Class 9: Halloween Candy Mini-Project

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```r
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
```

```r
nrow(candy)
```

```
[1] 85
```

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

```
[1] 38
```

> Q1. How many different candy types are in this dataset?

85

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

38

```r
candy["100 Grand", ]$winpercent
```

```
[1] 66.97173
```

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

100 Grand - 66.97173

Q4. What is the winpercent value for "Kit Kat"?

76.7686

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

49.6535

```r
#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	

skim_variable	n_missing	complete_rate	mean	sd	p0	p25	p50	p75	p100	hist
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	

```r
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
```

```r
candy |>
  filter(rownames(candy) %in% c("Dum Dums", "Twix")) |>
  select(winpercent)
```

```
         winpercent
Dum Dums   39.46056
Twix       81.64291
```

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

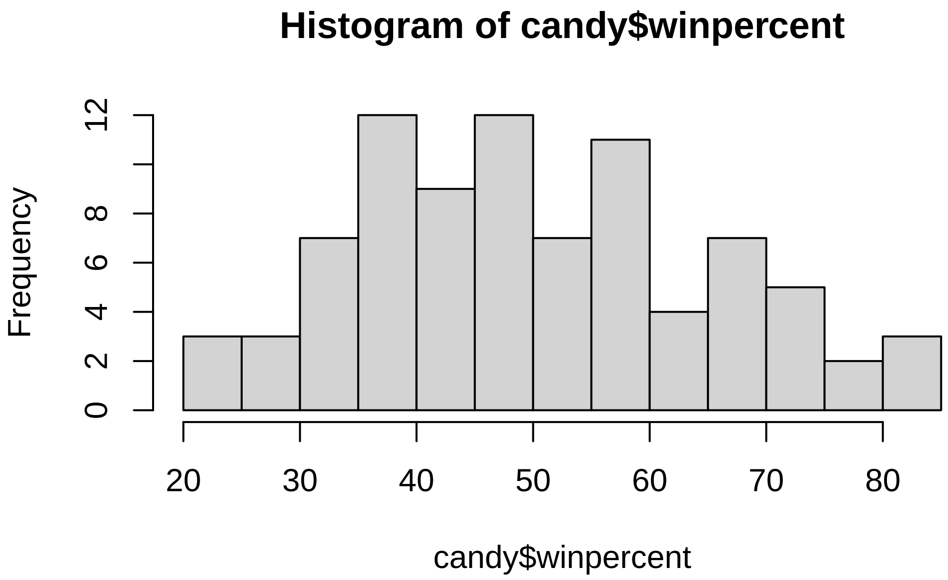
winpercent - mean is 2 orders of magnitude higher

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

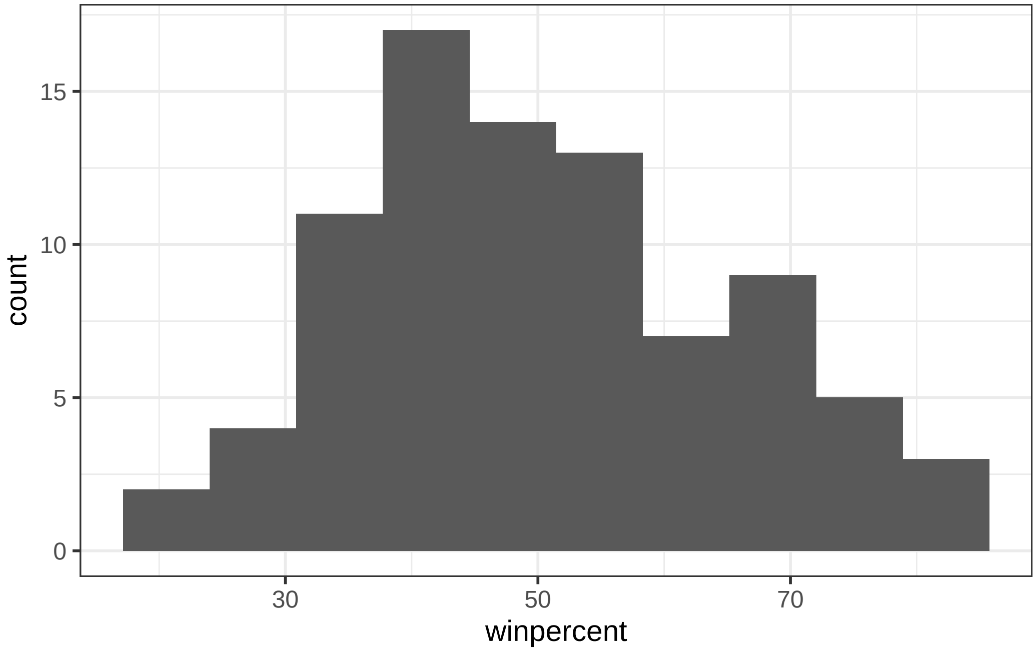
Zero means it does not contain chocolate, one means it contains chocolate

> Q8. Plot a histogram of winpercent values

```
hist(candy$winpercent, breaks = 10)
```



```
library(ggplot2)

ggplot(candy) +
  aes(winpercent) +
  geom_histogram(bins=10) +
  theme_bw()
```



Q9. Is the distribution of winpercent values symmetrical?

No - there is a longer tail toward the higher win percent values

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

Below

```
candy |>
  filter(winpercent > 75) |>
  filter(pricepercent < 0.5)
```

```
                   chocolate fruity caramel peanutyalmondy nougat
Reese's Miniatures         1      0       0              1      0
                   crispedricewafer hard bar pluribus sugarpercent pricepercent
Reese's Miniatures                0    0   0        0        0.034        0.279
                   winpercent
Reese's Miniatures   81.86626
```

```
inds <- candy$chocolate == 1
choc.win <- candy[inds,]$winpercent

inds <- candy$fruity == 1
fruit.win <- candy[inds,]$winpercent
```

```r
mean(candy$winpercent[as.logical(candy$chocolate)])
```

```
[1] 60.92153
```

```r
mean(candy$winpercent[as.logical(candy$fruity)])
```

```
[1] 44.11974
```

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

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

```r
summary(choc.win)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  34.72   50.35   60.80   60.92   70.74   84.18 
```

```r
summary(fruit.win)
```

```
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  22.45   39.04   42.97   44.12   52.11   67.04 
```

```r
t.test(x= candy$winpercent[as.logical(candy$chocolate)],
       y=(candy$winpercent[as.logical(candy$fruity)])
)
```

```

    Welch Two Sample t-test

data:  candy$winpercent[as.logical(candy$chocolate)] and (candy$winpercent[as.logical(candy$
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 
```

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

Chocolate candy is ranked higher than fruit candy on average

Q12. Is this difference statistically significant?

Yes, with an alpha 0.5

```
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
```

There are two related fnctions that are useful here `sort()` and `order()`

```
play <- c(2,1,5,3)
sort(play)
```

```
[1] 1 2 3 5
```

```
order(play)
```

```
[1] 2 1 4 3
```

```r
inds <- order(candy$winpercent, decreasing=F)
head(candy[inds,])
```

```
                   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
                   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
Root Beer Barrels                 0    1   0        1        0.732        0.069
                   winpercent
Nik L Nip            22.44534
Boston Baked Beans   23.41782
Chiclets             24.52499
Super Bubble         27.30386
Jawbusters           28.12744
Root Beer Barrels    29.70369
```

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

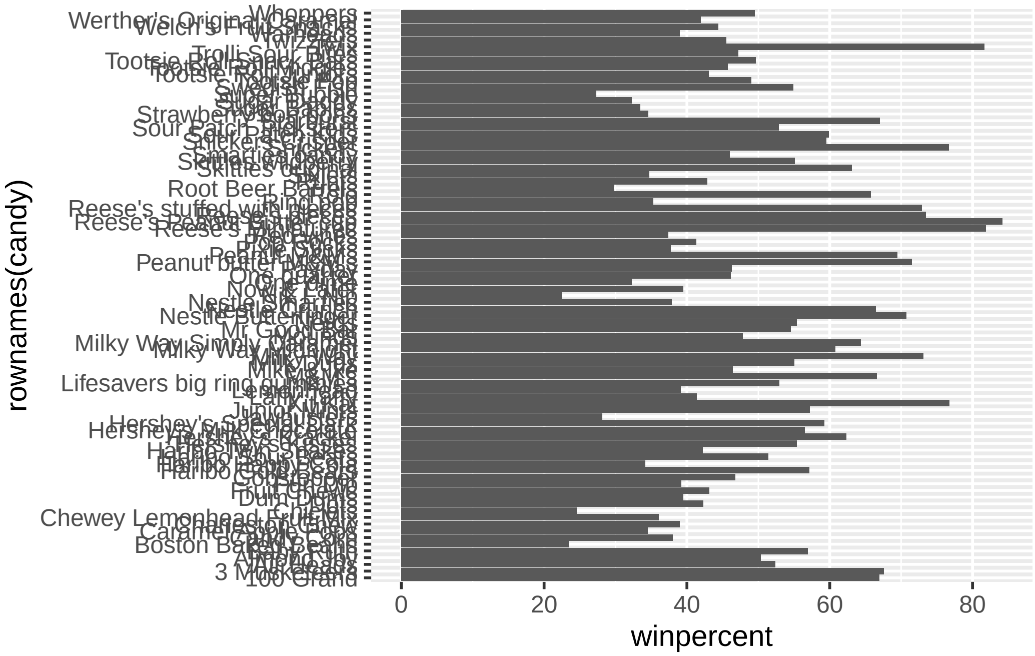
Nik L Nip, Boston Baked Beans, Chiclets, Super Bubble, Jawbusters

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

Snickers, Kit Kat, Twix, Reese's Miniatures, Reese's Peanut Butter Cup

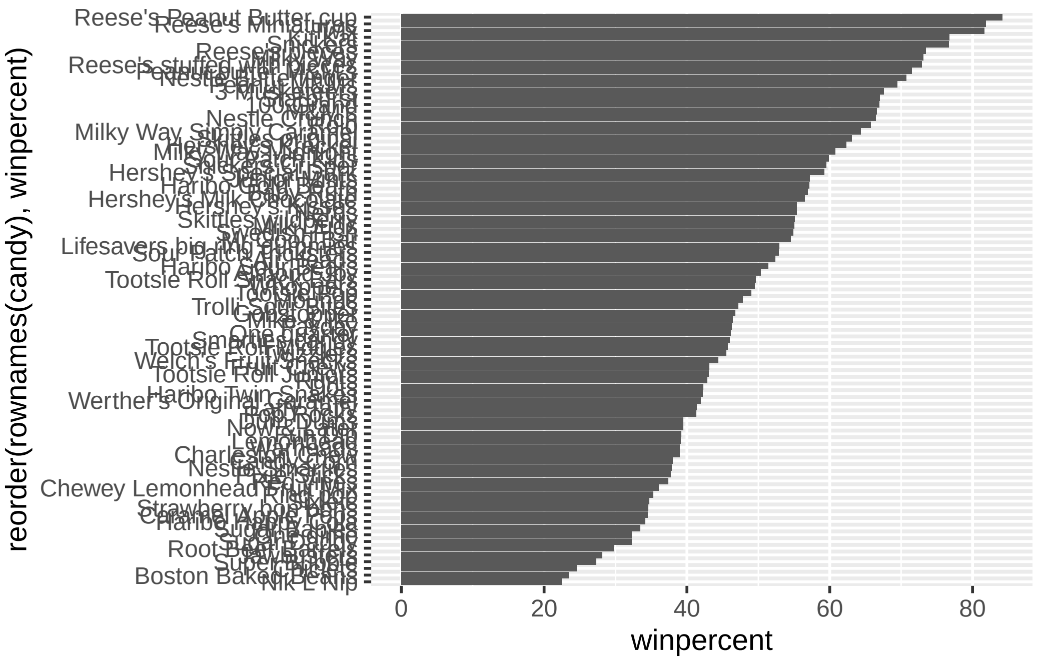
Q15. Make a first barplot of candy ranking based on winpercent values.

```r
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?

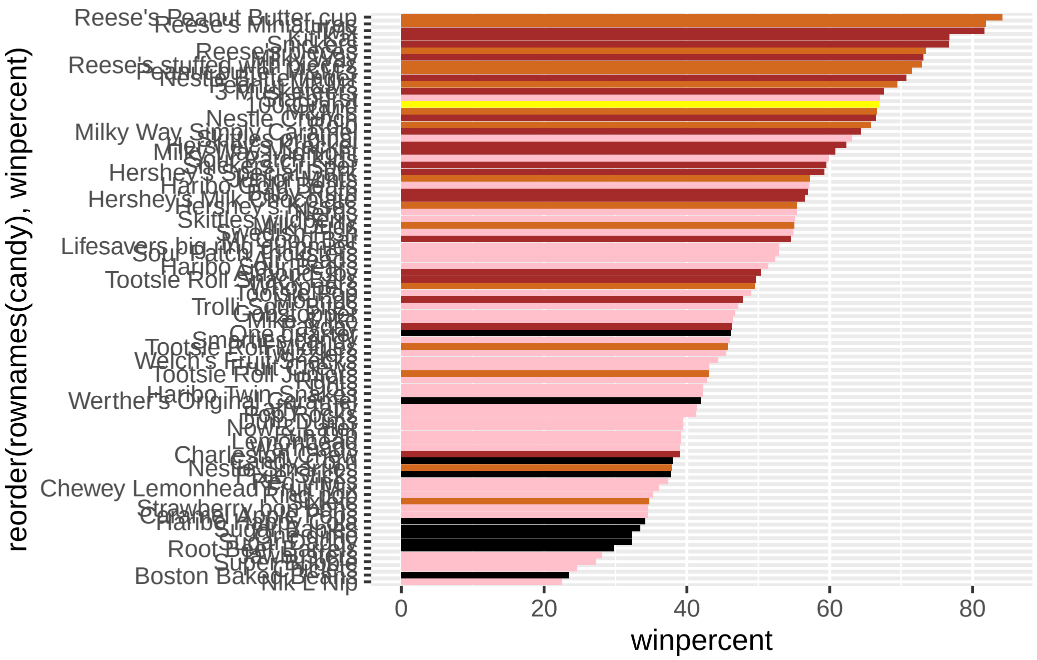
```r
library(ggplot2)

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



Q. Color your favorite candy your favourite color

```
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"
my_cols[rownames(candy) == "100 Grand"] = "yellow"
```

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



```r
?rep()
```

Q17. What is the worst ranked chocolate candy?

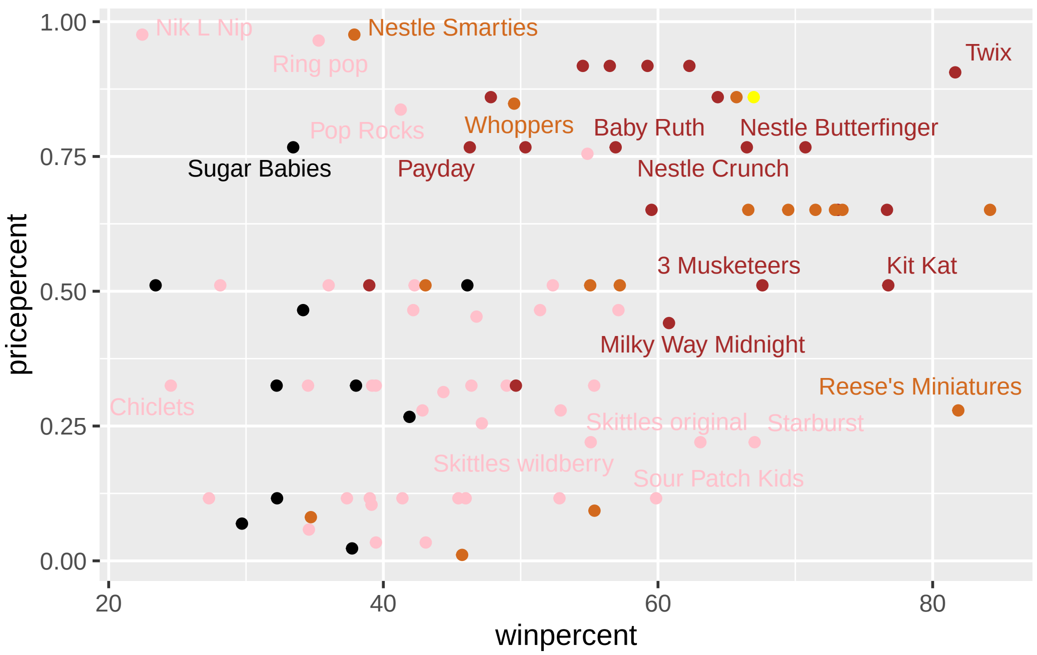
Sixlets

Q18. What is the best ranked fruity candy?

Starburst

```r
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's Miniatures

```
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
```

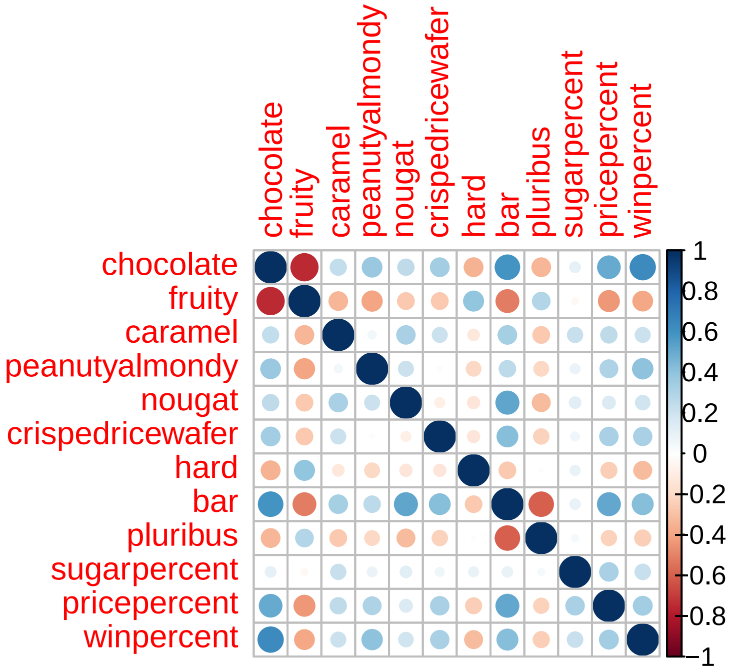
Q20. What are the top 5 most expensive candy types in the dataset and of these which is the least popular?

Nik L Nip - least popular Nestle Smarties Ring pop
Hershey's Krackel Hershey's Milk Chocolate

```
cij <- cor(candy)

#install.packages("corrplot")
library(corrplot)
```

```
corrplot 0.95 loaded
```

```
corrplot(cij)
```



Principal Component Analysis

```
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
```

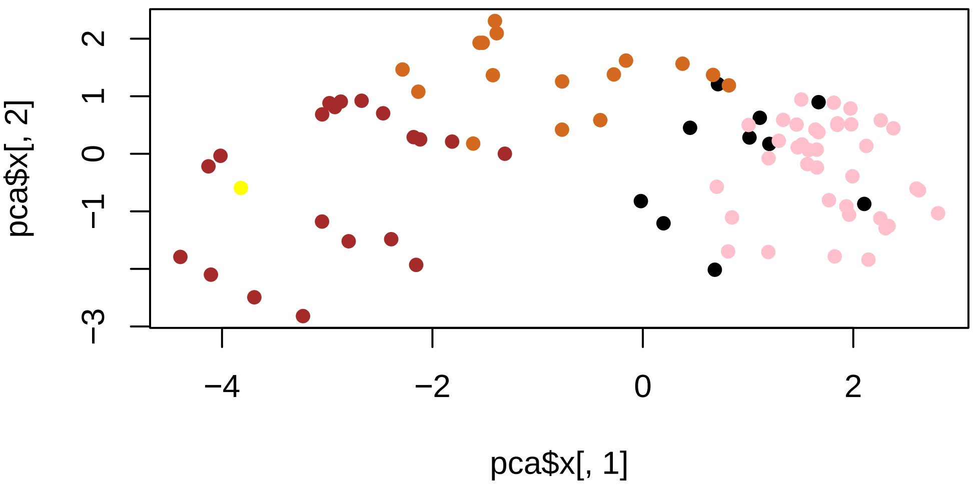
```
                           PC8     PC9    PC10    PC11    PC12
Standard deviation     0.74530 0.67824 0.62349 0.43974 0.39760
Proportion of Variance 0.04629 0.03833 0.03239 0.01611 0.01317
Cumulative Proportion  0.89998 0.93832 0.97071 0.98683 1.00000
```

```
pca
```

```
Standard deviations (1, .., p=12):
 [1] 2.0787503 1.1378302 1.1091894 1.0753337 0.9518204 0.8192321 0.8153014
 [8] 0.7452991 0.6782391 0.6234867 0.4397418 0.3976039

Rotation (n x k) = (12 x 12):
                        PC1         PC2         PC3          PC4          PC5
chocolate        -0.4019466  0.21404160  0.01601358 -0.016673032  0.066035846
fruity            0.3683883 -0.18304666 -0.13765612 -0.004479829  0.143535325
caramel          -0.2299709 -0.40349894 -0.13294166 -0.024889542 -0.507301501
peanutyalmondy   -0.2407155  0.22446919  0.18272802  0.466784287  0.399930245
nougat           -0.2268102 -0.47016599  0.33970244  0.299581403 -0.188852418
crispedricewafer -0.2215182  0.09719527 -0.36485542 -0.605594730  0.034652316
hard              0.2111587 -0.43262603 -0.20295368 -0.032249660  0.574557816
bar              -0.3947433 -0.22255618  0.10696092 -0.186914549  0.077794806
pluribus          0.2600041  0.36920922 -0.26813772  0.287246604 -0.392796479
sugarpercent     -0.1083088 -0.23647379 -0.65509692  0.433896248  0.007469103
pricepercent     -0.3207361  0.05883628 -0.33048843  0.063557149  0.043358887
winpercent       -0.3298035  0.21115347 -0.13531766  0.117930997  0.168755073
                         PC6         PC7         PC8          PC9         PC10
chocolate        -0.09018950 -0.08360642 -0.49084856 -0.151651568  0.107661356
fruity           -0.04266105  0.46147889  0.39805802 -0.001248306  0.362062502
caramel          -0.40346502 -0.44274741  0.26963447  0.019186442  0.229799010
peanutyalmondy   -0.09416259 -0.25710489  0.45771445  0.381068550 -0.145912362
nougat            0.09012643  0.36663902 -0.18793955  0.385278987  0.011323453
crispedricewafer -0.09007640  0.13077042  0.13567736  0.511634999 -0.264810144
hard             -0.12767365 -0.31933477 -0.38881683  0.258154433  0.220779142
bar               0.25307332  0.24192992 -0.02982691  0.091872886 -0.003232321
pluribus          0.03184932  0.04066352 -0.28652547  0.529954405  0.199303452
sugarpercent      0.02737834  0.14721840 -0.04114076 -0.217685759 -0.488103337
pricepercent      0.62908570 -0.14308215  0.16722078 -0.048991557  0.507716043
winpercent       -0.56947283  0.40260385 -0.02936405 -0.124440117  0.358431235
                        PC11        PC12
chocolate         0.10045278  0.69784924
fruity            0.17494902  0.50624242
caramel           0.13515820  0.07548984
```

```
peanutyalmondy    0.11244275  0.12972756
nougat           -0.38954473  0.09223698
crispedricewafer -0.22615618  0.11727369
hard              0.01342330 -0.10430092
bar               0.74956878 -0.22010569
pluribus          0.27971527 -0.06169246
sugarpercent      0.05373286  0.04733985
pricepercent     -0.26396582 -0.06698291
winpercent       -0.11251626 -0.37693153
```

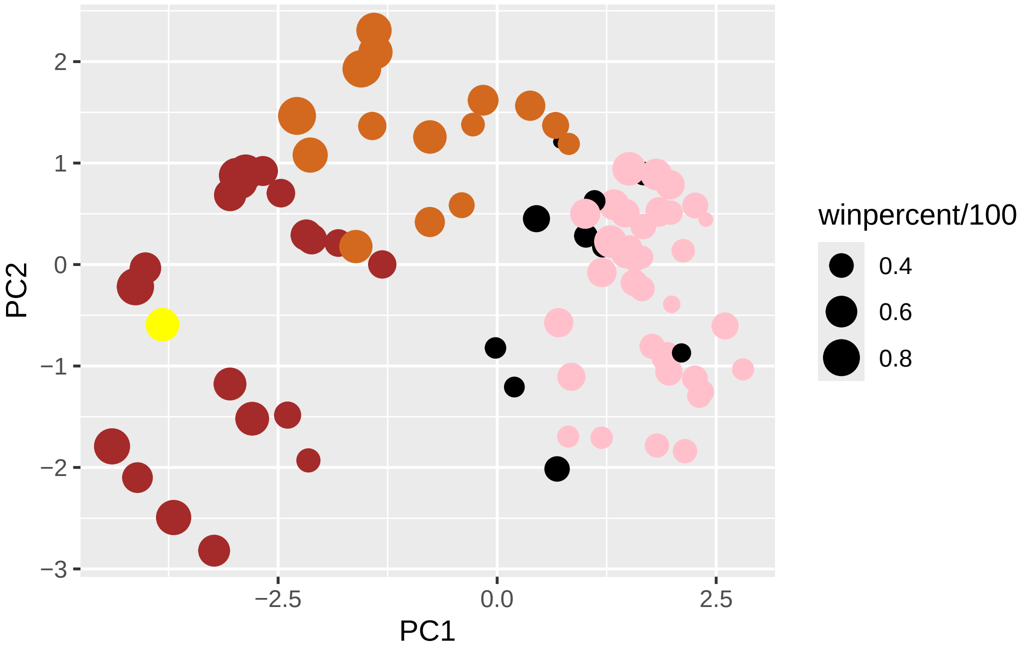
```
plot(pca$x[,1], pca$x[,2], col=my_cols, pch=16)
```



A ggplot version of our PCA plot

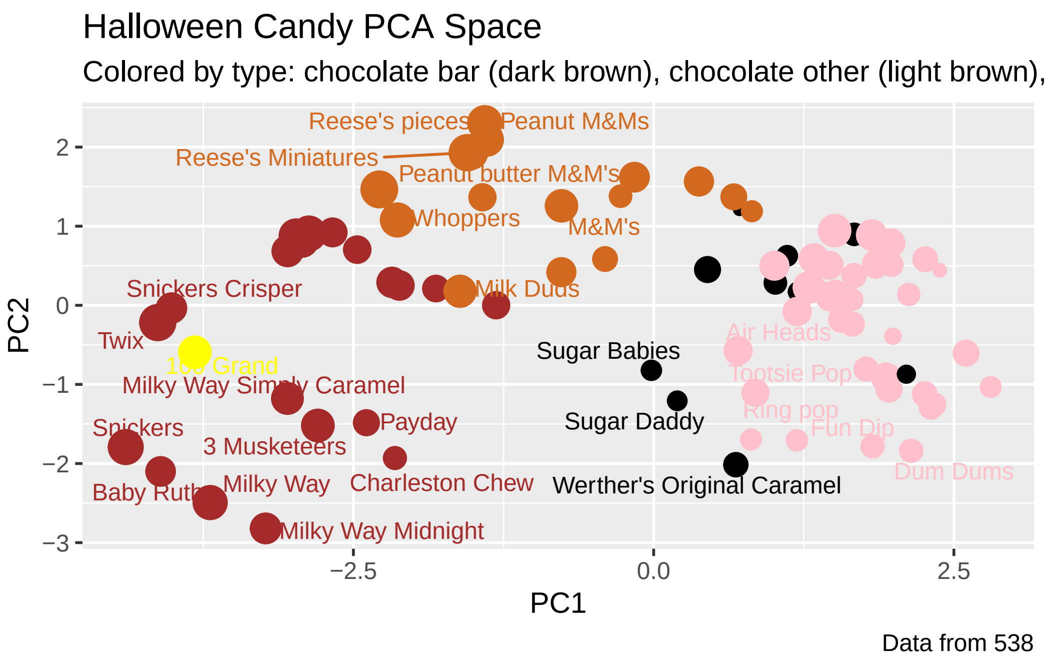
```
# Make a new data-frame with our PCA results and candy data
my_data <- cbind(candy, pca$x[,1:3])
```

```
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
```


Halloween Candy PCA Space

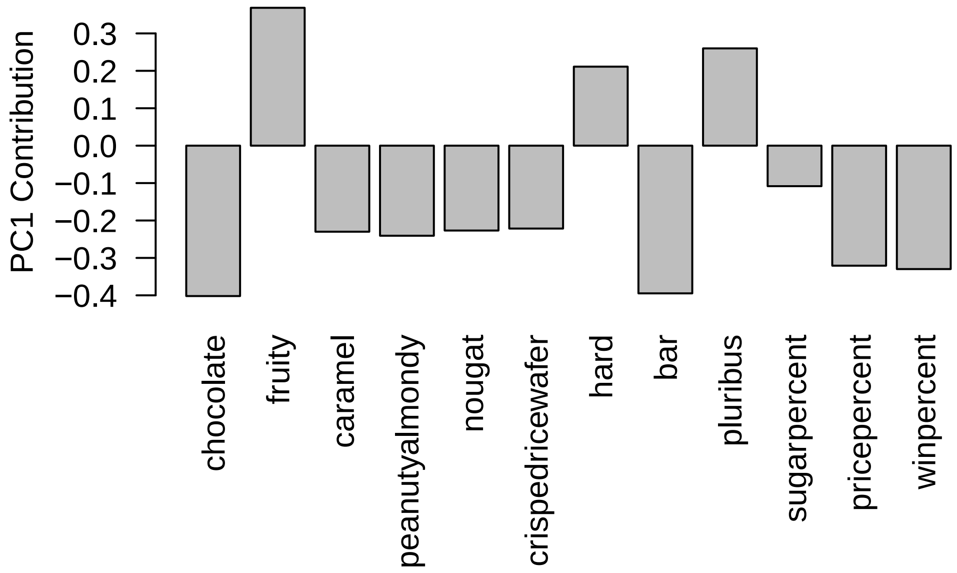
Colored by type: chocolate bar (dark brown), chocolate other (light brown),

Data from 538

```
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 
```

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



NOTES

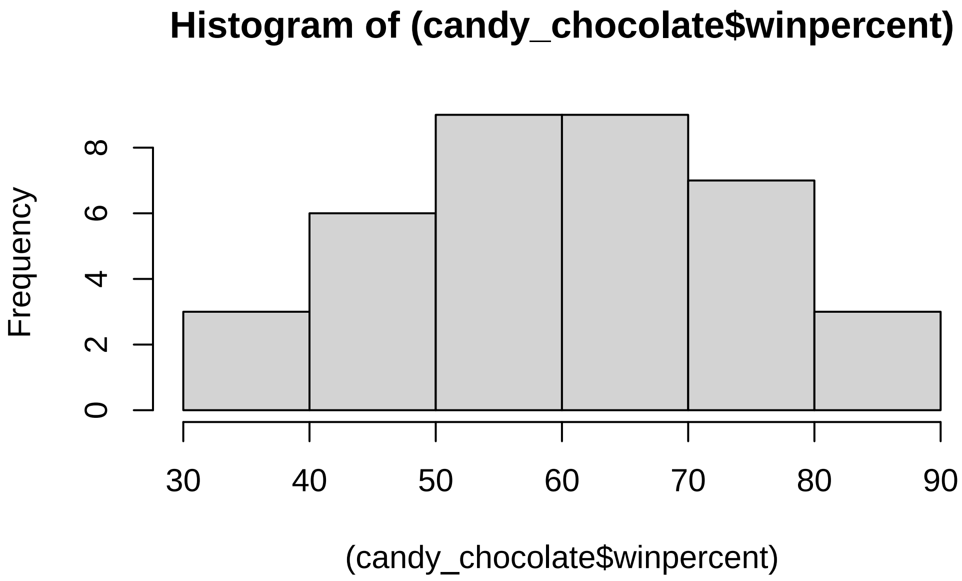
The `%in%` operator is useful for checking the intersection of two vectors.

```
c("barry", "liz", "chandra") %in% c("paul", "alice", "liz")
```

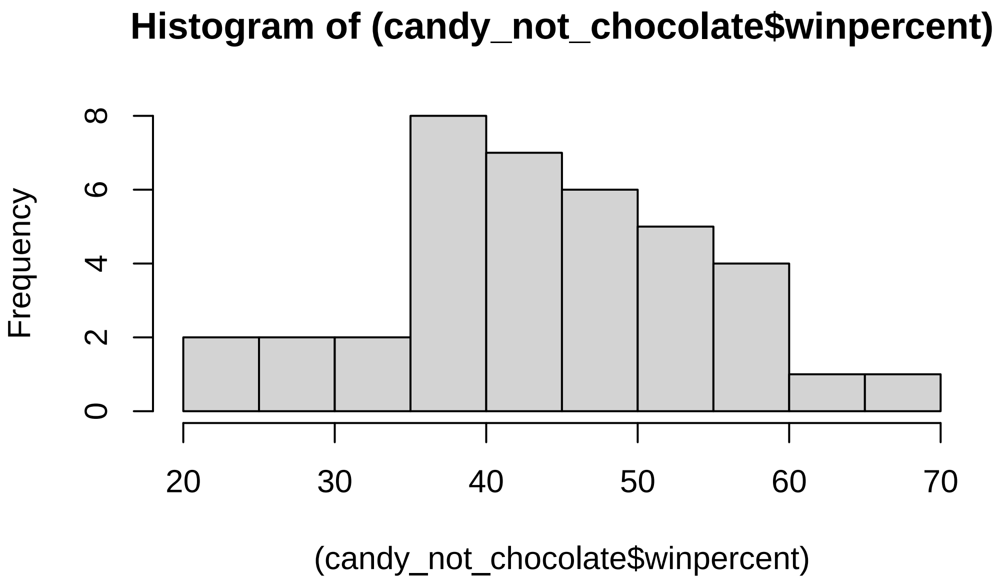
```
[1] FALSE  TRUE FALSE
```

```
candy_chocolate <-
  candy |>
  filter(chocolate == 1)

candy_not_chocolate <-
  candy |>
  filter(fruity == 1)
```

```
hist((candy_chocolate$winpercent))
```



```
hist((candy_not_chocolate$winpercent))
```



```
play <- c("sawyer", "barry")
rep(play, each = 3)
```

```
[1] "sawyer" "sawyer" "sawyer" "barry"  "barry"  "barry"
```