

# Class 10- Halloween mini project

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## Background

as it is nearly halloween and the half way point in the quarter lets do a mini project to help us figure out the best candy!

out come from 538 website and its available as CSV file:

## Data export

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

	chocolate	fruity	caramel	peanut	almond	nougat	crisped	rice	wafer
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

```
library(flextable)
```

Warning: package 'flextable' was built under R version 4.5.2

```
flextable::flextable( head(candy, 10) )
```

chocolate	fruity	caramel	peanut	almond	nougat	crispedrice	wafer	hard	bar	pluribus	sugarpercent
1	0	1	0	0	0	1	0	0	1	0	0.732
1	0	0	0	0	1	0	0	0	1	0	0.604
0	0	0	0	0	0	0	0	0	0	0	0.011
0	0	0	0	0	0	0	0	0	0	0	0.011
0	1	0	0	0	0	0	0	0	0	0	0.906
1	0	0	1	0	0	0	0	0	1	0	0.465
1	0	1	1	1	0	0	0	0	1	0	0.511
0	0	0	1	0	0	0	0	0	0	1	0.511
0	0	0	0	0	0	0	0	0	0	1	0.511
0	1	1	0	0	0	0	0	0	0	0	0.767

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
```

my favorite candy winpercent

```
candy["Twix",]$winpercent
```

```
[1] 81.64291
```

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

Q4. What is the winpercent value for "Kit Kat"? Q5. What is the winpercent value for "Tootsie Roll Snack Bars"?

```
library(dplyr)
```

Adjuntando el paquete: 'dplyr'

The following objects are masked from 'package:stats':

filter, lag

The following objects are masked from 'package:base':

intersect, setdiff, setequal, union

```
candy |>
  filter(rownames(candy)=="twix") |>
  select (winpercent)
```

```
[1] winpercent
<0 rows> (o 0- extensión row.names)
```

## quick overview

```
library("skimr")
```

Warning: package 'skimr' was built under R version 4.5.2

```
skim(candy)
```

Table 2: 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	
peanutyalmond	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)
```

Table 4: 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	
peanutyalmond	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 winpercent is on a 0-100 scale the rest are 0-1 scale.

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

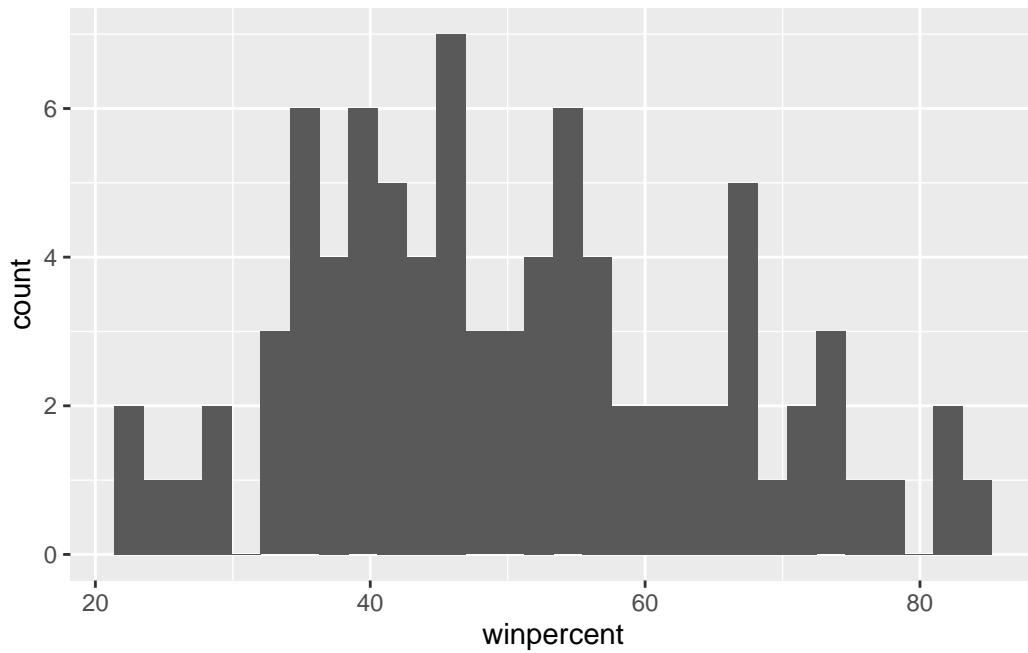
That the candy doesn't contain chocolate

Q8. Plot a histogram of winpercent values

```
library(ggplot2)

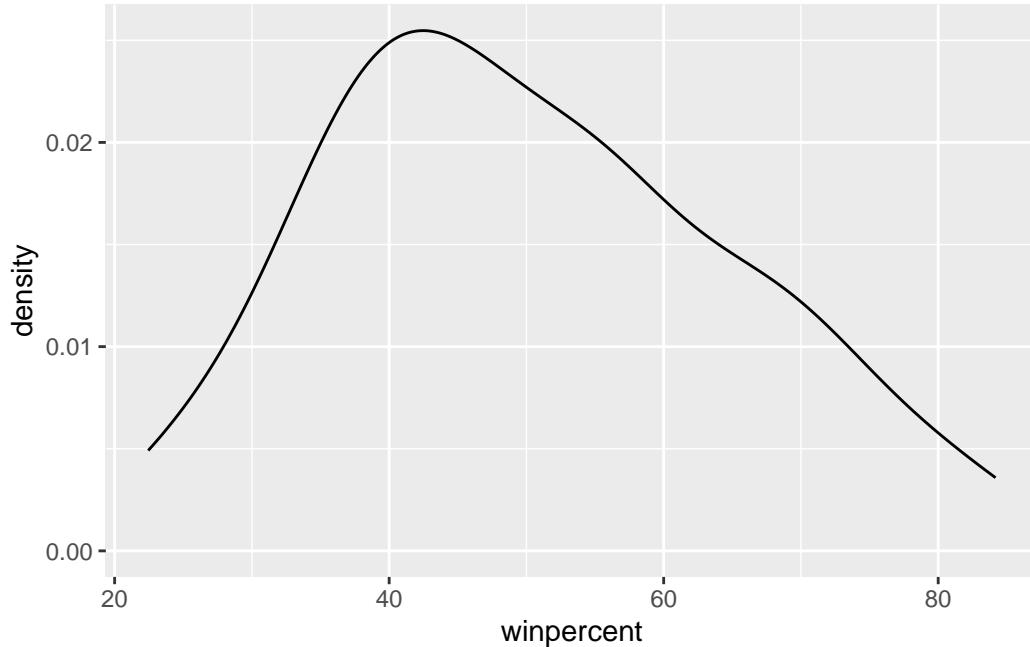
ggplot(candy) +
  aes(winpercent) +
  geom_histogram(bins=20)
```

```
Warning in geom_histogram(binds = 20): Ignoring unknown parameters: `binds`  
`stat_bin()` using `bins = 30`. Pick better value `binwidth`.
```



Q9. Is the distribution of winpercent values symmetrical?

```
ggplot(candy)+  
  aes(winpercent)+  
  geom_density()
```



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

```
mean(candy$winpercent)
```

```
[1] 50.31676
```

```
summary(candy$winpercent)
```

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
	22.45	39.14	47.83	50.32	59.86	84.18

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

```
#1. find all chocolate in the candy data set
#2. find their winpercent value
#3. calculate the mean of these values

#4-6.do the same for the fruity candy
#7 compare mean winpercents of the chocolate vs fruity
#8 pick the highest as the winner

choc.ind <- candy$chocolate==1
```

```
choc.win<-candy[choc.inds,]$winpercent  
choc.mean<- mean(choc.win)  
choc.mean
```

```
[1] 60.92153
```

```
mean(candy[candy$chocolate==1,]$winpercent)
```

```
[1] 60.92153
```

```
mean(candy[candy$fruity==1,]$winpercent)
```

```
[1] 44.11974
```

```
fruity.inds <-candy$fruity==1  
fruity.win<-candy[fruity.inds,]$winpercent  
fruity.mean<- mean(fruity.win)  
fruity.mean
```

```
[1] 44.11974
```

```
candy|>  
  filter(chocolate==1)|>  
  select (winpercent)
```

	winpercent
100 Grand	66.97173
3 Musketeers	67.60294
Almond Joy	50.34755
Baby Ruth	56.91455
Charleston Chew	38.97504
Hershey's Kisses	55.37545
Hershey's Krackel	62.28448
Hershey's Milk Chocolate	56.49050
Hershey's Special Dark	59.23612
Junior Mints	57.21925
Kit Kat	76.76860
Peanut butter M&M's	71.46505

M&M's	66.57458
Milk Duds	55.06407
Milky Way	73.09956
Milky Way Midnight	60.80070
Milky Way Simply Caramel	64.35334
Mounds	47.82975
Mr Good Bar	54.52645
Nestle Butterfinger	70.73564
Nestle Crunch	66.47068
Peanut M&Ms	69.48379
Reese's Miniatures	81.86626
Reese's Peanut Butter cup	84.18029
Reese's pieces	73.43499
Reese's stuffed with pieces	72.88790
Rolo	65.71629
Sixlets	34.72200
Nestle Smarties	37.88719
Snickers	76.67378
Snickers Crisper	59.52925
Tootsie Pop	48.98265
Tootsie Roll Juniors	43.06890
Tootsie Roll Midgies	45.73675
Tootsie Roll Snack Bars	49.65350
Twix	81.64291
Whoppers	49.52411

Q12. Is this difference statistically significant?

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

Welch Two Sample t-test

```
data: choc.win and fruity.win
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
```

## Overall Candy Ranking

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

```
candy |>
  arrange(winpercent) |>
  head(5)
```

	chocolate	fruity	caramel	peanuty	almondy	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	
	crispedrice	wafers	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						

```
x<-c(5,1,10,4)
#sort(x)
order(x)
```

[1] 2 4 1 3

```
#(candy$winpercent)
```

```
ord.ind<-order(candy$winpercent)
head(candy[rev(ord.ind),],5)
```

	chocolate	fruity	caramel	peanuty	almondy	nougat
Reese's Peanut Butter cup	1	0	0		1	0

	crisped	rice	wafer	hard	bar	pluribus	sugar	percent
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	
	price	percent		win	percent			
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						

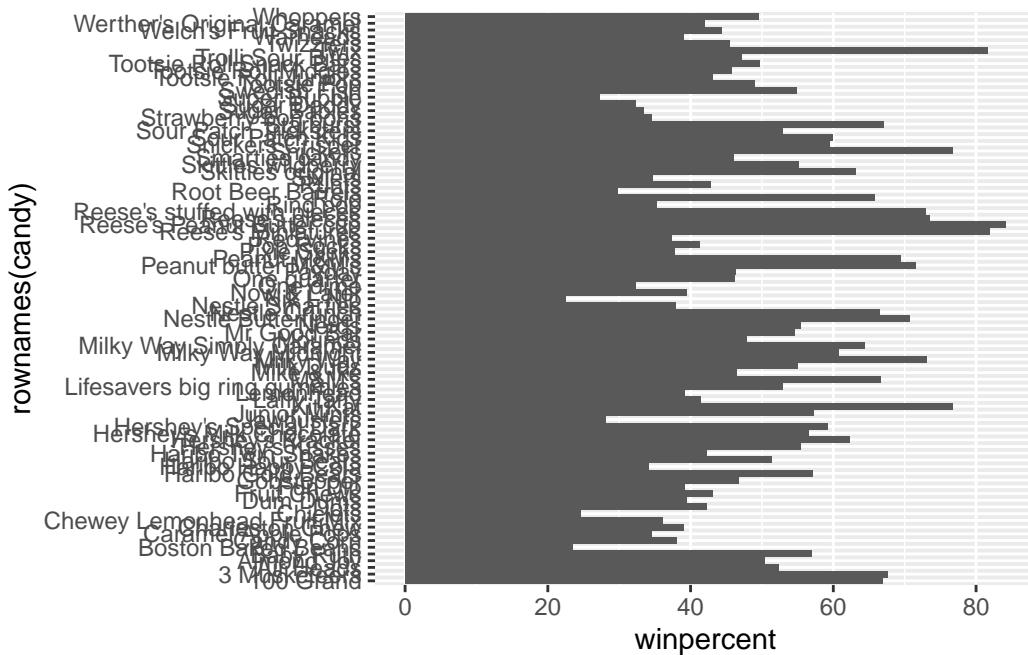
Q14. What are the top 5 all time favorite candy types out of this set?

```
candy |>
  arrange(winpercent) |>
  head(5)
```

	chocolate	fruity	caramel	peanut	yalmond	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		
	crisped	rice	wafer	hard	bar	pluribus	sugar	percent
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
	win	percent						
Nik L Nip		22.44534						
Boston Baked Beans		23.41782						
Chiclets		24.52499						
Super Bubble		27.30386						
Jawbusters		28.12744						

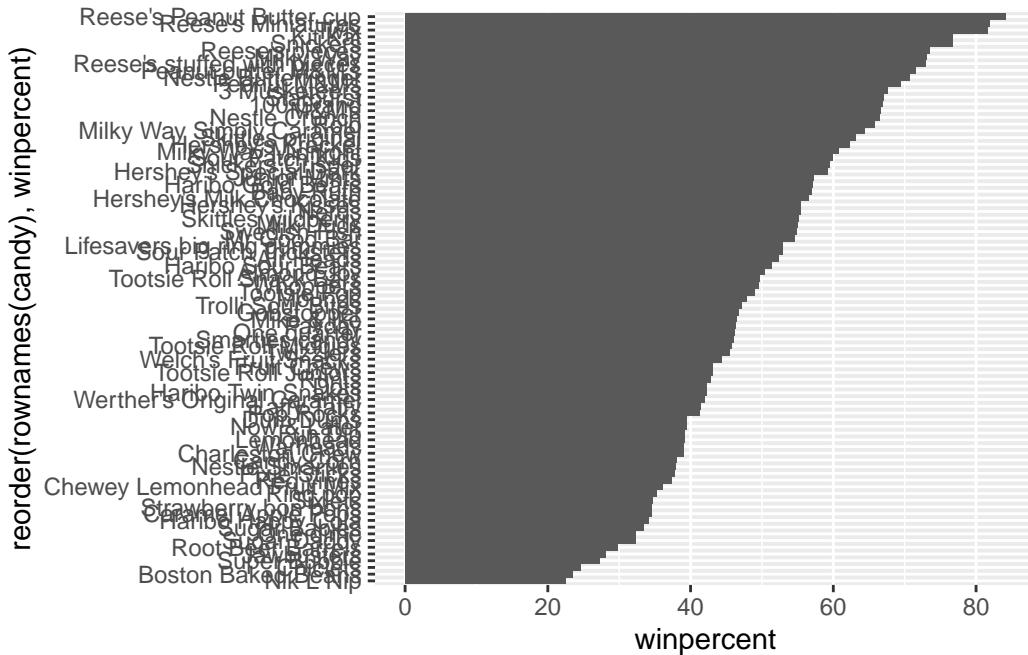
Q15. Make a first barplot of candy ranking based on winpercent values.

```
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(x=winpercent,  
      y=reorder (rownames(candy), winpercent))+  
  geom_col()
```



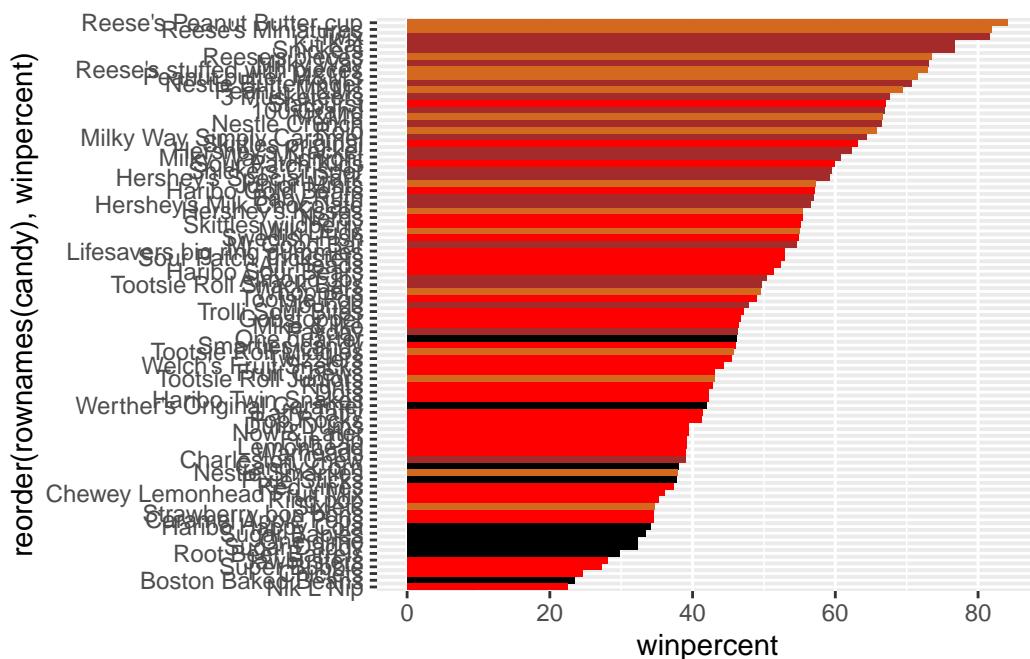
add some color based on the “type of candy”

```
my_cols<-rep("black",nrow(candy))
my_cols[as.logical(candy$chocolate)]<-"chocolate"
my_cols[as.logical(candy$fruity)]<-"red"
my_cols[as.logical(candy$bar)]<- "brown"
my_cols
```

[1]	"brown"	"brown"	"black"	"black"	"red"	"brown"
[7]	"brown"	"black"	"black"	"red"	"brown"	"red"
[13]	"red"	"red"	"red"	"red"	"red"	"red"
[19]	"red"	"black"	"red"	"red"	"chocolate"	"brown"
[25]	"brown"	"brown"	"red"	"chocolate"	"brown"	"red"
[31]	"red"	"red"	"chocolate"	"chocolate"	"red"	"chocolate"
[37]	"brown"	"brown"	"brown"	"brown"	"brown"	"red"
[43]	"brown"	"brown"	"red"	"red"	"brown"	"chocolate"
[49]	"black"	"red"	"red"	"chocolate"	"chocolate"	"chocolate"
[55]	"chocolate"	"red"	"chocolate"	"black"	"red"	"chocolate"
[61]	"red"	"red"	"chocolate"	"red"	"brown"	"brown"
[67]	"red"	"red"	"red"	"red"	"black"	"black"
[73]	"red"	"red"	"red"	"chocolate"	"chocolate"	"brown"
[79]	"red"	"brown"	"red"	"red"	"red"	"black"
[85]	"chocolate"					

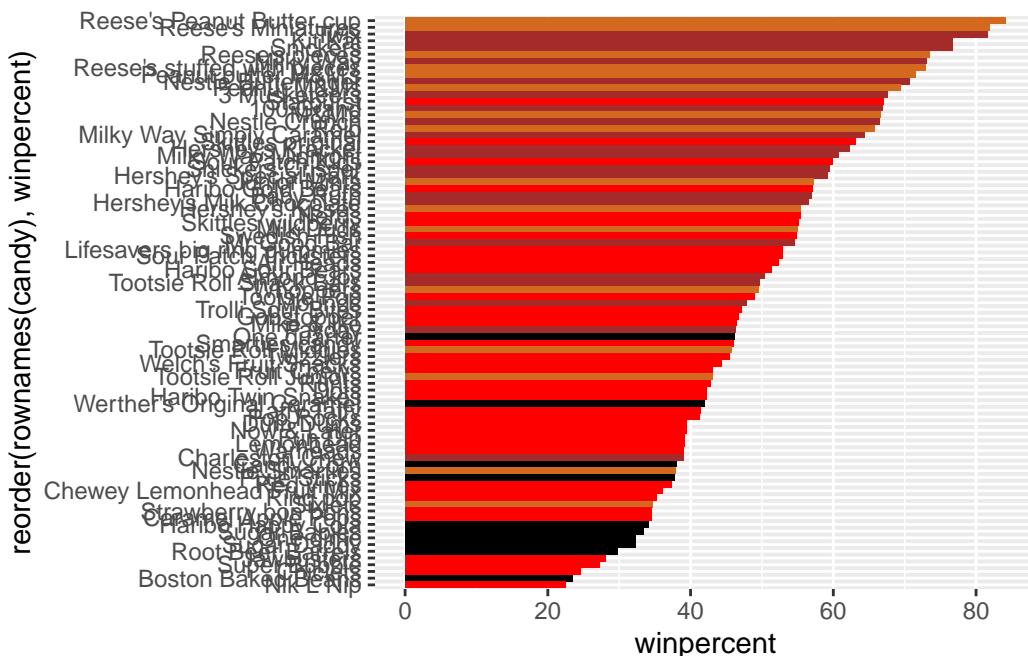
```
ggplot(candy) +
  aes(x=winpercent,
      y=reorder (rownames(candy), winpercent))+
```

geom\_col(fill=my\_cols)



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

geom\_col(fill=my\_cols)



## Winpercent and pricepercent

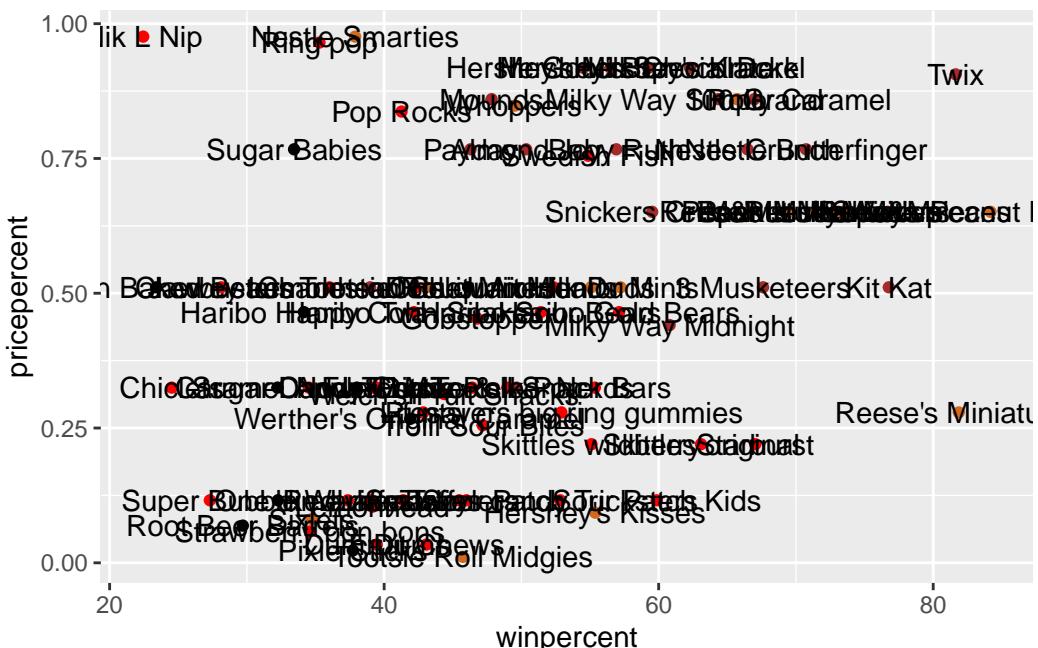
a plot with both variables/columns winpercent and pricepercent

```
my_cols[as.logical(candy$fruity)]<-"red"

ggplot(candy) +
  aes(winpercent,pricepercent,
      label=row.names(candy))+
```

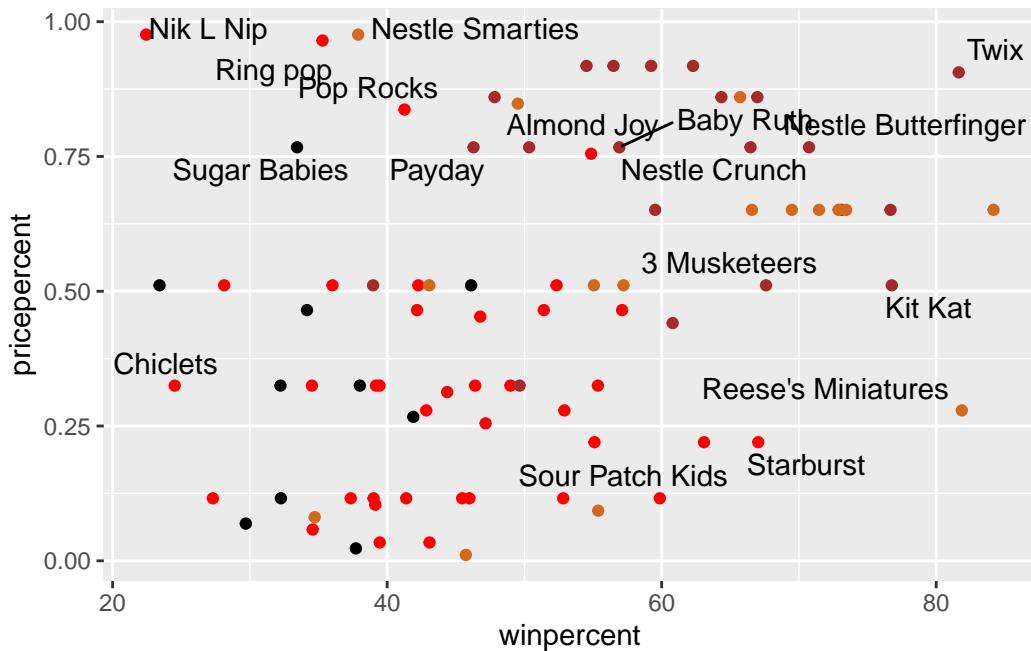
geom\_point(col=my\_cols)+

geom\_text()



```
library(ggrepel)
ggplot(candy) +
  aes(winpercent, pricepercent,
      label=row.names(candy)) +
  geom_point(col=my_cols) +
  geom_text_repel(max.overlaps=7)
```

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



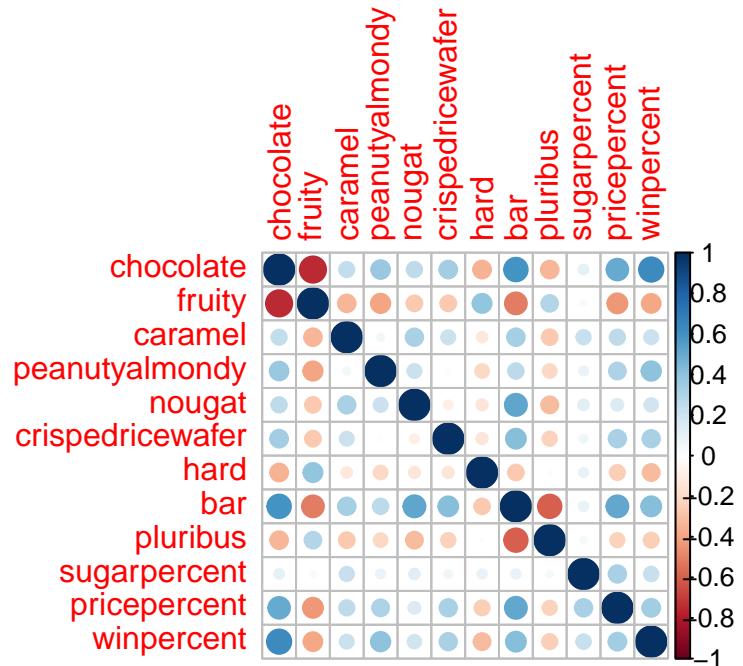
### Exploring the correlation structure

Now that we've explored the dataset a little, we'll see how the variables interact with one another. We'll use correlation and view the results with the corrplot package to plot a correlation matrix.

```
library(corrplot)
```

```
corrplot 0.95 loaded
```

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



## Principal Component Analysis

the function to use is called `prcomp()` with an optional `scale=T/F` argument.

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

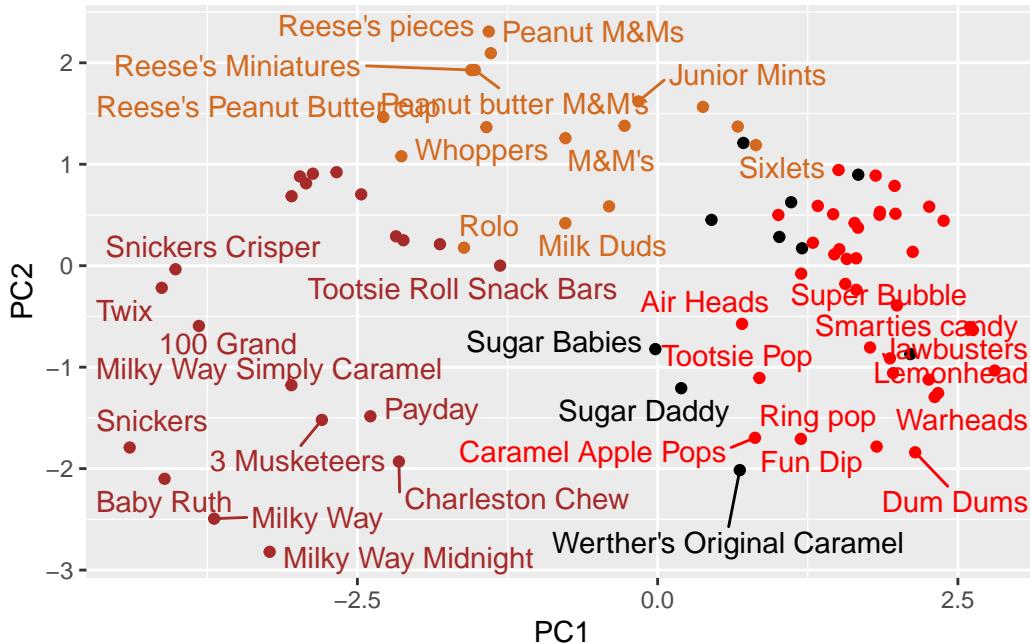
Importance of components:

	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Standard deviation	2.0788	1.1378	1.1092	1.0753	0.9518	0.8192	0.8153
Proportion of Variance	0.3601	0.1079	0.1025	0.0963	0.0755	0.0559	0.0553
Cumulative Proportion	0.3601	0.4680	0.5705	0.6668	0.7424	0.7983	0.8536
	PC8	PC9	PC10	PC11	PC12		
Standard deviation	0.7453	0.6782	0.6234	0.4397	0.3976		
Proportion of Variance	0.0462	0.0383	0.0323	0.0161	0.0131		
Cumulative Proportion	0.8999	0.9383	0.9707	0.9868	1.0000		

our main PCA results figure:

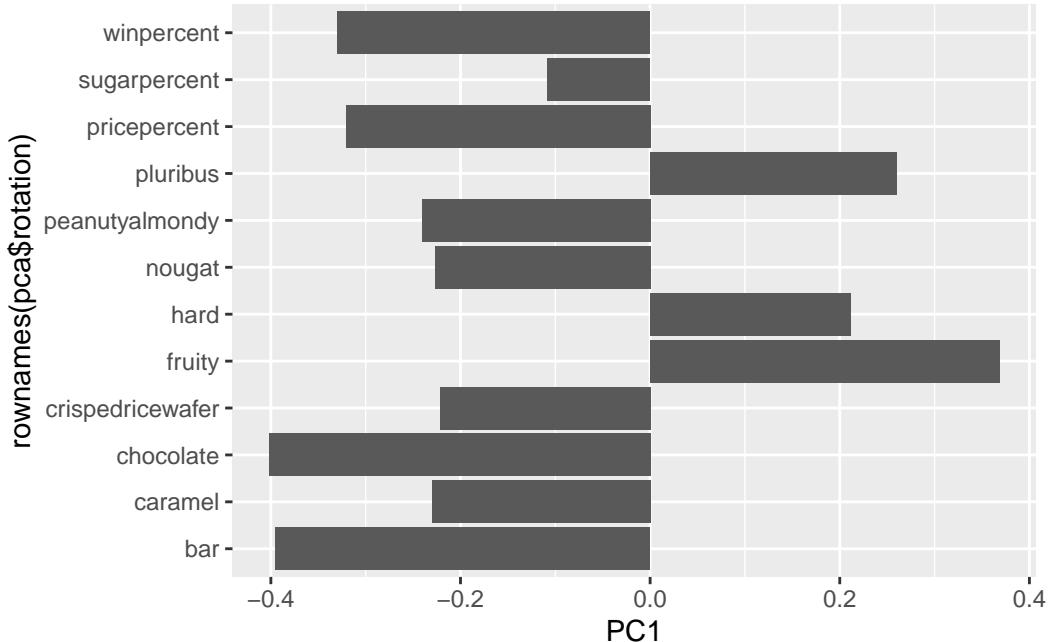
```
ggplot(pca$x) +
  aes(PC1,PC2,label=rownames(pca$x)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols)
```

Warning: ggrepel: 48 unlabeled data points (too many overlaps). Consider increasing max.overlaps



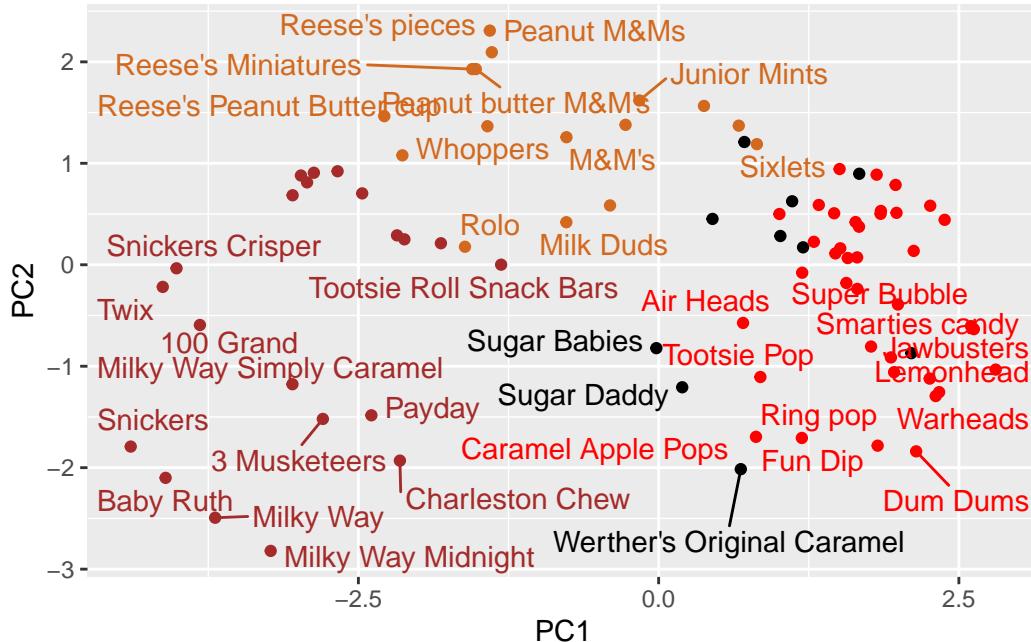
we should also examine the variable “loadings” or contributions of the original variables to the new PCs

```
ggplot(pca$rotation) +
  aes(PC1,rownames(pca$rotation)) +
  geom_col()
```



```
ggplot(pca$x) +
  aes(PC1,PC2,label=rownames(pca$x)) +
  geom_point(col=my_cols) +
  geom_text_repel(col=my_cols)
```

Warning: ggrepel: 48 unlabeled data points (too many overlaps). Consider increasing max.overlaps



interactive plots can be zoomed on and “brushed” over can be made with **plotly** package. Its output is interactive and will not render to PDF

```
library(plotly)
```

```
Warning: package 'plotly' was built under R version 4.5.2
```

```
Adjuntando el paquete: 'plotly'
```

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

```
last_plot
```

```
The following objects are masked from 'package:flextable':
```

```
highlight, style
```

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

```
filter
```

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

layout

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

