

lab9.0

lab 9

```
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

```
nrow(candy)
```

[1] 85

Q2

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

```
[1] 38
```

Q3

```
candy["Snickers", "winpercent"]
```

```
[1] 76.67378
```

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

```
[1] 76.67378
```

Q4

```
candy["Kit Kat",]$winpercent
```

```
[1] 76.7686
```

Q5

```
candy["Tootsie Roll Snack Bars",]$winpercent
```

```
[1] 49.6535
```

quick over view with skimr

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

Table 1: Data summary

Name	candy
Number of rows	85
Number of columns	12

Column type frequency:	
numeric	12
<hr/>	
Group variables	None
<hr/>	

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	

it looks like the **winpercent** column is on a different scale than the others (0-100% rather than 0-1) we will need to scale this dataset before analysis like PCA

Q6

it looks like the **winpercent** column is on a different scale than the others (0-100% rather than 0-1) we will need to scale this dataset before analysis like PCA

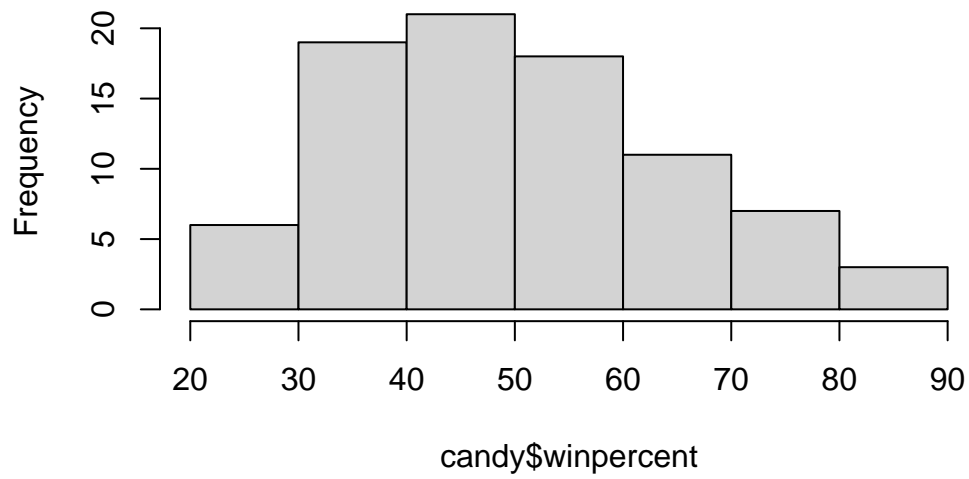
Q7

0 represents false/not part of that category and 1 vis versa

Q8

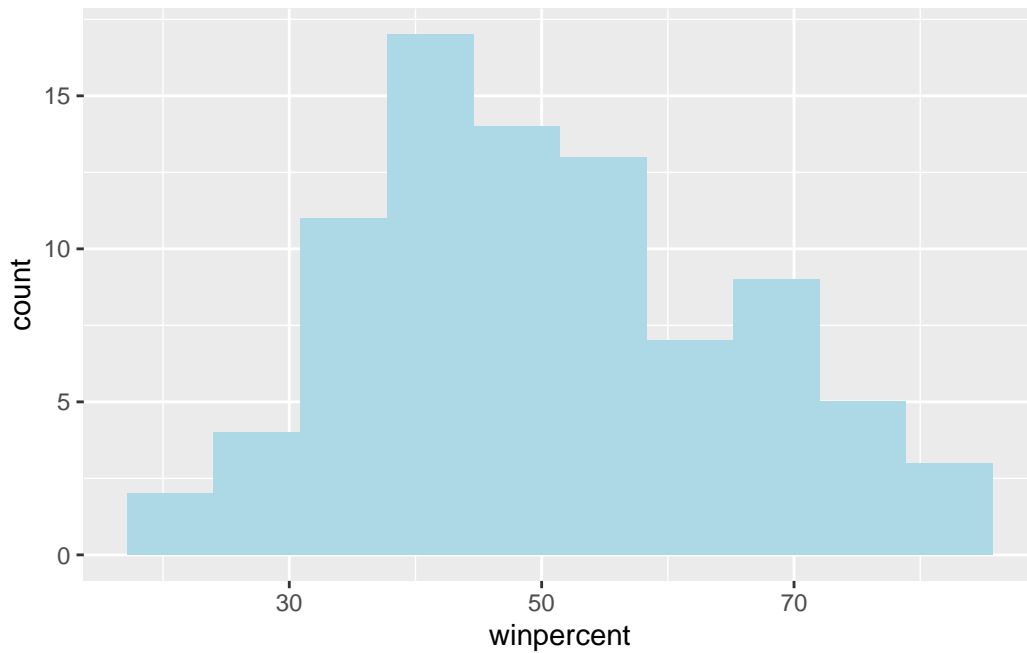
```
hist(candy$winpercent)
```

Histogram of candy\$winpercent



```
library(ggplot2)

ggplot(candy) +
  aes(winpercent) +
  geom_histogram(bins = 10, fill = "lightblue")
```



Q 10

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

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

Q11

- step 1: find all “chocolate” candy
- step 2: find all their “winpercent” values
- step 3: summerize these values
- step 4: find all “fruity” candy
- step 5: find all their “winpercent” values
- step 6: summerize these values
- step 7: compare the two summary values

1. find all chocolate candy

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

2. find their winpercent values

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

3. summerize these values

```
choc.mean <- mean(choc.win)
```

do the same thing with fruity

1. find all chocolate candy

```
fruit.inds <- candy$fruity == 1
```

2. find their winpercent values

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

3. summerize these values

```
fruit.mean <- mean(fruit.win)
```

so clearly chocolate has a higher mean winpercent thna fruity candy

```
choc.mean
```

```
[1] 60.92153
```

```
fruit.mean
```

```
[1] 44.11974
```

Q12

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

Welch Two Sample t-test

```
data:  choc.win and fruit.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
```

Q13

```
# not that useful just sorts values
sort(candy$winpercent)
```

```
[1] 22.44534 23.41782 24.52499 27.30386 28.12744 29.70369 32.23100 32.26109
[9] 33.43755 34.15896 34.51768 34.57899 34.72200 35.29076 36.01763 37.34852
[17] 37.72234 37.88719 38.01096 38.97504 39.01190 39.14106 39.18550 39.44680
[25] 39.46056 41.26551 41.38956 41.90431 42.17877 42.27208 42.84914 43.06890
[33] 43.08892 44.37552 45.46628 45.73675 45.99583 46.11650 46.29660 46.41172
[41] 46.78335 47.17323 47.82975 48.98265 49.52411 49.65350 50.34755 51.41243
[49] 52.34146 52.82595 52.91139 54.52645 54.86111 55.06407 55.10370 55.35405
[57] 55.37545 56.49050 56.91455 57.11974 57.21925 59.23612 59.52925 59.86400
[65] 60.80070 62.28448 63.08514 64.35334 65.71629 66.47068 66.57458 66.97173
[73] 67.03763 67.60294 69.48379 70.73564 71.46505 72.88790 73.09956 73.43499
[81] 76.67378 76.76860 81.64291 81.86626 84.18029
```

```
x <- c(10,1,100)
order(x)
```

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

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

```
[1] 1 10 100
```

the `order()` function tells us how it arrange the elements of the input to make them sorted in order to order them

we can determine the order of winpercent to make them sorted and use that order to arrange the whole dataset

```
ord.inds <- order(candy$winpercent, decreasing = T)
head( candy[ord.inds,])
```

	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
Reese's pieces	1	0	0		1	0

	crisped	rice	wafer	hard	bar	pluribus	sugar
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

	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	
Reese's pieces	0.651	73.43499	

Q14

```
head( candy[ord.inds,])
```

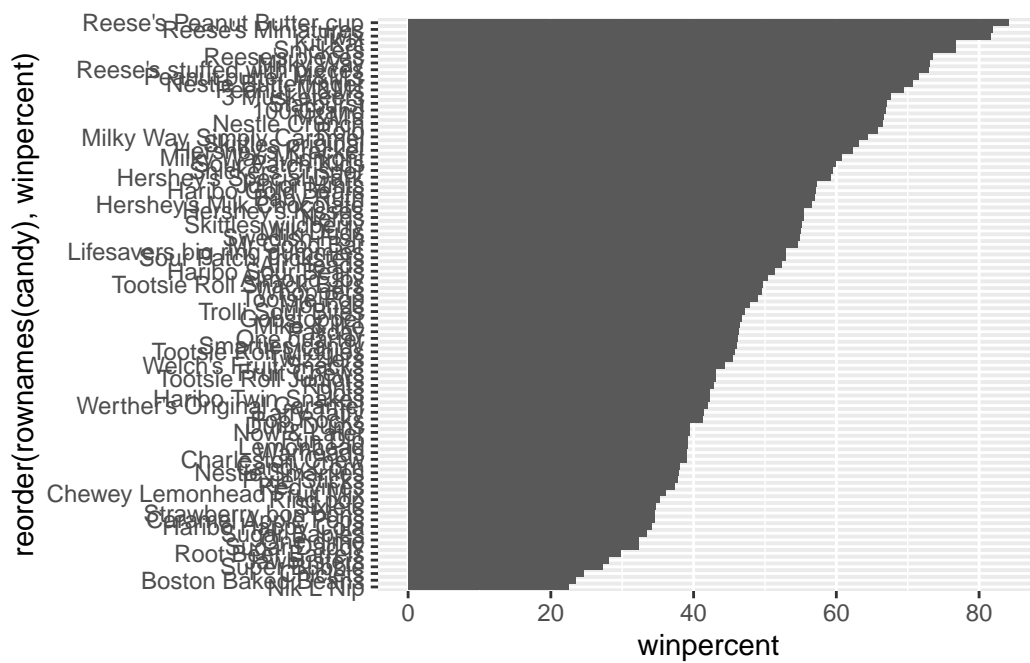
	chocolate	fruity	caramel	peanut	almond	nougat
Reese's Peanut Butter cup	1	0	0		1	0
Reese's Miniatures	1	0	0		1	0
Twix	1	0	1		0	0
Kit Kat	1	0	0		0	0
Snickers	1	0	1		1	1
Reese's pieces	1	0	0		1	0

	crisped	rice	wafer	hard	bar	pluribus	sugar
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
	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			

Q15/16

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



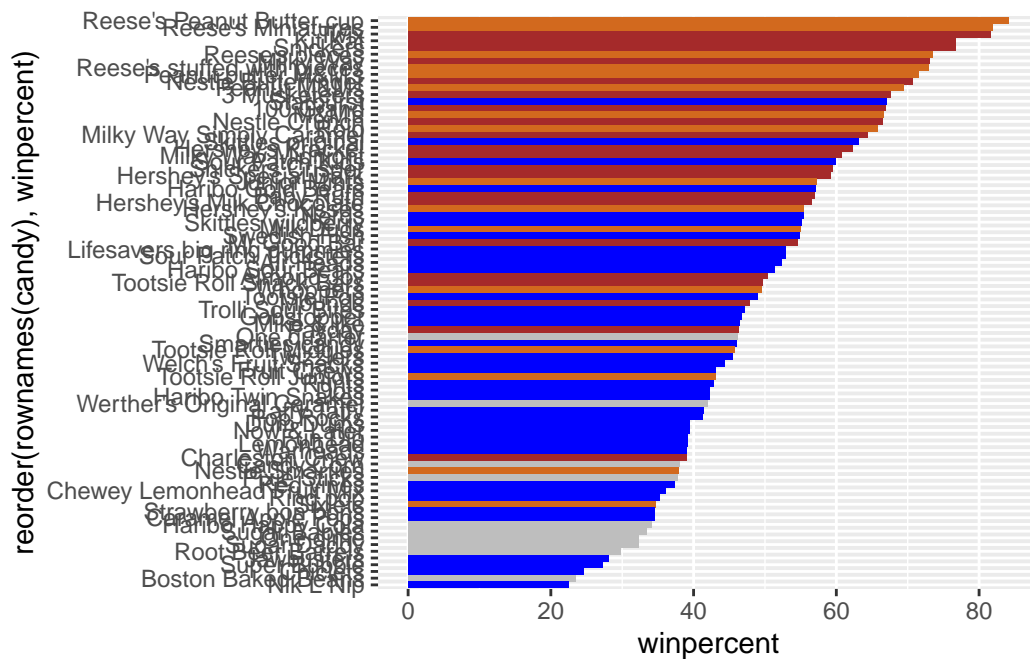
time to add color

we need to make our own separate color vector where we can spell out exactly what candy id colored

```
mycols <- rep("gray", nrow(candy))
mycols[candy$chocolate == 1] <- "chocolate"
mycols[candy$bar == 1] <- "brown"
mycols[candy$fruity == 1] <- "blue"
mycols
```

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

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

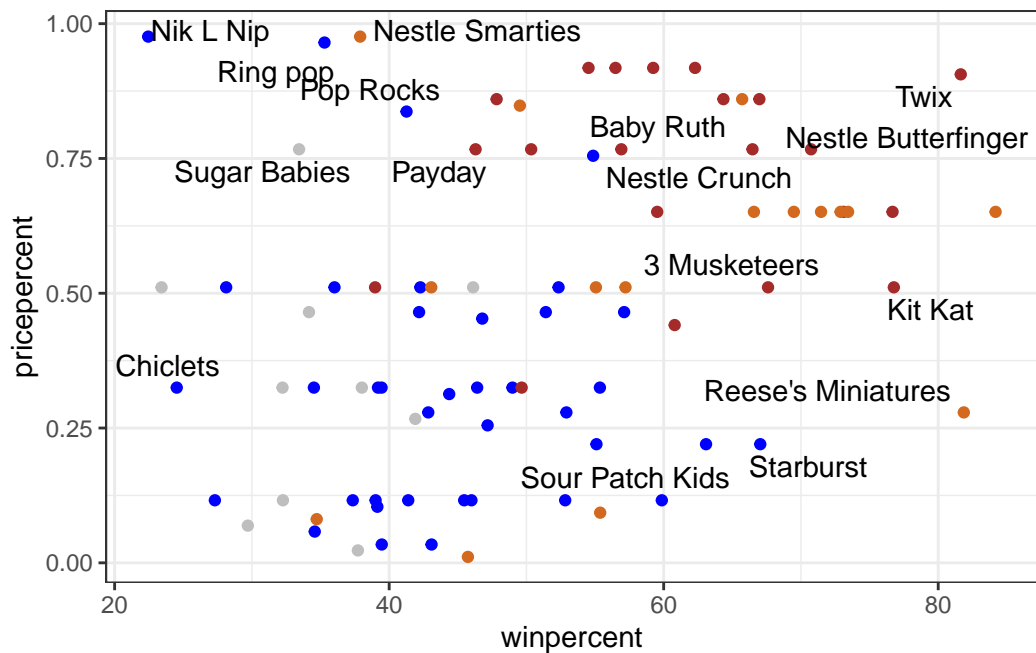


make a plot of winpercent x-axis vs pricepercent y axis

```
library(ggrepel)
```

```
ggplot(candy) +
  aes(winpercent, pricepercent, label=rownames(candy)) +
  geom_point(col=mycols) +
  geom_text_repel(max.overlaps = 6) +
  theme_bw()
```

Warning: ggrepel: 69 unlabeled data points (too many overlaps). Consider increasing max.overlaps



to avoid the pverplotting of the text labels we cna use the add on package **ggrepel**

Q19

Q20

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

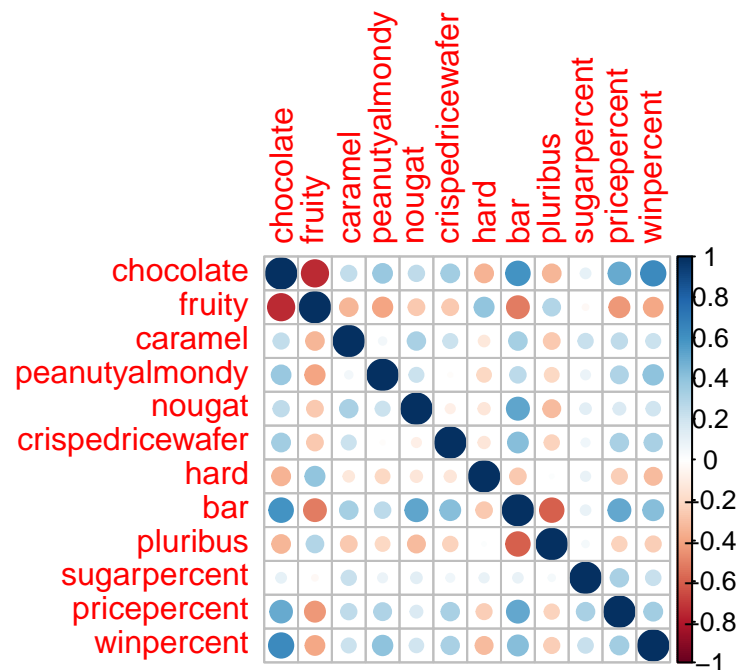
	pricepercent	winpercent
Nik L Nip	0.976	22.44534
Nestle Smarties	0.976	37.88719
Ring pop	0.965	35.29076
Hershey's Krackel	0.918	62.28448
Hershey's Milk Chocolate	0.918	56.49050

5

```
library(corrplot)
```

corrplot 0.95 loaded

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



```
##6
```

```
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

```
attributes(pca)
```

```
$names
```

```
[1] "sdev"      "rotation" "center"   "scale"     "x"
```

```
$class
```

```
[1] "prcomp"
```

lets plot results

```
pca$x
```

	PC1	PC2	PC3	PC4
100 Grand	-3.81986175	-0.5935787670	-2.186308676	-2.37159574
3 Musketeers	-2.79602364	-1.5196062111	1.412198551	0.69943868
One dime	1.20258363	0.1718120657	2.060771178	-1.20067824
One quarter	0.44865378	0.4519735621	1.476492844	-1.00177141
Air Heads	0.70289922	-0.5731343263	-0.929389343	0.41245656
Almond Joy	-2.46833834	0.7035501120	0.858108916	0.57249739
Baby Ruth	-4.10531223	-2.1000967736	1.347834706	1.85505225
Boston Baked Beans	0.71385813	1.2098216537	0.941899950	1.10219913
Candy Corn	1.01357204	0.2834319621	-0.840681586	0.83664703
Caramel Apple Pops	0.81049645	-1.6960889498	-0.207020586	-0.30186567
Charleston Chew	-2.15436587	-1.9304213037	1.675469334	0.46999498
Chewey Lemonhead Fruit Mix	1.65268482	0.0726434944	-0.909617411	0.58609915
Chiclets	2.38180817	0.4430926071	1.000422079	-0.59998577
Dots	1.51249936	0.1623958592	-0.967135199	0.63622661
Dum Dums	2.14430933	-1.8388386160	-0.385372660	-0.14796280
Fruit Chews	2.26133763	0.5818322520	0.978626618	-0.39164187
Fun Dip	1.82383348	-1.7828662094	-0.719415821	-0.08544003
Gobstopper	1.96047812	-1.0584680267	-1.873874385	0.84237208
Haribo Gold Bears	1.33360746	0.5892699921	-0.431929774	0.33530766
Haribo Happy Cola	1.11167365	0.6257697808	0.054459647	0.16024129
Haribo Sour Bears	1.46152952	0.5073691482	-0.379443632	0.28956535
Haribo Twin Snakes	1.66849016	0.3748646265	-0.294528131	0.21556045
Hershey's Kisses	0.37722675	1.5654519145	1.104739528	-0.30451907
Hershey's Krackel	-3.04788356	0.6850792787	-1.154357778	-2.79294516
Hershey's Milk Chocolate	-2.11696417	0.2504568891	0.218316614	-0.64942872
Hershey's Special Dark	-2.17850376	0.2898570052	0.193067056	-0.62742342
Jawbusters	2.62491587	-0.6343671618	0.114043053	-0.54172092
Junior Mints	-0.16010610	1.6194428347	0.442156347	-0.08935729
Kit Kat	-2.87086546	0.9069655335	-0.545771148	-2.94691419
Laffy Taffy	1.65450042	-0.2379605144	1.217408326	-0.81578254
Lemonhead	2.33564695	-1.2553404646	1.125823900	-1.18755633
Lifesavers big ring gummies	1.19528766	-0.0783610246	0.814040659	-0.61506538

Peanut butter M&M's	-1.52223814	1.9291395890	-0.815897653	2.27060871
M&M's	-0.76747561	1.2573539136	-1.260658369	0.98037043
Mike & Ike	1.57487290	0.0664259746	-1.114406454	0.84284942
Milk Duds	-0.76836937	0.4192793946	-0.137573021	-0.01222490
Milky Way	-3.69272218	-2.4933313173	0.843423990	0.70792542
Milky Way Midnight	-3.23036513	-2.8201031327	0.902884388	0.75904764
Milky Way Simply Caramel	-3.04936226	-1.1774777304	-1.382617058	0.15488883
Mounds	-1.81292795	0.2120726312	0.636094539	-0.91126847
Mr Good Bar	-2.67327849	0.9217207344	0.997161433	0.40634715
Nerds	1.93426895	-0.9133307225	-1.670281710	0.79359684
Nestle Butterfinger	-2.97855081	0.8798835368	0.348599786	0.94918411
Nestle Crunch	-2.92740488	0.8119013154	-0.747159803	-2.97250665
Nik L Nip	1.63985272	0.4210217322	-0.083217936	-0.24015596
Now & Later	1.98070982	0.5117150919	0.460099768	-0.21340533
Payday	-2.39180556	-1.4839637512	2.091687409	1.65680787
Peanut M&Ms	-1.38897069	2.0947188031	-0.260214925	1.89874716
Pixie Sticks	1.67042227	0.8969792365	1.394703254	-0.48031281
Pop Rocks	1.76879348	-0.8060325640	-1.567639814	0.42017068
Red vines	2.12406849	0.1366822960	-0.115183020	0.27721045
Reese's Miniatures	-1.55210251	1.9287569793	1.884620322	0.48605155
Reese's Peanut Butter cup	-2.28427985	1.4648923293	-0.156138940	1.63994489
Reese's pieces	-1.40590761	2.3077984818	0.136661895	1.64348077
Reese's stuffed with pieces	-2.13382398	1.0787289654	-0.673152403	1.96066081
Ring pop	1.19274412	-1.7069749284	-1.423826969	0.02570015
Rolo	-1.61259322	0.1773734932	-1.931879747	1.00697641
Root Beer Barrels	2.10440254	-0.8711340556	-0.594335570	0.36204105
Runts	2.25699185	-1.1223199934	-1.557678507	0.71996790
Sixlets	0.81799664	1.1888290122	1.093105891	-0.33001942
Skittles original	1.29259129	0.2263705137	-1.306145308	1.05900061
Skittles wildberry	1.47148517	0.1118354559	-1.232745536	0.99503181
Nestle Smarties	-0.27556563	1.3792344137	-0.080047831	-0.03345921
Smarties candy	2.60115214	-0.6047947520	0.003482896	-0.21938457
Snickers	-4.39576792	-1.7919312516	1.434654778	1.89861891
Snickers Crisper	-4.01457335	-0.0347673522	-1.089868643	-1.42309414
Sour Patch Kids	1.81551769	0.8879445215	0.863881832	-0.32795118
Sour Patch Tricksters	1.97326660	0.7869473239	0.928605869	-0.38435897
Starburst	1.50658493	0.9437290830	0.487658690	-0.12150268
Strawberry bon bons	2.80647837	-1.0331193111	-0.524069119	0.13960292
Sugar Babies	-0.01900559	-0.8219542293	-1.802826526	0.92212945
Sugar Daddy	0.19642038	-1.2073694698	0.520140143	-0.59663517
Super Bubble	1.99242820	-0.3915898648	1.481310204	-1.01767057
Swedish Fish	1.00547407	0.5003327040	-1.068588828	0.59499272
Tootsie Pop	0.84734171	-1.1060686710	-0.480874078	-0.23675349

Tootsie Roll Juniors	-0.40463667	0.5848580362	0.836999949	-0.59623669
Tootsie Roll Midgies	0.66730732	1.3709464980	1.179339290	-0.32789249
Tootsie Roll Snack Bars	-1.31149842	0.0009721286	0.885976952	-0.78242207
Trolli Sour Bites	1.85048456	0.5304055168	0.254559391	-0.02435072
Twix	-4.12909044	-0.2180299573	-1.943536689	-2.52917855
Twizzlers	1.56312584	-0.1794588354	1.179917535	-0.78310886
Warheads	2.30707033	-1.2940268825	1.004249910	-1.11380521
Welch's Fruit Snacks	1.84808801	0.5022006184	0.213204782	-0.03387254
Werther's Original Caramel	0.68420363	-2.0146385440	0.506488679	-0.97208672
Whoppers	-1.42549552	1.3654147702	-2.759982292	-1.23030133
	PC5	PC6	PC7	PC8
100 Grand	-0.66236243	-0.545218405	-0.14340559	0.577224229
3 Musketeers	-0.16006665	0.382588420	2.02155526	-1.502574960
One dime	-0.269777985	0.094950530	-0.77220066	0.155622104
One quarter	-0.05093737	0.428354037	-0.59089199	0.359134372
Air Heads	0.33108524	0.188791601	0.96808076	1.012393252
Almond Joy	1.43200435	1.022273480	-0.66604596	0.608261288
Baby Ruth	-0.53157179	0.026152894	-0.27477854	0.617961302
Boston Baked Beans	-0.01286555	1.147068667	-1.66290853	1.017203801
Candy Corn	-0.92992691	0.482570575	-0.17268382	-0.433778134
Caramel Apple Pops	-1.26916612	-0.641471733	-0.77030933	1.705704289
Charleston Chew	-0.48839246	1.490541025	1.23825892	-1.445444979
Chewy Lemonhead Fruit Mix	-0.64216946	0.867070020	0.51175007	0.500258867
Chiclets	-0.82031918	0.835939962	-0.06670709	0.514147274
Dots	-0.57043885	0.625011322	0.68287986	0.487777458
Dum Dums	1.60464382	-0.712637531	-0.06881335	-0.229647214
Fruit Chews	-0.64943194	-0.515343269	0.62911226	0.295017216
Fun Dip	1.64564645	-0.061325594	-0.22205535	-0.058799069
Gobstopper	0.97535806	0.006638151	0.09322099	-0.594393205
Haribo Gold Bears	-0.41418743	-0.076745232	0.97316112	0.470072508
Haribo Happy Cola	-0.96450884	0.897177682	-0.57777493	-0.279999961
Haribo Sour Bears	-0.47964306	0.144138214	0.81700174	0.481462045
Haribo Twin Snakes	-0.58554144	0.501497845	0.56435691	0.499888780
Hershey's Kisses	-0.65415252	-0.956497265	-0.15459157	-1.475048333
Hershey's Krackel	0.64433919	0.815979037	0.72869731	-0.058197261
Hershey's Milk Chocolate	0.45257976	1.365951323	0.09727415	-0.537271619
Hershey's Special Dark	0.48406856	1.259690716	0.17239789	-0.542750795
Jawbusters	0.74872541	0.777635266	-0.86953189	-0.404938915
Junior Mints	-0.56772916	-0.100807494	-0.27701048	-1.244289684
Kit Kat	0.74560410	-0.651964126	1.26789202	-0.308264629
Laffy Taffy	0.12742282	-0.323401158	0.50907401	0.902891431
Lemonhead	1.59348201	-0.612577970	-0.46974919	-0.088239458
Lifesavers big ring gummies	0.28553918	-0.405905368	0.76717408	0.968451468

Peanut butter M&M's	0.70534888	-0.535487043	-0.31945944	-0.055419751
M&M's	-0.42260375	-0.093849007	0.23580574	-1.272394704
Mike & Ike	-0.54748868	0.068855836	0.96217007	0.350296998
Milk Duds	-1.94930706	-1.088570940	-1.46793514	-0.532609515
Milky Way	-1.43541753	-0.603255019	0.91522507	-0.708957591
Milky Way Midnight	-1.60495490	-0.577210751	0.75050728	-0.825932767
Milky Way Simply Caramel	-0.81154750	-0.095588630	-0.56663709	0.057913957
Mounds	0.34136052	1.562117376	-0.17156397	-0.536908890
Mr Good Bar	1.49882941	1.178267833	-0.70645139	0.710404328
Nerds	1.05269810	-0.612484674	0.36162582	-0.677966908
Nestle Butterfinger	1.66950147	0.246674393	-0.03583585	0.547351886
Nestle Crunch	0.66634611	0.310195315	0.85793736	-0.137897493
Nik L Nip	-0.74139722	2.364290586	-0.37097983	0.877307522
Now & Later	-0.64458895	0.275284807	0.43215999	0.459054334
Payday	0.57021053	1.685803617	0.71659189	0.920899230
Peanut M&Ms	0.67649842	-0.481270608	-0.49445201	-0.017712739
Pixie Sticks	-1.00053741	-0.249857693	-0.45261662	-0.491657159
Pop Rocks	0.96236780	1.036365445	-0.40726527	-0.314719629
Red vines	-0.69083254	-0.068691578	0.66734570	0.288409391
Reese's Miniatures	1.52874138	-1.896976303	-0.34129661	0.391227548
Reese's Peanut Butter cup	1.62984822	-1.101118658	-0.10711621	0.504507095
Reese's pieces	0.71687442	-0.652294629	-0.48369702	0.001608461
Reese's stuffed with pieces	1.50741757	-0.638134777	-0.27656579	0.488051492
Ring pop	1.69809389	1.498435385	-0.64909630	0.323514628
Rolo	-1.75944281	-0.678446043	-1.06073297	-0.430807299
Root Beer Barrels	0.42962062	-0.109312144	-1.19510153	-1.555611980
Runts	0.90293644	-0.227471967	0.05500446	-0.683423916
Sixlets	-0.89038600	-0.174585492	-0.66527067	-1.454385221
Skittles original	-0.37037605	-0.800924438	1.50687697	0.245536582
Skittles wildberry	-0.46191313	-0.492027764	1.28849431	0.261464394
Nestle Smarties	-0.71703419	1.677902657	-1.00236322	-0.943766974
Smarties candy	0.89831080	-0.766691658	-0.09224917	-0.697074269
Snickers	-0.32409247	-0.999567686	0.29375023	0.519082351
Snickers Crisper	0.28905186	-0.982077142	-0.99809936	1.715122168
Sour Patch Kids	-0.44613213	-0.989653570	1.01684337	0.317967197
Sour Patch Tricksters	-0.52684967	-0.717267988	0.82427320	0.332012368
Starburst	-0.34591253	-1.030380238	1.20373631	0.352584423
Strawberry bon bons	0.76654988	-0.423292666	-0.21835972	-0.752170933
Sugar Babies	-2.27338367	0.557052968	-1.67505130	0.548087948
Sugar Daddy	-1.58729466	-0.485682924	-1.85240975	0.941435233
Super Bubble	-0.03565422	0.216125641	0.09347559	0.939439208
Swedish Fish	-0.39241423	0.662591135	0.83851208	0.624071063
Tootsie Pop	1.88703233	-0.633721587	-0.18826747	-1.043909239

Tootsie Roll Juniors	0.05449315	0.394706045	-0.68468874	-0.662902544
Tootsie Roll Midgies	-0.77589776	-0.759442617	-0.35278919	-1.510639321
Tootsie Roll Snack Bars	0.28510912	0.328392863	0.22536722	-0.875755689
Trolli Sour Bites	-0.56414212	-0.168850396	0.72703429	0.389139607
Twix	-0.49203516	-1.029755076	0.13814854	0.601927243
Twizzlers	0.17417770	-0.481177950	0.62061848	0.894755897
Warheads	1.59506307	-0.576609554	-0.45482313	-0.087796992
Welch's Fruit Snacks	-0.58742724	0.067119205	0.62144223	0.428665533
Werther's Original Caramel	0.00698052	-1.343145309	-2.51219819	-0.091968746
Whoppers	-0.46170658	0.678567795	0.16799768	-0.639281286
	PC9	PC10	PC11	
100 Grand	0.379148201	-0.154099543	0.141903843	
3 Musketeers	0.023832701	-0.155239068	-0.517927160	
One dime	-0.453988975	-0.943783623	-0.515870807	
One quarter	-0.638889823	0.095579648	-0.986719399	
Air Heads	-1.383012190	-0.573723493	-0.514453684	
Almond Joy	-0.139059851	-0.312778705	1.061148660	
Baby Ruth	1.143067977	0.264099876	-0.009085882	
Boston Baked Beans	1.396216830	-0.973188567	0.102073964	
Candy Corn	-0.173119296	-1.580718107	-0.026369468	
Caramel Apple Pops	-0.916479426	-0.201217892	0.098522113	
Charleston Chew	0.265940391	-0.852594237	-0.299018234	
Chewey Lemonhead Fruit Mix	-0.056700856	-0.274516517	0.133783407	
Chiclets	0.600474625	0.299142845	0.263138381	
Dots	-0.109595061	-0.122162631	0.085957526	
Dum Dums	-0.385161810	-0.858986682	0.026635152	
Fruit Chews	0.431017129	0.094469913	0.405402342	
Fun Dip	-0.432729164	-0.348623806	-0.240086957	
Gobstopper	0.401434380	0.160051400	0.173108273	
Haribo Gold Bears	-0.021735861	0.618649969	-0.035818163	
Haribo Happy Cola	0.174940628	-0.664580531	-0.210044044	
Haribo Sour Bears	0.026531168	0.479623974	0.007823919	
Haribo Twin Snakes	0.104620713	0.254698661	0.078430922	
Hershey's Kisses	0.015418665	-0.009459574	0.108560740	
Hershey's Krackel	0.589905081	-0.259828939	-0.295461506	
Hershey's Milk Chocolate	-1.211270861	0.556641044	0.566669950	
Hershey's Special Dark	-1.234490726	0.623522410	0.545675013	
Jawbusters	1.175121068	1.211984587	0.107699541	
Junior Mints	-0.125729538	0.657349544	-0.278384695	
Kit Kat	0.627262392	-0.428229606	-0.052463331	
Laffy Taffy	-0.694575541	-0.358253574	-0.196159662	
Lemonhead	0.133629280	0.441715610	-0.165939908	
Lifesavers big ring gummies	-0.856144679	0.130909678	-0.425911984	

Peanut butter M&M's	0.267660757	-0.221930007	-0.095957385
M&M's	-0.712293695	0.050005905	-0.359922697
Mike & Ike	-0.220487198	-0.593471988	0.252731956
Milk Duds	-0.136911155	1.039501593	0.120288784
Milky Way	0.004765911	0.843304841	-0.327048378
Milky Way Midnight	0.046247663	-0.050365745	-0.014682753
Milky Way Simply Caramel	-1.628250067	0.337544026	1.024026651
Mounds	-1.038014053	0.444568191	0.664244259
Mr Good Bar	-0.083279402	0.319687965	0.860817575
Nerds	0.395546909	0.241504770	0.214795902
Nestle Butterfinger	-0.418486899	-0.056067346	0.931659519
Nestle Crunch	0.670459908	-0.224206267	-0.210210679
Nik L Nip	0.390203352	1.144571263	-0.293659295
Now & Later	0.340332791	0.362285847	0.182098894
Payday	1.592516886	-0.586376631	-0.517961675
Peanut M&Ms	0.463012748	0.130263439	-0.124891428
Pixie Sticks	0.506958178	-0.721036477	0.100340132
Pop Rocks	0.614743430	1.229233468	-0.196822517
Red vines	0.116010128	-0.683310675	0.459814126
Reese's Miniatures	-0.201912762	0.339292365	-0.538620165
Reese's Peanut Butter cup	-0.813354976	-0.127457497	-0.769615618
Reese's pieces	0.573552037	0.549292897	-0.190638431
Reese's stuffed with pieces	-0.924164172	-0.865127171	-0.632341326
Ring pop	-0.509522417	0.693685961	-0.801535980
Rolo	-0.716390425	0.955937401	-0.177541179
Root Beer Barrels	0.748159981	-1.361887249	0.275586696
Runts	0.490713003	-0.186267132	0.357472263
Sixlets	0.120551003	-0.694412596	0.295248736
Skittles original	-0.396609466	-0.492989386	0.235345367
Skittles wildberry	-0.329109954	-0.687411685	0.296377074
Nestle Smarties	-0.095850762	0.891841882	-0.546823295
Smarties candy	0.957784710	0.645048933	0.369028845
Snickers	1.040500931	0.639420129	-0.064039216
Snickers Crisper	1.597773064	-0.876877339	0.668926998
Sour Patch Kids	0.319739180	0.748914211	0.190355889
Sour Patch Tricksters	0.379260358	0.577472316	0.244173747
Starburst	0.178115491	0.966910650	0.055007728
Strawberry bon bons	0.831798717	-0.257396978	0.567295681
Sugar Babies	-0.204221618	-0.392704656	-0.026264253
Sugar Daddy	-0.751459910	-0.659787353	-0.269135682
Super Bubble	-0.530802993	-0.601257076	-0.099471654
Swedish Fish	-0.159360361	0.838989403	-0.260036175
Tootsie Pop	-0.721118894	0.326836317	-0.137911107

Tootsie Roll Juniors	-1.149669881	-0.284072969	-0.704615875
Tootsie Roll Midgies	0.074811904	-0.471079914	0.266947340
Tootsie Roll Snack Bars	-1.078720446	-0.723988086	1.173413519
Trolli Sour Bites	0.215399333	0.265589321	0.205354764
Twix	0.390371217	0.606070076	-0.048120393
Twizzlers	-0.729052624	-0.258947465	-0.227333151
Warheads	0.096482954	0.378764818	-0.167107014
Welch's Fruit Snacks	0.229115315	0.300496305	0.173167709
Werther's Original Caramel	0.028457521	0.448967578	-0.298604763
Whoppers	1.212121185	-1.054026246	-1.220426934

PC12

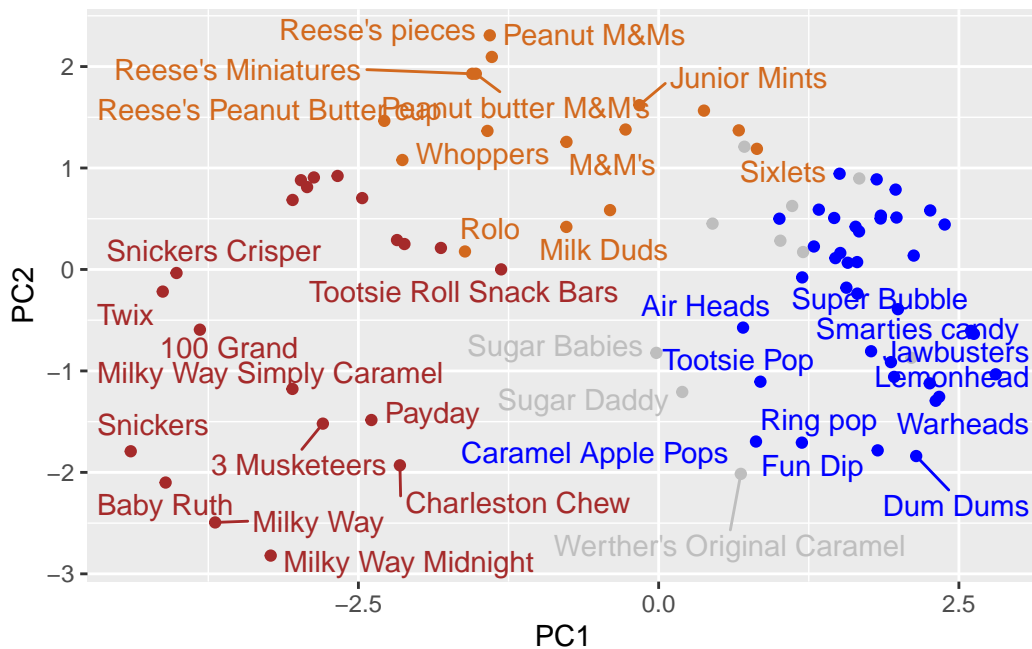
100 Grand	0.0646988318
3 Musketeers	-0.1839471662
One dime	-0.5107477914
One quarter	-0.9582719109
Air Heads	0.0442992399
Almond Joy	0.1889347102
Baby Ruth	0.5798508261
Boston Baked Beans	-0.1012981497
Candy Corn	-0.6799350975
Caramel Apple Pops	0.6962504166
Charleston Chew	0.5494017342
Chewey Lemonhead Fruit Mix	0.3105973331
Chiclets	0.5337581991
Dots	0.1503797578
Dum Dums	0.1849692597
Fruit Chews	0.1399898762
Fun Dip	0.1237990873
Gobstopper	-0.1944414618
Haribo Gold Bears	-0.2638818244
Haribo Happy Cola	-0.6879064447
Haribo Sour Bears	-0.1176800541
Haribo Twin Snakes	0.1188546962
Hershey's Kisses	0.1984492942
Hershey's Krackel	-0.0817067486
Hershey's Milk Chocolate	-0.3573702410
Hershey's Special Dark	-0.4277036644
Jawbusters	0.1337584661
Junior Mints	0.0649489483
Kit Kat	-0.3769186469
Laffy Taffy	0.3026020451
Lemonhead	0.0619011170
Lifesavers big ring gummies	-0.0228900695

Peanut butter M&M's	0.1200218111
M&M's	-0.1023879726
Mike & Ike	0.1113757406
Milk Duds	0.3400578947
Milky Way	-0.1552479006
Milky Way Midnight	0.2304632793
Milky Way Simply Caramel	-0.2533060125
Mounds	-0.1415021722
Mr Good Bar	0.0210418054
Nerds	-0.3936975444
Nestle Butterfinger	-0.3100685916
Nestle Crunch	-0.1731325150
Nik L Nip	0.4597035356
Now & Later	0.1806417362
Payday	-0.7729766006
Peanut M&Ms	0.1319358415
Pixie Sticks	-0.7378511713
Pop Rocks	-0.1936682261
Red vines	0.3438211129
Reese's Miniatures	-0.0689054242
Reese's Peanut Butter cup	-0.1005437626
Reese's pieces	-0.0005861225
Reese's stuffed with pieces	0.2335945192
Ring pop	0.0735408387
Rolo	0.0787870205
Root Beer Barrels	-0.7082327026
Runts	-0.0585635801
Sixlets	0.7459023430
Skittles original	-0.2795750540
Skittles wildberry	-0.0751177198
Nestle Smarties	0.4628839641
Smarties candy	-0.2022435492
Snickers	0.0911696493
Snickers Crisper	0.6306015108
Sour Patch Kids	-0.3186623415
Sour Patch Tricksters	-0.1383715363
Starburst	-0.5130782116
Strawberry bon bons	0.1543709171
Sugar Babies	-0.4541934821
Sugar Daddy	-0.2885121237
Super Bubble	0.6537195364
Swedish Fish	-0.2507351031
Tootsie Pop	1.2506316262

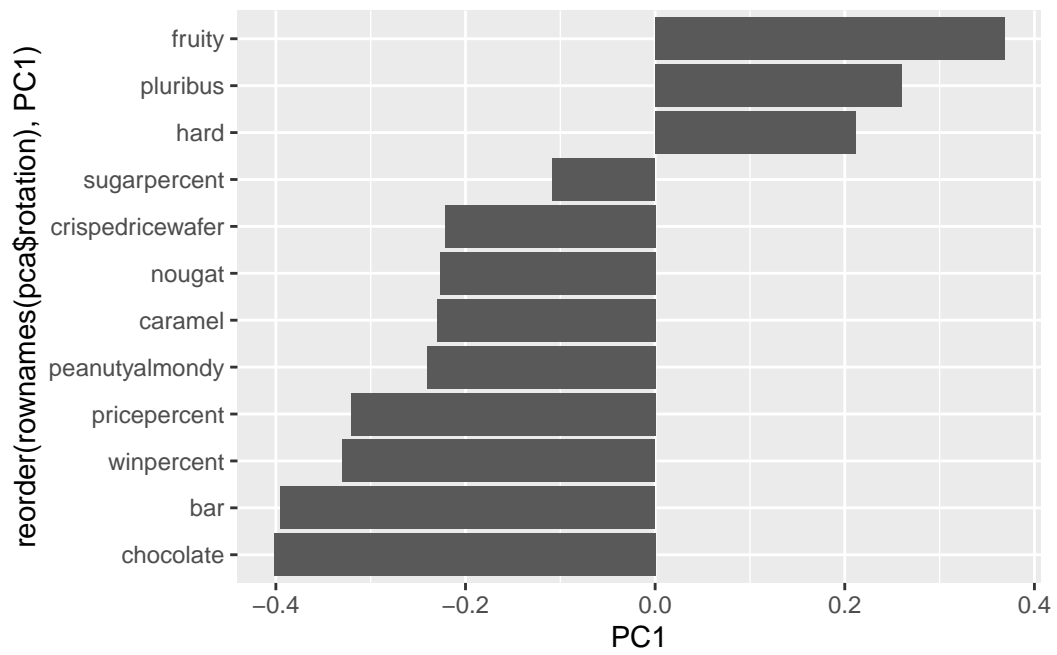
Tootsie Roll Juniors	0.5695856300
Tootsie Roll Midgies	0.4724506497
Tootsie Roll Snack Bars	-0.0373596827
Trolli Sour Bites	0.0146955266
Twix	-0.3530484324
Twizzlers	0.1981702880
Warheads	0.0702649429
Welch's Fruit Snacks	0.0727669700
Werther's Original Caramel	-0.8335356607
Whoppers	0.7201599382

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

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



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



Q24

fruity