Class 09: Halloween Mini Project

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##Halloween Mini Project

Today is Halloween and we will aplly lots of the analysis methods and R graphics approaches to find out all about typical Halloween candy.

Importing candy data

```
candy_file <- "candy-data.csv"
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
```

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

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

```
[1] 38
```

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

```
#My favorite candy in the dataset is Junior Mints
candy["Junior Mints", ]$winpercent
```

```
[1] 57.21925
```

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
```

`skimr::skim()` function gives you a quick overview of a given dataset

```
#install skimr package install.packages("skimr")
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?

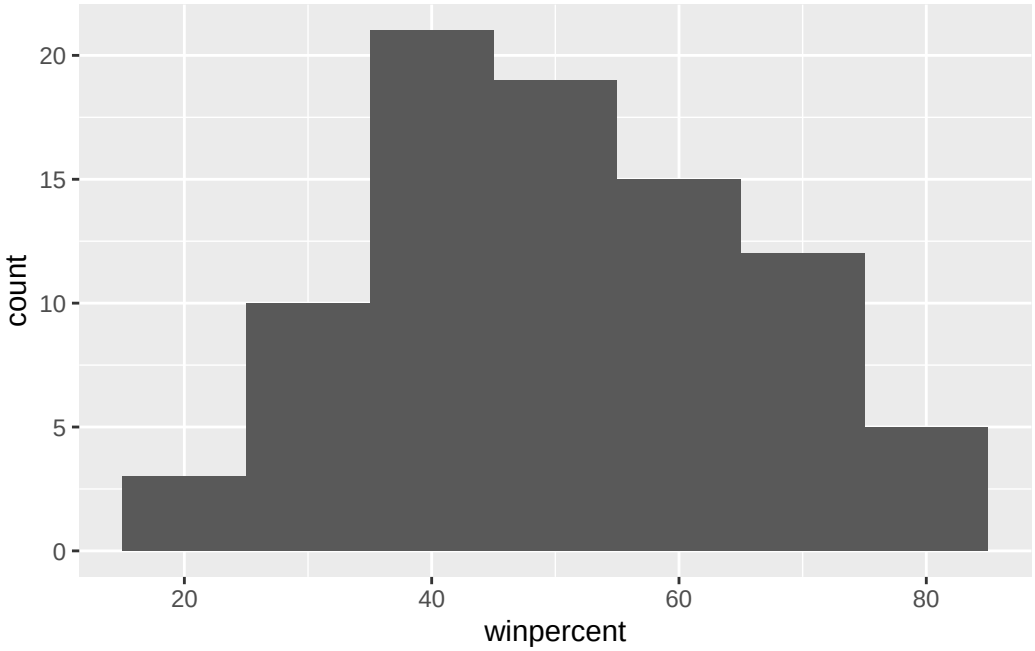
Yes, the winpercent appears to be on a different scale.

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

Zero represents that the candy is not considered a chocolate and one represents it is.

Q8. Plot a histogram of winpercent values

```
library(ggplot2)
ggplot(candy,aes(winpercent)) +geom_histogram(binwidth=10)
```



Q9. Is the distribution of winpercent values symmetrical?

The distribution of winpercent values are not symmetrical past on the histogram.

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?

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

mean(candy_chocolate) > mean(candy_fruity)
```

```
[1] TRUE
```

On average, chocolate candy is higher ranked than fruit candy.

Q12. Is this difference statistically significant?

```
t.test(candy_chocolate, candy_fruity)
```

```
    Welch Two Sample t-test

data:  candy_chocolate and candy_fruity
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 difference is statistically significant because the p-value is >0.05.

Overall Candy Rankings

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

```
#using tidyverse
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
```

```
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
```

```
#by ascending order
```

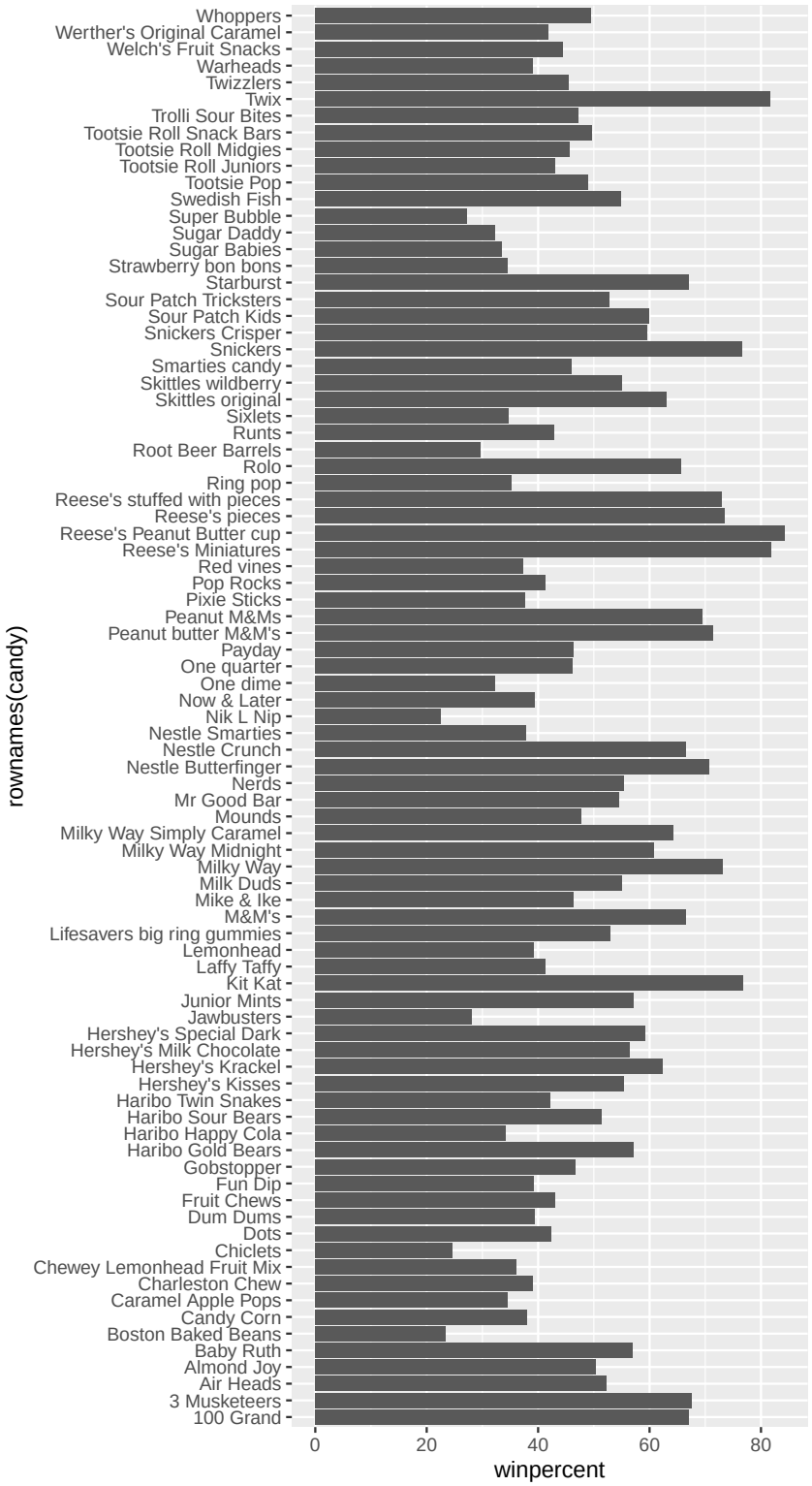
Q14. What are the top 5 all time favorite candy types out of this set?

```
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
```

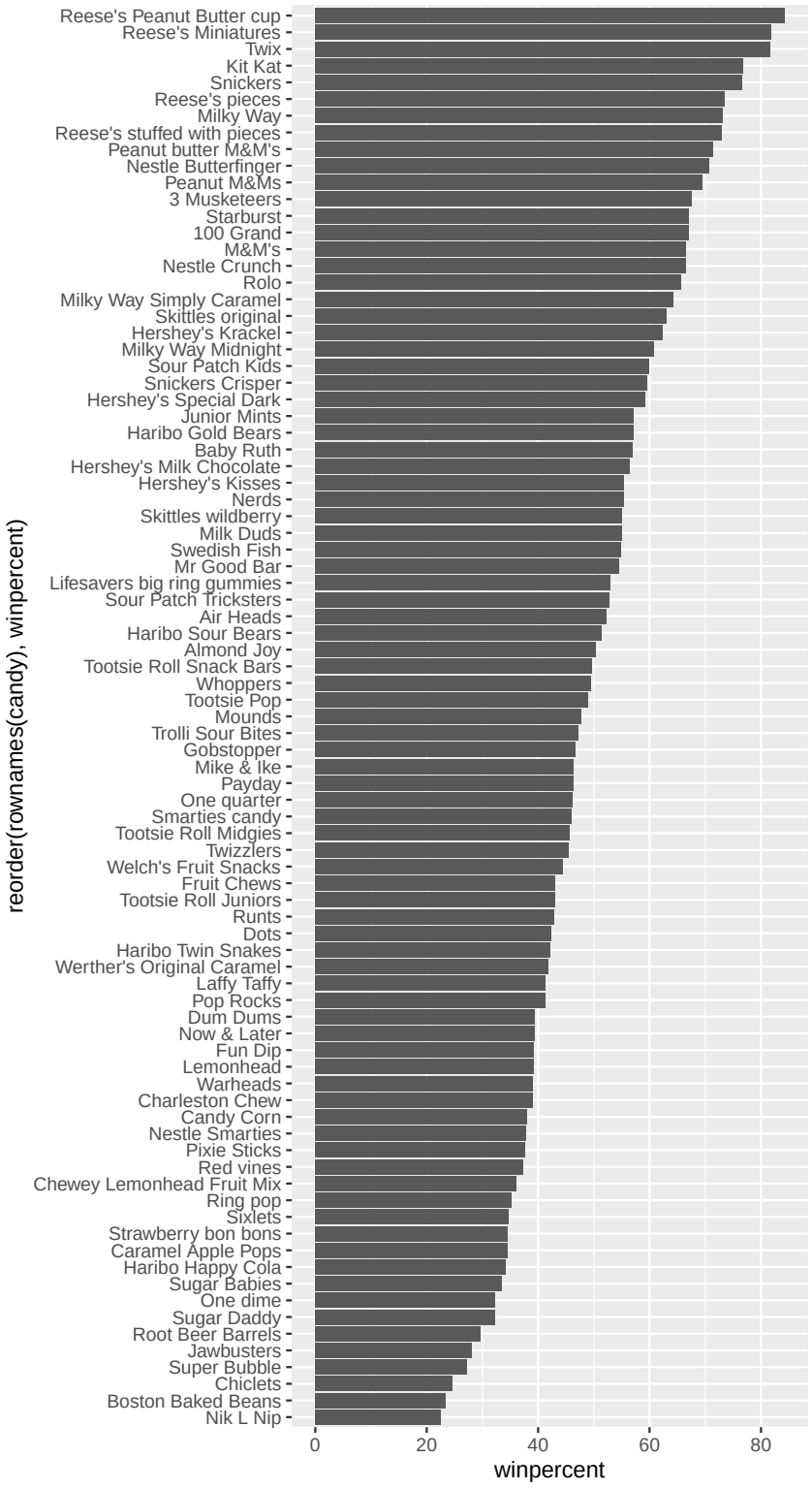
Q15. Make a first barplot of candy ranking based on winpercent values.

```
library(ggplot2)
ggplot(candy, aes(winpercent, rownames(candy))) +
  geom_col()
```


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

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()
```

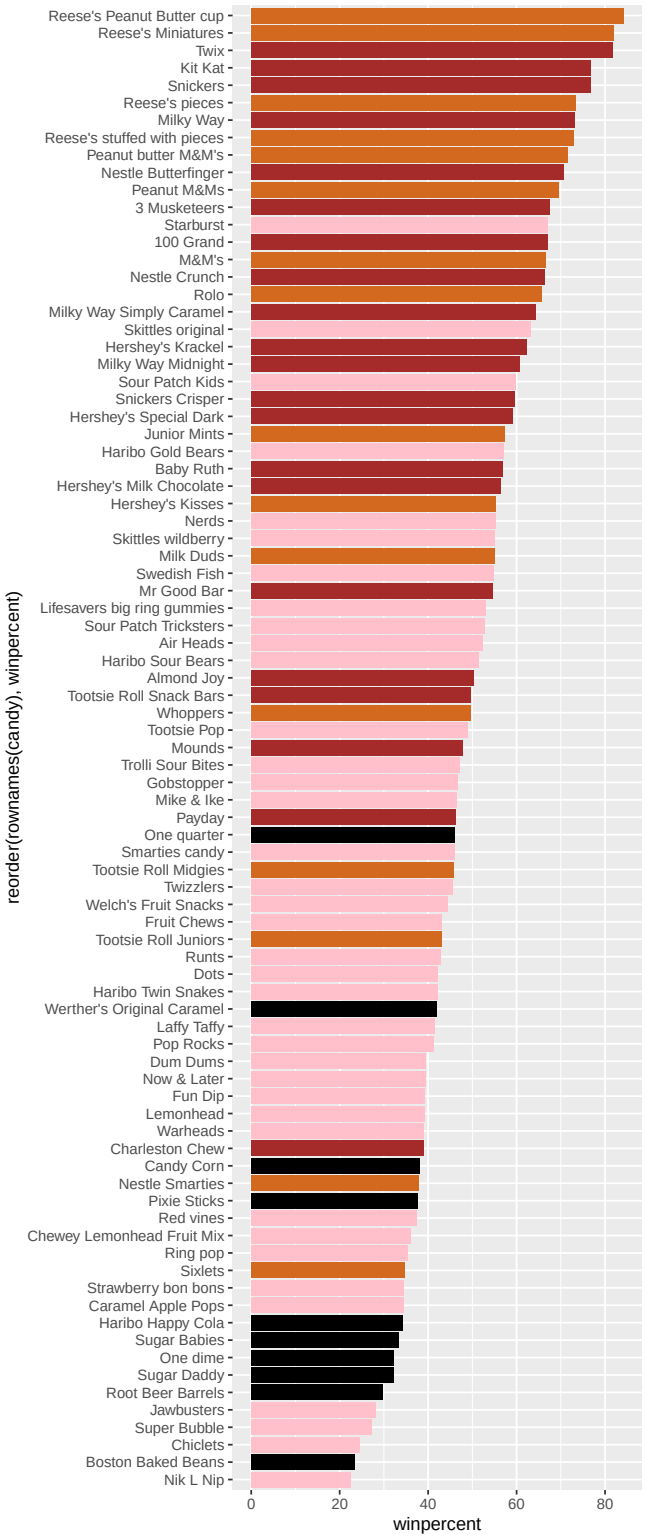

reorder(rownames(candy), winpercent)
Reese's Peanut Butter cup
Reese's Miniatures
Twix
Kit Kat
Snickers
Reese's pieces
Milky Way
Reese's stuffed with pieces
Peanut butter M&M's
Nestle Butterfinger
Peanut M&Ms
3 Musketeers
Starburst
100 Grand
M&M's
Nestle Crunch
Rolo
Milky Way Simply Caramel
Skittles 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
winpercent

Time to add some useful color :)

Create color vectors for each candy type. `fill=my_cols` for geom_col()

```
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)
```


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), winpercent)
0
20
40
60
80
winpercent

Q17. What is the worst ranked chocolate candy?

Sixlets is the worst ranked chocolate candy.

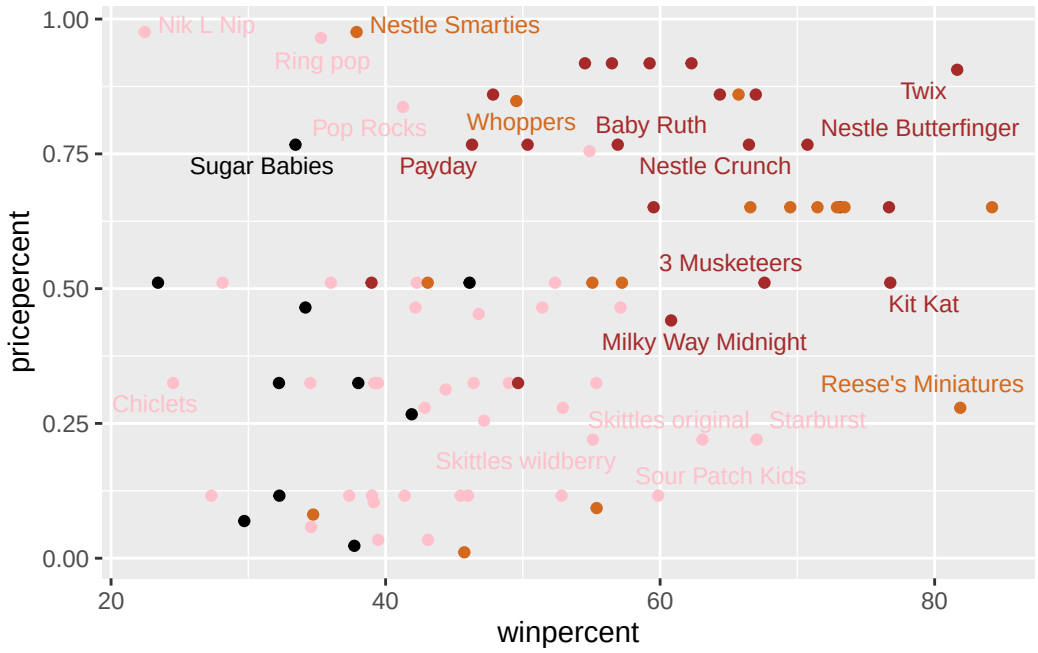
Q18. What is the best ranked fruity candy?

Starburst is the best ranked fruity candy.

##Taking a look at pricepercent

```
#install ggrepel package `install.packages("ggrepel")
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 = 5)
```

```
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 Miniatures

Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular?

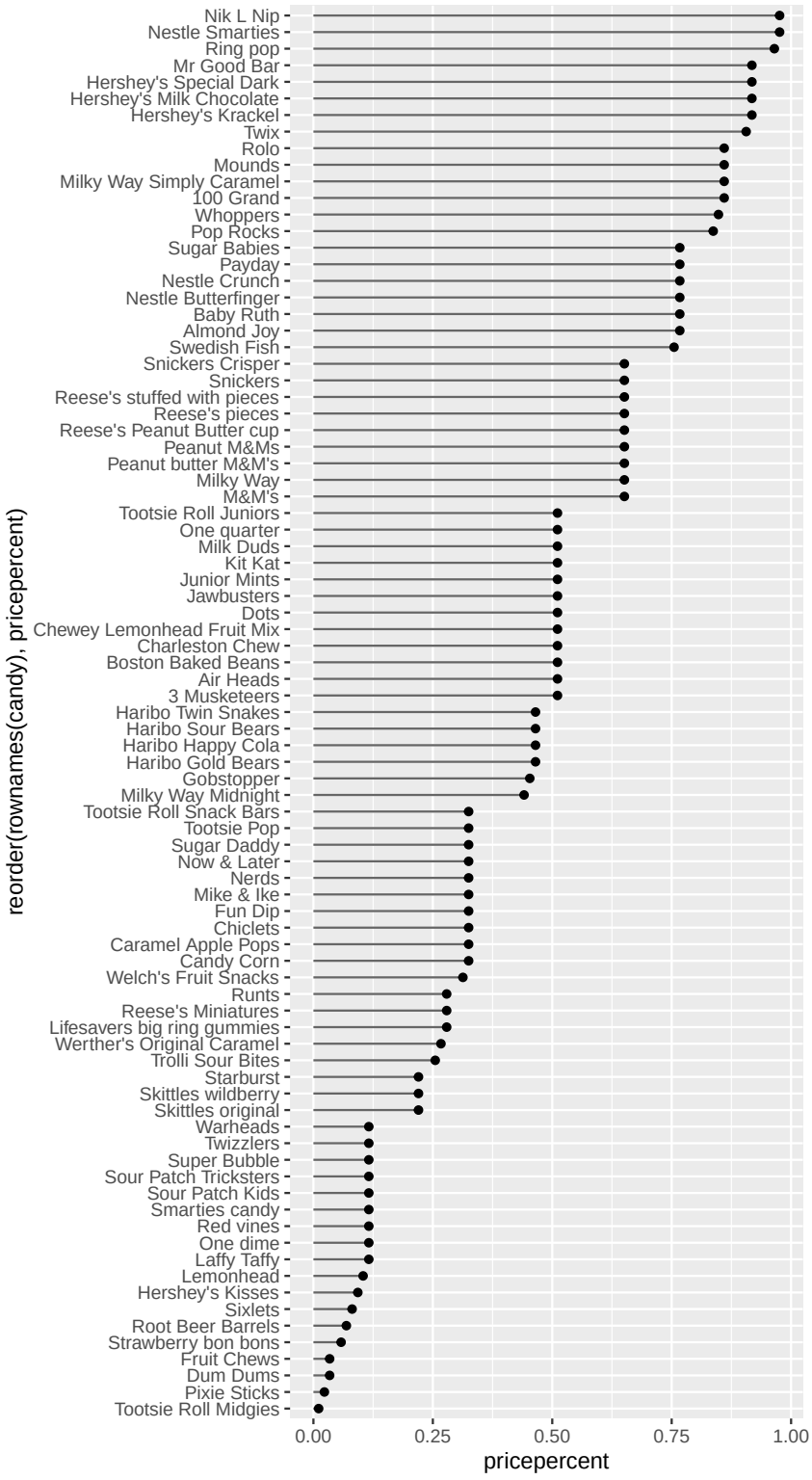
```
ord <- order(candy$pricepercent, decreasing = TRUE)
head( candy[ord,c(11,12)], n=5 )
```

```
                        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
```

```
#11,12 are the position for pricepercent and winpercent
```

Q21. Make a barplot again with geom_col() this time using pricepercent and then improve this step by step, first ordering the x-axis by value and finally making a so called "dot chat" or "lollipop" chart by swapping geom_col() for geom_point() + geom_segment().

```
# Make a lollipop chart of pricepercent
ggplot(candy) +
  aes(pricepercent, reorder(rownames(candy), pricepercent)) +
  geom_segment(aes(yend = reorder(rownames(candy), pricepercent),
                   xend = 0), col="gray40") +
    geom_point()
```

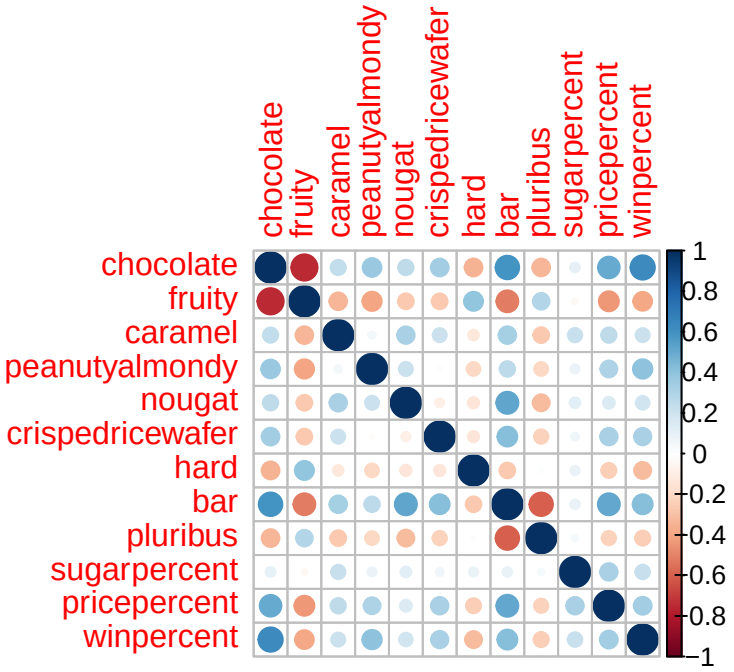

Nik L Nip
Nestle Smarties
Ring pop
Mr Good Bar
Hershey's Special Dark
Hershey's Milk Chocolate
Hershey's Krackel
Twix
Rolo
Mounds
Milky Way Simply Caramel
100 Grand
Whoppers
Pop Rocks
Sugar Babies
Payday
Nestle Crunch
Nestle Butterfinger
Baby Ruth
Almond Joy
Swedish Fish
Snickers Crisper
Snickers
Reese's stuffed with pieces
Reese's pieces
Reese's Peanut Butter cup
Peanut M&Ms
Peanut butter M&M's
Milky Way
M&M's
Tootsie Roll Juniors
One quarter
Milk Duds
Kit Kat
Junior Mints
Jawbusters
Dots
Chewey Lemonhead Fruit Mix
Charleston Chew
Boston Baked Beans
Air Heads
3 Musketeers
Haribo Twin Snakes
Haribo Sour Bears
Haribo Happy Cola
Haribo Gold Bears
Gobstopper
Milky Way Midnight
Tootsie Roll Snack Bars
Tootsie Pop
Sugar Daddy
Now & Later
Nerds
Mike & Ike
Fun Dip
Chiclets
Caramel Apple Pops
Candy Corn
Welch's Fruit Snacks
Runts
Reese's Miniatures
Lifesavers big ring gummies
Werther's Original Caramel
Trolli Sour Bites
Starburst
Skittles wildberry
Skittles original
Warheads
Twizzlers
Super Bubble
Sour Patch Tricksters
Sour Patch Kids
Smarties candy
Red vines
One dime
Laffy Taffy
Lemonhead
Hershey's Kisses
Sixlets
Root Beer Barrels
Strawberry bon bons
Fruit Chews
Dum Dums
Pixie Sticks
Tootsie Roll Midgies
reorder(rownames(candy), pricepercent)
0.00
0.25
0.50
0.75
1.00
pricepercent

##Exploring the correlation structure

```
#install corrplot package install.packages("corrplot")
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)?

Fruit and Chocolate variables are anti-correlated.

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

Chocolate and winpercent are most postitively correlated.

##Principal Component Analysis

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

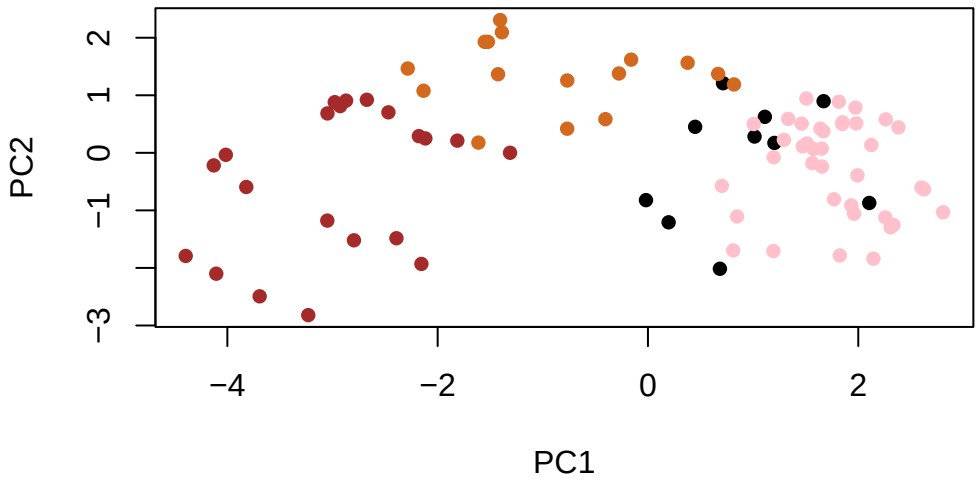
The default is scale= FALSE

```
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
```

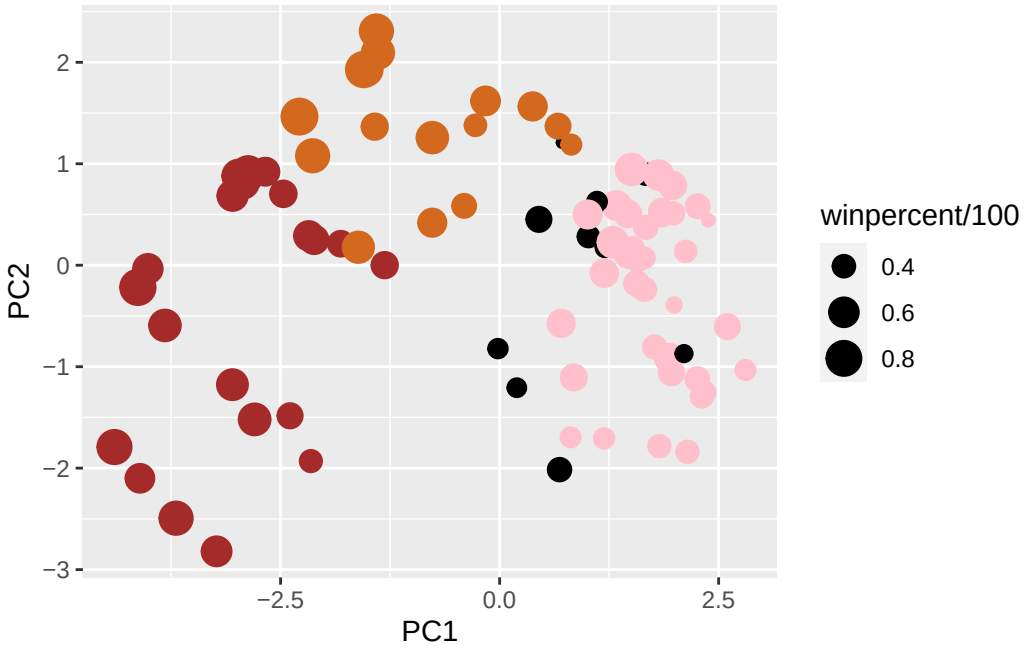
Plot main PCA score plot of PC1 vs PC2.

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



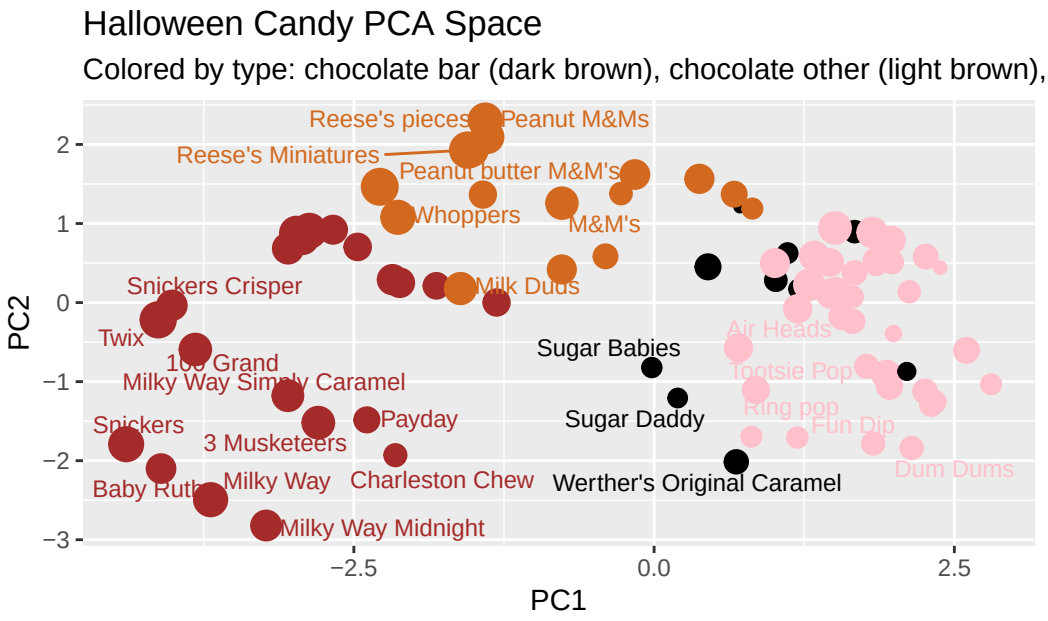

```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])
```

```
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
```



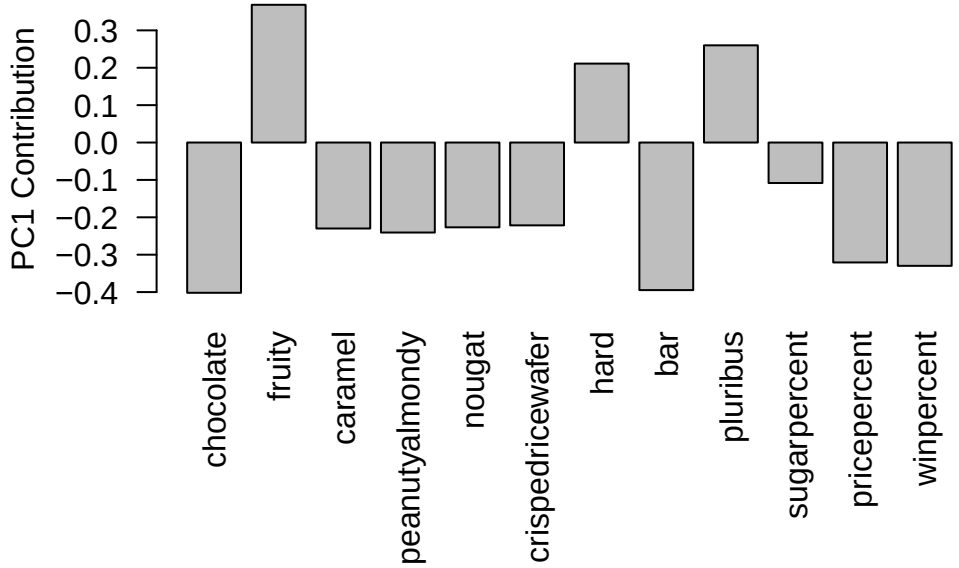

```
library(ggrepel)

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

```
Warning: ggrepel: 59 unlabeled data points (too many overlaps). Consider
increasing max.overlaps
```




```
#install plotly package `install.package("plotly")
#library(plotly)
#ggplotly(p)
```

```
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?

Fruity, hard, and pluribus are picked up most strongly by PC1 in the positive direction. This makes sense as these variables are all positively correlated with one another.