Halloween Mini Project

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Importing candy data

```
candy_file <- "https://raw.githubusercontent.com/fivethirtyeight/data/master/candy-power-r
candy=read.csv(candy_file, 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
```

```
#85 different types of candy
```

Q2. How many fruity candy types are in the dataset?

```
table(candy$fruity)
```

```
 0  1
47 38
```

```
#38 fruity candy types
```

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

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

```
[1] 51.41243
```

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",]$winpercent
```

```
[1] 49.6535
```

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

Table 1: Data summary

Name	candy
Number of rows	85
Number of columns	12

Table 1: Data summary

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?

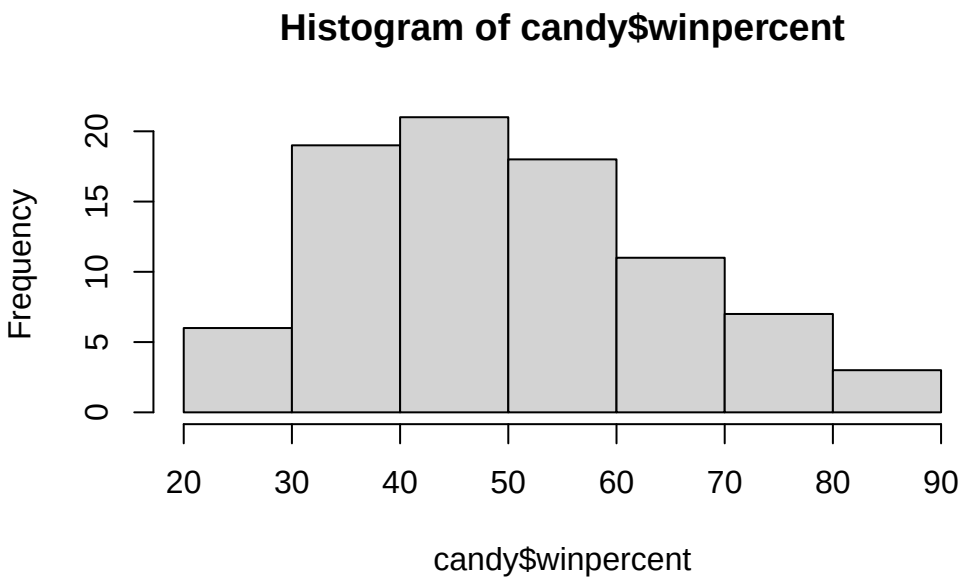
For the other columns, the values are between 0 and 1, but for the winpercent, the values are much larger than 1.

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

I think a zero means false (the candy is not a chocalte type) and a one means true (the candy is a chocolate type)

Q8. Plot a histogram of winpercent values

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



Q9. Is the distribution of winpercent values symmetrical?

The distribution is mostly symmetrical. It follows a normal distribution pattern.

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

The center is slightly below 50% (between 40-50%)

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

```
chocolate <- candy$winpercent[as.logical(candy$chocolate)]
fruit <- candy$winpercent[as.logical(candy$fruity)]

mean(chocolate)
```

```
[1] 60.92153
```

```
mean(fruit)
```

```
[1] 44.11974
```

```
mean(chocolate)>mean(fruit)
```

```
[1] TRUE
```

On average chocolate (60.92%) is ranked higher than fruit candy (44.11%)

Q12. Is this difference statistically significant?

```
t.test(chocolate,fruit)
```

```
    Welch Two Sample t-test

data:  chocolate and fruit
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
```

The results are statistically significant as the p value is less than 0.05 which we use as a threshold for significance

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

```
head(candy[order(candy$winpercent,decreasing=F),], n=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 five least liked candy types 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?

```
head(candy[order(candy$winpercent, decreasing=T),], n=5)
```

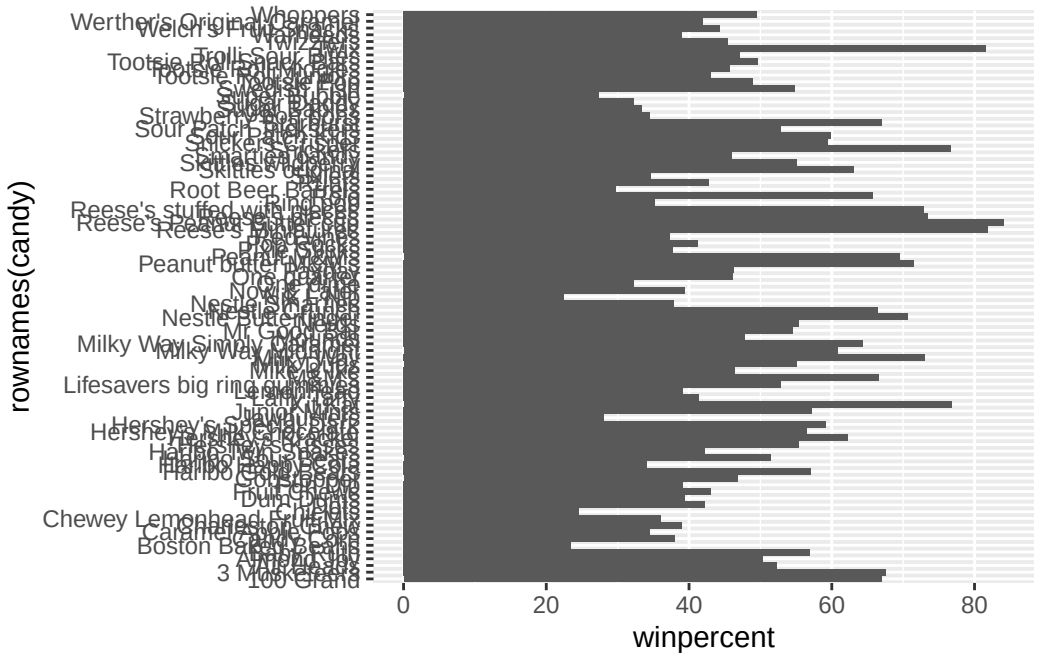
```
                        chocolate fruity caramel peanutyalmondy nougat
Reese's Peanut Butter cup         1      0       0              1      0
Reese's Miniatures                1      0       0              1      0
Twix                              1      0       1              0      0
Kit Kat                           1      0       0              0      0
Snickers                          1      0       1              1      1
                        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
                        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
```

The five most liked candies 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.

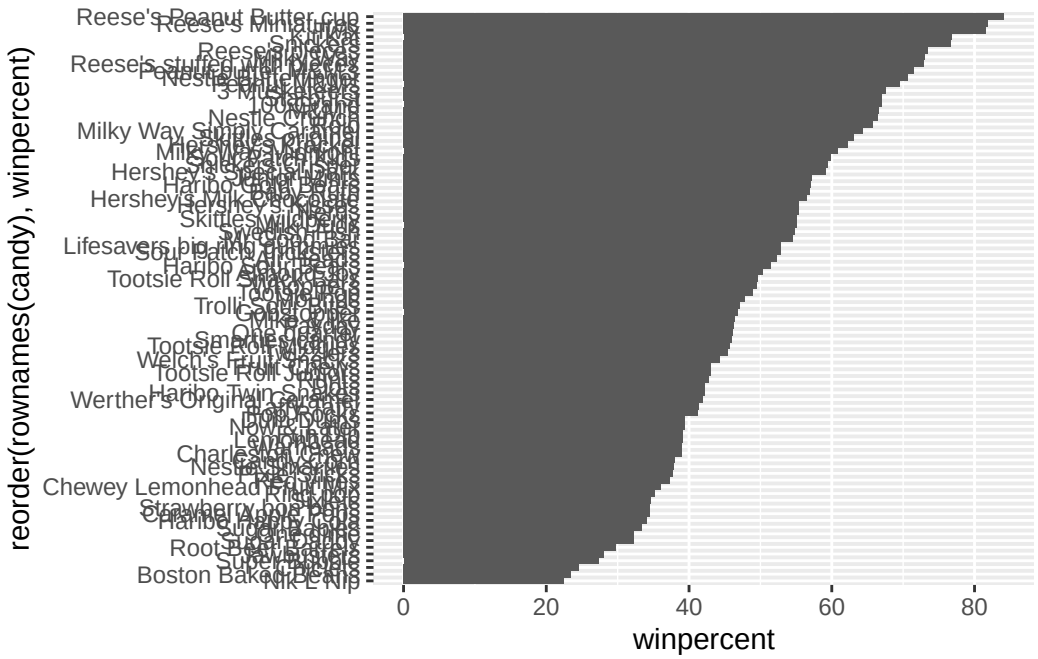
```
library(ggplot2)
```

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



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

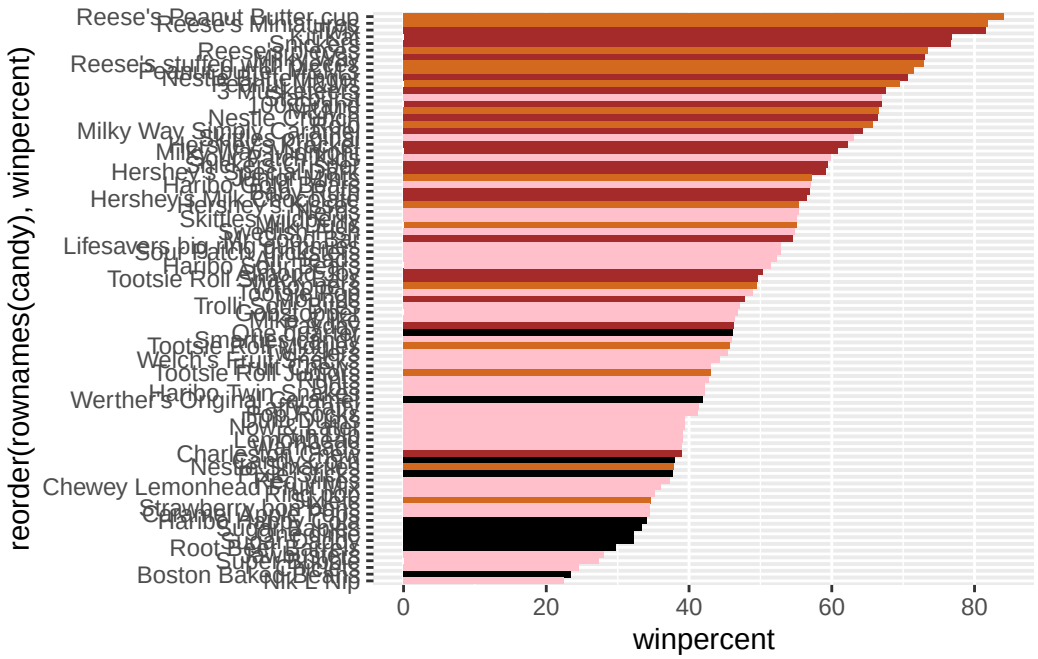
```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_col()
```



To change the color of the bars in the graph:

```
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"
```

```
ggplot(candy) +
  aes(winpercent, reorder(rownames(candy),winpercent)) +
  geom_col(fill=my_cols)
```



Q17. What is the worst ranked chocolate candy?

The worst ranked chocolate candy are sixlets as it is the shortest chocolate colored bar in the graph meaning they have the lowest win percent of all the chocolate candies.

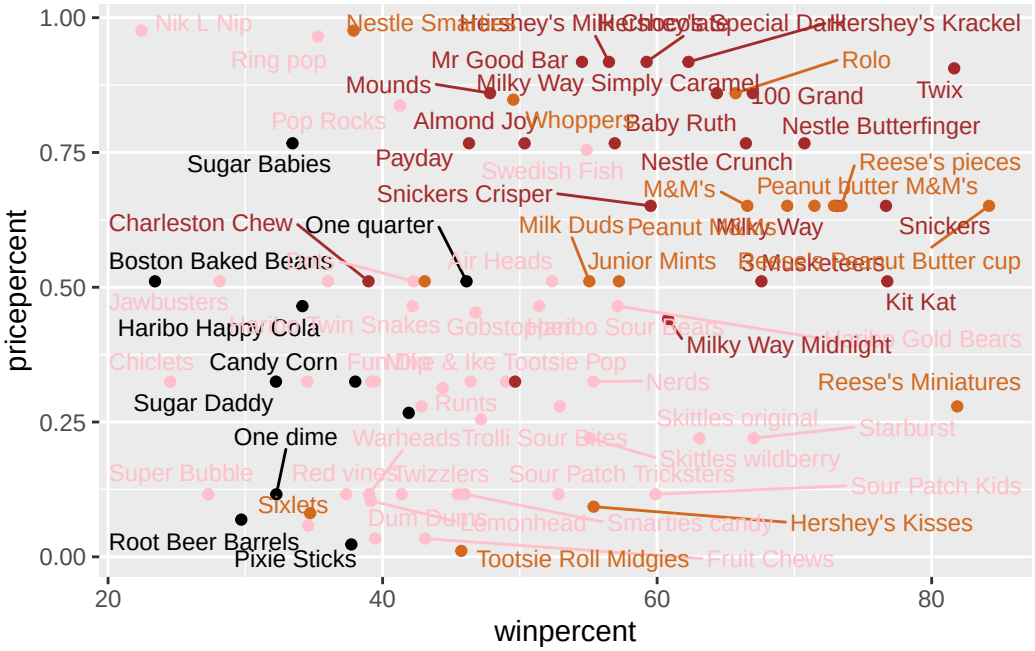
Q18. What is the best ranked fruity candy?

The best ranked fruity candy are Starbursts as they are the longest pink colored bar in the graph meaning they have the highest win percent of all the fruity candies.

Taking a look at pricepoints

```
library(ggrepel)

# How about a plot of price vs win
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols, size=3.3, max.overlaps = 15)
```

```
Warning: ggrepel: 10 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?

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

	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 Minatures are one of the highest ranked candies in terms of winpercent (2nd highest) and the cheapest (lowest pricepercent) compared to the other highly ranked candies.

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 = T)
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
```

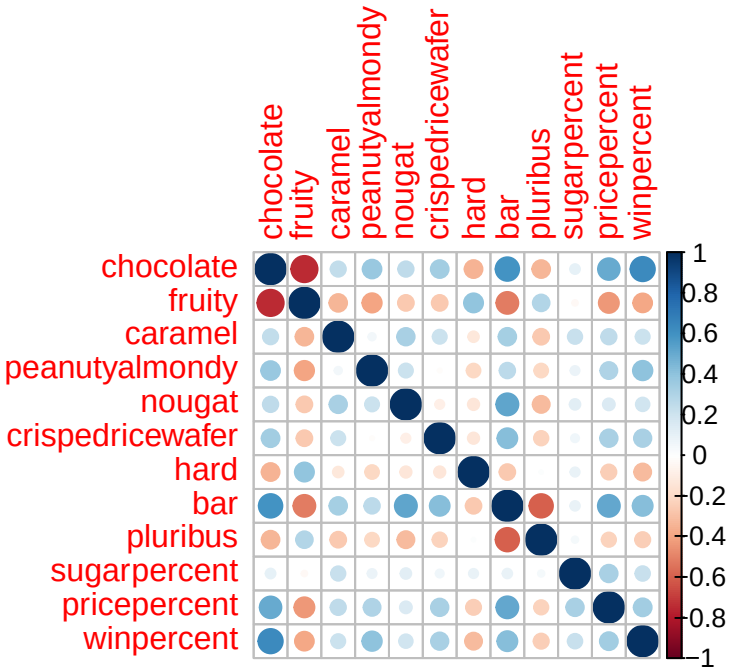
The least popular of the five most expensive candies are Nik L Nips as it has one of the highest price percents but one of the lowest win percents

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 anti-correlated which can be seen because the color is dark red which corresponds to a negative number and the circle is relatively large.

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

Not counting the strong correlation that occurs between a variable being compared to itself (which obviously has the highest correlation), the two variables that are most positively correlated are win percent and chocolate since they have a relatively large circle and it is a semi dark blue indicating a positive correlation. This shows that chocolate is a very popular candy type which is also reflected in the bar graph above.

PCA

Let's apply PCA using the prcom() function to our candy dataset remembering to set the scale=TRUE argument.

```
pca <- prcomp(candy, 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
```

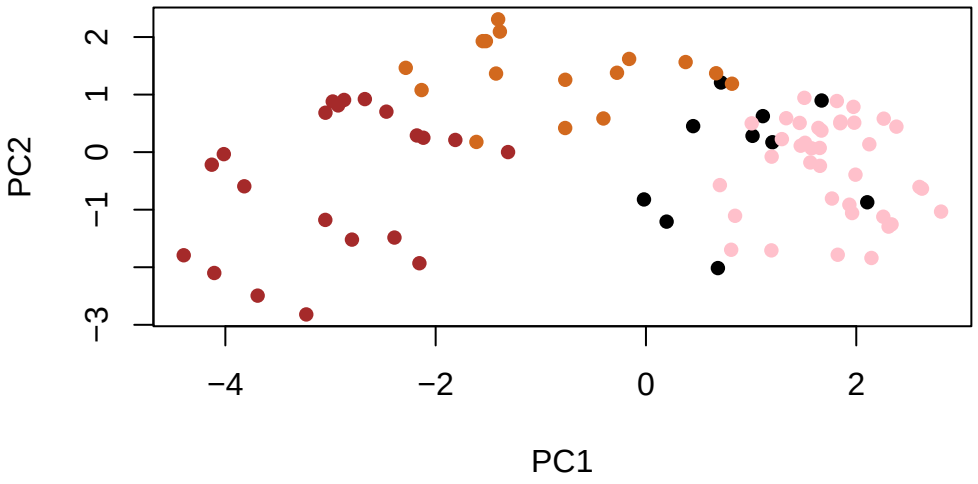
```
pca$rotation[,1]
```

```
      chocolate           fruity          caramel   peanutyalmondy
     -0.4019466        0.3683883       -0.2299709       -0.2407155
         nougat crispedricewafer             hard              bar
     -0.2268102       -0.2215182        0.2111587       -0.3947433
       pluribus     sugarpercent     pricepercent       winpercent
      0.2600041       -0.1083088       -0.3207361       -0.3298035
```

```
#by scaling the data, it makes it so the SD of PC1 isn't a huge number and allows us to be
```

Now we can plot our main PCA score plot of PC1 vs PC2.

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



Make a new data-frame with our PCA results and candy data

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

	chocolate	fruity	caramel	peanutyalmondy	nougat
100 Grand	1	0	1	0	0
3 Musketeers	1	0	0	0	1
One dime	0	0	0	0	0
One quarter	0	0	0	0	0
Air Heads	0	1	0	0	0
Almond Joy	1	0	0	1	0
Baby Ruth	1	0	1	1	1
Boston Baked Beans	0	0	0	1	0
Candy Corn	0	0	0	0	0

Caramel Apple Pops	0	1	1	0	0
Charleston Chew	1	0	0	0	1
Chewey Lemonhead Fruit Mix	0	1	0	0	0
Chiclets	0	1	0	0	0
Dots	0	1	0	0	0
Dum Dums	0	1	0	0	0
Fruit Chews	0	1	0	0	0
Fun Dip	0	1	0	0	0
Gobstopper	0	1	0	0	0
Haribo Gold Bears	0	1	0	0	0
Haribo Happy Cola	0	0	0	0	0
Haribo Sour Bears	0	1	0	0	0
Haribo Twin Snakes	0	1	0	0	0
Hershey's Kisses	1	0	0	0	0
Hershey's Krackel	1	0	0	0	0
Hershey's Milk Chocolate	1	0	0	0	0
Hershey's Special Dark	1	0	0	0	0
Jawbusters	0	1	0	0	0
Junior Mints	1	0	0	0	0
Kit Kat	1	0	0	0	0
Laffy Taffy	0	1	0	0	0
Lemonhead	0	1	0	0	0
Lifesavers big ring gummies	0	1	0	0	0
Peanut butter M&M's	1	0	0	1	0
M&M's	1	0	0	0	0
Mike & Ike	0	1	0	0	0
Milk Duds	1	0	1	0	0
Milky Way	1	0	1	0	1
Milky Way Midnight	1	0	1	0	1
Milky Way Simply Caramel	1	0	1	0	0
Mounds	1	0	0	0	0
Mr Good Bar	1	0	0	1	0
Nerds	0	1	0	0	0
Nestle Butterfinger	1	0	0	1	0
Nestle Crunch	1	0	0	0	0
Nik L Nip	0	1	0	0	0
Now & Later	0	1	0	0	0
Payday	0	0	0	1	1
Peanut M&Ms	1	0	0	1	0
Pixie Sticks	0	0	0	0	0
Pop Rocks	0	1	0	0	0
Red vines	0	1	0	0	0
Reese's Miniatures	1	0	0	1	0

Reese's Peanut Butter cup	1	0	0	1	0
Reese's pieces	1	0	0	1	0
Reese's stuffed with pieces	1	0	0	1	0
Ring pop	0	1	0	0	0
Rolo	1	0	1	0	0
Root Beer Barrels	0	0	0	0	0
Runts	0	1	0	0	0
Sixlets	1	0	0	0	0
Skittles original	0	1	0	0	0
Skittles wildberry	0	1	0	0	0
Nestle Smarties	1	0	0	0	0
Smarties candy	0	1	0	0	0
Snickers	1	0	1	1	1
Snickers Crisper	1	0	1	1	0
Sour Patch Kids	0	1	0	0	0
Sour Patch Tricksters	0	1	0	0	0
Starburst	0	1	0	0	0
Strawberry bon bons	0	1	0	0	0
Sugar Babies	0	0	1	0	0
Sugar Daddy	0	0	1	0	0
Super Bubble	0	1	0	0	0
Swedish Fish	0	1	0	0	0
Tootsie Pop	1	1	0	0	0
Tootsie Roll Juniors	1	0	0	0	0
Tootsie Roll Midgies	1	0	0	0	0
Tootsie Roll Snack Bars	1	0	0	0	0
Trolli Sour Bites	0	1	0	0	0
Twix	1	0	1	0	0
Twizzlers	0	1	0	0	0
Warheads	0	1	0	0	0
Welch's Fruit Snacks	0	1	0	0	0
Werther's Original Caramel	0	0	1	0	0
Whoppers	1	0	0	0	0

	crisped	ricewafer	hard	bar	pluribus	sugarpercent
100 Grand	1	0	1	0		0.732
3 Musketeers	0	0	1	0		0.604
One dime	0	0	0	0		0.011
One quarter	0	0	0	0		0.011
Air Heads	0	0	0	0		0.906
Almond Joy	0	0	1	0		0.465
Baby Ruth	0	0	1	0		0.604
Boston Baked Beans	0	0	0	1		0.313
Candy Corn	0	0	0	1		0.906

Caramel Apple Pops	0	0	0	0	0.604
Charleston Chew	0	0	1	0	0.604
Chewey Lemonhead Fruit Mix	0	0	0	1	0.732
Chiclets	0	0	0	1	0.046
Dots	0	0	0	1	0.732
Dum Dums	0	1	0	0	0.732
Fruit Chews	0	0	0	1	0.127
Fun Dip	0	1	0	0	0.732
Gobstopper	0	1	0	1	0.906
Haribo Gold Bears	0	0	0	1	0.465
Haribo Happy Cola	0	0	0	1	0.465
Haribo Sour Bears	0	0	0	1	0.465
Haribo Twin Snakes	0	0	0	1	0.465
Hershey's Kisses	0	0	0	1	0.127
Hershey's Krackel	1	0	1	0	0.430
Hershey's Milk Chocolate	0	0	1	0	0.430
Hershey's Special Dark	0	0	1	0	0.430
Jawbusters	0	1	0	1	0.093
Junior Mints	0	0	0	1	0.197
Kit Kat	1	0	1	0	0.313
Laffy Taffy	0	0	0	0	0.220
Lemonhead	0	1	0	0	0.046
Lifesavers big ring gummies	0	0	0	0	0.267
Peanut butter M&M's	0	0	0	1	0.825
M&M's	0	0	0	1	0.825
Mike & Ike	0	0	0	1	0.872
Milk Duds	0	0	0	1	0.302
Milky Way	0	0	1	0	0.604
Milky Way Midnight	0	0	1	0	0.732
Milky Way Simply Caramel	0	0	1	0	0.965
Mounds	0	0	1	0	0.313
Mr Good Bar	0	0	1	0	0.313
Nerds	0	1	0	1	0.848
Nestle Butterfinger	0	0	1	0	0.604
Nestle Crunch	1	0	1	0	0.313
Nik L Nip	0	0	0	1	0.197
Now & Later	0	0	0	1	0.220
Payday	0	0	1	0	0.465
Peanut M&Ms	0	0	0	1	0.593
Pixie Sticks	0	0	0	1	0.093
Pop Rocks	0	1	0	1	0.604
Red vines	0	0	0	1	0.581
Reese's Miniatures	0	0	0	0	0.034

Reese's Peanut Butter cup	0	0	0	0	0.720
Reese's pieces	0	0	0	1	0.406
Reese's stuffed with pieces	0	0	0	0	0.988
Ring pop	0	1	0	0	0.732
Rolo	0	0	0	1	0.860
Root Beer Barrels	0	1	0	1	0.732
Runts	0	1	0	1	0.872
Sixlets	0	0	0	1	0.220
Skittles original	0	0	0	1	0.941
Skittles wildberry	0	0	0	1	0.941
Nestle Smarties	0	0	0	1	0.267
Smarties candy	0	1	0	1	0.267
Snickers	0	0	1	0	0.546
Snickers Crisper	1	0	1	0	0.604
Sour Patch Kids	0	0	0	1	0.069
Sour Patch Tricksters	0	0	0	1	0.069
Starburst	0	0	0	1	0.151
Strawberry bon bons	0	1	0	1	0.569
Sugar Babies	0	0	0	1	0.965
Sugar Daddy	0	0	0	0	0.418
Super Bubble	0	0	0	0	0.162
Swedish Fish	0	0	0	1	0.604
Tootsie Pop	0	1	0	0	0.604
Tootsie Roll Juniors	0	0	0	0	0.313
Tootsie Roll Midgies	0	0	0	1	0.174
Tootsie Roll Snack Bars	0	0	1	0	0.465
Trolli Sour Bites	0	0	0	1	0.313
Twix	1	0	1	0	0.546
Twizzlers	0	0	0	0	0.220
Warheads	0	1	0	0	0.093
Welch's Fruit Snacks	0	0	0	1	0.313
Werther's Original Caramel	0	1	0	0	0.186
Whoppers	1	0	0	1	0.872

	pricepercent	winpercent	PC1	PC2
100 Grand	0.860	66.97173	-3.81986175	-0.5935787670
3 Musketeers	0.511	67.60294	-2.79602364	-1.5196062111
One dime	0.116	32.26109	1.20258363	0.1718120657
One quarter	0.511	46.11650	0.44865378	0.4519735621
Air Heads	0.511	52.34146	0.70289922	-0.5731343263
Almond Joy	0.767	50.34755	-2.46833834	0.7035501120
Baby Ruth	0.767	56.91455	-4.10531223	-2.1000967736
Boston Baked Beans	0.511	23.41782	0.71385813	1.2098216537
Candy Corn	0.325	38.01096	1.01357204	0.2834319621

Caramel Apple Pops	0.325	34.51768	0.81049645	-1.6960889498
Charleston Chew	0.511	38.97504	-2.15436587	-1.9304213037
Chewey Lemonhead Fruit Mix	0.511	36.01763	1.65268482	0.0726434944
Chiclets	0.325	24.52499	2.38180817	0.4430926071
Dots	0.511	42.27208	1.51249936	0.1623958592
Dum Dums	0.034	39.46056	2.14430933	-1.8388386160
Fruit Chews	0.034	43.08892	2.26133763	0.5818322520
Fun Dip	0.325	39.18550	1.82383348	-1.7828662094
Gobstopper	0.453	46.78335	1.96047812	-1.0584680267
Haribo Gold Bears	0.465	57.11974	1.33360746	0.5892699921
Haribo Happy Cola	0.465	34.15896	1.11167365	0.6257697808
Haribo Sour Bears	0.465	51.41243	1.46152952	0.5073691482
Haribo Twin Snakes	0.465	42.17877	1.66849016	0.3748646265
Hershey's Kisses	0.093	55.37545	0.37722675	1.5654519145
Hershey's Krackel	0.918	62.28448	-3.04788356	0.6850792787
Hershey's Milk Chocolate	0.918	56.49050	-2.11696417	0.2504568891
Hershey's Special Dark	0.918	59.23612	-2.17850376	0.2898570052
Jawbusters	0.511	28.12744	2.62491587	-0.6343671618
Junior Mints	0.511	57.21925	-0.16010610	1.6194428347
Kit Kat	0.511	76.76860	-2.87086546	0.9069655335
Laffy Taffy	0.116	41.38956	1.65450042	-0.2379605144
Lemonhead	0.104	39.14106	2.33564695	-1.2553404646
Lifesavers big ring gummies	0.279	52.91139	1.19528766	-0.0783610246
Peanut butter M&M's	0.651	71.46505	-1.52223814	1.9291395890
M&M's	0.651	66.57458	-0.76747561	1.2573539136
Mike & Ike	0.325	46.41172	1.57487290	0.0664259746
Milk Duds	0.511	55.06407	-0.76836937	0.4192793946
Milky Way	0.651	73.09956	-3.69272218	-2.4933313173
Milky Way Midnight	0.441	60.80070	-3.23036513	-2.8201031327
Milky Way Simply Caramel	0.860	64.35334	-3.04936226	-1.1774777304
Mounds	0.860	47.82975	-1.81292795	0.2120726312
Mr Good Bar	0.918	54.52645	-2.67327849	0.9217207344
Nerds	0.325	55.35405	1.93426895	-0.9133307225
Nestle Butterfinger	0.767	70.73564	-2.97855081	0.8798835368
Nestle Crunch	0.767	66.47068	-2.92740488	0.8119013154
Nik L Nip	0.976	22.44534	1.63985272	0.4210217322
Now & Later	0.325	39.44680	1.98070982	0.5117150919
Payday	0.767	46.29660	-2.39180556	-1.4839637512
Peanut M&Ms	0.651	69.48379	-1.38897069	2.0947188031
Pixie Sticks	0.023	37.72234	1.67042227	0.8969792365
Pop Rocks	0.837	41.26551	1.76879348	-0.8060325640
Red vines	0.116	37.34852	2.12406849	0.1366822960
Reese's Miniatures	0.279	81.86626	-1.55210251	1.9287569793

Reese's Peanut Butter cup	0.651	84.18029	-2.28427985	1.4648923293
Reese's pieces	0.651	73.43499	-1.40590761	2.3077984818
Reese's stuffed with pieces	0.651	72.88790	-2.13382398	1.0787289654
Ring pop	0.965	35.29076	1.19274412	-1.7069749284
Rolo	0.860	65.71629	-1.61259322	0.1773734932
Root Beer Barrels	0.069	29.70369	2.10440254	-0.8711340556
Runts	0.279	42.84914	2.25699185	-1.1223199934
Sixlets	0.081	34.72200	0.81799664	1.1888290122
Skittles original	0.220	63.08514	1.29259129	0.2263705137
Skittles wildberry	0.220	55.10370	1.47148517	0.1118354559
Nestle Smarties	0.976	37.88719	-0.27556563	1.3792344137
Smarties candy	0.116	45.99583	2.60115214	-0.6047947520
Snickers	0.651	76.67378	-4.39576792	-1.7919312516
Snickers Crisper	0.651	59.52925	-4.01457335	-0.0347673522
Sour Patch Kids	0.116	59.86400	1.81551769	0.8879445215
Sour Patch Tricksters	0.116	52.82595	1.97326660	0.7869473239
Starburst	0.220	67.03763	1.50658493	0.9437290830
Strawberry bon bons	0.058	34.57899	2.80647837	-1.0331193111
Sugar Babies	0.767	33.43755	-0.01900559	-0.8219542293
Sugar Daddy	0.325	32.23100	0.19642038	-1.2073694698
Super Bubble	0.116	27.30386	1.99242820	-0.3915898648
Swedish Fish	0.755	54.86111	1.00547407	0.5003327040
Tootsie Pop	0.325	48.98265	0.84734171	-1.1060686710
Tootsie Roll Juniors	0.511	43.06890	-0.40463667	0.5848580362
Tootsie Roll Midgies	0.011	45.73675	0.66730732	1.3709464980
Tootsie Roll Snack Bars	0.325	49.65350	-1.31149842	0.0009721286
Trolli Sour Bites	0.255	47.17323	1.85048456	0.5304055168
Twix	0.906	81.64291	-4.12909044	-0.2180299573
Twizzlers	0.116	45.46628	1.56312584	-0.1794588354
Warheads	0.116	39.01190	2.30707033	-1.2940268825
Welch's Fruit Snacks	0.313	44.37552	1.84808801	0.5022006184
Werther's Original Caramel	0.267	41.90431	0.68420363	-2.0146385440
Whoppers	0.848	49.52411	-1.42549552	1.3654147702

	PC3
100 Grand	2.186308676
3 Musketeers	-1.412198551
One dime	-2.060771178
One quarter	-1.476492844
Air Heads	0.929389343
Almond Joy	-0.858108916
Baby Ruth	-1.347834706
Boston Baked Beans	-0.941899950
Candy Corn	0.840681586

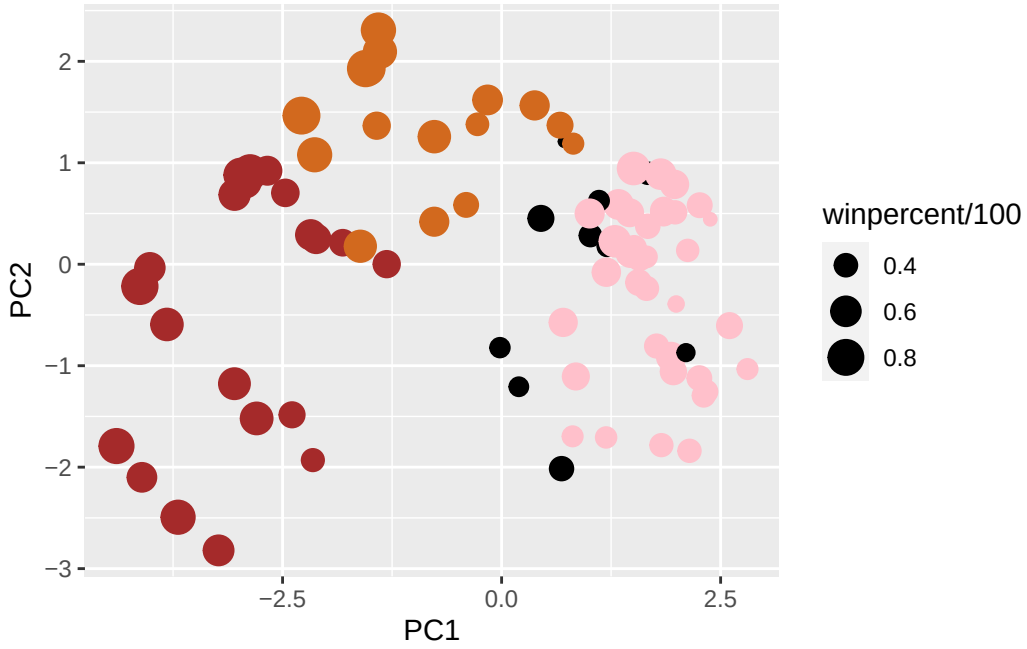
```
Caramel Apple Pops           0.207020586
Charleston Chew             -1.675469334
Chewey Lemonhead Fruit Mix   0.909617411
Chiclets                    -1.000422079
Dots                         0.967135199
Dum Dums                     0.385372660
Fruit Chews                 -0.978626618
Fun Dip                      0.719415821
Gobstopper                   1.873874385
Haribo Gold Bears            0.431929774
Haribo Happy Cola           -0.054459647
Haribo Sour Bears            0.379443632
Haribo Twin Snakes           0.294528131
Hershey's Kisses            -1.104739528
Hershey's Krackel            1.154357778
Hershey's Milk Chocolate    -0.218316614
Hershey's Special Dark      -0.193067056
Jawbusters                  -0.114043053
Junior Mints                -0.442156347
Kit Kat                      0.545771148
Laffy Taffy                 -1.217408326
Lemonhead                   -1.125823900
Lifesavers big ring gummies -0.814040659
Peanut butter M&M's          0.815897653
M&M's                        1.260658369
Mike & Ike                   1.114406454
Milk Duds                    0.137573021
Milky Way                   -0.843423990
Milky Way Midnight          -0.902884388
Milky Way Simply Caramel     1.382617058
Mounds                      -0.636094539
Mr Good Bar                 -0.997161433
Nerds                        1.670281710
Nestle Butterfinger         -0.348599786
Nestle Crunch                0.747159803
Nik L Nip                    0.083217936
Now & Later                 -0.460099768
Payday                      -2.091687409
Peanut M&Ms                  0.260214925
Pixie Sticks                -1.394703254
Pop Rocks                    1.567639814
Red vines                    0.115183020
Reese's Miniatures          -1.884620322
```

```
Reese's Peanut Butter cup    0.156138940
Reese's pieces              -0.136661895
Reese's stuffed with pieces  0.673152403
Ring pop                     1.423826969
Rolo                         1.931879747
Root Beer Barrels            0.594335570
Runts                        1.557678507
Sixlets                     -1.093105891
Skittles original            1.306145308
Skittles wildberry           1.232745536
Nestle Smarties              0.080047831
Smarties candy              -0.003482896
Snickers                    -1.434654778
Snickers Crisper             1.089868643
Sour Patch Kids             -0.863881832
Sour Patch Tricksters       -0.928605869
Starburst                   -0.487658690
Strawberry bon bons          0.524069119
Sugar Babies                 1.802826526
Sugar Daddy                 -0.520140143
Super Bubble                -1.481310204
Swedish Fish                 1.068588828
Tootsie Pop                  0.480874078
Tootsie Roll Juniors        -0.836999949
Tootsie Roll Midgies        -1.179339290
Tootsie Roll Snack Bars     -0.885976952
Trolli Sour Bites           -0.254559391
Twix                         1.943536689
Twizzlers                   -1.179917535
Warheads                    -1.004249910
Welch's Fruit Snacks        -0.213204782
Werther's Original Caramel  -0.506488679
Whoppers                     2.759982292
```

Create a new plot using ggplot and the new data frame

```
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)
```

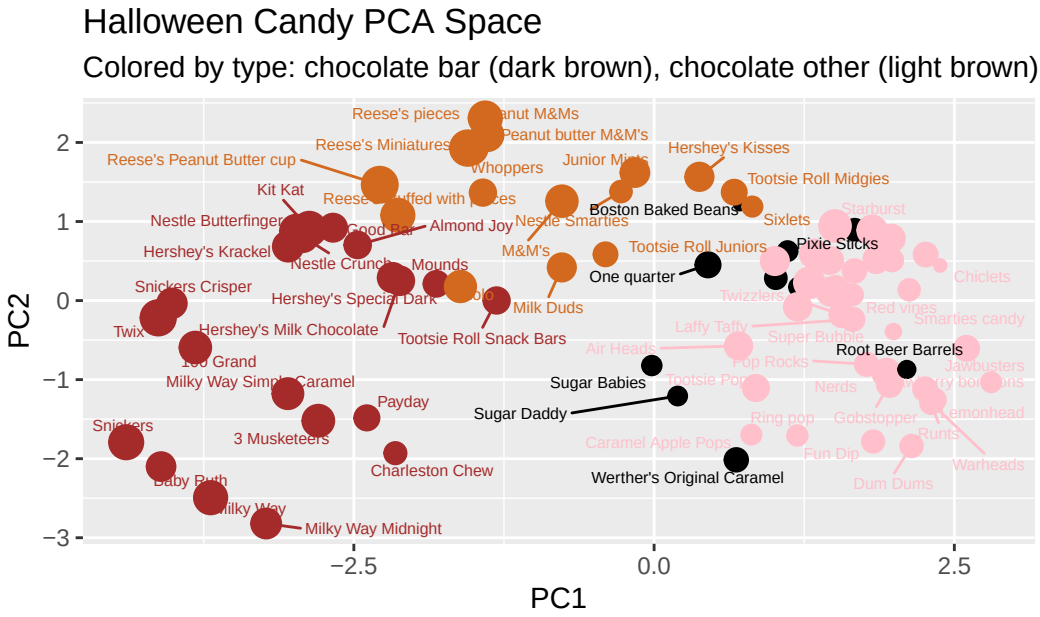
```
p
```



Label the plot with candy names and add a title and subtitle

```
library(ggrepel)

p + geom_text_repel(size=2, col=my_cols, max.overlaps = 15)  +
  theme(legend.position = "none") +
  labs(title="Halloween Candy PCA Space",
       subtitle="Colored by type: chocolate bar (dark brown), chocolate other (light brown
       caption="Data from 538")
```

```
Warning: ggrepel: 20 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```



Data from 538

Generate an interactive plot

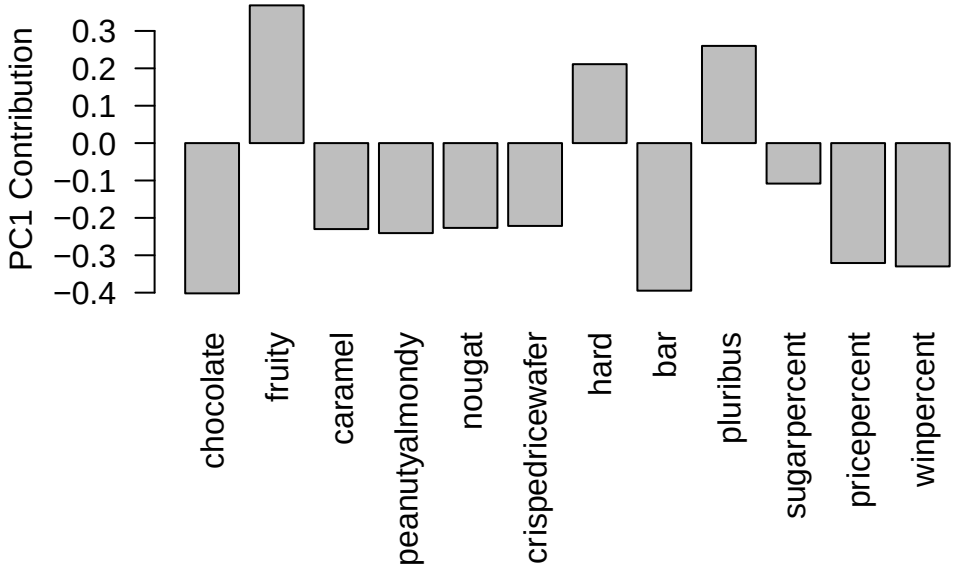
```
library(plotly)
```

```
Attaching package: 'plotly'

The following object is masked from 'package:ggplot2':

    last_plot

The following object is masked from 'package:stats':

    filter

The following object is masked from 'package:graphics':

    layout
```

```
#ggplotly(p)
```

Let's finish by taking a quick look at PCA our loadings. Do these make sense to you? Notice the opposite effects of chocolate and fruity and the similar effects of chocolate and bar (i.e. we already know they are correlated).

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



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

The variables fruity, hard, and pluribus are picked up by PC1 in the positive direction. This makes sense to me because when you look at the previous graphs (the colored bar graph and other PC1 graphs) and the data table, the fruity candy (which is typically hard and pluribus) has a lower win percent score than the other types of candy. It has a positive PC1 score (seen in the PC1 and PC2 graphs) because it's low win percent score is the main cause for variation within the data set. The variation it causes is the reason it is picked up strongly by PC1 in the positive direction.