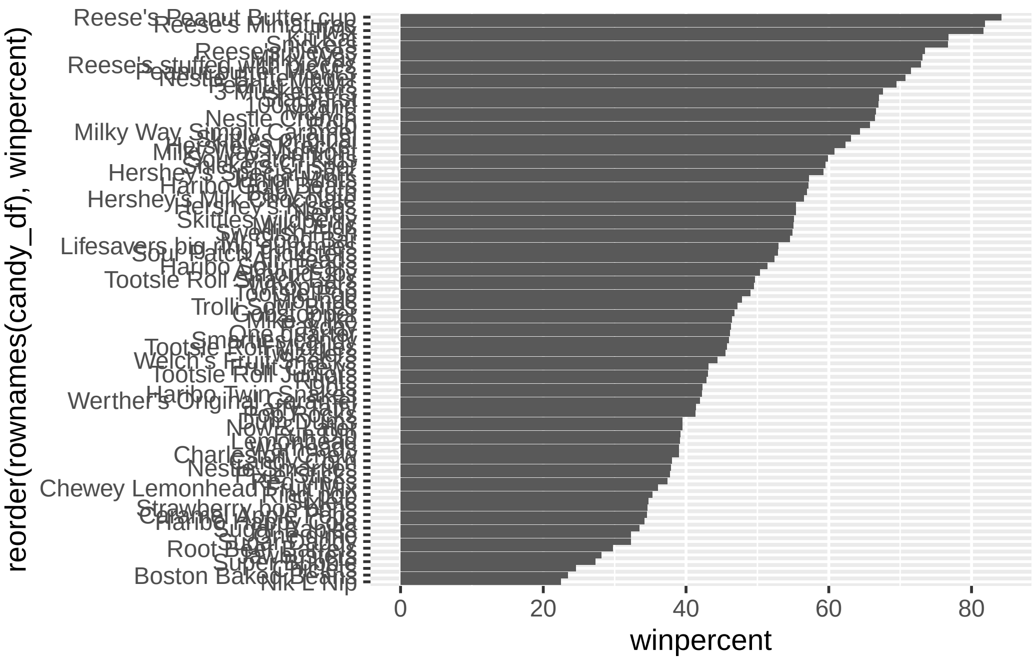
Q.15 Make a first barplot of candy ranking based on winpercent values.

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



Q.16 This is quite ugly, use the reorder() function to get the bars sorted by winpercent?

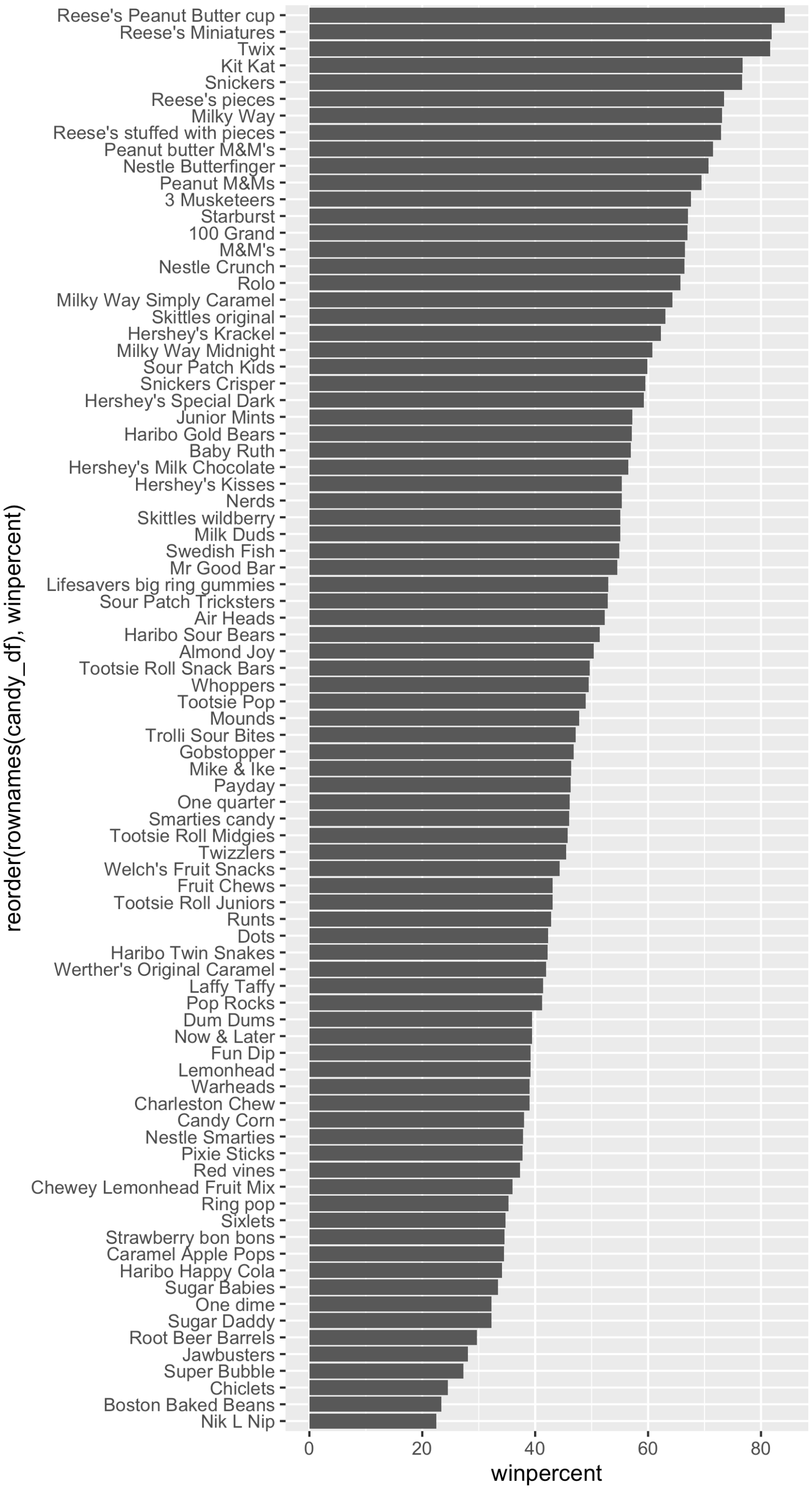
```
ggplot(candy_df) + aes(winpercent, reorder(rownames(candy_df), winpercent)) + geom_col()
```



Adjust figure height:

```
ggsave("mybarplot.png", height=10)
```

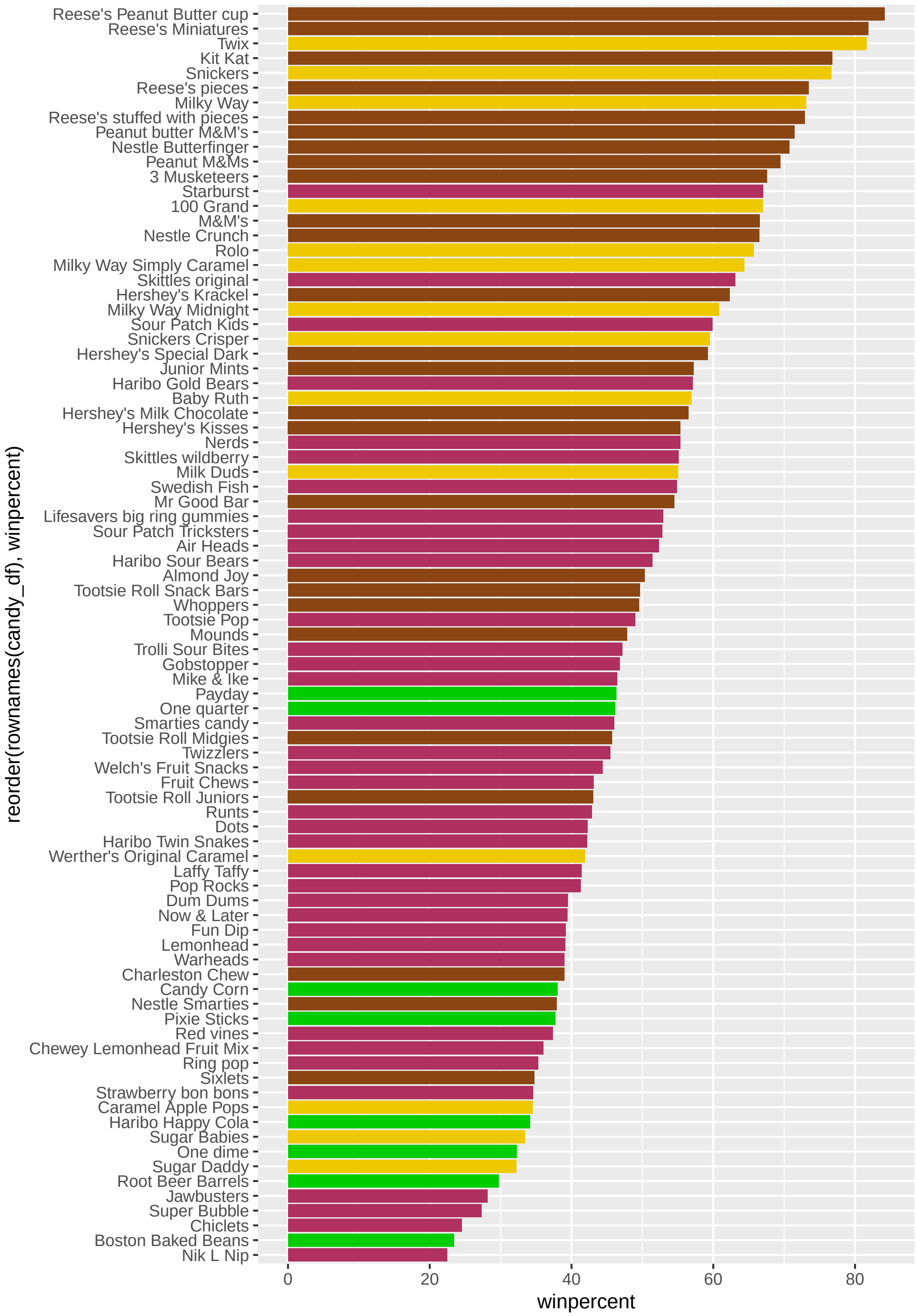
```
Saving 5.5 x 10 in image
```


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
reorder(rownames(candy_df), winpercent)
0
20
40
60
80
winpercent

Add some color:

```
plot.cols <- rep("green3", nrow(candy_df))
plot.cols[as.logical(candy_df$chocolate)] = "chocolate4"
plot.cols[as.logical(candy_df$fruity)] = "maroon"
plot.cols[as.logical(candy_df$caramel)] = "gold2"

ggplot(candy_df) + aes(winpercent, reorder(rownames(candy_df), winpercent)) + geom_col(fil
```


Reese's Peanut Butter cup
Reese's Miniatures
Twix
Kit Kat
Snickers
Reese's pieces
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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
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Trolli Sour Bites
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Werther's Original Caramel
Laffy Taffy
Pop Rocks
Dum Dums
Now & Later
Fun Dip
Lemonhead
Warheads
Charleston Chew
Candy Corn
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One dime
Sugar Daddy
Root Beer Barrels
Jawbusters
Super Bubble
Chiclets
Boston Baked Beans
Nik L Nip
reorder(rownames(candy_df), winpercent)
0
20
40
60
80
winpercent

Q.17 What is the worst ranked chocolate candy?

Sixlets are the worst ranked chocolate candy.

Q.18 What is the best ranked fruity candy?

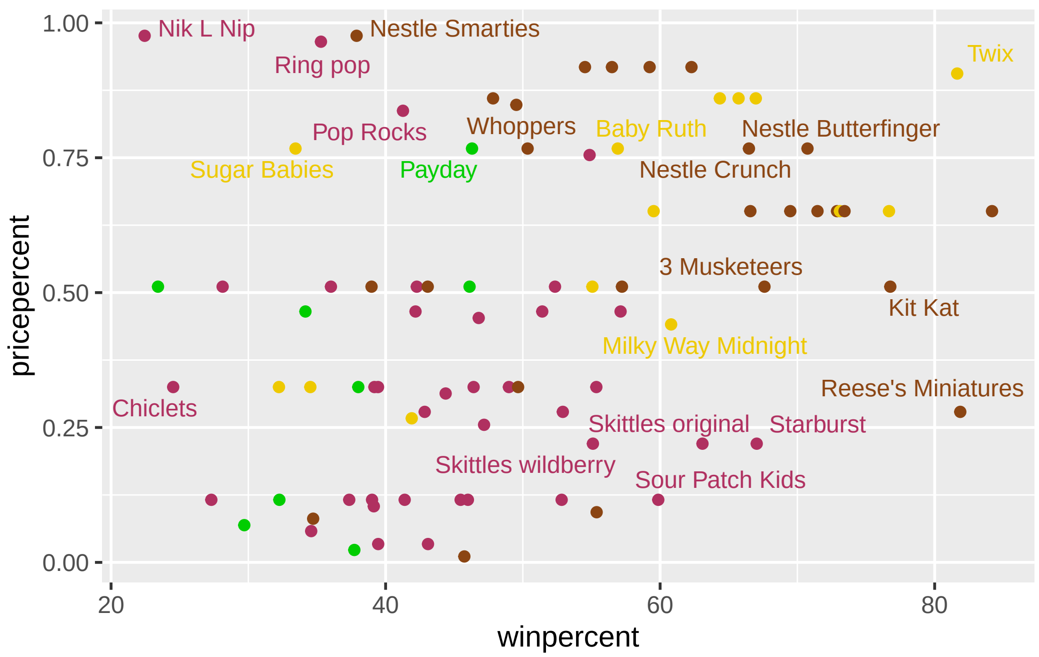
The best ranked fruity candy is starbursts

Plot winpercent vs. pricepercent

```r
library(ggrepel)

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

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



Q.19 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 offer the most bang for your buck.

> Q.20 What are the top 5 most expensive candy types in the dataset and of these which is the least popular?

```
temp <- candy_df[order(candy_df$pricepercent, decreasing=T), ]
head(temp, n=5)
```

```
                         chocolate fruity caramel peanutyalmondy nougat
Nik L Nip                        0      1       0              0      0
Nestle Smarties                  1      0       0              0      0
Ring pop                         0      1       0              0      0
Mr Good Bar                      1      0       0              1      0
Hershey's Milk Chocolate         1      0       0              0      0
                         crispedricewafer hard bar pluribus sugarpercent
Nik L Nip                               0    0   0        1        0.197
Nestle Smarties                         0    0   0        1        0.267
Ring pop                                0    1   0        0        0.732
Mr Good Bar                             0    0   1        0        0.313
Hershey's Milk Chocolate                0    0   1        0        0.430
                         pricepercent winpercent
Nik L Nip                       0.976   22.44534
Nestle Smarties                 0.976   37.88719
Ring pop                        0.965   35.29076
Mr Good Bar                     0.918   54.52645
Hershey's Milk Chocolate        0.918   56.49050
```

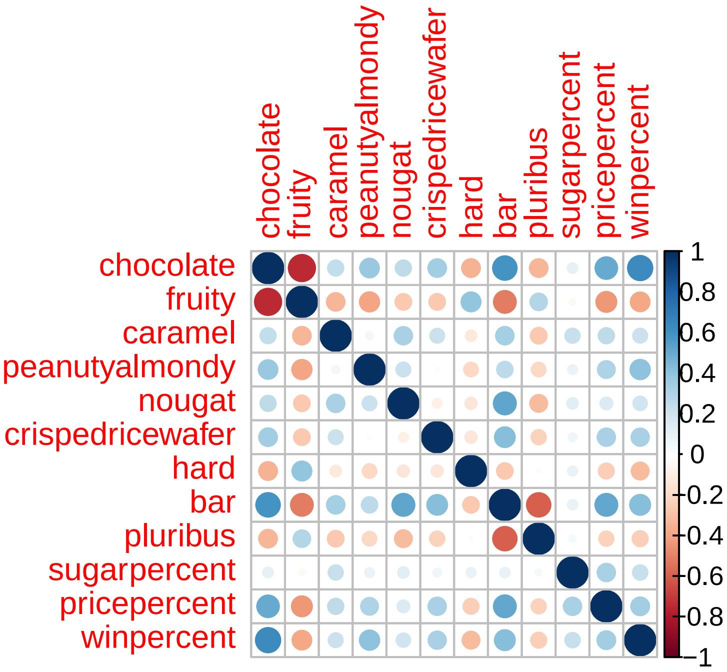
Nik L Nip are the least popular of the most expensive candies.

Correlation

```
library(corrplot)
```

```
corrplot 0.92 loaded
```

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



Q.22 Which two variables are anti-correlated?

Chocolate and fruit are anti-correlated

Q.23 Which two variables are most strongly correlated?

Chocolate and win percent are positively correlated.

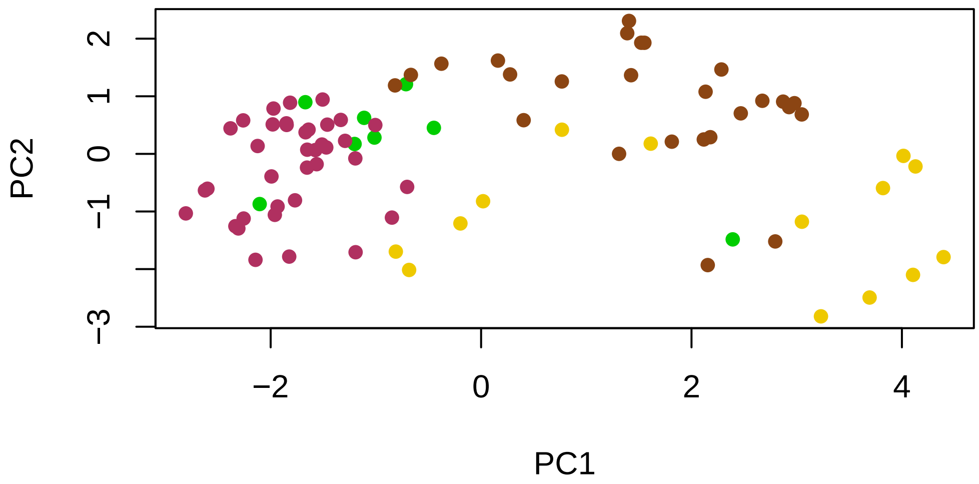
PCA

```
pca <- prcomp(candy_df, scale.=T)
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 PC1 vs PC2

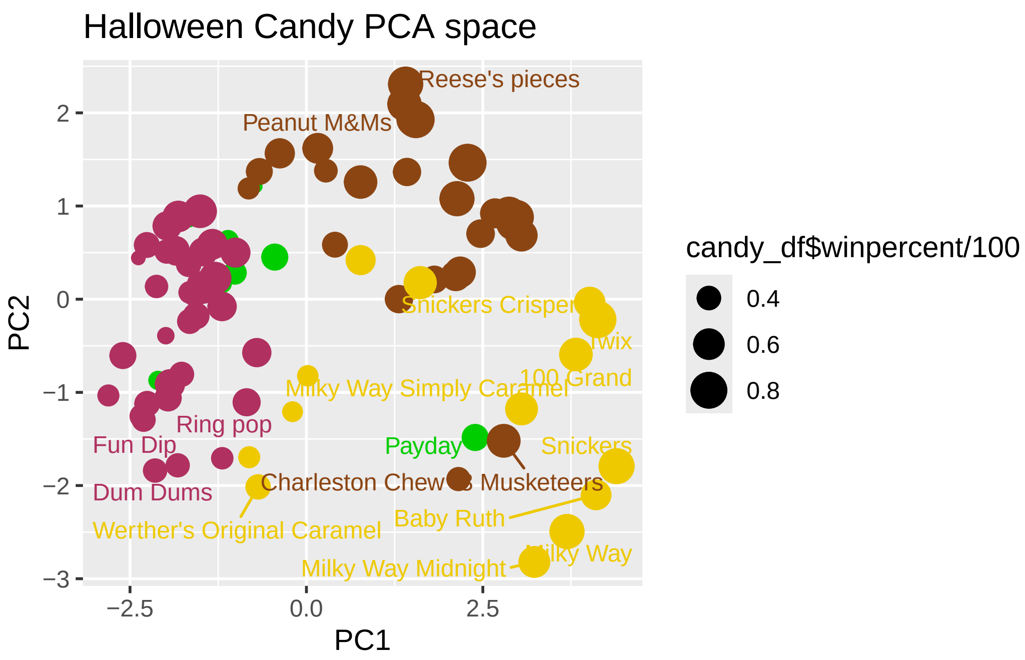
```r
plot(pca$x[,1:2], col=plot.cols, pch=16)
```



Use ggplot

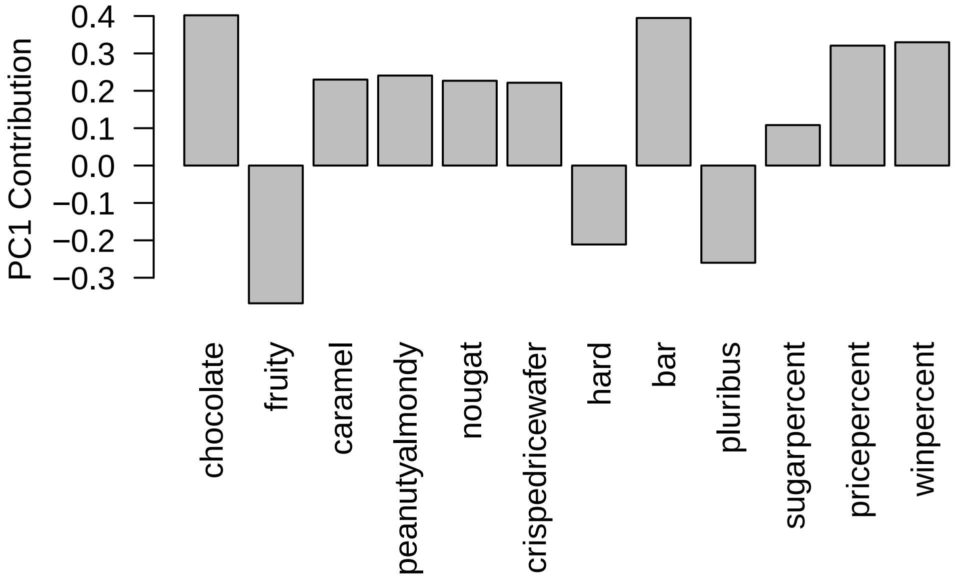
```r
ggplot(pca$x) + aes(x=pca$x[,1], y=pca$x[,2], size=candy_df$winpercent/100) + geom_point(c
  labs(title = "Halloween Candy PCA space") + xlab("PC1") + ylab("PC2") +
  geom_text_repel(col=plot.cols, size=3.3, max.overlaps=7, label=row.names(candy_df))
```

```
Warning: ggrepel: 68 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



How do the original variables contribute to PCs? For this we look at the loadings component of our results object ie. the `pca$rotation` object.

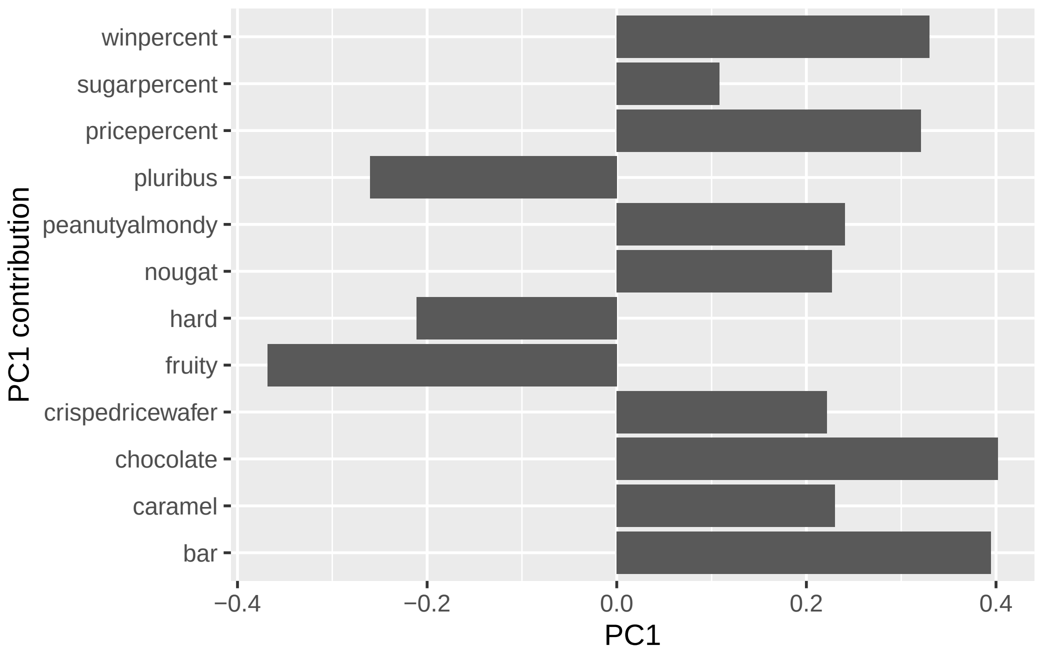
```r
par(mar=c(8,4,2,2))
barplot(pca$rotation[,1], las=2, ylab="PC1 Contribution")
```



Or with ggplot

```
res <- pca$rotation

ggplot(res) + aes(PC1, rownames(res)) + geom_col() + ylab("PC1 contribution")
```



Q.24 What original variables are picked up strongly by PC1 in the negative direction? Do these make sense to you?

Fruit, pluribus, and hard are all picked up in the negative direction and these make sense based on the correlation analysis done previously.