

# Class 11: Candy Project

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In today's class we will examine 538 candy data and see if this helps us gain some more feeling for how PCA and other methods work.

```
candy <- read.csv("candy-data.txt", 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
```

Q. What are these fruity candy?

We can use the ==

```
rownames(candy[ candy$fruity == 1, ])
```

```
[1] "Air Heads"           "Caramel Apple Pops"
[3] "Chewey Lemonhead Fruit Mix" "Chiclets"
[5] "Dots"                "Dum Dums"
[7] "Fruit Chews"         "Fun Dip"
[9] "Gobstopper"          "Haribo Gold Bears"
[11] "Haribo Sour Bears"    "Haribo Twin Snakes"
[13] "Jawbusters"          "Laffy Taffy"
[15] "Lemonhead"           "Lifesavers big ring gummies"
[17] "Mike & Ike"           "Nerds"
[19] "Nik L Nip"            "Now & Later"
[21] "Pop Rocks"           "Red vines"
[23] "Ring pop"            "Runts"
[25] "Skittles original"    "Skittles wildberry"
[27] "Smarties candy"       "Sour Patch Kids"
[29] "Sour Patch Tricksters" "Starburst"
[31] "Strawberry bon bons"  "Super Bubble"
[33] "Swedish Fish"         "Tootsie Pop"
[35] "Trolli Sour Bites"    "Twizzlers"
[37] "Warheads"             "Welch's Fruit Snacks"
```

**How often does my favorite candy win**

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

```
candy["Caramel Apple Pops",]$winpercent
```

```
[1] 34.51768
```

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
```

We are downloading the `skim()` function to give us a quick overview of the dataset.

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

Q6. Is there any variable/column that looks to be on a different scale to the majority of the other columns in the dataset?

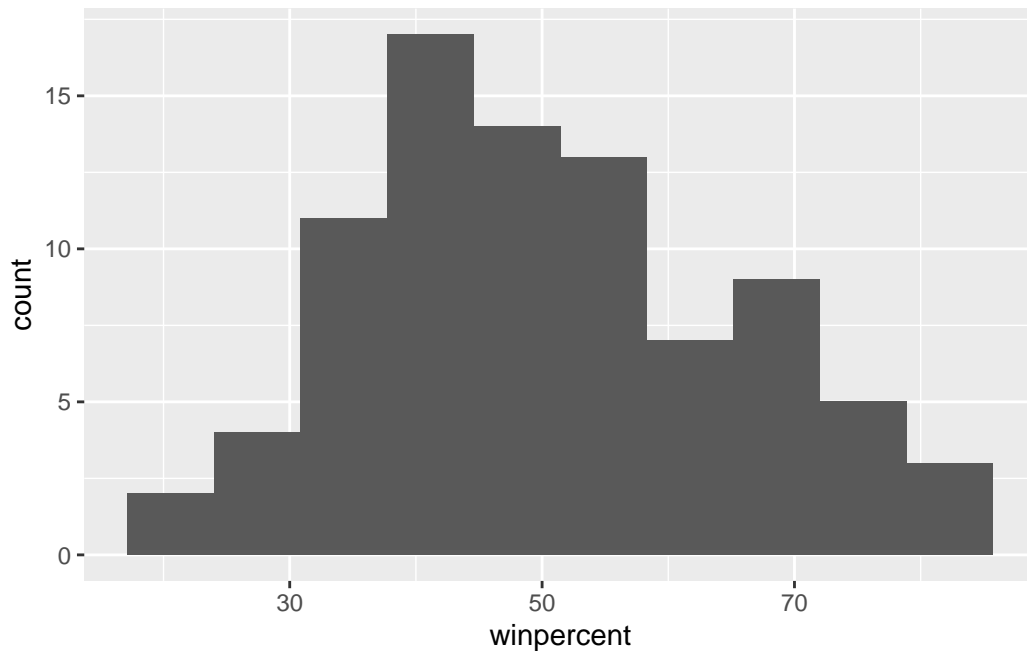
Yes, the `winpercent` column is on a 0:100 scale and all others appear to be 0:1 scale.

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

A zero means the candy isn’t classified as containing chocolate.

Q8. Plot a histogram of winpercent values

```
library(ggplot2)
ggplot(candy) +
  aes(x=winpercent)+
  geom_histogram(bins=10)
```



Q9. Is the distribution of winpercent values symmetrical?

No

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

It is below 50% with a mean of:

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

```
[1] 50.31676
```

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

```
# filter/select/subset to just chocolate rows
chocolate.candy <- candy[as.logical(candy$chocolate), ]
# get winpercent value
chocolate.winpercent <- chocolate.candy$winpercent
#calculate their mean winpercent values
mean(chocolate.winpercent)
```

```
[1] 60.92153
```

We will now do the same thing for fruity candy:

```
fruity.candy <- candy[as.logical(candy$fruity), ]
fruity.winpercent <- fruity.candy$winpercent
mean(fruity.winpercent)
```

```
[1] 44.11974
```

On average, chocolate has the higher ranking compared to fruity candy.

Q12. Is this difference statistically significant?

```
t.test(chocolate.winpercent, fruity.winpercent)
```

Welch Two Sample t-test

```
data: chocolate.winpercent and fruity.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
```

## Overall candy rankings

There is a base R function called `sort()` for, guess what sorting vectors of input.

```
x <- c(5,2,10)

#sort(x, decreasing = TRUE)
sort(x)
```

```
[1]  2  5 10
```

The buddy function to `sort()` that is often more useful is called `order()`. It returns the “indices” of the input that would result in it being sorted.

```
order(x)
```

```
[1] 2 1 3
```

```
x[order(x)]
```

```
[1] 2 5 10
```

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

I can order by winpercent

```
ord <- order(candy$winpercent,decreasing=FALSE)
candy[ord,]
```

|                            | 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      |
| Sugar Daddy                | 0         | 0      | 1       | 0              | 0      |
| One dime                   | 0         | 0      | 0       | 0              | 0      |
| Sugar Babies               | 0         | 0      | 1       | 0              | 0      |
| Haribo Happy Cola          | 0         | 0      | 0       | 0              | 0      |
| Caramel Apple Pops         | 0         | 1      | 1       | 0              | 0      |
| Strawberry bon bons        | 0         | 1      | 0       | 0              | 0      |
| Sixlets                    | 1         | 0      | 0       | 0              | 0      |
| Ring pop                   | 0         | 1      | 0       | 0              | 0      |
| Chewey Lemonhead Fruit Mix | 0         | 1      | 0       | 0              | 0      |
| Red vines                  | 0         | 1      | 0       | 0              | 0      |
| Pixie Sticks               | 0         | 0      | 0       | 0              | 0      |
| Nestle Smarties            | 1         | 0      | 0       | 0              | 0      |
| Candy Corn                 | 0         | 0      | 0       | 0              | 0      |
| Charleston Chew            | 1         | 0      | 0       | 0              | 1      |
| Warheads                   | 0         | 1      | 0       | 0              | 0      |
| Lemonhead                  | 0         | 1      | 0       | 0              | 0      |
| Fun Dip                    | 0         | 1      | 0       | 0              | 0      |
| Now & Later                | 0         | 1      | 0       | 0              | 0      |

|                             |   |   |   |   |   |
|-----------------------------|---|---|---|---|---|
| Dum Dums                    | 0 | 1 | 0 | 0 | 0 |
| Pop Rocks                   | 0 | 1 | 0 | 0 | 0 |
| Laffy Taffy                 | 0 | 1 | 0 | 0 | 0 |
| Werther's Original Caramel  | 0 | 0 | 1 | 0 | 0 |
| Haribo Twin Snakes          | 0 | 1 | 0 | 0 | 0 |
| Dots                        | 0 | 1 | 0 | 0 | 0 |
| Runts                       | 0 | 1 | 0 | 0 | 0 |
| Tootsie Roll Juniors        | 1 | 0 | 0 | 0 | 0 |
| Fruit Chews                 | 0 | 1 | 0 | 0 | 0 |
| Welch's Fruit Snacks        | 0 | 1 | 0 | 0 | 0 |
| Twizzlers                   | 0 | 1 | 0 | 0 | 0 |
| Tootsie Roll Midgies        | 1 | 0 | 0 | 0 | 0 |
| Smarties candy              | 0 | 1 | 0 | 0 | 0 |
| One quarter                 | 0 | 0 | 0 | 0 | 0 |
| Payday                      | 0 | 0 | 0 | 1 | 1 |
| Mike & Ike                  | 0 | 1 | 0 | 0 | 0 |
| Gobstopper                  | 0 | 1 | 0 | 0 | 0 |
| Trolli Sour Bites           | 0 | 1 | 0 | 0 | 0 |
| Mounds                      | 1 | 0 | 0 | 0 | 0 |
| Tootsie Pop                 | 1 | 1 | 0 | 0 | 0 |
| Whoppers                    | 1 | 0 | 0 | 0 | 0 |
| Tootsie Roll Snack Bars     | 1 | 0 | 0 | 0 | 0 |
| Almond Joy                  | 1 | 0 | 0 | 1 | 0 |
| Haribo Sour Bears           | 0 | 1 | 0 | 0 | 0 |
| Air Heads                   | 0 | 1 | 0 | 0 | 0 |
| Sour Patch Tricksters       | 0 | 1 | 0 | 0 | 0 |
| Lifesavers big ring gummies | 0 | 1 | 0 | 0 | 0 |
| Mr Good Bar                 | 1 | 0 | 0 | 1 | 0 |
| Swedish Fish                | 0 | 1 | 0 | 0 | 0 |
| Milk Duds                   | 1 | 0 | 1 | 0 | 0 |
| Skittles wildberry          | 0 | 1 | 0 | 0 | 0 |
| Nerds                       | 0 | 1 | 0 | 0 | 0 |
| Hershey's Kisses            | 1 | 0 | 0 | 0 | 0 |
| Hershey's Milk Chocolate    | 1 | 0 | 0 | 0 | 0 |
| Baby Ruth                   | 1 | 0 | 1 | 1 | 1 |
| Haribo Gold Bears           | 0 | 1 | 0 | 0 | 0 |
| Junior Mints                | 1 | 0 | 0 | 0 | 0 |
| Hershey's Special Dark      | 1 | 0 | 0 | 0 | 0 |
| Snickers Crisper            | 1 | 0 | 1 | 1 | 0 |
| Sour Patch Kids             | 0 | 1 | 0 | 0 | 0 |
| Milky Way Midnight          | 1 | 0 | 1 | 0 | 1 |
| Hershey's Krackel           | 1 | 0 | 0 | 0 | 0 |
| Skittles original           | 0 | 1 | 0 | 0 | 0 |

|                             |         |           |          |          |              |       |
|-----------------------------|---------|-----------|----------|----------|--------------|-------|
| Milky Way Simply Caramel    | 1       | 0         | 1        | 0        | 0            |       |
| Rolo                        | 1       | 0         | 1        | 0        | 0            |       |
| Nestle Crunch               | 1       | 0         | 0        | 0        | 0            |       |
| M&M's                       | 1       | 0         | 0        | 0        | 0            |       |
| 100 Grand                   | 1       | 0         | 1        | 0        | 0            |       |
| Starburst                   | 0       | 1         | 0        | 0        | 0            |       |
| 3 Musketeers                | 1       | 0         | 0        | 0        | 1            |       |
| Peanut M&Ms                 | 1       | 0         | 0        | 1        | 0            |       |
| Nestle Butterfinger         | 1       | 0         | 0        | 1        | 0            |       |
| Peanut butter M&M's         | 1       | 0         | 0        | 1        | 0            |       |
| Reese's stuffed with pieces | 1       | 0         | 0        | 1        | 0            |       |
| Milky Way                   | 1       | 0         | 1        | 0        | 1            |       |
| Reese's pieces              | 1       | 0         | 0        | 1        | 0            |       |
| 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            |       |
|                             | crisped | ricewafer | hard bar | pluribus | sugarpercent |       |
| Nik L Nip                   |         | 0         | 0        | 0        | 1            | 0.197 |
| Boston Baked Beans          |         | 0         | 0        | 0        | 1            | 0.313 |
| Chiclets                    |         | 0         | 0        | 0        | 1            | 0.046 |
| Super Bubble                |         | 0         | 0        | 0        | 0            | 0.162 |
| Jawbusters                  |         | 0         | 1        | 0        | 1            | 0.093 |
| Root Beer Barrels           |         | 0         | 1        | 0        | 1            | 0.732 |
| Sugar Daddy                 |         | 0         | 0        | 0        | 0            | 0.418 |
| One dime                    |         | 0         | 0        | 0        | 0            | 0.011 |
| Sugar Babies                |         | 0         | 0        | 0        | 1            | 0.965 |
| Haribo Happy Cola           |         | 0         | 0        | 0        | 1            | 0.465 |
| Caramel Apple Pops          |         | 0         | 0        | 0        | 0            | 0.604 |
| Strawberry bon bons         |         | 0         | 1        | 0        | 1            | 0.569 |
| Sixlets                     |         | 0         | 0        | 0        | 1            | 0.220 |
| Ring pop                    |         | 0         | 1        | 0        | 0            | 0.732 |
| Chewey Lemonhead Fruit Mix  |         | 0         | 0        | 0        | 1            | 0.732 |
| Red vines                   |         | 0         | 0        | 0        | 1            | 0.581 |
| Pixie Sticks                |         | 0         | 0        | 0        | 1            | 0.093 |
| Nestle Smarties             |         | 0         | 0        | 0        | 1            | 0.267 |
| Candy Corn                  |         | 0         | 0        | 0        | 1            | 0.906 |
| Charleston Chew             |         | 0         | 0        | 1        | 0            | 0.604 |
| Warheads                    |         | 0         | 1        | 0        | 0            | 0.093 |
| Lemonhead                   |         | 0         | 1        | 0        | 0            | 0.046 |
| Fun Dip                     |         | 0         | 1        | 0        | 0            | 0.732 |
| Now & Later                 |         | 0         | 0        | 0        | 1            | 0.220 |



|                             |   |   |   |   |       |
|-----------------------------|---|---|---|---|-------|
| Dum Dums                    | 0 | 1 | 0 | 0 | 0.732 |
| Pop Rocks                   | 0 | 1 | 0 | 1 | 0.604 |
| Laffy Taffy                 | 0 | 0 | 0 | 0 | 0.220 |
| Werther's Original Caramel  | 0 | 1 | 0 | 0 | 0.186 |
| Haribo Twin Snakes          | 0 | 0 | 0 | 1 | 0.465 |
| Dots                        | 0 | 0 | 0 | 1 | 0.732 |
| Runts                       | 0 | 1 | 0 | 1 | 0.872 |
| Tootsie Roll Juniors        | 0 | 0 | 0 | 0 | 0.313 |
| Fruit Chews                 | 0 | 0 | 0 | 1 | 0.127 |
| Welch's Fruit Snacks        | 0 | 0 | 0 | 1 | 0.313 |
| Twizzlers                   | 0 | 0 | 0 | 0 | 0.220 |
| Tootsie Roll Midgies        | 0 | 0 | 0 | 1 | 0.174 |
| Smarties candy              | 0 | 1 | 0 | 1 | 0.267 |
| One quarter                 | 0 | 0 | 0 | 0 | 0.011 |
| Payday                      | 0 | 0 | 1 | 0 | 0.465 |
| Mike & Ike                  | 0 | 0 | 0 | 1 | 0.872 |
| Gobstopper                  | 0 | 1 | 0 | 1 | 0.906 |
| Trolli Sour Bites           | 0 | 0 | 0 | 1 | 0.313 |
| Mounds                      | 0 | 0 | 1 | 0 | 0.313 |
| Tootsie Pop                 | 0 | 1 | 0 | 0 | 0.604 |
| Whoppers                    | 1 | 0 | 0 | 1 | 0.872 |
| Tootsie Roll Snack Bars     | 0 | 0 | 1 | 0 | 0.465 |
| Almond Joy                  | 0 | 0 | 1 | 0 | 0.465 |
| Haribo Sour Bears           | 0 | 0 | 0 | 1 | 0.465 |
| Air Heads                   | 0 | 0 | 0 | 0 | 0.906 |
| Sour Patch Tricksters       | 0 | 0 | 0 | 1 | 0.069 |
| Lifesavers big ring gummies | 0 | 0 | 0 | 0 | 0.267 |
| Mr Good Bar                 | 0 | 0 | 1 | 0 | 0.313 |
| Swedish Fish                | 0 | 0 | 0 | 1 | 0.604 |
| Milk Duds                   | 0 | 0 | 0 | 1 | 0.302 |
| Skittles wildberry          | 0 | 0 | 0 | 1 | 0.941 |
| Nerds                       | 0 | 1 | 0 | 1 | 0.848 |
| Hershey's Kisses            | 0 | 0 | 0 | 1 | 0.127 |
| Hershey's Milk Chocolate    | 0 | 0 | 1 | 0 | 0.430 |
| Baby Ruth                   | 0 | 0 | 1 | 0 | 0.604 |
| Haribo Gold Bears           | 0 | 0 | 0 | 1 | 0.465 |
| Junior Mints                | 0 | 0 | 0 | 1 | 0.197 |
| Hershey's Special Dark      | 0 | 0 | 1 | 0 | 0.430 |
| Snickers Crisper            | 1 | 0 | 1 | 0 | 0.604 |
| Sour Patch Kids             | 0 | 0 | 0 | 1 | 0.069 |
| Milky Way Midnight          | 0 | 0 | 1 | 0 | 0.732 |
| Hershey's Krackel           | 1 | 0 | 1 | 0 | 0.430 |
| Skittles original           | 0 | 0 | 0 | 1 | 0.941 |

|                             |   |   |   |   |       |
|-----------------------------|---|---|---|---|-------|
| Milky Way Simply Caramel    | 0 | 0 | 1 | 0 | 0.965 |
| Rolo                        | 0 | 0 | 0 | 1 | 0.860 |
| Nestle Crunch               | 1 | 0 | 1 | 0 | 0.313 |
| M&M's                       | 0 | 0 | 0 | 1 | 0.825 |
| 100 Grand                   | 1 | 0 | 1 | 0 | 0.732 |
| Starburst                   | 0 | 0 | 0 | 1 | 0.151 |
| 3 Musketeers                | 0 | 0 | 1 | 0 | 0.604 |
| Peanut M&Ms                 | 0 | 0 | 0 | 1 | 0.593 |
| Nestle Butterfinger         | 0 | 0 | 1 | 0 | 0.604 |
| Peanut butter M&M's         | 0 | 0 | 0 | 1 | 0.825 |
| Reese's stuffed with pieces | 0 | 0 | 0 | 0 | 0.988 |
| Milky Way                   | 0 | 0 | 1 | 0 | 0.604 |
| Reese's pieces              | 0 | 0 | 0 | 1 | 0.406 |
| 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 |
|----------------------------|--------------|------------|
| Nik L Nip                  | 0.976        | 22.44534   |
| Boston Baked Beans         | 0.511        | 23.41782   |
| Chiclets                   | 0.325        | 24.52499   |
| Super Bubble               | 0.116        | 27.30386   |
| Jawbusters                 | 0.511        | 28.12744   |
| Root Beer Barrels          | 0.069        | 29.70369   |
| Sugar Daddy                | 0.325        | 32.23100   |
| One dime                   | 0.116        | 32.26109   |
| Sugar Babies               | 0.767        | 33.43755   |
| Haribo Happy Cola          | 0.465        | 34.15896   |
| Caramel Apple Pops         | 0.325        | 34.51768   |
| Strawberry bon bons        | 0.058        | 34.57899   |
| Sixlets                    | 0.081        | 34.72200   |
| Ring pop                   | 0.965        | 35.29076   |
| Chewey Lemonhead Fruit Mix | 0.511        | 36.01763   |
| Red vines                  | 0.116        | 37.34852   |
| Pixie Sticks               | 0.023        | 37.72234   |
| Nestle Smarties            | 0.976        | 37.88719   |
| Candy Corn                 | 0.325        | 38.01096   |
| Charleston Chew            | 0.511        | 38.97504   |
| Warheads                   | 0.116        | 39.01190   |
| Lemonhead                  | 0.104        | 39.14106   |
| Fun Dip                    | 0.325        | 39.18550   |
| Now & Later                | 0.325        | 39.44680   |

|                             |       |          |
|-----------------------------|-------|----------|
| Dum Dums                    | 0.034 | 39.46056 |
| Pop Rocks                   | 0.837 | 41.26551 |
| Laffy Taffy                 | 0.116 | 41.38956 |
| Werther's Original Caramel  | 0.267 | 41.90431 |
| Haribo Twin Snakes          | 0.465 | 42.17877 |
| Dots                        | 0.511 | 42.27208 |
| Runts                       | 0.279 | 42.84914 |
| Tootsie Roll Juniors        | 0.511 | 43.06890 |
| Fruit Chews                 | 0.034 | 43.08892 |
| Welch's Fruit Snacks        | 0.313 | 44.37552 |
| Twizzlers                   | 0.116 | 45.46628 |
| Tootsie Roll Midgies        | 0.011 | 45.73675 |
| Smarties candy              | 0.116 | 45.99583 |
| One quarter                 | 0.511 | 46.11650 |
| Payday                      | 0.767 | 46.29660 |
| Mike & Ike                  | 0.325 | 46.41172 |
| Gobstopper                  | 0.453 | 46.78335 |
| Trolli Sour Bites           | 0.255 | 47.17323 |
| Mounds                      | 0.860 | 47.82975 |
| Tootsie Pop                 | 0.325 | 48.98265 |
| Whoppers                    | 0.848 | 49.52411 |
| Tootsie Roll Snack Bars     | 0.325 | 49.65350 |
| Almond Joy                  | 0.767 | 50.34755 |
| Haribo Sour Bears           | 0.465 | 51.41243 |
| Air Heads                   | 0.511 | 52.34146 |
| Sour Patch Tricksters       | 0.116 | 52.82595 |
| Lifesavers big ring gummies | 0.279 | 52.91139 |
| Mr Good Bar                 | 0.918 | 54.52645 |
| Swedish Fish                | 0.755 | 54.86111 |
| Milk Duds                   | 0.511 | 55.06407 |
| Skittles wildberry          | 0.220 | 55.10370 |
| Nerds                       | 0.325 | 55.35405 |
| Hershey's Kisses            | 0.093 | 55.37545 |
| Hershey's Milk Chocolate    | 0.918 | 56.49050 |
| Baby Ruth                   | 0.767 | 56.91455 |
| Haribo Gold Bears           | 0.465 | 57.11974 |
| Junior Mints                | 0.511 | 57.21925 |
| Hershey's Special Dark      | 0.918 | 59.23612 |
| Snickers Crisper            | 0.651 | 59.52925 |
| Sour Patch Kids             | 0.116 | 59.86400 |
| Milky Way Midnight          | 0.441 | 60.80070 |
| Hershey's Krackel           | 0.918 | 62.28448 |
| Skittles original           | 0.220 | 63.08514 |

|                             |       |          |
|-----------------------------|-------|----------|
| Milky Way Simply Caramel    | 0.860 | 64.35334 |
| Rolo                        | 0.860 | 65.71629 |
| Nestle Crunch               | 0.767 | 66.47068 |
| M&M's                       | 0.651 | 66.57458 |
| 100 Grand                   | 0.860 | 66.97173 |
| Starburst                   | 0.220 | 67.03763 |
| 3 Musketeers                | 0.511 | 67.60294 |
| Peanut M&Ms                 | 0.651 | 69.48379 |
| Nestle Butterfinger         | 0.767 | 70.73564 |
| Peanut butter M&M's         | 0.651 | 71.46505 |
| Reese's stuffed with pieces | 0.651 | 72.88790 |
| Milky Way                   | 0.651 | 73.09956 |
| Reese's pieces              | 0.651 | 73.43499 |
| 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 |

```
head(candy[ord,],5)
```

|                    | chocolate | fruity  | caramel | peanut | almond | 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          | 22.44     | 534     |         |        |        |          |       |         |
| Boston Baked Beans | 23.41     | 782     |         |        |        |          |       |         |
| Chiclets           | 24.52     | 499     |         |        |        |          |       |         |
| Super Bubble       | 27.30     | 386     |         |        |        |          |       |         |
| Jawbusters         | 28.12     | 744     |         |        |        |          |       |         |

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

```
ord<- order(candy$winpercent,decreasing=TRUE)
candy[ord,]
```

|                             | 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      |
| Reese's pieces              | 1         | 0      | 0       | 1              | 0      |
| Milky Way                   | 1         | 0      | 1       | 0              | 1      |
| Reese's stuffed with pieces | 1         | 0      | 0       | 1              | 0      |
| Peanut butter M&M's         | 1         | 0      | 0       | 1              | 0      |
| Nestle Butterfinger         | 1         | 0      | 0       | 1              | 0      |
| Peanut M&Ms                 | 1         | 0      | 0       | 1              | 0      |
| 3 Musketeers                | 1         | 0      | 0       | 0              | 1      |
| Starburst                   | 0         | 1      | 0       | 0              | 0      |
| 100 Grand                   | 1         | 0      | 1       | 0              | 0      |
| M&M's                       | 1         | 0      | 0       | 0              | 0      |
| Nestle Crunch               | 1         | 0      | 0       | 0              | 0      |
| Rolo                        | 1         | 0      | 1       | 0              | 0      |
| Milky Way Simply Caramel    | 1         | 0      | 1       | 0              | 0      |
| Skittles original           | 0         | 1      | 0       | 0              | 0      |
| Hershey's Krackel           | 1         | 0      | 0       | 0              | 0      |
| Milky Way Midnight          | 1         | 0      | 1       | 0              | 1      |
| Sour Patch Kids             | 0         | 1      | 0       | 0              | 0      |
| Snickers Crisper            | 1         | 0      | 1       | 1              | 0      |
| Hershey's Special Dark      | 1         | 0      | 0       | 0              | 0      |
| Junior Mints                | 1         | 0      | 0       | 0              | 0      |
| Haribo Gold Bears           | 0         | 1      | 0       | 0              | 0      |
| Baby Ruth                   | 1         | 0      | 1       | 1              | 1      |
| Hershey's Milk Chocolate    | 1         | 0      | 0       | 0              | 0      |
| Hershey's Kisses            | 1         | 0      | 0       | 0              | 0      |
| Nerds                       | 0         | 1      | 0       | 0              | 0      |
| Skittles wildberry          | 0         | 1      | 0       | 0              | 0      |
| Milk Duds                   | 1         | 0      | 1       | 0              | 0      |
| Swedish Fish                | 0         | 1      | 0       | 0              | 0      |
| Mr Good Bar                 | 1         | 0      | 0       | 1              | 0      |
| Lifesavers big ring gummies | 0         | 1      | 0       | 0              | 0      |
| Sour Patch Tricksters       | 0         | 1      | 0       | 0              | 0      |
| Air Heads                   | 0         | 1      | 0       | 0              | 0      |
| Haribo Sour Bears           | 0         | 1      | 0       | 0              | 0      |

|                            |   |   |   |   |   |
|----------------------------|---|---|---|---|---|
| Almond Joy                 | 1 | 0 | 0 | 1 | 0 |
| Tootsie Roll Snack Bars    | 1 | 0 | 0 | 0 | 0 |
| Whoppers                   | 1 | 0 | 0 | 0 | 0 |
| Tootsie Pop                | 1 | 1 | 0 | 0 | 0 |
| Mounds                     | 1 | 0 | 0 | 0 | 0 |
| Trolli Sour Bites          | 0 | 1 | 0 | 0 | 0 |
| Gobstopper                 | 0 | 1 | 0 | 0 | 0 |
| Mike & Ike                 | 0 | 1 | 0 | 0 | 0 |
| Payday                     | 0 | 0 | 0 | 1 | 1 |
| One quarter                | 0 | 0 | 0 | 0 | 0 |
| Smarties candy             | 0 | 1 | 0 | 0 | 0 |
| Tootsie Roll Midgies       | 1 | 0 | 0 | 0 | 0 |
| Twizzlers                  | 0 | 1 | 0 | 0 | 0 |
| Welch's Fruit Snacks       | 0 | 1 | 0 | 0 | 0 |
| Fruit Chews                | 0 | 1 | 0 | 0 | 0 |
| Tootsie Roll Juniors       | 1 | 0 | 0 | 0 | 0 |
| Runts                      | 0 | 1 | 0 | 0 | 0 |
| Dots                       | 0 | 1 | 0 | 0 | 0 |
| Haribo Twin Snakes         | 0 | 1 | 0 | 0 | 0 |
| Werther's Original Caramel | 0 | 0 | 1 | 0 | 0 |
| Laffy Taffy                | 0 | 1 | 0 | 0 | 0 |
| Pop Rocks                  | 0 | 1 | 0 | 0 | 0 |
| Dum Dums                   | 0 | 1 | 0 | 0 | 0 |
| Now & Later                | 0 | 1 | 0 | 0 | 0 |
| Fun Dip                    | 0 | 1 | 0 | 0 | 0 |
| Lemonhead                  | 0 | 1 | 0 | 0 | 0 |
| Warheads                   | 0 | 1 | 0 | 0 | 0 |
| Charleston Chew            | 1 | 0 | 0 | 0 | 1 |
| Candy Corn                 | 0 | 0 | 0 | 0 | 0 |
| Nestle Smarties            | 1 | 0 | 0 | 0 | 0 |
| Pixie Sticks               | 0 | 0 | 0 | 0 | 0 |
| Red vines                  | 0 | 1 | 0 | 0 | 0 |
| Chewey Lemonhead Fruit Mix | 0 | 1 | 0 | 0 | 0 |
| Ring pop                   | 0 | 1 | 0 | 0 | 0 |
| Sixlets                    | 1 | 0 | 0 | 0 | 0 |
| Strawberry bon bons        | 0 | 1 | 0 | 0 | 0 |
| Caramel Apple Pops         | 0 | 1 | 1 | 0 | 0 |
| Haribo Happy Cola          | 0 | 0 | 0 | 0 | 0 |
| Sugar Babies               | 0 | 0 | 1 | 0 | 0 |
| One dime                   | 0 | 0 | 0 | 0 | 0 |
| Sugar Daddy                | 0 | 0 | 1 | 0 | 0 |
| Root Beer Barrels          | 0 | 0 | 0 | 0 | 0 |
| Jawbusters                 | 0 | 1 | 0 | 0 | 0 |

|                             |         |           |          |          |              |
|-----------------------------|---------|-----------|----------|----------|--------------|
| Super Bubble                | 0       | 1         | 0        | 0        | 0            |
| Chiclets                    | 0       | 1         | 0        | 0        | 0            |
| Boston Baked Beans          | 0       | 0         | 0        | 1        | 0            |
| Nik L Nip                   | 0       | 1         | 0        | 0        | 0            |
|                             | crisped | ricewafer | 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        |
| Reese's pieces              | 0       | 0         | 0        | 1        | 0.406        |
| Milky Way                   | 0       | 0         | 1        | 0        | 0.604        |
| Reese's stuffed with pieces | 0       | 0         | 0        | 0        | 0.988        |
| Peanut butter M&M's         | 0       | 0         | 0        | 1        | 0.825        |
| Nestle Butterfinger         | 0       | 0         | 1        | 0        | 0.604        |
| Peanut M&Ms                 | 0       | 0         | 0        | 1        | 0.593        |
| 3 Musketeers                | 0       | 0         | 1        | 0        | 0.604        |
| Starburst                   | 0       | 0         | 0        | 1        | 0.151        |
| 100 Grand                   | 1       | 0         | 1        | 0        | 0.732        |
| M&M's                       | 0       | 0         | 0        | 1        | 0.825        |
| Nestle Crunch               | 1       | 0         | 1        | 0        | 0.313        |
| Rolo                        | 0       | 0         | 0        | 1        | 0.860        |
| Milky Way Simply Caramel    | 0       | 0         | 1        | 0        | 0.965        |
| Skittles original           | 0       | 0         | 0        | 1        | 0.941        |
| Hershey's Krackel           | 1       | 0         | 1        | 0        | 0.430        |
| Milky Way Midnight          | 0       | 0         | 1        | 0        | 0.732        |
| Sour Patch Kids             | 0       | 0         | 0        | 1        | 0.069        |
| Snickers Crisper            | 1       | 0         | 1        | 0        | 0.604        |
| Hershey's Special Dark      | 0       | 0         | 1        | 0        | 0.430        |
| Junior Mints                | 0       | 0         | 0        | 1        | 0.197        |
| Haribo Gold Bears           | 0       | 0         | 0        | 1        | 0.465        |
| Baby Ruth                   | 0       | 0         | 1        | 0        | 0.604        |
| Hershey's Milk Chocolate    | 0       | 0         | 1        | 0        | 0.430        |
| Hershey's Kisses            | 0       | 0         | 0        | 1        | 0.127        |
| Nerds                       | 0       | 1         | 0        | 1        | 0.848        |
| Skittles wildberry          | 0       | 0         | 0        | 1        | 0.941        |
| Milk Duds                   | 0       | 0         | 0        | 1        | 0.302        |
| Swedish Fish                | 0       | 0         | 0        | 1        | 0.604        |
| Mr Good Bar                 | 0       | 0         | 1        | 0        | 0.313        |
| Lifesavers big ring gummies | 0       | 0         | 0        | 0        | 0.267        |
| Sour Patch Tricksters       | 0       | 0         | 0        | 1        | 0.069        |
| Air Heads                   | 0       | 0         | 0        | 0        | 0.906        |
| Haribo Sour Bears           | 0       | 0         | 0        | 1        | 0.465        |

|                            |   |   |   |   |       |
|----------------------------|---|---|---|---|-------|
| Almond Joy                 | 0 | 0 | 1 | 0 | 0.465 |
| Tootsie Roll Snack Bars    | 0 | 0 | 1 | 0 | 0.465 |
| Whoppers                   | 1 | 0 | 0 | 1 | 0.872 |
| Tootsie Pop                | 0 | 1 | 0 | 0 | 0.604 |
| Mounds                     | 0 | 0 | 1 | 0 | 0.313 |
| Trolli Sour Bites          | 0 | 0 | 0 | 1 | 0.313 |
| Gobstopper                 | 0 | 1 | 0 | 1 | 0.906 |
| Mike & Ike                 | 0 | 0 | 0 | 1 | 0.872 |
| Payday                     | 0 | 0 | 1 | 0 | 0.465 |
| One quarter                | 0 | 0 | 0 | 0 | 0.011 |
| Smarties candy             | 0 | 1 | 0 | 1 | 0.267 |
| Tootsie Roll Midgies       | 0 | 0 | 0 | 1 | 0.174 |
| Twizzlers                  | 0 | 0 | 0 | 0 | 0.220 |
| Welch's Fruit Snacks       | 0 | 0 | 0 | 1 | 0.313 |
| Fruit Chews                | 0 | 0 | 0 | 1 | 0.127 |
| Tootsie Roll Juniors       | 0 | 0 | 0 | 0 | 0.313 |
| Runts                      | 0 | 1 | 0 | 1 | 0.872 |
| Dots                       | 0 | 0 | 0 | 1 | 0.732 |
| Haribo Twin Snakes         | 0 | 0 | 0 | 1 | 0.465 |
| Werther's Original Caramel | 0 | 1 | 0 | 0 | 0.186 |
| Laffy Taffy                | 0 | 0 | 0 | 0 | 0.220 |
| Pop Rocks                  | 0 | 1 | 0 | 1 | 0.604 |
| Dum Dums                   | 0 | 1 | 0 | 0 | 0.732 |
| Now & Later                | 0 | 0 | 0 | 1 | 0.220 |
| Fun Dip                    | 0 | 1 | 0 | 0 | 0.732 |
| Lemonhead                  | 0 | 1 | 0 | 0 | 0.046 |
| Warheads                   | 0 | 1 | 0 | 0 | 0.093 |
| Charleston Chew            | 0 | 0 | 1 | 0 | 0.604 |
| Candy Corn                 | 0 | 0 | 0 | 1 | 0.906 |
| Nestle Smarties            | 0 | 0 | 0 | 1 | 0.267 |
| Pixie Sticks               | 0 | 0 | 0 | 1 | 0.093 |
| Red vines                  | 0 | 0 | 0 | 1 | 0.581 |
| Chewey Lemonhead Fruit Mix | 0 | 0 | 0 | 1 | 0.732 |
| Ring pop                   | 0 | 1 | 0 | 0 | 0.732 |
| Sixlets                    | 0 | 0 | 0 | 1 | 0.220 |
| Strawberry bon bons        | 0 | 1 | 0 | 1 | 0.569 |
| Caramel Apple Pops         | 0 | 0 | 0 | 0 | 0.604 |
| Haribo Happy Cola          | 0 | 0 | 0 | 1 | 0.465 |
| Sugar Babies               | 0 | 0 | 0 | 1 | 0.965 |
| One dime                   | 0 | 0 | 0 | 0 | 0.011 |
| Sugar Daddy                | 0 | 0 | 0 | 0 | 0.418 |
| Root Beer Barrels          | 0 | 1 | 0 | 1 | 0.732 |
| Jawbusters                 | 0 | 1 | 0 | 1 | 0.093 |



|                    |   |   |   |   |       |
|--------------------|---|---|---|---|-------|
| Super Bubble       | 0 | 0 | 0 | 0 | 0.162 |
| Chiclets           | 0 | 0 | 0 | 1 | 0.046 |
| Boston Baked Beans | 0 | 0 | 0 | 1 | 0.313 |
| Nik L Nip          | 0 | 0 | 0 | 1 | 0.197 |

|                             | 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 pieces              | 0.651        | 73.43499   |
| Milky Way                   | 0.651        | 73.09956   |
| Reese's stuffed with pieces | 0.651        | 72.88790   |
| Peanut butter M&M's         | 0.651        | 71.46505   |
| Nestle Butterfinger         | 0.767        | 70.73564   |
| Peanut M&Ms                 | 0.651        | 69.48379   |
| 3 Musketeers                | 0.511        | 67.60294   |
| Starburst                   | 0.220        | 67.03763   |
| 100 Grand                   | 0.860        | 66.97173   |
| M&M's                       | 0.651        | 66.57458   |
| Nestle Crunch               | 0.767        | 66.47068   |
| Rolo                        | 0.860        | 65.71629   |
| Milky Way Simply Caramel    | 0.860        | 64.35334   |
| Skittles original           | 0.220        | 63.08514   |
| Hershey's Krackel           | 0.918        | 62.28448   |
| Milky Way Midnight          | 0.441        | 60.80070   |
| Sour Patch Kids             | 0.116        | 59.86400   |
| Snickers Crisper            | 0.651        | 59.52925   |
| Hershey's Special Dark      | 0.918        | 59.23612   |
| Junior Mints                | 0.511        | 57.21925   |
| Haribo Gold Bears           | 0.465        | 57.11974   |
| Baby Ruth                   | 0.767        | 56.91455   |
| Hershey's Milk Chocolate    | 0.918        | 56.49050   |
| Hershey's Kisses            | 0.093        | 55.37545   |
| Nerds                       | 0.325        | 55.35405   |
| Skittles wildberry          | 0.220        | 55.10370   |
| Milk Duds                   | 0.511        | 55.06407   |
| Swedish Fish                | 0.755        | 54.86111   |
| Mr Good Bar                 | 0.918        | 54.52645   |
| Lifesavers big ring gummies | 0.279        | 52.91139   |
| Sour Patch Tricksters       | 0.116        | 52.82595   |
| Air Heads                   | 0.511        | 52.34146   |
| Haribo Sour Bears           | 0.465        | 51.41243   |

|                            |       |          |
|----------------------------|-------|----------|
| Almond Joy                 | 0.767 | 50.34755 |
| Tootsie Roll Snack Bars    | 0.325 | 49.65350 |
| Whoppers                   | 0.848 | 49.52411 |
| Tootsie Pop                | 0.325 | 48.98265 |
| Mounds                     | 0.860 | 47.82975 |
| Trolli Sour Bites          | 0.255 | 47.17323 |
| Gobstopper                 | 0.453 | 46.78335 |
| Mike & Ike                 | 0.325 | 46.41172 |
| Payday                     | 0.767 | 46.29660 |
| One quarter                | 0.511 | 46.11650 |
| Smarties candy             | 0.116 | 45.99583 |
| Tootsie Roll Midgies       | 0.011 | 45.73675 |
| Twizzlers                  | 0.116 | 45.46628 |
| Welch's Fruit Snacks       | 0.313 | 44.37552 |
| Fruit Chews                | 0.034 | 43.08892 |
| Tootsie Roll Juniors       | 0.511 | 43.06890 |
| Runts                      | 0.279 | 42.84914 |
| Dots                       | 0.511 | 42.27208 |
| Haribo Twin Snakes         | 0.465 | 42.17877 |
| Werther's Original Caramel | 0.267 | 41.90431 |
| Laffy Taffy                | 0.116 | 41.38956 |
| Pop Rocks                  | 0.837 | 41.26551 |
| Dum Dums                   | 0.034 | 39.46056 |
| Now & Later                | 0.325 | 39.44680 |
| Fun Dip                    | 0.325 | 39.18550 |
| Lemonhead                  | 0.104 | 39.14106 |
| Warheads                   | 0.116 | 39.01190 |
| Charleston Chew            | 0.511 | 38.97504 |
| Candy Corn                 | 0.325 | 38.01096 |
| Nestle Smarties            | 0.976 | 37.88719 |
| Pixie Sticks               | 0.023 | 37.72234 |
| Red vines                  | 0.116 | 37.34852 |
| Chewey Lemonhead Fruit Mix | 0.511 | 36.01763 |
| Ring pop                   | 0.965 | 35.29076 |
| Sixlets                    | 0.081 | 34.72200 |
| Strawberry bon bons        | 0.058 | 34.57899 |
| Caramel Apple Pops         | 0.325 | 34.51768 |
| Haribo Happy Cola          | 0.465 | 34.15896 |
| Sugar Babies               | 0.767 | 33.43755 |
| One dime                   | 0.116 | 32.26109 |
| Sugar Daddy                | 0.325 | 32.23100 |
| Root Beer Barrels          | 0.069 | 29.70369 |
| Jawbusters                 | 0.511 | 28.12744 |

|                    |       |          |
|--------------------|-------|----------|
| Super Bubble       | 0.116 | 27.30386 |
| Chiclets           | 0.325 | 24.52499 |
| Boston Baked Beans | 0.511 | 23.41782 |
| Nik L Nip          | 0.976 | 22.44534 |

```
head(candy[ord,],5)
```

|                           | chocolate | fruity | caramel | peanut | almond | 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      |

|                           | crisped | rice | wafer | hard | bar | pluribus | sugar | percent |
|---------------------------|---------|------|-------|------|-----|----------|-------|---------|
| 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   |

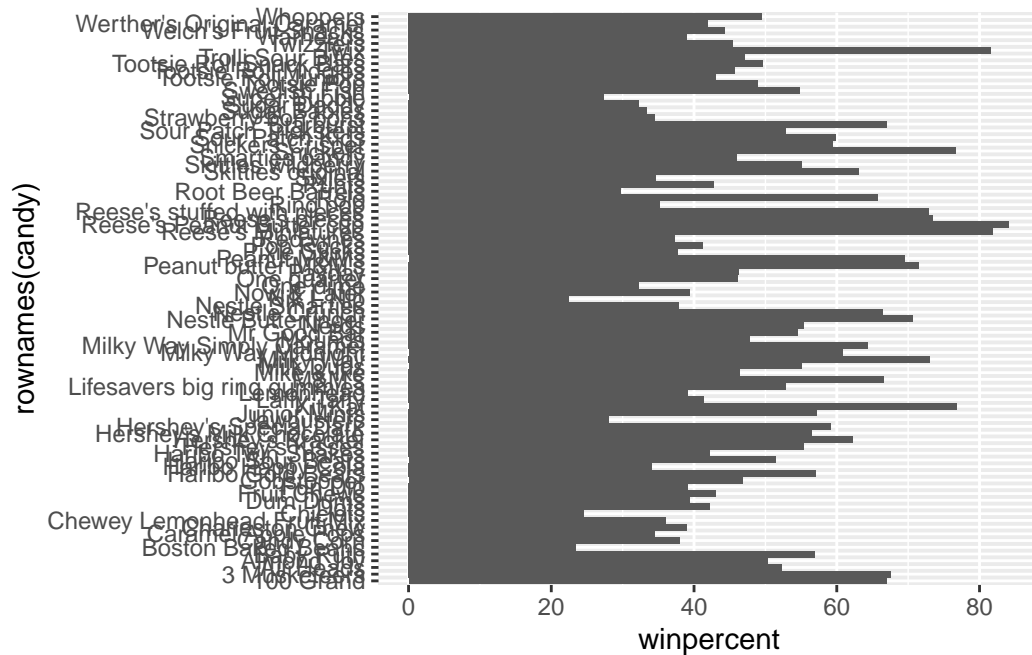
  

|                           | price | percent  | winpercent |
|---------------------------|-------|----------|------------|
| Reese's Peanut Butter cup | 0.651 | 84.18029 |            |
| Reese's Miniatures        | 0.279 | 81.86626 |            |
| Twix                      | 0.906 | 81.64291 |            |
| Kit Kat                   | 0.511 | 76.76860 |            |
| Snickers                  | 0.651 | 76.67378 |            |

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

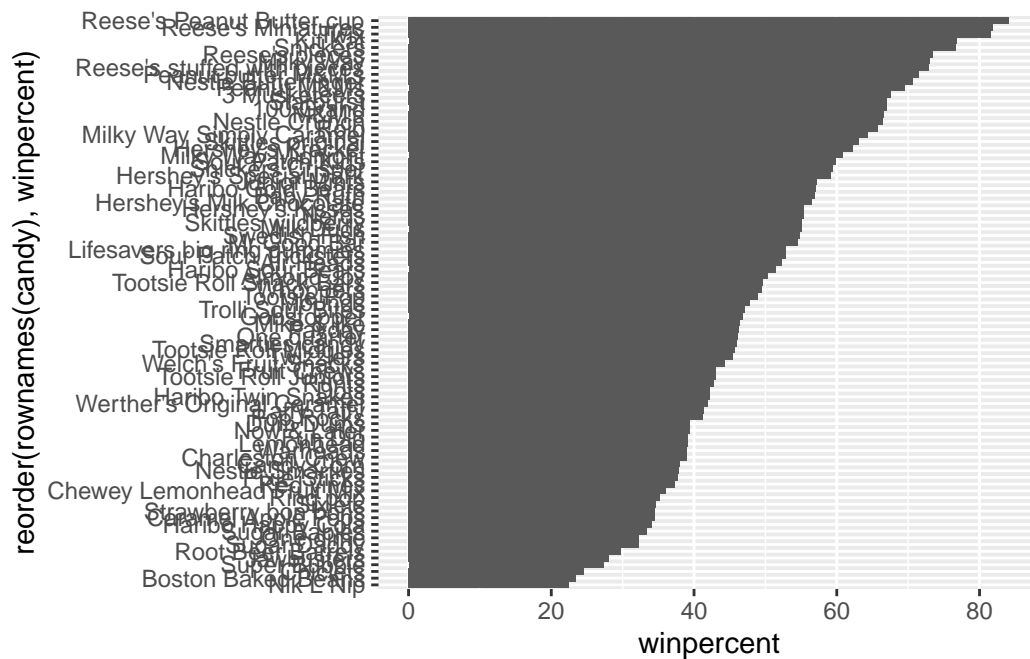
```
library(ggplot2)

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



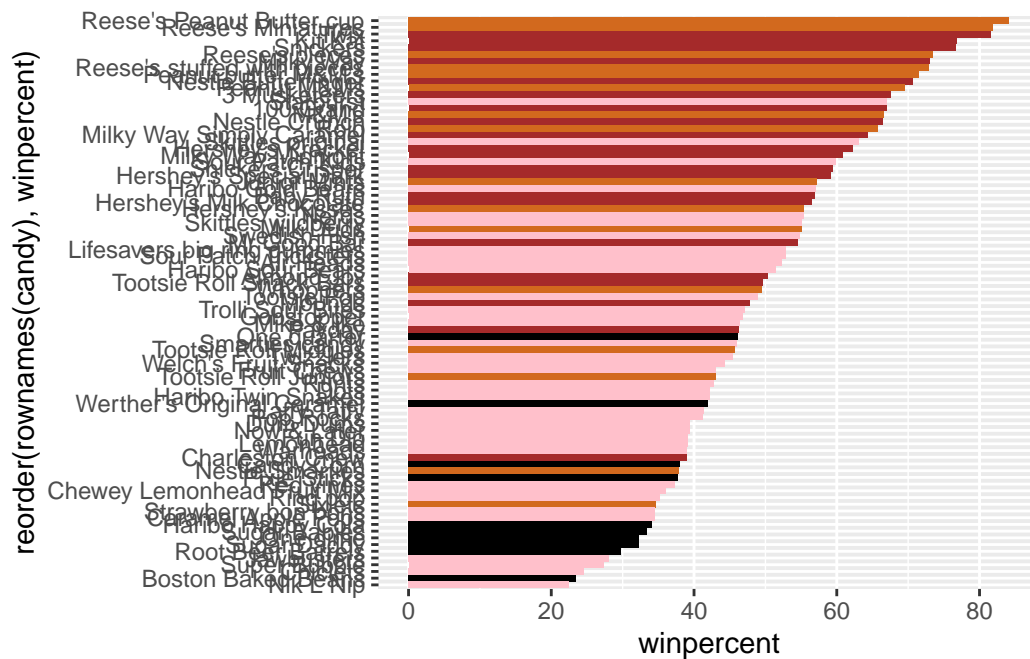
Q16. This is quite ugly, use the `reorder()` function to get the bars sorted by winpercent?

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



```
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?

sixlets

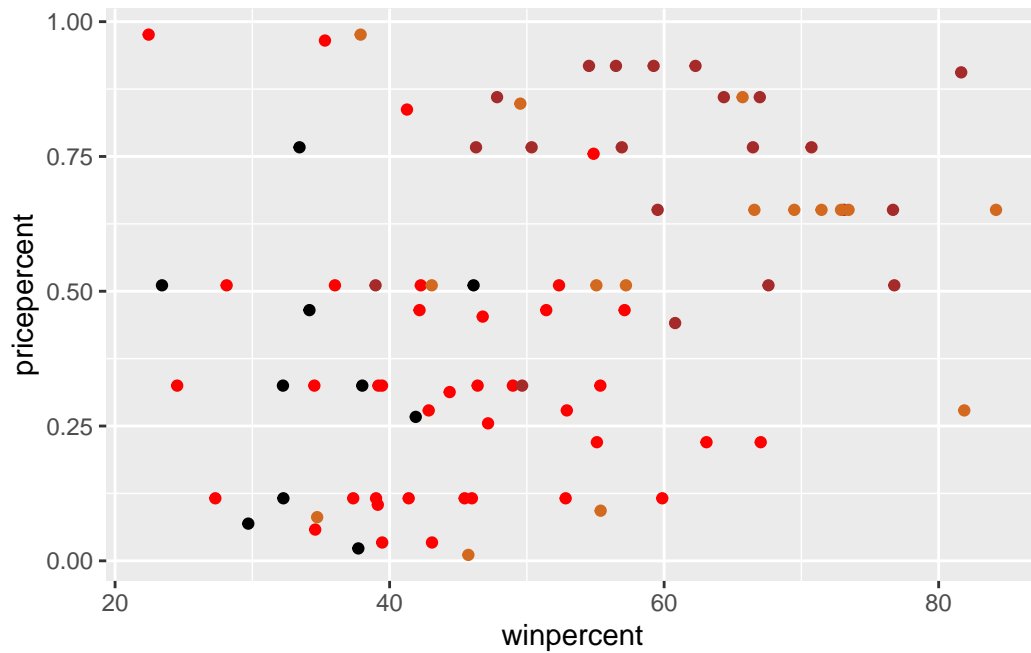
Q18. What is the best ranked fruity candy?

Starburts

What is the best candy for the least money?

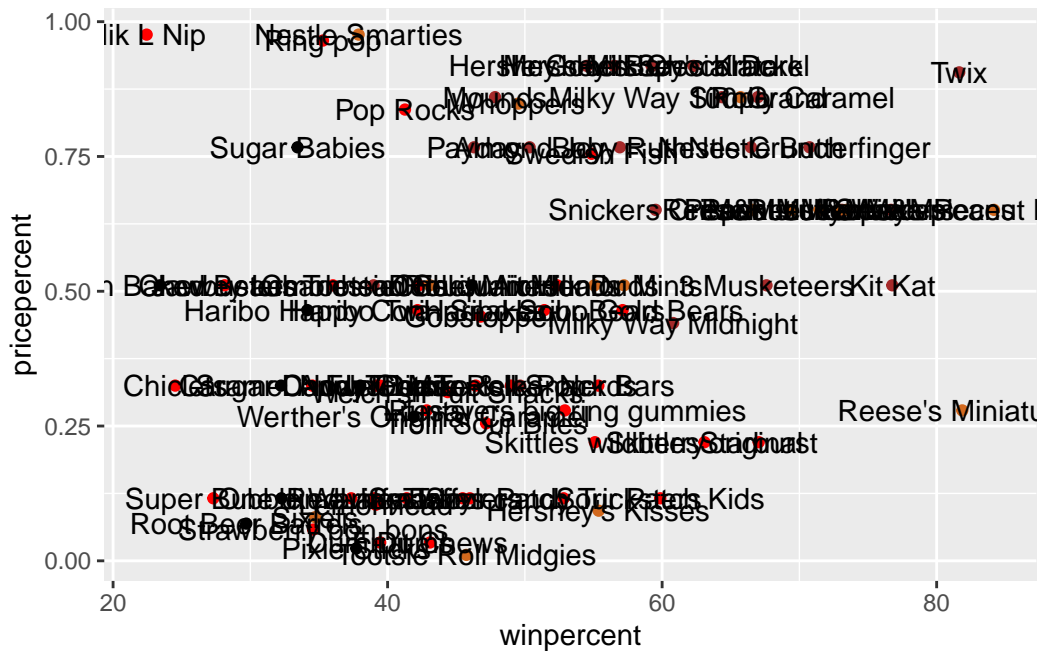
```
my_cols[as.logical(candy$fruity)] = "red"
```

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



Add some labels

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



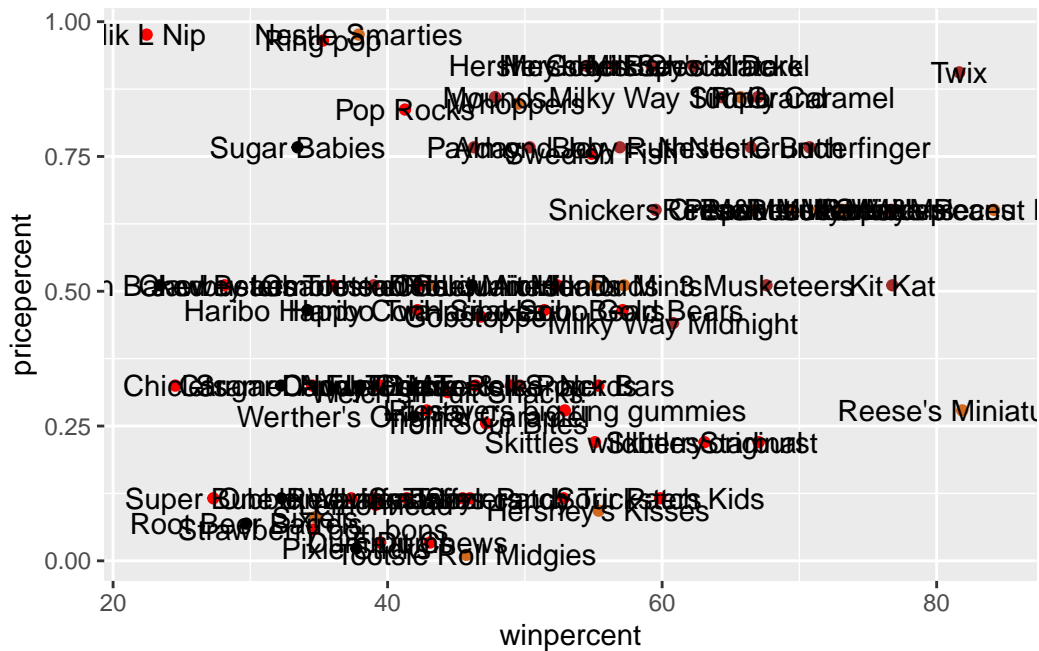
To deal with overlapping labels I can use the **ggrepel** package.

```
#install.packages("ggrepel")

library(ggrepel)

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





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$pricepercent, decreasing = FALSE)
head(candy[ord,c(11,12)])
```

|                      | pricepercent | winpercent |
|----------------------|--------------|------------|
| Tootsie Roll Midgies | 0.011        | 45.73675   |
| Pixie Sticks         | 0.023        | 37.72234   |
| Dum Dums             | 0.034        | 39.46056   |
| Fruit Chews          | 0.034        | 43.08892   |
| Strawberry bon bons  | 0.058        | 34.57899   |
| Root Beer Barrels    | 0.069        | 29.70369   |

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)])
```

```
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 |
| Hershey's Special Dark   | 0.918 | 59.23612 |

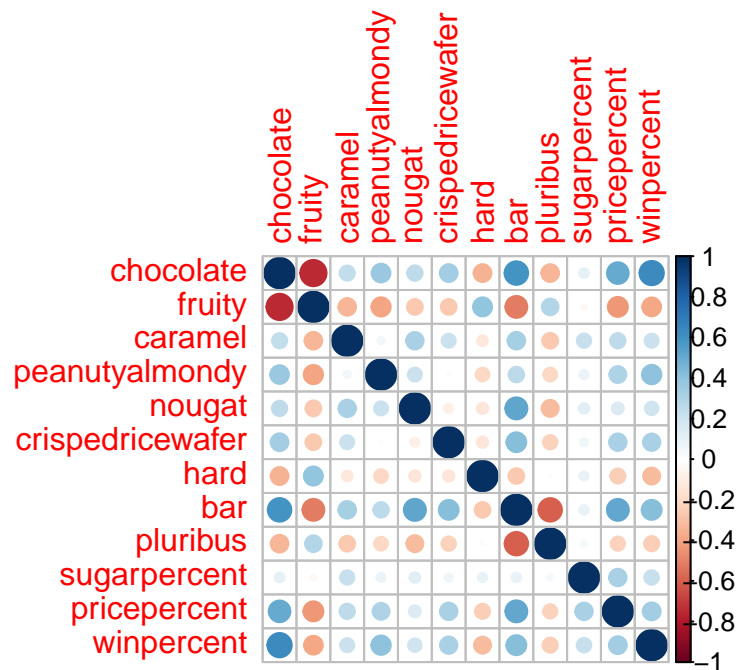
## 5 Exploring the correlation structure

Pearson correlation goes between -1 and +1 with zero indicating no correlation and values close to one being very highly (ani) correlated.

```
#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)?

Chocolate and fruity are anti-correlated.

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

Chocolate and winpercent or chocolate and bar.

## 6. Principal Component Analysis

The base R function for PCA is called `prcomp()` and we can set “scale=TRUE/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 |

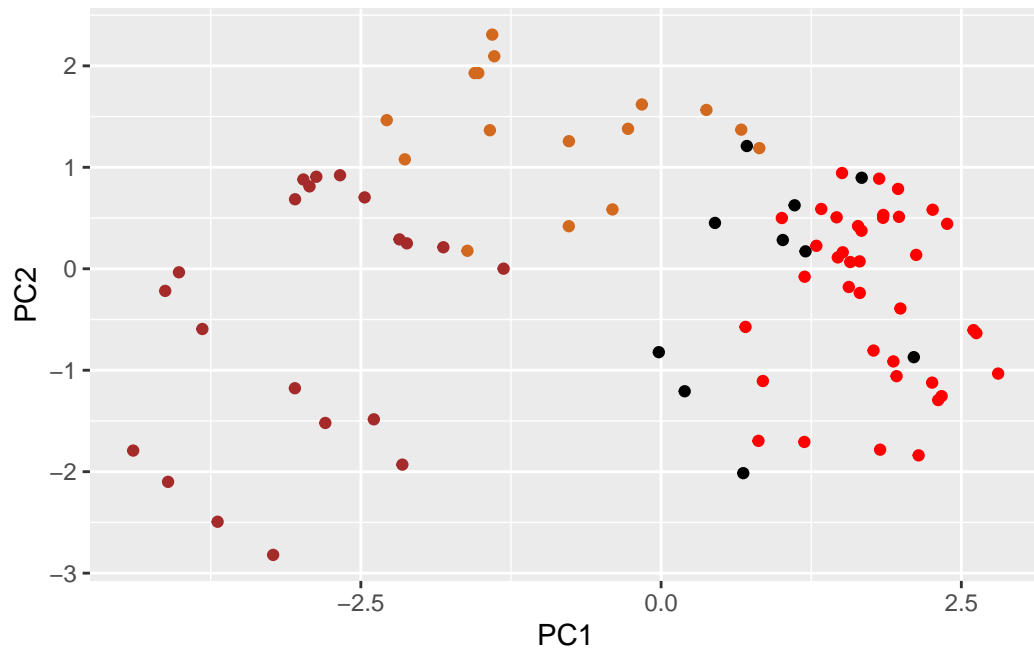
  

|                        | PC8     | PC9     | PC10    | PC11    | PC12    |
|------------------------|---------|---------|---------|---------|---------|
| Standard deviation     | 0.74530 | 0.67824 | 0.62349 | 0.43974 | 0.39760 |
| Proportion of Variance | 0.04629 | 0.03833 | 0.03239 | 0.01611 | 0.01317 |
| Cumulative Proportion  | 0.89998 | 0.93832 | 0.97071 | 0.98683 | 1.00000 |

The main result of PCA - i.e. the new PC plot (projection of candy on our new PC axis) is contained in `pca$x`

```
pc <- as.data.frame(pca$x)

ggplot(pc) +
  aes(PC1, PC2, label = rownames(pc)) +
  geom_point(col=my_cols) #+
```



```
#geom_text_repel(max.overlaps = 5)
```

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

