Assignment 5

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10/8/2020

```
library(lubridate)
##
## Attaching package: 'lubridate'
## The following objects are masked from 'package:base':
##
##     date, intersect, setdiff, union
library("plyr")
library("ggplot2")
library(RColorBrewer)
library("dplyr")
##
## Attaching package: 'dplyr'
## The following objects are masked from 'package:plyr':
##
##     arrange, count, desc, failwith, id, mutate, rename, summarise,
##     summarize
## The following objects are masked from 'package:stats':
##
##     filter, lag
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
dataset = read.csv("data.csv", header= T)
head(dataset)
##   Store Dept       Date weeklySales isHoliday Type   Size Temperature
## 1     1    1 2010-02-05    24924.50     False    A 151315       42.31
## 2     1    1 2010-02-12    46039.49      True    A 151315       38.51
## 3     1    1 2010-02-19    41595.55     False    A 151315       39.93
## 4     1    1 2010-02-26    19403.54     False    A 151315       46.63
## 5     1    1 2010-03-05    21827.90     False    A 151315       46.50
## 6     1    1 2010-03-12    21043.39     False    A 151315       57.79
##   Fuel_Price MarkDown1 MarkDown2 MarkDown3 MarkDown4 MarkDown5      CPI
## 1      2.572        NA        NA        NA        NA        NA 211.0964
## 2      2.548        NA        NA        NA        NA        NA 211.2422
## 3      2.514        NA        NA        NA        NA        NA 211.2891
## 4      2.561        NA        NA        NA        NA        NA 211.3196
## 5      2.625        NA        NA        NA        NA        NA 211.3501
## 6      2.667        NA        NA        NA        NA        NA 211.3806
##   Unemployment
## 1        8.106
## 2        8.106
## 3        8.106
## 4        8.106
## 5        8.106
## 6        8.106
```

We can see that there are few null values in the data set for column Markdown 1 - 5. We will also split the data column in 3 as Day, Month and Year.

```
dataset$Year <- year(ymd(dataset$Date))
dataset$Month <- month(ymd(dataset$Date))
dataset$Day <- day(ymd(dataset$Date))
dataset$Dept = as.factor(dataset$Dept)
dataset$Store = as.factor(dataset$Store)
dataset$MarkDown1[is.na(dataset$MarkDown1)] = 0
dataset$MarkDown2[is.na(dataset$MarkDown2)] = 0
dataset$MarkDown3[is.na(dataset$MarkDown3)] = 0
dataset$MarkDown4[is.na(dataset$MarkDown4)] = 0
dataset$MarkDown5[is.na(dataset$MarkDown5)] = 0
dataset = fastDummies::dummy_cols(dataset, select_columns = "Type")
dataset$IsHoliday[dataset$isHoliday == "False"] = 0
dataset$IsHoliday[dataset$isHoliday == "True"] = 1
head(dataset)
##   Store Dept       Date weeklySales isHoliday Type   Size Temperature
## 1     1    1 2010-02-05    24924.50     False    A 151315       42.31
## 2     1    1 2010-02-12    46039.49      True    A 151315       38.51
## 3     1    1 2010-02-19    41595.55     False    A 151315       39.93
## 4     1    1 2010-02-26    19403.54     False    A 151315       46.63
## 5     1    1 2010-03-05    21827.90     False    A 151315       46.50
## 6     1    1 2010-03-12    21043.39     False    A 151315       57.79
##   Fuel_Price MarkDown1 MarkDown2 MarkDown3 MarkDown4 MarkDown5      CPI
## 1      2.572         0         0         0         0         0 211.0964
## 2      2.548         0         0         0         0         0 211.2422
## 3      2.514         0         0         0         0         0 211.2891
## 4      2.561         0         0         0         0         0 211.3196
## 5      2.625         0         0         0         0         0 211.3501
## 6      2.667         0         0         0         0         0 211.3806
##   Unemployment Year Month Day Type_A Type_B Type_C IsHoliday
## 1        8.106 2010     2   5      1      0      0         0
## 2        8.106 2010     2  12      1      0      0         1
## 3        8.106 2010     2  19      1      0      0         0
## 4        8.106 2010     2  26      1      0      0         0
## 5        8.106 2010     3   5      1      0      0         0
## 6        8.106 2010     3  12      1      0      0         0
dim(dataset)
## [1] 421570     23
```

As we can see from the result now there are 19 columns and 421570 rows.

```
names(dataset)
##  [1] "Store"        "Dept"         "Date"         "weeklySales"  "isHolida
y"
##  [6] "Type"         "Size"         "Temperature"  "Fuel_Price"   "MarkDown
1"
## [11] "MarkDown2"    "MarkDown3"    "MarkDown4"    "MarkDown5"    "CPI"
## [16] "Unemployment" "Year"         "Month"        "Day"          "Type_A"
## [21] "Type_B"       "Type_C"       "IsHoliday"
```

Here are all the columns.

```r
dataset$Dept = as.numeric(as.factor(dataset$Dept))
dataset$Store = as.numeric(as.factor(dataset$Store))
features = c("Store","Dept","IsHoliday","Type_A","Type_B","Type_C","Size","Te
mperature","Fuel_Price","MarkDown1","MarkDown2","MarkDown3","MarkDown4","Mark
Down5","CPI","Unemployment","Year","Month","Day")
correlation = cor(select(dataset,features))
## Note: Using an external vector in selections is ambiguous.
## i Use `all_of(features)` instead of `features` to silence this message.
## i See <https://tidyselect.r-lib.org/reference/faq-external-vector.html>.
## This message is displayed once per session.
correlation
##                      Store          Dept     IsHoliday        Type_A
## Store         1.000000e+00  0.0178584995 -0.0005479880 -3.711910e-02
## Dept          1.785850e-02  1.0000000000  0.0008145392  1.483679e-02
## IsHoliday    -5.479880e-04  0.0008145392  1.0000000000  4.510244e-04
## Type_A       -3.711910e-02  0.0148367901  0.0004510244  1.000000e+00
## Type_B       -2.334614e-01 -0.0266658257  0.0001665544 -8.138609e-01
## Type_C        4.390041e-01  0.0185027364 -0.0010173333 -3.428122e-01
## Size         -1.828815e-01  0.0048985478  0.0005930379  7.629980e-01
## Temperature  -5.009694e-02  0.0021942853 -0.1559485588  2.449254e-02
## Fuel_Price    6.529017e-02  0.0032132940 -0.0782811372 -3.797326e-02
## MarkDown1    -5.984407e-02  0.0029738257 -0.0035206128  8.655521e-02
## MarkDown2    -3.382905e-02  0.0013160405  0.2076041075  4.087267e-02
## MarkDown3    -2.033075e-02  0.0017420548  0.2664712738  1.508334e-02
## MarkDown4    -4.272446e-02  0.0029791067  0.0115652658  6.373702e-02
## MarkDown5    -1.245152e-02  0.0035482620 -0.0152353840  1.178766e-01
## CPI          -2.110878e-01 -0.0078554073 -0.0019435109  8.373918e-02
## Unemployment  2.085517e-01  0.0055632982  0.0104595436 -9.257384e-02
## Year          2.997023e-03  0.0031071962 -0.0567457166 -2.448069e-03
## Month         1.010586e-03  0.0007516354  0.1233757957  3.723572e-05
## Day          -1.475649e-05 -0.0006329292  0.0454654764 -4.309774e-04
##                      Type_B        Type_C          Size  Temperature
## Store        -2.334614e-01  4.390041e-01 -0.1828814601 -0.050096943
## Dept         -2.666583e-02  1.850274e-02  0.0048985478  0.002194285
## IsHoliday     1.665544e-04 -1.017333e-03  0.0005930379 -0.155948559
## Type_A       -8.138609e-01 -3.428122e-01  0.7629980028  0.024492540
## Type_B        1.000000e+00 -2.668484e-01 -0.4556463094 -0.109032479
## Type_C       -2.668484e-01  1.000000e+00 -0.5288519709  0.135650651
## Size         -4.556463e-01 -5.288520e-01  1.0000000000 -0.058312940
## Temperature  -1.090325e-01  1.356507e-01 -0.0583129400  1.000000000
## Fuel_Price    3.731651e-02  2.652071e-03  0.0033611898  0.143858819
## MarkDown1    -4.814368e-03 -1.357760e-01  0.1697875496 -0.026415133
## MarkDown2    -8.214310e-03 -5.451076e-02  0.0783722018 -0.179672448
## MarkDown3     1.889849e-03 -2.807237e-02  0.0336414162 -0.056026324
## MarkDown4    -8.012383e-03 -9.275974e-02  0.1273335605 -0.050280910
## MarkDown5    -6.390971e-02 -9.218524e-02  0.1530106983 -0.014752445
## CPI          -8.181678e-02 -6.614913e-03 -0.0033143575  0.182111607
## Unemployment -1.343546e-02  1.752630e-01 -0.0682382537  0.096730180
## Year         -7.320125e-04  5.243788e-03 -0.0049750235  0.065814407
## Month         1.851664e-05 -9.169469e-05 -0.0012099517  0.235982818
```

```
## Day           5.029719e-04 -9.834492e-05 -0.0003855656  0.026832260
##                Fuel_Price    MarkDown1    MarkDown2    MarkDown3    MarkDo
wn4
## Store         0.065290173 -0.059844067 -0.033829052 -0.020330749 -0.042724
458
## Dept          0.003213294  0.002973826  0.001316041  0.001742055  0.002979
107
## IsHoliday    -0.078281137 -0.003520613  0.207604107  0.266471274  0.011565
266
## Type_A       -0.037973260  0.086555210  0.040872670  0.015083336  0.063737
017
## Type_B        0.037316514 -0.004814368 -0.008214310  0.001889849 -0.008012
383
## Type_C        0.002652071 -0.135775964 -0.054510760 -0.028072368 -0.092759
738
## Size          0.003361190  0.169787550  0.078372202  0.033641416  0.127333
560
## Temperature   0.143858819 -0.026415133 -0.179672448 -0.056026324 -0.050280
910
## Fuel_Price    1.000000000  0.297056262  0.029153237  0.018614902  0.166621
948
## MarkDown1     0.297056262  1.000000000  0.174867684 -0.014410940  0.838904
415
## MarkDown2     0.029153237  0.174867684  1.000000000 -0.006080232  0.113249
988
## MarkDown3     0.018614902 -0.014410940 -0.006080232  1.000000000 -0.012020
093
## MarkDown4     0.166621948  0.838904415  0.113249988 -0.012020093  1.000000
000
## MarkDown5     0.215419702  0.415050183  0.131735086  0.042471160  0.303369
575
## CPI          -0.164210406  0.010914758 -0.003553899 -0.005838833 -0.002047
144
## Unemployment -0.033852703 -0.105168294 -0.041427281 -0.018077638 -0.076512
836
## Year          0.779632916  0.501044100  0.131867456  0.006788973  0.335339
705
## Month        -0.040876313 -0.089205657 -0.019359653  0.116030627 -0.105569
219
## Day           0.028058129 -0.126186649  0.051970945  0.072155858 -0.152752
601
##                  MarkDown5          CPI Unemployment          Year
Month
## Store        -0.012451517 -0.211087783  0.208551684  0.0029970230  1.01058
6e-03
## Dept          0.003548262 -0.007855407  0.005563298  0.0031071962  7.51635
4e-04
## IsHoliday    -0.015235384 -0.001943511  0.010459544 -0.0567457166  1.23375
8e-01
## Type_A        0.117876551  0.083739176 -0.092573843 -0.0024480693  3.72357
```

```
2e-05
## Type_B       -0.063909709 -0.081816782 -0.013435463 -0.0007320125  1.85166
4e-05
## Type_C       -0.092185244 -0.006614913  0.175263040  0.0052437876 -9.16946
9e-05
## Size          0.153010698 -0.003314358 -0.068238254 -0.0049750235 -1.20995
2e-03
## Temperature  -0.014752445  0.182111607  0.096730180  0.0658144066  2.35982
8e-01
## Fuel_Price    0.215419702 -0.164210406 -0.033852703  0.7796329164 -4.08763
1e-02
## MarkDown1     0.415050183  0.010914758 -0.105168294  0.5010441005 -8.92056
6e-02
## MarkDown2     0.131735086 -0.003553899 -0.041427281  0.1318674559 -1.93596
5e-02
## MarkDown3     0.042471160 -0.005838833 -0.018077638  0.0067889728  1.16030
6e-01
## MarkDown4     0.303369575 -0.002047144 -0.076512836  0.3353397045 -1.05569
2e-01
## MarkDown5     1.000000000  0.067905904 -0.120406278  0.4029641619  5.57697
0e-02
## CPI           0.067905904  1.000000000 -0.299953018  0.0745444605  5.28187
1e-03
## Unemployment -0.120406278 -0.299953018  1.000000000 -0.2371607688 -1.24437
0e-02
## Year          0.402964162  0.074544460 -0.237160769  1.0000000000 -1.94288
2e-01
## Month         0.055769695  0.005281871 -0.012443703 -0.1942882285  1.00000
0e+00
## Day          -0.055893177  0.002743724 -0.003793180  0.0058350780  1.63625
8e-02
##                       Day
## Store        -1.475649e-05
## Dept         -6.329292e-04
## IsHoliday     4.546548e-02
## Type_A       -4.309774e-04
## Type_B        5.029719e-04
## Type_C       -9.834492e-05
## Size         -3.855656e-04
## Temperature   2.683226e-02
## Fuel_Price    2.805813e-02
## MarkDown1    -1.261866e-01
## MarkDown2     5.197095e-02
## MarkDown3     7.215586e-02
## MarkDown4    -1.527526e-01
## MarkDown5    -5.589318e-02
## CPI           2.743724e-03
## Unemployment -3.793180e-03
## Year          5.835078e-03
```

```
## Month         1.636258e-02
## Day           1.000000e+00
dataset_pca = prcomp(select(dataset,features), scale=TRUE)
dataset_pca
## Standard deviations (1, .., p=19):
##  [1] 1.735166e+00 1.551401e+00 1.346517e+00 1.232186e+00 1.176126e+00
##  [6] 1.116132e+00 1.091073e+00 9.989793e-01 9.774789e-01 9.401126e-01
## [11] 9.043427e-01 8.449065e-01 7.888711e-01 7.162845e-01 6.694644e-01
## [16] 4.649532e-01 3.888724e-01 3.340617e-01 3.732385e-13
##
## Rotation (n x k) = (19 x 19):
##                       PC1          PC2          PC3          PC4
PC5
## Store         0.101338347  0.091916309 -0.513516476  0.251997574 -0.001935
214
## Dept         -0.004080003 -0.007831044 -0.046139485  0.018866256  0.009505
749
## IsHoliday     0.012198689 -0.042117612  0.122765651  0.430598905  0.456416
377
## Type_A       -0.269997489 -0.528338823 -0.185112881 -0.009266895 -0.013346
619
## Type_B        0.146653872  0.403632005  0.488509836 -0.004351486 -0.076292
464
## Type_C        0.210717990  0.223741121 -0.482751803  0.022405038  0.145479
166
## Size         -0.300383406 -0.464123852  0.028723361  0.048095997 -0.091823
360
## Temperature   0.019910709  0.010812768 -0.218666013 -0.510512052  0.200853
851
## Fuel_Price   -0.275443967  0.294661098 -0.203742513 -0.123886920  0.121192
144
## MarkDown1    -0.453413949  0.200206338  0.005221163  0.109824771 -0.089168
444
## MarkDown2    -0.141257544  0.020994379  0.103183191  0.347793218  0.162072
576
## MarkDown3    -0.009497715 -0.034055919  0.081007342  0.226594899  0.487643
095
## MarkDown4    -0.390865591  0.174396291  0.014503077  0.150090049 -0.149722
791
## MarkDown5    -0.335044476  0.096936758 -0.035119875  0.004296702  0.144248
500
## CPI          -0.056574087 -0.083696668  0.141163027 -0.416193607  0.252065
716
## Unemployment  0.171545851  0.020992482 -0.259550101  0.252639451 -0.190136
441
## Year         -0.389065387  0.314135135 -0.130186448 -0.141176642  0.137111
788
## Month         0.077922298 -0.079345988  0.005109959 -0.088709204  0.432577
095
## Day           0.059412275 -0.036413098  0.006627105 -0.008888773  0.283046
```

```
556
##                      PC6          PC7           PC8          PC9
PC10
## Store         0.061086191 -0.078145177  0.0299040623  0.073793008 -0.14095
1607
## Dept          0.018072337 -0.010273283 -0.9977935984 -0.032181832  0.00598
4284
## IsHoliday     0.107760643  0.006727446  0.0129311781  0.034867960  0.03256
3692
## Type_A       -0.050710292 -0.041302498  0.0119666806  0.030914991 -0.01245
3237
## Type_B       -0.139582813  0.142378737 -0.0274509310 -0.033940176 -0.02187
7852
## Type_C        0.309772095 -0.161681024  0.0245323503  0.003596134  0.05602
4880
## Size         -0.185567211  0.086119471  0.0010860492 -0.006638435 -0.00888
8054
## Temperature  -0.002198471  0.359324120  0.0088510932 -0.219426059  0.19543
1729
## Fuel_Price   -0.482204934 -0.022570393 -0.0025723236  0.076513162 -0.15681
7692
## MarkDown1     0.222747819  0.188452025  0.0049684296 -0.061031613  0.23718
4486
## MarkDown2     0.073828460 -0.247589409  0.0268547341 -0.612315382 -0.22674
0528
## MarkDown3    -0.098476660  0.133442483 -0.0149225410  0.553249762  0.24959
6232
## MarkDown4     0.322676103  0.224784551  0.0044506178 -0.014085200  0.33379
8845
## MarkDown5     0.089877318  0.089284428  0.0055416453 -0.063043394 -0.24364
1828
## CPI           0.451357854 -0.274497724  0.0092080205 -0.012353740  0.15627
4240
## Unemployment -0.161452270  0.391750111  0.0237151179 -0.217639424  0.29233
2377
## Year         -0.216978460 -0.214598559  0.0006121195  0.080368012 -0.08316
2286
## Month         0.046100158  0.535683306 -0.0014352308 -0.217696184 -0.36495
7414
## Day          -0.378676557 -0.271360815  0.0096460435 -0.381907173  0.56715
1486
##                     PC11         PC12         PC13          PC14
PC15
## Store         0.285937561 -0.098966639  0.035443355 -0.6654692527 -2.86107
6e-01
## Dept         -0.008419339  0.006238431  0.006405709 -0.0100002378  9.29936
9e-06
## IsHoliday    -0.350527166 -0.228194058  0.608349231  0.0556684274 -1.62377
3e-01
## Type_A       -0.040459037 -0.042276585  0.007406043  0.0035649783  1.08294
```

```
1e-02
## Type_B        0.051967567  0.046704622  0.048087260 -0.2557266645 -1.17887
1e-01
## Type_C       -0.016911522 -0.005388315 -0.090026625  0.4075224935  1.72627
6e-01
## Size         -0.014953982  0.008268893  0.016888929 -0.1196165401 -2.45382
7e-03
## Temperature  -0.290872963  0.011021819 -0.066663694 -0.0049459406 -5.87144
3e-01
## Fuel_Price   -0.224696355 -0.124326140  0.027088672 -0.0677477967  2.14724
5e-01
## MarkDown1     0.071395327 -0.148722198 -0.054028221 -0.0292195316  3.92548
5e-02
## MarkDown2    -0.264198371  0.143078463 -0.467690896 -0.0664937901 -1.02666
9e-01
## MarkDown3     0.002401877  0.273300215 -0.477165739 -0.0470998594 -4.53831
5e-02
## MarkDown4     0.083847097 -0.241194449 -0.081107535 -0.0008326417  1.81135
9e-02
## MarkDown5     0.408496632  0.641238287  0.314421877  0.2082893346 -1.86527
0e-01
## CPI          -0.126280354  0.212472767  0.122309601 -0.4708447432  3.33685
3e-01
## Unemployment -0.283622099  0.452012463  0.159435076 -0.1608653752  3.69796
8e-01
## Year         -0.146334233 -0.002483245  0.060832279 -0.0365537208  1.12541
7e-01
## Month         0.277924550 -0.269961065 -0.082262970 -0.0517141279  3.82328
6e-01
## Day           0.459901246 -0.097265167  0.083972506  0.0329275677  3.02050
7e-02
##                       PC16          PC17          PC18          PC19
## Store        -0.0201653518  0.0064646965 -0.0080510752 -7.788021e-14
## Dept         -0.0002017792 -0.0005154555  0.0001926768  4.343564e-15
## IsHoliday    -0.0208226765  0.0002087695  0.0156194400  6.273852e-16
## Type_A        0.4125947234 -0.0208444350  0.0374472527 -6.574321e-01
## Type_B       -0.1733601306  0.0108628680 -0.0403525786 -6.408318e-01
## Type_C       -0.4040517639  0.0170102351  0.0031287872 -3.963807e-01
## Size         -0.7802905632  0.0456654150 -0.1224051099  9.108548e-16
## Temperature  -0.0268032451  0.0109099849 -0.0198922461  3.097591e-16
## Fuel_Price   -0.0677427660 -0.4165298231  0.4547674844  3.375827e-16
## MarkDown1    -0.0038527297  0.5679082814  0.4838312343 -4.412066e-16
## MarkDown2     0.0126969980 -0.0605410731  0.0110476373  3.074830e-17
## MarkDown3     0.0133030849  0.0070851851  0.0066958749 -1.055134e-16
## MarkDown4     0.0319323891 -0.5663149078 -0.3339511006  2.342835e-16
## MarkDown5     0.0018146579 -0.1332996200  0.0632993671 -3.597752e-17
## CPI          -0.0591193049 -0.0919004682  0.0913705932 -2.443829e-16
## Unemployment  0.0837632981  0.0505364259 -0.0865456794 -1.651853e-16
## Year          0.0917821075  0.3792262438 -0.6296045956  7.958731e-16
```

```
## Month         0.0329757944  0.0609653457 -0.1113671062  5.321175e-16
## Day           0.0073597391 -0.0130023773  0.0050564269 -8.880060e-16
summary(dataset_pca)
## Importance of components:
##                           PC1    PC2     PC3     PC4    PC5     PC6     PC
7
## Standard deviation     1.7352 1.5514 1.34652 1.23219 1.1761 1.11613 1.0910
7
## Proportion of Variance 0.1585 0.1267 0.09543 0.07991 0.0728 0.06557 0.0626
5
## Cumulative Proportion  0.1585 0.2851 0.38057 0.46048 0.5333 0.59885 0.6615
0
##                           PC8     PC9    PC10    PC11    PC12    PC13   P
C14
## Standard deviation     0.99898 0.97748 0.94011 0.90434 0.84491 0.78887 0.7
163
## Proportion of Variance 0.05252 0.05029 0.04652 0.04304 0.03757 0.03275 0.0
270
## Cumulative Proportion  0.71402 0.76431 0.81083 0.85387 0.89144 0.92420 0.9
512
##                           PC15    PC16    PC17    PC18      PC19
## Standard deviation     0.66946 0.46495 0.38887 0.33406 3.732e-13
## Proportion of Variance 0.02359 0.01138 0.00796 0.00587 0.000e+00
## Cumulative Proportion  0.97479 0.98617 0.99413 1.00000 1.000e+00
dataset_eigen = dataset_pca$sdev^2
names(dataset_eigen) <- paste("PC",1:19,sep="")
dataset_eigen
##          PC1          PC2          PC3          PC4          PC5
PC6
## 3.010800e+00 2.406846e+00 1.813107e+00 1.518282e+00 1.383272e+00 1.245750e
+00
##          PC7          PC8          PC9         PC10         PC11         P
C12
## 1.190440e+00 9.979596e-01 9.554649e-01 8.838117e-01 8.178357e-01 7.138670e
-01
##         PC13         PC14         PC15         PC16         PC17         P
C18
## 6.223176e-01 5.130635e-01 4.481826e-01 2.161815e-01 1.512217e-01 1.115972e
-01
##         PC19
## 1.393070e-25
sumlambdas = sum(dataset_eigen)
sumlambdas
## [1] 19
propvar = dataset_eigen/sumlambdas
propvar
##          PC1          PC2          PC3          PC4          PC5
PC6
## 1.584632e-01 1.266761e-01 9.542669e-02 7.990957e-02 7.280377e-02 6.556577e
-02
```

```
##          PC7          PC8          PC9         PC10         PC11          P
C12
## 6.265476e-02 5.252419e-02 5.028763e-02 4.651641e-02 4.304399e-02 3.757195e
-02
##         PC13         PC14         PC15         PC16         PC17          P
C18
## 3.275356e-02 2.700334e-02 2.358856e-02 1.137797e-02 7.959037e-03 5.873536e
-03
##         PC19
## 7.331947e-27
dataset_cumvar <- cumsum(propvar)
dataset_cumvar
##       PC1       PC2       PC3       PC4       PC5       PC6       PC7
PC8
## 0.1584632 0.2851393 0.3805660 0.4604755 0.5332793 0.5988451 0.6614998 0.71
40240
##       PC9      PC10      PC11      PC12      PC13      PC14      PC15
PC16
## 0.7643117 0.8108281 0.8538720 0.8914440 0.9241976 0.9512009 0.9747895 0.98
61674
##      PC17      PC18      PC19
## 0.9941265 1.0000000 1.0000000
matlambdas <- rbind(dataset_eigen,propvar,dataset_cumvar)
rownames(matlambdas) <- c("Eigenvalues","Prop. variance","Cum. prop. variance
")
round(matlambdas,4)
##                        PC1    PC2    PC3    PC4    PC5    PC6    PC7    PC
8
## Eigenvalues         3.0108 2.4068 1.8131 1.5183 1.3833 1.2457 1.1904 0.998
0
## Prop. variance      0.1585 0.1267 0.0954 0.0799 0.0728 0.0656 0.0627 0.052
5
## Cum. prop. variance 0.1585 0.2851 0.3806 0.4605 0.5333 0.5988 0.6615 0.714
0
##                        PC9   PC10   PC11   PC12   PC13   PC14   PC15   PC1
6
## Eigenvalues         0.9555 0.8838 0.8178 0.7139 0.6223 0.5131 0.4482 0.216
2
## Prop. variance      0.0503 0.0465 0.0430 0.0376 0.0328 0.0270 0.0236 0.011
4
## Cum. prop. variance 0.7643 0.8108 0.8539 0.8914 0.9242 0.9512 0.9748 0.986
2
##                       PC17   PC18 PC19
## Eigenvalues         0.1512 0.1116    0
## Prop. variance      0.0080 0.0059    0
## Cum. prop. variance 0.9941 1.0000    1
summary(dataset_pca)
## Importance of components:
##                           PC1    PC2     PC3     PC4    PC5     PC6     PC
7
```

```
## Standard deviation     1.7352 1.5514 1.34652 1.23219 1.1761 1.11613 1.0910
7
## Proportion of Variance 0.1585 0.1267 0.09543 0.07991 0.0728 0.06557 0.0626
5
## Cumulative Proportion  0.1585 0.2851 0.38057 0.46048 0.5333 0.59885 0.6615
0
##                            PC8     PC9    PC10    PC11    PC12    PC13   P
C14
## Standard deviation     0.99898 0.97748 0.94011 0.90434 0.84491 0.78887 0.7
163
## Proportion of Variance 0.05252 0.05029 0.04652 0.04304 0.03757 0.03275 0.0
270
## Cumulative Proportion  0.71402 0.76431 0.81083 0.85387 0.89144 0.92420 0.9
512
##                           PC15    PC16    PC17    PC18      PC19
## Standard deviation     0.66946 0.46495 0.38887 0.33406 3.732e-13
## Proportion of Variance 0.02359 0.01138 0.00796 0.00587 0.000e+00
## Cumulative Proportion  0.97479 0.98617 0.99413 1.00000 1.000e+00
dataset_pca$rotation
##                        PC1          PC2          PC3          PC4
PC5
## Store         0.101338347  0.091916309 -0.513516476  0.251997574 -0.001935
214
## Dept         -0.004080003 -0.007831044 -0.046139485  0.018866256  0.009505
749
## IsHoliday     0.012198689 -0.042117612  0.122765651  0.430598905  0.456416
377
## Type_A       -0.269997489 -0.528338823 -0.185112881 -0.009266895 -0.013346
619
## Type_B        0.146653872  0.403632005  0.488509836 -0.004351486 -0.076292
464
## Type_C        0.210717990  0.223741121 -0.482751803  0.022405038  0.145479
166
## Size         -0.300383406 -0.464123852  0.028723361  0.048095997 -0.091823
360
## Temperature   0.019910709  0.010812768 -0.218666013 -0.510512052  0.200853
851
## Fuel_Price   -0.275443967  0.294661098 -0.203742513 -0.123886920  0.121192
144
## MarkDown1    -0.453413949  0.200206338  0.005221163  0.109824771 -0.089168
444
## MarkDown2    -0.141257544  0.020994379  0.103183191  0.347793218  0.162072
576
## MarkDown3    -0.009497715 -0.034055919  0.081007342  0.226594899  0.487643
095
## MarkDown4    -0.390865591  0.174396291  0.014503077  0.150090049 -0.149722
791
## MarkDown5    -0.335044476  0.096936758 -0.035119875  0.004296702  0.144248
500
## CPI          -0.056574087 -0.083696668  0.141163027 -0.416193607  0.252065
```

```
716
## Unemployment  0.171545851  0.020992482 -0.259550101  0.252639451 -0.190136
441
## Year         -0.389065387  0.314135135 -0.130186448 -0.141176642  0.137111
788
## Month         0.077922298 -0.079345988  0.005109959 -0.088709204  0.432577
095
## Day           0.059412275 -0.036413098  0.006627105 -0.008888773  0.283046
556
##                        PC6          PC7           PC8          PC9
PC10
## Store         0.061086191 -0.078145177  0.0299040623  0.073793008 -0.14095
1607
## Dept          0.018072337 -0.010273283 -0.9977935984 -0.032181832  0.00598
4284
## IsHoliday     0.107760643  0.006727446  0.0129311781  0.034867960  0.03256
3692
## Type_A       -0.050710292 -0.041302498  0.0119666806  0.030914991 -0.01245
3237
## Type_B       -0.139582813  0.142378737 -0.0274509310 -0.033940176 -0.02187
7852
## Type_C        0.309772095 -0.161681024  0.0245323503  0.003596134  0.05602
4880
## Size         -0.185567211  0.086119471  0.0010860492 -0.006638435 -0.00888
8054
## Temperature  -0.002198471  0.359324120  0.0088510932 -0.219426059  0.19543
1729
## Fuel_Price   -0.482204934 -0.022570393 -0.0025723236  0.076513162 -0.15681
7692
## MarkDown1     0.222747819  0.188452025  0.0049684296 -0.061031613  0.23718
4486
## MarkDown2     0.073828460 -0.247589409  0.0268547341 -0.612315382 -0.22674
0528
## MarkDown3    -0.098476660  0.133442483 -0.0149225410  0.553249762  0.24959
6232
## MarkDown4     0.322676103  0.224784551  0.0044506178 -0.014085200  0.33379
8845
## MarkDown5     0.089877318  0.089284428  0.0055416453 -0.063043394 -0.24364
1828
## CPI           0.451357854 -0.274497724  0.0092080205 -0.012353740  0.15627
4240
## Unemployment -0.161452270  0.391750111  0.0237151179 -0.217639424  0.29233
2377
## Year         -0.216978460 -0.214598559  0.0006121195  0.080368012 -0.08316
2286
## Month         0.046100158  0.535683306 -0.0014352308 -0.217696184 -0.36495
7414
## Day          -0.378676557 -0.271360815  0.0096460435 -0.381907173  0.56715
1486
##                       PC11         PC12         PC13          PC14
```

```
PC15
## Store         0.285937561 -0.098966639  0.035443355 -0.6654692527 -2.86107
6e-01
## Dept         -0.008419339  0.006238431  0.006405709 -0.0100002378  9.29936
9e-06
## IsHoliday    -0.350527166 -0.228194058  0.608349231  0.0556684274 -1.62377
3e-01
## Type_A       -0.040459037 -0.042276585  0.007406043  0.0035649783  1.08294
1e-02
## Type_B        0.051967567  0.046704622  0.048087260 -0.2557266645 -1.17887
1e-01
## Type_C       -0.016911522 -0.005388315 -0.090026625  0.4075224935  1.72627
6e-01
## Size         -0.014953982  0.008268893  0.016888929 -0.1196165401 -2.45382
7e-03
## Temperature  -0.290872963  0.011021819 -0.066663694 -0.0049459406 -5.87144
3e-01
## Fuel_Price   -0.224696355 -0.124326140  0.027088672 -0.0677477967  2.14724
5e-01
## MarkDown1     0.071395327 -0.148722198 -0.054028221 -0.0292195316  3.92548
5e-02
## MarkDown2    -0.264198371  0.143078463 -0.467690896 -0.0664937901 -1.02666
9e-01
## MarkDown3     0.002401877  0.273300215 -0.477165739 -0.0470998594 -4.53831
5e-02
## MarkDown4     0.083847097 -0.241194449 -0.081107535 -0.0008326417  1.81135
9e-02
## MarkDown5     0.408496632  0.641238287  0.314421877  0.2082893346 -1.86527
0e-01
## CPI          -0.126280354  0.212472767  0.122309601 -0.4708447432  3.33685
3e-01
## Unemployment -0.283622099  0.452012463  0.159435076 -0.1608653752  3.69796
8e-01
## Year         -0.146334233 -0.002483245  0.060832279 -0.0365537208  1.12541
7e-01
## Month         0.277924550 -0.269961065 -0.082262970 -0.0517141279  3.82328
6e-01
## Day           0.459901246 -0.097265167  0.083972506  0.0329275677  3.02050
7e-02
##                        PC16          PC17          PC18          PC19
## Store        -0.0201653518  0.0064646965 -0.0080510752 -7.788021e-14
## Dept         -0.0002017792 -0.0005154555  0.0001926768  4.343564e-15
## IsHoliday    -0.0208226765  0.0002087695  0.0156194400  6.273852e-16
## Type_A        0.4125947234 -0.0208444350  0.0374472527 -6.574321e-01
## Type_B       -0.1733601306  0.0108628680 -0.0403525786 -6.408318e-01
## Type_C       -0.4040517639  0.0170102351  0.0031287872 -3.963807e-01
## Size         -0.7802905632  0.0456654150 -0.1224051099  9.108548e-16
## Temperature  -0.0268032451  0.0109099849 -0.0198922461  3.097591e-16
## Fuel_Price   -0.0677427660 -0.4165298231  0.4547674844  3.375827e-16
## MarkDown1    -0.0038527297  0.5679082814  0.4838312343 -4.412066e-16
```

```
## MarkDown2     0.0126969980 -0.0605410731  0.0110476373  3.074830e-17
## MarkDown3     0.0133030849  0.0070851851  0.0066958749 -1.055134e-16
## MarkDown4     0.0319323891 -0.5663149078 -0.3339511006  2.342835e-16
## MarkDown5     0.0018146579 -0.1332996200  0.0632993671 -3.597752e-17
## CPI          -0.0591193049 -0.0919004682  0.0913705932 -2.443829e-16
## Unemployment  0.0837632981  0.0505364259 -0.0865456794 -1.651853e-16
## Year          0.0917821075  0.3792262438 -0.6296045956  7.958731e-16
## Month         0.0329757944  0.0609653457 -0.1113671062  5.321175e-16
## Day           0.0073597391 -0.0130023773  0.0050564269 -8.880060e-16
print(dataset_pca)
## Standard deviations (1, .., p=19):
##  [1] 1.735166e+00 1.551401e+00 1.346517e+00 1.232186e+00 1.176126e+00
##  [6] 1.116132e+00 1.091073e+00 9.989793e-01 9.774789e-01 9.401126e-01
## [11] 9.043427e-01 8.449065e-01 7.888711e-01 7.162845e-01 6.694644e-01
## [16] 4.649532e-01 3.888724e-01 3.340617e-01 3.732385e-13
##
## Rotation (n x k) = (19 x 19):
##                       PC1          PC2          PC3          PC4
PC5
## Store         0.101338347  0.091916309 -0.513516476  0.251997574 -0.001935
214
## Dept         -0.004080003 -0.007831044 -0.046139485  0.018866256  0.009505
749
## IsHoliday     0.012198689 -0.042117612  0.122765651  0.430598905  0.456416
377
## Type_A       -0.269997489 -0.528338823 -0.185112881 -0.009266895 -0.013346
619
## Type_B        0.146653872  0.403632005  0.488509836 -0.004351486 -0.076292
464
## Type_C        0.210717990  0.223741121 -0.482751803  0.022405038  0.145479
166
## Size         -0.300383406 -0.464123852  0.028723361  0.048095997 -0.091823
360
## Temperature   0.019910709  0.010812768 -0.218666013 -0.510512052  0.200853
851
## Fuel_Price   -0.275443967  0.294661098 -0.203742513 -0.123886920  0.121192
144
## MarkDown1    -0.453413949  0.200206338  0.005221163  0.109824771 -0.089168
444
## MarkDown2    -0.141257544  0.020994379  0.103183191  0.347793218  0.162072
576
## MarkDown3    -0.009497715 -0.034055919  0.081007342  0.226594899  0.487643
095
## MarkDown4    -0.390865591  0.174396291  0.014503077  0.150090049 -0.149722
791
## MarkDown5    -0.335044476  0.096936758 -0.035119875  0.004296702  0.144248
500
## CPI          -0.056574087 -0.083696668  0.141163027 -0.416193607  0.252065
716
## Unemployment  0.171545851  0.020992482 -0.259550101  0.252639451 -0.190136
```

```
441
## Year         -0.389065387  0.314135135 -0.130186448 -0.141176642  0.137111
788
## Month         0.077922298 -0.079345988  0.005109959 -0.088709204  0.432577
095
## Day           0.059412275 -0.036413098  0.006627105 -0.008888773  0.283046
556
##                        PC6           PC7           PC8           PC9
PC10
## Store         0.061086191 -0.078145177  0.0299040623  0.073793008 -0.14095
1607
## Dept          0.018072337 -0.010273283 -0.9977935984 -0.032181832  0.00598
4284
## IsHoliday     0.107760643  0.006727446  0.0129311781  0.034867960  0.03256
3692
## Type_A       -0.050710292 -0.041302498  0.0119666806  0.030914991 -0.01245
3237
## Type_B       -0.139582813  0.142378737 -0.0274509310 -0.033940176 -0.02187
7852
## Type_C        0.309772095 -0.161681024  0.0245323503  0.003596134  0.05602
4880
## Size         -0.185567211  0.086119471  0.0010860492 -0.006638435 -0.00888
8054
## Temperature  -0.002198471  0.359324120  0.0088510932 -0.219426059  0.19543
1729
## Fuel_Price   -0.482204934 -0.022570393 -0.0025723236  0.076513162 -0.15681
7692
## MarkDown1     0.222747819  0.188452025  0.0049684296 -0.061031613  0.23718
4486
## MarkDown2     0.073828460 -0.247589409  0.0268547341 -0.612315382 -0.22674
0528
## MarkDown3    -0.098476660  0.133442483 -0.0149225410  0.553249762  0.24959
6232
## MarkDown4     0.322676103  0.224784551  0.0044506178 -0.014085200  0.33379
8845
## MarkDown5     0.089877318  0.089284428  0.0055416453 -0.063043394 -0.24364
1828
## CPI           0.451357854 -0.274497724  0.0092080205 -0.012353740  0.15627
4240
## Unemployment -0.161452270  0.391750111  0.0237151179 -0.217639424  0.29233
2377
## Year         -0.216978460 -0.214598559  0.0006121195  0.080368012 -0.08316
2286
## Month         0.046100158  0.535683306 -0.0014352308 -0.217696184 -0.36495
7414
## Day          -0.378676557 -0.271360815  0.0096460435 -0.381907173  0.56715
1486
##                       PC11          PC12          PC13          PC14
PC15
## Store         0.285937561 -0.098966639  0.035443355 -0.6654692527 -2.86107
```

```
6e-01
## Dept         -0.008419339  0.006238431  0.006405709 -0.0100002378  9.29936
9e-06
## IsHoliday    -0.350527166 -0.228194058  0.608349231  0.0556684274 -1.62377
3e-01
## Type_A       -0.040459037 -0.042276585  0.007406043  0.0035649783  1.08294
1e-02
## Type_B        0.051967567  0.046704622  0.048087260 -0.2557266645 -1.17887
1e-01
## Type_C       -0.016911522 -0.005388315 -0.090026625  0.4075224935  1.72627
6e-01
## Size         -0.014953982  0.008268893  0.016888929 -0.1196165401 -2.45382
7e-03
## Temperature  -0.290872963  0.011021819 -0.066663694 -0.0049459406 -5.87144
3e-01
## Fuel_Price   -0.224696355 -0.124326140  0.027088672 -0.0677477967  2.14724
5e-01
## MarkDown1     0.071395327 -0.148722198 -0.054028221 -0.0292195316  3.92548
5e-02
## MarkDown2    -0.264198371  0.143078463 -0.467690896 -0.0664937901 -1.02666
9e-01
## MarkDown3     0.002401877  0.273300215 -0.477165739 -0.0470998594 -4.53831
5e-02
## MarkDown4     0.083847097 -0.241194449 -0.081107535 -0.0008326417  1.81135
9e-02
## MarkDown5     0.408496632  0.641238287  0.314421877  0.2082893346 -1.86527
0e-01
## CPI          -0.126280354  0.212472767  0.122309601 -0.4708447432  3.33685
3e-01
## Unemployment -0.283622099  0.452012463  0.159435076 -0.1608653752  3.69796
8e-01
## Year         -0.146334233 -0.002483245  0.060832279 -0.0365537208  1.12541
7e-01
## Month         0.277924550 -0.269961065 -0.082262970 -0.0517141279  3.82328
6e-01
## Day           0.459901246 -0.097265167  0.083972506  0.0329275677  3.02050
7e-02
##                       PC16          PC17          PC18          PC19
## Store        -0.0201653518  0.0064646965 -0.0080510752 -7.788021e-14
## Dept         -0.0002017792 -0.0005154555  0.0001926768  4.343564e-15
## IsHoliday    -0.0208226765  0.0002087695  0.0156194400  6.273852e-16
## Type_A        0.4125947234 -0.0208444350  0.0374472527 -6.574321e-01
## Type_B       -0.1733601306  0.0108628680 -0.0403525786 -6.408318e-01
## Type_C       -0.4040517639  0.0170102351  0.0031287872 -3.963807e-01
## Size         -0.7802905632  0.0456654150 -0.1224051099  9.108548e-16
## Temperature  -0.0268032451  0.0109099849 -0.0198922461  3.097591e-16
## Fuel_Price   -0.0677427660 -0.4165298231  0.4547674844  3.375827e-16
## MarkDown1    -0.0038527297  0.5679082814  0.4838312343 -4.412066e-16
## MarkDown2     0.0126969980 -0.0605410731  0.0110476373  3.074830e-17
## MarkDown3     0.0133030849  0.0070851851  0.0066958749 -1.055134e-16
```

```
## MarkDown4     0.0319323891 -0.5663149078 -0.3339511006  2.342835e-16
## MarkDown5     0.0018146579 -0.1332996200  0.0632993671 -3.597752e-17
## CPI          -0.0591193049 -0.0919004682  0.0913705932 -2.443829e-16
## Unemployment  0.0837632981  0.0505364259 -0.0865456794 -1.651853e-16
## Year          0.0917821075  0.3792262438 -0.6296045956  7.958731e-16
## Month         0.0329757944  0.0609653457 -0.1113671062  5.321175e-16
## Day           0.0073597391 -0.0130023773  0.0050564269 -8.880060e-16
```

1st Option Based on retating components that account for 70% to 90% of the variance, we need to retain PC1 to PC8 or PC1 to PC12.

2nd Option Based on the rule of sum to choose all components with eigen values larger than 0.7, we need to retain PC1 to PC12.

```
dataset_pca$x
##                      PC1           PC2           PC3           PC4
PC5
##      [1,]  4.762275e-01 -2.155530e+00  1.299508e+00 -1.320725e-01 -
1.472243e+00
##      [2,]  5.815413e-01 -2.367293e+00  1.841060e+00  1.654581e+00
4.919413e-01
##      [3,]  6.032438e-01 -2.252848e+00  1.364785e+00 -6.680457e-02 -
1.059554e+00
##      [4,]  6.297072e-01 -2.247900e+00  1.269893e+00 -2.723459e-01 -
7.476421e-01
##      [5,]  4.725706e-01 -2.144022e+00  1.228783e+00 -2.923926e-01 -
1.277602e+00
##      [6,]  5.069916e-01 -2.139597e+00  1.081707e+00 -6.236027e-01 -
9.170382e-01
##      [7,]  5.194372e-01 -2.136185e+00  1.100910e+00 -5.544465e-01 -
7.126955e-01
##      [8,]  5.566463e-01 -2.159004e+00  1.137265e+00 -4.760799e-01 -
5.185284e-01
##      [9,]  4.101165e-01 -2.088581e+00  1.038994e+00 -8.132772e-01 -
1.017686e+00
##     [10,]  4.311499e-01 -2.082398e+00  9.783668e-01 -9.314116e-01 -
7.400460e-01
##     [11,]  4.565230e-01 -2.086540e+00  9.608449e-01 -9.600908e-01 -
4.995118e-01
##     [12,]  5.103173e-01 -2.124775e+00  9.892849e-01 -9.222033e-01 -
2.930353e-01
##     [13,]  5.696842e-01 -2.161921e+00  9.706085e-01 -9.958516e-01 -
4.299254e-02
##     [14,]  4.101833e-01 -2.052246e+00  8.692280e-01 -1.156422e+00 -
5.831395e-01
##     [15,]  4.486905e-01 -2.067842e+00  8.396431e-01 -1.230348e+00 -
3.275090e-01
##     [16,]  5.144091e-01 -2.114580e+00  8.387165e-01 -1.278800e+00 -
8.869080e-02
```

```
##     [17,]  6.060818e-01 -2.185009e+00  8.273833e-01 -1.381471e+00
1.652962e-01
##     [18,]  4.995199e-01 -2.144793e+00  8.328290e-01 -1.379752e+00 -
4.871172e-01
##     [19,]  5.685729e-01 -2.198439e+00  8.586596e-01 -1.372641e+00 -
2.715820e-01
##     [20,]  6.386813e-01 -2.245318e+00  8.341061e-01 -1.473185e+00 -
1.337886e-02
##     [21,]  6.769947e-01 -2.263773e+00  8.291548e-01 -1.489758e+00
2.189587e-01
##     [22,]  5.298341e-01 -2.184282e+00  8.493745e-01 -1.404783e+00 -
4.230822e-01
##     [23,]  5.932666e-01 -2.230758e+00  8.713534e-01 -1.391473e+00 -
2.092960e-01
##     [24,]  6.550843e-01 -2.270504e+00  8.534188e-01 -1.467249e+00
4.104569e-02
##     [25,]  7.116378e-01 -2.309428e+00  8.633803e-01 -1.477548e+00
2.665802e-01
##     [26,]  7.380897e-01 -2.319161e+00  8.729631e-01 -1.452672e+00
4.857020e-01
##     [27,]  6.125793e-01 -2.249315e+00  7.995725e-01 -1.600794e+00 -
1.016070e-01
##     [28,]  6.206750e-01 -2.237043e+00  7.783713e-01 -1.622469e+00
1.410443e-01
##     [29,]  6.846803e-01 -2.284284e+00  8.001314e-01 -1.611943e+00
3.559461e-01
##     [30,]  7.577325e-01 -2.343083e+00  8.422468e-01 -1.566937e+00
5.545960e-01
##     [31,]  6.398203e-01 -2.296977e+00  8.917165e-01 -1.447218e+00 -
1.430591e-01
##     [32,]  7.395695e-01 -2.499890e+00  1.412110e+00  3.027047e-01
1.837062e+00
##     [33,]  7.328218e-01 -2.351455e+00  8.893943e-01 -1.487597e+00
3.206956e-01
##     [34,]  7.537308e-01 -2.354428e+00  8.901687e-01 -1.474470e+00
5.458850e-01
##     [35,]  6.290861e-01 -2.301603e+00  9.840993e-01 -1.216231e+00 -
1.732488e-01
##     [36,]  6.498755e-01 -2.316267e+00  1.070689e+00 -1.011961e+00 -
2.515803e-02
##     [37,]  6.485333e-01 -2.287714e+00  9.990484e-01 -1.133226e+00
2.599987e-01
##     [38,]  6.958640e-01 -2.312151e+00  9.705311e-01 -1.216354e+00
5.171506e-01
##     [39,]  7.484750e-01 -2.347284e+00  9.826089e-01 -1.215448e+00
7.390280e-01
```

```
##     [40,]  6.139947e-01 -2.295755e+00  1.107383e+00 -9.100026e-01 -
2.913983e-02
##     [41,]  6.389470e-01 -2.299402e+00  1.085212e+00 -9.522293e-01
2.172922e-01
##     [42,]  6.519410e-01 -2.305449e+00  1.168188e+00 -7.428215e-01
3.649892e-01
##     [43,]  7.831291e-01 -2.514400e+00  1.513602e+00  5.821722e-01
2.508263e+00
##     [44,]  6.033162e-01 -2.304495e+00  1.209992e+00 -6.746817e-01 -
6.076240e-02
##     [45,]  5.667590e-01 -2.248278e+00  1.189643e+00 -6.354056e-01
1.683468e-01
##     [46,]  6.025265e-01 -2.258501e+00  1.141566e+00 -7.460269e-01
4.393896e-01
##     [47,]  6.425123e-01 -2.275235e+00  1.109797e+00 -8.266324e-01
6.973373e-01
##     [48,]  6.992698e-01 -2.434691e+00  1.616016e+00  9.424543e-01
2.680902e+00
##     [49,] -2.926828e-01 -1.486815e+00  9.377270e-01 -6.106346e-01 -
1.158088e+00
##     [50,] -2.633440e-01 -1.519091e+00  1.092656e+00 -2.640406e-01 -
1.069677e+00
##     [51,] -2.268668e-01 -1.522729e+00  9.822138e-01 -5.230915e-01 -
7.381595e-01
##     [52,] -1.765128e-01 -1.556617e+00  9.940018e-01 -5.266977e-01 -
5.133058e-01
##     [53,] -3.049825e-01 -1.496447e+00  1.006563e+00 -4.847657e-01 -
1.176123e+00
##     [54,] -2.364790e-01 -1.673278e+00  1.548250e+00  1.341666e+00
7.819226e-01
##     [55,] -2.282997e-01 -1.511307e+00  8.158692e-01 -9.389381e-01 -
5.399529e-01
##     [56,] -1.872402e-01 -1.524941e+00  7.476525e-01 -1.107817e+00 -
2.461518e-01
##     [57,] -4.437075e-01 -1.321302e+00  6.746283e-01 -1.085281e+00 -
7.671617e-01
##     [58,] -5.058350e-01 -1.244672e+00  6.763365e-01 -9.750577e-01 -
5.593098e-01
##     [59,] -4.661798e-01 -1.250300e+00  5.606080e-01 -1.247269e+00 -
2.235134e-01
##     [60,] -4.022193e-01 -1.285339e+00  4.879668e-01 -1.452369e+00
7.889403e-02
##     [61,] -5.892467e-01 -1.184707e+00  5.859375e-01 -1.180917e+00 -
6.602250e-01
##     [62,] -5.915931e-01 -1.146272e+00  4.457788e-01 -1.456951e+00 -
3.120541e-01
```

```
##     [63,] -6.133832e-01 -1.096085e+00  3.574392e-01 -1.593982e+00 -
1.498231e-02
##     [64,] -6.027058e-01 -1.083426e+00  3.145185e-01 -1.667767e+00
2.480877e-01
##     [65,] -5.582764e-01 -1.111538e+00  3.304698e-01 -1.650905e+00
4.658557e-01
##     [66,] -7.562775e-01 -9.833426e-01  3.605308e-01 -1.477292e+00 -
1.988019e-01
##     [67,] -6.929001e-01 -1.010854e+00  2.388064e-01 -1.789530e+00
1.468654e-01
##     [68,] -6.585080e-01 -1.039034e+00  3.346652e-01 -1.574692e+00
2.866343e-01
##     [69,] -5.270865e-01 -1.139507e+00  2.733037e-01 -1.825882e+00
5.893722e-01
##     [70,] -6.076588e-01 -1.116460e+00  2.319540e-01 -1.949026e+00 -
2.028039e-02
##     [71,] -5.290382e-01 -1.177786e+00  2.575450e-01 -1.943505e+00
1.925190e-01
##     [72,] -4.713138e-01 -1.211954e+00  2.286902e-01 -2.037926e+00
4.513757e-01
##     [73,] -4.011606e-01 -1.270564e+00  2.869768e-01 -1.956090e+00
6.361426e-01
##     [74,] -4.634191e-01 -1.240228e+00  2.402261e-01 -1.958714e+00
7.885327e-04
##     [75,] -3.893086e-01 -1.297657e+00  2.620937e-01 -1.962671e+00
2.191515e-01
##     [76,] -3.960639e-01 -1.264316e+00  1.933602e-01 -2.071333e+00
5.006526e-01
##     [77,] -3.972869e-01 -1.246348e+00  1.979426e-01 -2.022972e+00
7.173210e-01
##     [78,] -3.673434e-01 -1.255054e+00  1.771233e-01 -2.068439e+00
9.637948e-01
##     [79,] -5.022981e-01 -1.175704e+00  1.027287e-01 -2.205996e+00
3.745329e-01
##     [80,] -4.282028e-01 -1.235037e+00  1.392383e-01 -2.176696e+00
5.794237e-01
##     [81,] -3.312077e-01 -1.318754e+00  1.918121e-01 -2.139091e+00
7.750477e-01
##     [82,] -2.673038e-01 -1.369092e+00  2.345862e-01 -2.083710e+00
9.720534e-01
##     [83,] -4.124108e-01 -1.287508e+00  2.153198e-01 -2.086475e+00
3.310301e-01
##     [84,] -3.378725e-01 -1.480025e+00  8.353171e-01 -8.673363e-02
2.217039e+00
##     [85,] -3.220526e-01 -1.355390e+00  3.234299e-01 -1.883052e+00
6.975375e-01
```

```
##     [86,] -2.440508e-01 -1.425566e+00  4.052251e-01 -1.763210e+00
8.653686e-01
##     [87,] -1.255436e-01 -1.525097e+00  4.153903e-01 -1.851263e+00
1.106618e+00
##     [88,] -2.360973e-01 -1.506752e+00  5.682727e-01 -1.565674e+00
3.767267e-01
##     [89,] -1.798038e-01 -1.542178e+00  5.507742e-01 -1.640349e+00
6.286164e-01
##     [90,] -1.886499e-01 -1.525578e+00  6.167299e-01 -1.448295e+00
7.894496e-01
##     [91,] -1.496986e-01 -1.541154e+00  5.802660e-01 -1.541390e+00
1.052990e+00
##     [92,] -2.772776e-01 -1.498626e+00  7.194031e-01 -1.214540e+00
2.746020e-01
##     [93,] -1.915834e+00 -9.220756e-01  7.823767e-01 -6.132075e-01
7.307160e-01
##     [94,] -1.142496e+00 -1.210084e+00  6.186461e-01 -1.275191e+00
9.146462e-01
##     [95,] -1.990353e-01 -2.127303e+00  2.014476e+00  2.626403e+00
7.710923e+00
##     [96,] -2.444179e+00 -8.800732e-01  7.292549e-01 -7.726288e-01
9.049265e-01
##     [97,] -1.993527e+00 -1.015502e+00  8.358844e-01 -6.612812e-01
7.079679e-01
##     [98,] -7.933911e-01 -1.422586e+00  8.296142e-01 -1.006342e+00
8.102234e-01
##     [99,] -4.289254e-01 -1.600236e+00  9.115101e-01 -9.416449e-01
1.007629e+00
##    [100,] -2.107063e+00 -1.403992e+00  2.347293e+00  4.046049e+00
4.406279e+00
##    [101,] -2.841467e+00 -4.366877e-01  1.154010e+00  6.784860e-01 -
1.825587e-02
##    [102,] -1.912652e+00 -6.465264e-01  8.732619e-01 -3.556898e-01 -
3.257330e-01
##    [103,] -1.619649e+00 -7.293114e-01  7.055593e-01 -8.948343e-01 -
2.006677e-01
##    [104,] -1.091963e+00 -9.221121e-01  6.785833e-01 -1.105653e+00 -
3.235881e-02
##    [105,] -7.445255e+00  1.866333e+00  7.691054e-01  8.428047e-01 -
2.127592e+00
##    [106,] -3.632698e+00 -1.287804e-02  1.283758e+00  1.672015e+00
1.172934e+00
##    [107,] -3.224237e+00 -1.377345e-02  9.046547e-01  2.265517e-01 -
3.206180e-01
##    [108,] -2.710496e+00 -2.519094e-01  6.112644e-01 -6.469373e-01
3.831626e-01
```

```
##    [109,] -5.587007e+00  1.122425e+00  4.941587e-01 -1.443590e-01 -
1.345014e+00
##    [110,] -2.458803e+00 -2.240969e-01  4.050240e-01 -1.248497e+00 -
2.386225e-01
##    [111,] -1.916130e+00 -3.969082e-01  3.397104e-01 -1.484222e+00 -
4.373318e-02
##    [112,] -1.935643e+00 -3.963507e-01  2.870346e-01 -1.592971e+00
3.281110e-01
##    [113,] -2.277411e+00 -2.172121e-01  2.634660e-01 -1.541114e+00
4.450259e-01
##    [114,] -2.805039e+00  1.718980e-02  2.148665e-01 -1.581113e+00 -
1.412119e-01
##    [115,] -2.087541e+00 -2.948714e-01  3.205973e-01 -1.478163e+00
1.842004e-01
##    [116,] -1.881135e+00 -4.377620e-01  2.571479e-01 -1.727742e+00
5.752777e-01
##    [117,] -1.920718e+00 -4.525973e-01  2.708886e-01 -1.742529e+00
7.624017e-01
##    [118,] -3.564359e+00  3.079090e-01  2.427044e-01 -1.463939e+00 -
3.080266e-01
##    [119,] -2.247853e+00 -3.057519e-01  2.760447e-01 -1.740897e+00
1.614104e-01
##    [120,] -2.117184e+00 -4.266296e-01  3.238378e-01 -1.702926e+00
4.816190e-01
.
.
.
[ reached getOption("max.print") -- omitted 421518 rows ]
weeklySales <- data.frame(WeeklySales=dataset$weeklySales)
dataset2_pca <- cbind(weeklySales, dataset_pca$x)
dataset2_pca
##      WeeklySales        PC1           PC2        PC3          PC4
PC5
## 1       24924.50  0.4762275 -2.155529915 1.29950753 -0.13207252 -
1.4722426623
## 2       46039.49  0.5815413 -2.367293415 1.84106046  1.65458065
0.4919413222
## 3       41595.55  0.6032438 -2.252847556 1.36478454 -0.06680457 -
1.0595536159
## 4       19403.54  0.6297072 -2.247900170 1.26989334 -0.27234587 -
0.7476420879
## 5       21827.90  0.4725706 -2.144021618 1.22878256 -0.29239263 -
1.2776022995
## 6       21043.39  0.5069916 -2.139597138 1.08170718 -0.62360266 -
0.9170382224
## 7       22136.64  0.5194372 -2.136184512 1.10090975 -0.55444646 -
```

```
0.7126954772
## 8       26229.21  0.5566463 -2.159003710 1.13726510 -0.47607994 -
0.5185283727
## 9       57258.43  0.4101165 -2.088581028 1.03899440 -0.81327720 -
1.0176860744
## 10      42960.91  0.4311499 -2.082398403 0.97836682 -0.93141161 -
0.7400459663
## 11      17596.96  0.4565230 -2.086540284 0.96084486 -0.96009083 -
0.4995118364
## 12      16145.35  0.5103173 -2.124774809 0.98928493 -0.92220331 -
0.2930352806
## 13      16555.11  0.5696842 -2.161920818 0.97060846 -0.99585160 -
0.0429925401
## 14      17413.94  0.4101833 -2.052246410 0.86922797 -1.15642207 -
0.5831394632
## 15      18926.74  0.4486905 -2.067842373 0.83964310 -1.23034792 -
0.3275090483
## 16      14773.04  0.5144091 -2.114579820 0.83871647 -1.27880045 -
0.0886907975
## 17      15580.43  0.6060818 -2.185008809 0.82738326 -1.38147062
0.1652961822
## 18      17558.09  0.4995199 -2.144792515 0.83282897 -1.37975238 -
0.4871171883
## 19      16637.62  0.5685729 -2.198439104 0.85865955 -1.37264077 -
0.2715819781
## 20      16216.27  0.6386813 -2.245317800 0.83410609 -1.47318539 -
0.0133788569
## 21      16328.72  0.6769947 -2.263773324 0.82915476 -1.48975790
0.2189587461
## 22      16333.14  0.5298341 -2.184281574 0.84937446 -1.40478287 -
0.4230822415
## 23      17688.76  0.5932666 -2.230757583 0.87135340 -1.39147287 -
0.2092959932
## 24      17150.84  0.6550843 -2.270504355 0.85341881 -1.46724929
0.0410456949
## 25      15360.45  0.7116378 -2.309427605 0.86338027 -1.47754815
0.2665802390
## 26      15381.82  0.7380897 -2.319160634 0.87296306 -1.45267151
0.4857020126
## 27      17508.41  0.6125793 -2.249314617 0.79957246 -1.60079381 -
0.1016070447
## 28      15536.40  0.6206750 -2.237043304 0.77837131 -1.62246897
0.1410442630
## 29      15740.13  0.6846803 -2.284284047 0.80013135 -1.61194290
0.3559461189
## 30      15793.87  0.7577325 -2.343082733 0.84224681 -1.56693659
```

```
0.5545960081
## 31       16241.78  0.6398203 -2.296976800 0.89171654 -1.44721751 -
0.1430590983
## 32       18194.74  0.7395695 -2.499889631 1.41210959  0.30270470
1.8370621208
## 33       19354.23  0.7328218 -2.351454625 0.88939433 -1.48759716
0.3206956190
## 34       18122.52  0.7537308 -2.354427855 0.89016871 -1.47447041
0.5458850260
## 35       20094.19  0.6290861 -2.301602578 0.98409934 -1.21623111 -
0.1732487943
```

..... (till 421,570 rows)

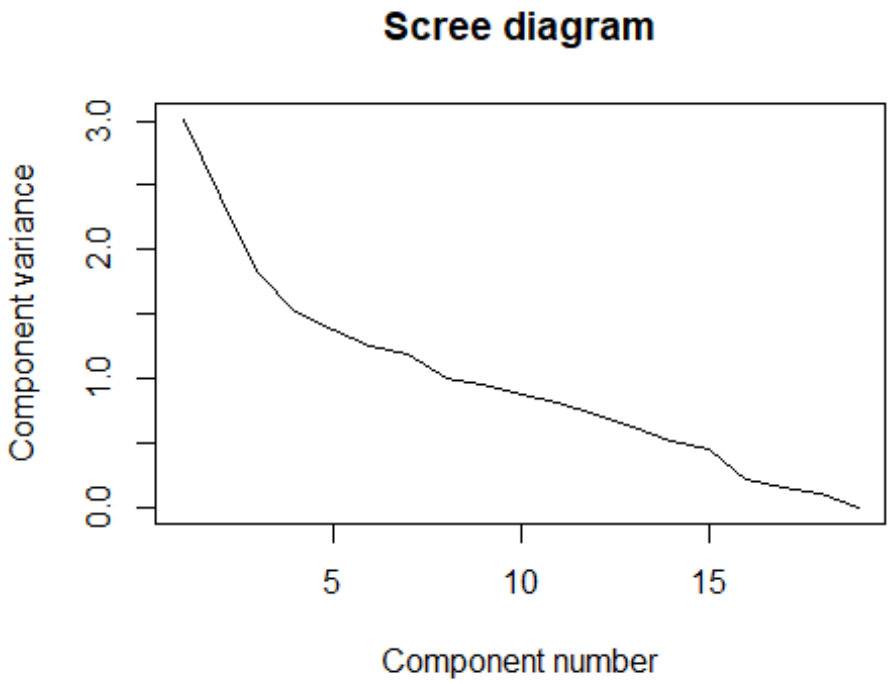
```
##  [ reached 'max' / getOption("max.print") -- omitted 416571 rows ]
tabmeansPC <- aggregate(dataset2_pca[,2:13],by=list(weeklySales=dataset$weekl
ySales),mean)
tabmeansPC
##      weeklySales           PC1           PC2           PC3
PC4
## 1       -4988.94  1.092029e+00 -2.0378134702 -1.4696978034
1.032714e+00
## 2       -3924.00  9.812029e-01  1.4597475331 -0.1390250007 -
1.005889e-01
## 3       -1750.00  1.970287e+00  0.3808546875  0.5996825770
1.316747e+00
## 4       -1699.00 -8.898703e-01  2.2609144022  1.7017438578
2.009858e-01
## 5       -1321.48 -4.049376e-02 -0.9937518544 -1.8209205001
1.224572e+00
## 6       -1098.00  4.586637e-01 -2.6951378406  0.8678152841 -
9.647888e-01
## 7       -1008.96  1.249464e+00  1.2220997963  1.6306675400 -
2.038364e+00
## 8        -898.00  5.397666e-01 -2.5840171669  0.6583343577 -
2.688177e-02
## 9        -863.00  5.957417e-01 -2.2672468519  1.2799457790 -
3.211432e-02
## 10       -798.00  1.160580e-02  0.1386170991  1.4652650091
1.923656e+00
## 11       -778.50 -7.837330e-01 -1.3755273534 -0.4230900783 -
1.149468e+00
## 12       -771.90 -7.359438e-01  2.4022328840 -0.3275837931 -
5.872017e-02
## 13       -705.00  1.051254e+00 -2.0784153093 -1.2188600442
1.789959e+00
## 14       -698.00  5.534451e-01 -2.4472484399  0.7155071667
3.526449e-01
```

```
## 15       -649.00 -1.840651e+00 -0.7345779347 -0.6102413549
2.795991e-01
## 16       -598.00  8.102603e-01 -1.4178107059  0.1298827611
8.207394e-01
## 17       -594.00 -6.182020e-01 -1.6475909191 -0.1761138680 -
1.800906e+00
## 18       -590.04  8.996515e-01  1.4118662191  1.2398765549 -
1.117441e+00
## 19       -548.14  2.130652e+00  0.5655675623  0.5852538029
1.114027e+00
## 20       -548.00 -1.049810e+00  2.5924086146 -0.1011159009 -
1.276544e-01
## 21       -543.00 -5.730511e-01 -0.6957668485 -1.1167288374 -
2.790019e-01
## 22       -515.00  6.461424e-01  1.1903495066  0.9403360474 -
6.731068e-02
## 23       -500.00  1.074162e+00  1.0512721355  2.5172777138
2.265797e+00
## 24       -499.00 -7.893772e-01 -1.0681018142 -0.5522043235
2.557789e-01
## 25       -498.00 -1.382816e-01 -0.7934913890  0.6885840085 -
2.381393e-01
## 26       -496.00  1.466284e+00 -0.1479840285  2.3378575961 -
6.579826e-01
## 27       -486.27  9.235196e-01  1.2374387814  1.8050196551
7.204233e-01
## 28       -465.08 -4.499004e-01 -1.5058678210 -0.3534446101 -
7.592303e-01
## 29       -465.00  1.361512e-01 -0.8702109473 -1.8008202975
1.155613e-01
## 30       -459.00  6.918477e-01  0.7950592573  2.9636663820
3.191291e+00
## 31       -454.42  9.085847e-02  1.9644180128 -0.3605177929 -
2.461402e-01
## 32       -450.00  1.835054e+00 -0.2387088924  1.2654445241 -
1.118402e+00
## 33       -449.00  4.529975e-01 -2.3077742882  0.5775662554
2.680844e+00
## 34       -448.00 -2.106495e+00  2.5062130810  0.5914904789 -
7.857484e-01
## 35       -439.00  6.116793e-01  1.1975476620  0.6148437412 -
1.101522e+00
## 36       -419.28 -2.984403e-01  0.2060193983 -1.2349880715 -
1.815139e+00
## 37       -410.00  7.047146e-01  1.1878970763  0.5997292324 -
9.838837e-01
```

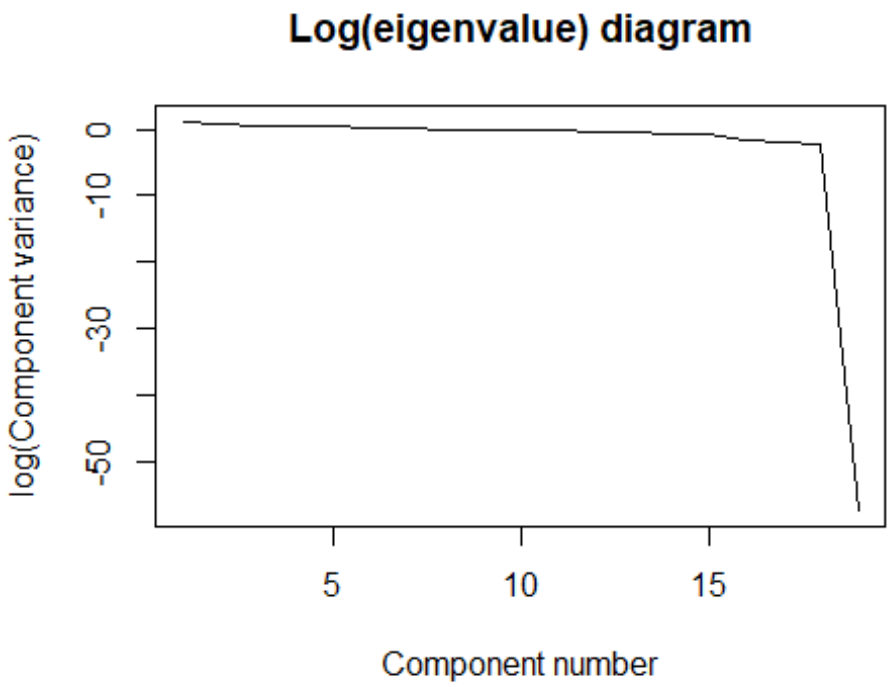
```
## 38       -409.00  5.991245e-01 -2.2016178520 -0.4665406725
3.440964e-01
## 39       -400.00  4.484425e-01  1.6642091612  0.8007454789
3.645792e-02
## 40       -399.00  4.781914e-01  0.9167470392  1.0628150123 -
6.359858e-01
## 41       -398.00  1.643233e+00 -0.2569933835  2.0899436772 -
1.407705e+00
## 42       -389.00 -1.382102e-01  1.9104886804  1.3501820751 -
9.547700e-01
## 43       -379.00  6.790186e-01  2.7772684424 -3.5350744766 -
6.182068e-01
## 44       -372.90  2.944950e+00  0.7104378416 -2.3801781240
3.560846e-01
## 45       -370.12 -7.748174e-01  1.8537455235  1.0720413010
1.928100e-01
## 46       -348.00  3.347149e-01 -1.0403956229 -1.5773569738
4.768617e-01
## 47       -342.84  3.034662e+00  0.5304046758 -1.8287350238
2.223969e+00
## 48       -335.00  8.660690e-02 -0.8130585420 -1.8038518951
1.857287e-01
## 49       -326.61 -7.747233e-02  2.0238770193  0.3254134035
1.482722e+00
## 50       -324.00  1.542457e+00 -0.0400439380  1.6516791277
1.121292e-01
. . . (till 359,464 rows, 13 columns)
##  [ reached 'max' / getOption("max.print") -- omitted 351772 rows ]
tabmeansPC <- tabmeansPC[rev(order(tabmeansPC$weeklySales)),]
tabmeansPC
##        weeklySales           PC1          PC2           PC3
PC4
## 359464   693099.36  1.771488e+00  0.069188713  1.8504265581
1.9970047750
## 359463   649770.18  6.260175e-01  0.827914061  1.5045820484
4.6631282544
## 359462   630999.19  4.606022e-01 -0.002946842  3.5996625395
7.1588204034
## 359461   627962.93  2.110076e+00  0.314444565  1.0624137874
2.6055903965
## 359460   474330.10  5.528941e-01 -2.561029036  0.7565258533
1.7779575507
## 359459   422306.25  4.407886e-01 -2.600614417  0.7635111714
1.4804971480
## 359458   420586.57  5.538717e-01 -2.307207998  0.0962148156
2.3772467178
```

```
## 359457   406988.63  1.700203e+00  0.282902534  1.4200181276
0.1751773205
## 359456   404245.03  1.691201e+00  0.265623380  1.3182116104
0.2168056095
## 359455   393705.20  1.890402e+00  0.116714959  1.6292797994
2.3846161175
## 359454   392023.02 -7.603098e-01 -2.487863835  1.9493851713
5.2378904616
## 359453   385051.04 -1.338004e+00 -2.358305708  2.3476390901
4.8318401817
## 359452   381072.11  5.577082e-01 -2.752074796  1.2853373433
1.9887692093
## 359451   375948.31 -5.684477e-01 -2.380475749  1.7041293334
4.9975692021
## 359450   369830.98  1.615779e+00  0.127704489  2.1449500872
2.2632281759
## 359449   368484.19 -4.435264e-01 -2.030484935  0.8032439381
5.0128971356
## 359448   360140.66  7.512978e-01  0.762390548  1.8019645880
4.9659629255
## 359447   359995.60  2.338243e+00  0.247535283  1.1146246131
2.9573886111
## 359446   356867.25  4.469273e-01 -2.338273341  0.5166229315
0.4329106090
## 359445   355356.39  1.160605e+00 -2.238677613 -0.8565957540
3.3373292886
## 359444   353008.64  1.924641e+00  0.094174674  1.7158824454
2.5556561852
## 359443   351763.71 -2.120222e-01 -1.803084421 -0.1907743637
5.2431465599
## 359442   351553.98 -4.537437e-01 -2.152224805  0.6134570619
4.1595648106
## 359441   347680.08  5.161753e-01  0.186039677  3.4233869724
6.0646424550
## 359440   345532.23  3.680145e-01  0.542316548  2.3567690364
4.7873336217
##  [ reached 'max' / getOption("max.print") -- omitted 351772 rows ]
```

```
tabfmeans <- t(tabmeansPC[,-1])
colnames(tabfmeans) <- t(as.vector(tabmeansPC[1]))
tabsdsPC <- aggregate(dataset2_pca[,2:13],by=list(weeklySales=dataset$weeklyS
ales),sd)
tabfsds <- t(tabsdsPC[,-1])
colnames(tabfsds) <- t(as.vector(tabsdsPC[1]))
plot(dataset_eigen, xlab = "Component number", ylab = "Component variance", t
ype = "l", main = "Scree diagram")
```




```
plot(log(dataset_eigen), xlab = "Component number",ylab = "log(Component vari
ance)", type="l",main = "Log(eigenvalue) diagram")
```




```
summary(dataset_pca)
## Importance of components:
##                           PC1    PC2     PC3     PC4    PC5     PC6     PC
```

```
7
## Standard deviation     1.7352 1.5514 1.34652 1.23219 1.1761 1.11613 1.0910
7
## Proportion of Variance 0.1585 0.1267 0.09543 0.07991 0.0728 0.06557 0.0626
5
## Cumulative Proportion  0.1585 0.2851 0.38057 0.46048 0.5333 0.59885 0.6615
0
##                            PC8     PC9    PC10    PC11    PC12    PC13   P
C14
## Standard deviation     0.99898 0.97748 0.94011 0.90434 0.84491 0.78887 0.7
163
## Proportion of Variance 0.05252 0.05029 0.04652 0.04304 0.03757 0.03275 0.0
270
## Cumulative Proportion  0.71402 0.76431 0.81083 0.85387 0.89144 0.92420 0.9
512
##                           PC15    PC16    PC17    PC18      PC19
## Standard deviation     0.66946 0.46495 0.38887 0.33406 3.732e-13
## Proportion of Variance 0.02359 0.01138 0.00796 0.00587 0.000e+00
## Cumulative Proportion  0.97479 0.98617 0.99413 1.00000 1.000e+00
cov(dataset_pca$x)
##                PC1           PC2           PC3           PC4           PC5
## PC1   3.010800e+00 -5.687086e-14 -2.744540e-13  6.765672e-14  3.179852e-14
## PC2  -5.687086e-14  2.406846e+00 -1.954752e-13  5.161694e-14  2.886857e-14
## PC3  -2.744540e-13 -1.954752e-13  1.813107e+00 -2.547748e-13 -5.908618e-14
## PC4   6.765672e-14  5.161694e-14 -2.547748e-13  1.518282e+00  7.026591e-14
## PC5   3.179852e-14  2.886857e-14 -5.908618e-14  7.026591e-14  1.383272e+00
## PC6   9.162174e-14  1.021239e-13 -2.171375e-13  1.184929e-13 -5.188619e-15
## PC7  -4.646730e-14 -3.739788e-14  1.245570e-13 -4.070546e-14 -1.022150e-14
## PC8   1.431752e-14  1.061402e-14 -4.181777e-14  1.565470e-14  2.137801e-15
## PC9  -1.213220e-16 -6.491116e-16 -2.580255e-14 -1.473236e-14  4.509428e-15
## PC10 -7.117623e-15  8.663435e-15  1.731390e-14  2.207495e-14 -2.683621e-14
## PC11  3.625217e-14  4.809146e-14 -1.133022e-13 -3.553305e-15  1.511019e-14
## PC12  6.065806e-15  9.105163e-15  1.761113e-14  1.023459e-14 -1.015901e-14
## PC13 -2.182891e-14 -1.192969e-14  3.421046e-14 -2.591971e-14  4.176114e-15
## PC14  1.757438e-15  2.852709e-14  4.413648e-14  6.809333e-14 -5.853484e-14
## PC15  7.638711e-15  7.684196e-15 -3.077543e-14  3.520211e-14 -2.843138e-14
## PC16 -7.201616e-14 -7.962515e-14  1.569345e-13 -7.806387e-14  4.214160e-16
## PC17  3.658320e-15 -1.632218e-15 -3.266473e-14  6.555205e-15  2.479811e-15
## PC18  3.528371e-14 -2.740523e-14  1.592442e-14  3.866650e-15 -4.059158e-15
## PC19  2.973633e-13  4.589571e-13  1.337869e-13 -2.264357e-14  1.977128e-14
##                PC6           PC7           PC8           PC9          PC10
## PC1   9.162174e-14 -4.646730e-14  1.431752e-14 -1.213220e-16 -7.117623e-15
## PC2   1.021239e-13 -3.739788e-14  1.061402e-14 -6.491116e-16  8.663435e-15
## PC3  -2.171375e-13  1.245570e-13 -4.181777e-14 -2.580255e-14  1.731390e-14
## PC4   1.184929e-13 -4.070546e-14  1.565470e-14 -1.473236e-14  2.207495e-14
## PC5  -5.188619e-15 -1.022150e-14  2.137801e-15  4.509428e-15 -2.683621e-14
## PC6   1.245750e+00 -1.240726e-14  7.115900e-15  1.795990e-14 -3.021673e-14
## PC7  -1.240726e-14  1.190440e+00 -5.032023e-15 -1.633157e-14  2.090458e-14
## PC8   7.115900e-15 -5.032023e-15  9.979596e-01  4.949588e-15 -2.561490e-15
## PC9   1.795990e-14 -1.633157e-14  4.949588e-15  9.554649e-01  1.000291e-15
```

```
## PC10 -3.021673e-14  2.090458e-14 -2.561490e-15  1.000291e-15  8.838117e-01
## PC11  7.133666e-14 -2.677380e-14  7.807942e-15 -3.615196e-15  1.534082e-14
## PC12 -2.463626e-14  1.316627e-14 -2.741318e-15  2.938867e-15 -4.826887e-15
## PC13  7.839294e-15 -1.632065e-15  1.388694e-16 -1.803998e-14  6.305730e-15
## PC14 -1.139375e-13  4.017528e-14 -7.958831e-15  2.013698e-14 -5.797921e-14
## PC15 -4.219406e-14  1.717126e-14 -1.411003e-15  7.001334e-15 -2.168398e-14
## PC16 -2.265315e-14  1.887494e-14  1.739916e-15 -1.212965e-14  2.794106e-14
## PC17 -1.364209e-14 -7.061573e-15  1.192970e-15  3.732628e-15 -8.935635e-15
## PC18 -1.924351e-15  4.077846e-15  1.552912e-15 -1.103595e-15 -1.814274e-15
## PC19  4.019024e-14  1.280380e-14 -9.272705e-15 -1.545629e-14  1.588837e-14
##               PC11          PC12          PC13          PC14          PC15
## PC1   3.625217e-14  6.065806e-15 -2.182891e-14  1.757438e-15  7.638711e-15
## PC2   4.809146e-14  9.105163e-15 -1.192969e-14  2.852709e-14  7.684196e-15
## PC3  -1.133022e-13  1.761113e-14  3.421046e-14  4.413648e-14 -3.077543e-14
## PC4  -3.553305e-15  1.023459e-14 -2.591971e-14  6.809333e-14  3.520211e-14
## PC5   1.511019e-14 -1.015901e-14  4.176114e-15 -5.853484e-14 -2.843138e-14
## PC6   7.133666e-14 -2.463626e-14  7.839294e-15 -1.139375e-13 -4.219406e-14
## PC7  -2.677380e-14  1.316627e-14 -1.632065e-15  4.017528e-14  1.717126e-14
## PC8   7.807942e-15 -2.741318e-15  1.388694e-16 -7.958831e-15 -1.411003e-15
## PC9  -3.615196e-15  2.938867e-15 -1.803998e-14  2.013698e-14  7.001334e-15
## PC10  1.534082e-14 -4.826887e-15  6.305730e-15 -5.797921e-14 -2.168398e-14
## PC11  8.178357e-01  7.760965e-15 -2.040624e-14  6.262640e-14  2.987889e-14
## PC12  7.760965e-15  7.138670e-01  1.668327e-14 -2.347934e-14 -9.699867e-15
## PC13 -2.040624e-14  1.668327e-14  6.223176e-01  3.141854e-14  1.080661e-14
## PC14  6.262640e-14 -2.347934e-14  3.141854e-14  5.130635e-01 -8.328942e-14
## PC15  2.987889e-14 -9.699867e-15  1.080661e-14 -8.328942e-14  4.481826e-01
## PC16 -5.675516e-14  1.280971e-14 -5.124871e-15  7.344752e-14  3.299900e-14
## PC17  2.943543e-15 -2.997106e-15  1.601744e-16 -1.256105e-14 -1.175552e-15
## PC18  3.989729e-15  4.568080e-15  1.755571e-15 -3.518004e-15 -4.588813e-15
## PC19 -8.189745e-15  1.550402e-14 -6.644674e-15  3.904692e-14  1.311406e-14
##               PC16          PC17          PC18          PC19
## PC1  -7.201616e-14  3.658320e-15  3.528371e-14  2.973633e-13
## PC2  -7.962515e-14 -1.632218e-15 -2.740523e-14  4.589571e-13
## PC3   1.569345e-13 -3.266473e-14  1.592442e-14  1.337869e-13
## PC4  -7.806387e-14  6.555205e-15  3.866650e-15 -2.264357e-14
## PC5   4.214160e-16  2.479811e-15 -4.059158e-15  1.977128e-14
## PC6  -2.265315e-14 -1.364209e-14 -1.924351e-15  4.019024e-14
## PC7   1.887494e-14 -7.061573e-15  4.077846e-15  1.280380e-14
## PC8   1.739916e-15  1.192970e-15  1.552912e-15 -9.272705e-15
## PC9  -1.212965e-14  3.732628e-15 -1.103595e-15 -1.545629e-14
## PC10  2.794106e-14 -8.935635e-15 -1.814274e-15  1.588837e-14
## PC11 -5.675516e-14  2.943543e-15  3.989729e-15 -8.189745e-15
## PC12  1.280971e-14 -2.997106e-15  4.568080e-15  1.550402e-14
## PC13 -5.124871e-15  1.601744e-16  1.755571e-15 -6.644674e-15
## PC14  7.344752e-14 -1.256105e-14 -3.518004e-15  3.904692e-14
## PC15  3.299900e-14 -1.175552e-15 -4.588813e-15  1.311406e-14
## PC16  2.161815e-01  1.699681e-15 -1.189542e-14 -3.634751e-14
## PC17  1.699681e-15  1.512217e-01 -6.780628e-16  1.165085e-15
## PC18 -1.189542e-14 -6.780628e-16  1.115972e-01 -1.454865e-15
## PC19 -3.634751e-14  1.165085e-15 -1.454865e-15  1.394196e-25
```

```
dataset_pca$rotation[,1]
##        Store         Dept    IsHoliday       Type_A       Type_B       Typ
e_C
##  0.101338347 -0.004080003  0.012198689 -0.269997489  0.146653872  0.210717
990
##         Size  Temperature   Fuel_Price    MarkDown1    MarkDown2    MarkDo
wn3
## -0.300383406  0.019910709 -0.275443967 -0.453413949 -0.141257544 -0.009497
715
##    MarkDown4    MarkDown5          CPI Unemployment         Year        Mo
nth
## -0.390865591 -0.335044476 -0.056574087  0.171545851 -0.389065387  0.077922
298
##          Day
##  0.059412275
dataset_pca$rotation
##                      PC1          PC2          PC3          PC4
PC5
## Store         0.101338347  0.091916309 -0.513516476  0.251997574 -0.001935
214
## Dept         -0.004080003 -0.007831044 -0.046139485  0.018866256  0.009505
749
## IsHoliday     0.012198689 -0.042117612  0.122765651  0.430598905  0.456416
377
## Type_A       -0.269997489 -0.528338823 -0.185112881 -0.009266895 -0.013346
619
## Type_B        0.146653872  0.403632005  0.488509836 -0.004351486 -0.076292
464
## Type_C        0.210717990  0.223741121 -0.482751803  0.022405038  0.145479
166
## Size         -0.300383406 -0.464123852  0.028723361  0.048095997 -0.091823
360
## Temperature   0.019910709  0.010812768 -0.218666013 -0.510512052  0.200853
851
## Fuel_Price   -0.275443967  0.294661098 -0.203742513 -0.123886920  0.121192
144
## MarkDown1    -0.453413949  0.200206338  0.005221163  0.109824771 -0.089168
444
## MarkDown2    -0.141257544  0.020994379  0.103183191  0.347793218  0.162072
576
## MarkDown3    -0.009497715 -0.034055919  0.081007342  0.226594899  0.487643
095
## MarkDown4    -0.390865591  0.174396291  0.014503077  0.150090049 -0.149722
791
## MarkDown5    -0.335044476  0.096936758 -0.035119875  0.004296702  0.144248
500
## CPI          -0.056574087 -0.083696668  0.141163027 -0.416193607  0.252065
716
## Unemployment  0.171545851  0.020992482 -0.259550101  0.252639451 -0.190136
441
```

```
## Year         -0.389065387  0.314135135 -0.130186448 -0.141176642  0.137111
788
## Month         0.077922298 -0.079345988  0.005109959 -0.088709204  0.432577
095
## Day           0.059412275 -0.036413098  0.006627105 -0.008888773  0.283046
556
##                        PC6           PC7           PC8           PC9
PC10
## Store         0.061086191 -0.078145177  0.0299040623  0.073793008 -0.14095
1607
## Dept          0.018072337 -0.010273283 -0.9977935984 -0.032181832  0.00598
4284
## IsHoliday     0.107760643  0.006727446  0.0129311781  0.034867960  0.03256
3692
## Type_A       -0.050710292 -0.041302498  0.0119666806  0.030914991 -0.01245
3237
## Type_B       -0.139582813  0.142378737 -0.0274509310 -0.033940176 -0.02187
7852
## Type_C        0.309772095 -0.161681024  0.0245323503  0.003596134  0.05602
4880
## Size         -0.185567211  0.086119471  0.0010860492 -0.006638435 -0.00888
8054
## Temperature  -0.002198471  0.359324120  0.0088510932 -0.219426059  0.19543
1729
## Fuel_Price   -0.482204934 -0.022570393 -0.0025723236  0.076513162 -0.15681
7692
## MarkDown1     0.222747819  0.188452025  0.0049684296 -0.061031613  0.23718
4486
## MarkDown2     0.073828460 -0.247589409  0.0268547341 -0.612315382 -0.22674
0528
## MarkDown3    -0.098476660  0.133442483 -0.0149225410  0.553249762  0.24959
6232
## MarkDown4     0.322676103  0.224784551  0.0044506178 -0.014085200  0.33379
8845
## MarkDown5     0.089877318  0.089284428  0.0055416453 -0.063043394 -0.24364
1828
## CPI           0.451357854 -0.274497724  0.0092080205 -0.012353740  0.15627
4240
## Unemployment -0.161452270  0.391750111  0.0237151179 -0.217639424  0.29233
2377
## Year         -0.216978460 -0.214598559  0.0006121195  0.080368012 -0.08316
2286
## Month         0.046100158  0.535683306 -0.0014352308 -0.217696184 -0.36495
7414
## Day          -0.378676557 -0.271360815  0.0096460435 -0.381907173  0.56715
1486
##                       PC11          PC12          PC13          PC14
PC15
## Store         0.285937561 -0.098966639  0.035443355 -0.6654692527 -2.86107
6e-01
```

```
## Dept         -0.008419339  0.006238431  0.006405709 -0.0100002378  9.29936
9e-06
## IsHoliday    -0.350527166 -0.228194058  0.608349231  0.0556684274 -1.62377
3e-01
## Type_A       -0.040459037 -0.042276585  0.007406043  0.0035649783  1.08294
1e-02
## Type_B        0.051967567  0.046704622  0.048087260 -0.2557266645 -1.17887
1e-01
## Type_C       -0.016911522 -0.005388315 -0.090026625  0.4075224935  1.72627
6e-01
## Size         -0.014953982  0.008268893  0.016888929 -0.1196165401 -2.45382
7e-03
## Temperature  -0.290872963  0.011021819 -0.066663694 -0.0049459406 -5.87144
3e-01
## Fuel_Price   -0.224696355 -0.124326140  0.027088672 -0.0677477967  2.14724
5e-01
## MarkDown1     0.071395327 -0.148722198 -0.054028221 -0.0292195316  3.92548
5e-02
## MarkDown2    -0.264198371  0.143078463 -0.467690896 -0.0664937901 -1.02666
9e-01
## MarkDown3     0.002401877  0.273300215 -0.477165739 -0.0470998594 -4.53831
5e-02
## MarkDown4     0.083847097 -0.241194449 -0.081107535 -0.0008326417  1.81135
9e-02
## MarkDown5     0.408496632  0.641238287  0.314421877  0.2082893346 -1.86527
0e-01
## CPI          -0.126280354  0.212472767  0.122309601 -0.4708447432  3.33685
3e-01
## Unemployment -0.283622099  0.452012463  0.159435076 -0.1608653752  3.69796
8e-01
## Year         -0.146334233 -0.002483245  0.060832279 -0.0365537208  1.12541
7e-01
## Month         0.277924550 -0.269961065 -0.082262970 -0.0517141279  3.82328
6e-01
## Day           0.459901246 -0.097265167  0.083972506  0.0329275677  3.02050
7e-02
##                        PC16          PC17          PC18          PC19
## Store        -0.0201653518  0.0064646965 -0.0080510752 -7.788021e-14
## Dept         -0.0002017792 -0.0005154555  0.0001926768  4.343564e-15
## IsHoliday    -0.0208226765  0.0002087695  0.0156194400  6.273852e-16
## Type_A        0.4125947234 -0.0208444350  0.0374472527 -6.574321e-01
## Type_B       -0.1733601306  0.0108628680 -0.0403525786 -6.408318e-01
## Type_C       -0.4040517639  0.0170102351  0.0031287872 -3.963807e-01
## Size         -0.7802905632  0.0456654150 -0.1224051099  9.108548e-16
## Temperature  -0.0268032451  0.0109099849 -0.0198922461  3.097591e-16
## Fuel_Price   -0.0677427660 -0.4165298231  0.4547674844  3.375827e-16
## MarkDown1    -0.0038527297  0.5679082814  0.4838312343 -4.412066e-16
## MarkDown2     0.0126969980 -0.0605410731  0.0110476373  3.074830e-17
## MarkDown3     0.0133030849  0.0070851851  0.0066958749 -1.055134e-16
## MarkDown4     0.0319323891 -0.5663149078 -0.3339511006  2.342835e-16
```

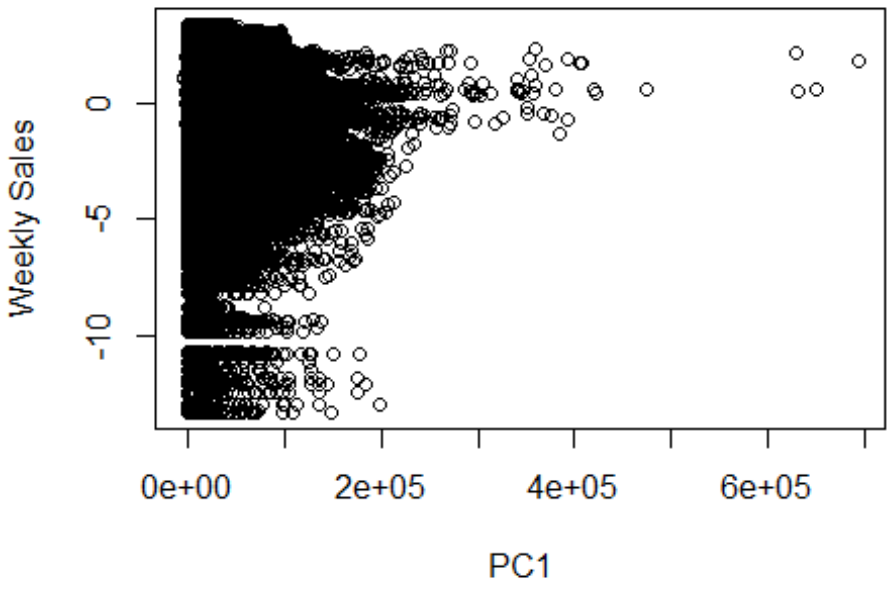
```
## MarkDown5     0.0018146579 -0.1332996200  0.0632993671 -3.597752e-17
## CPI          -0.0591193049 -0.0919004682  0.0913705932 -2.443829e-16
## Unemployment  0.0837632981  0.0505364259 -0.0865456794 -1.651853e-16
## Year          0.0917821075  0.3792262438 -0.6296045956  7.958731e-16
## Month         0.0329757944  0.0609653457 -0.1113671062  5.321175e-16
## Day           0.0073597391 -0.0130023773  0.0050564269 -8.880060e-16
#plot(select(dataset,features))
center <- dataset_pca$center
scale <- dataset_pca$scale
new_dataset <- as.matrix(select(dataset,features))
new_dataset
##           Store Dept IsHoliday Type_A Type_B Type_C   Size
Temperature
##      [1,]     1    1         0      1      0      0 151315
42.31
##      [2,]     1    1         1      1      0      0 151315
38.51
##      [3,]     1    1         0      1      0      0 151315
39.93
##      [4,]     1    1         0      1      0      0 151315
46.63
##      [5,]     1    1         0      1      0      0 151315
46.50
##      [6,]     1    1         0      1      0      0 151315
57.79
##      [7,]     1    1         0      1      0      0 151315
54.58
##      [8,]     1    1         0      1      0      0 151315
51.45
##      [9,]     1    1         0      1      0      0 151315
62.27
##     [10,]     1    1         0      1      0      0 151315
65.86
##     [11,]     1    1         0      1      0      0 151315
66.32
##     [12,]     1    1         0      1      0      0 151315
64.84
##     [13,]     1    1         0      1      0      0 151315
67.41
##     [14,]     1    1         0      1      0      0 151315
72.55
##     [15,]     1    1         0      1      0      0 151315
74.78
##     [16,]     1    1         0      1      0      0 151315
76.44
##     [17,]     1    1         0      1      0      0 151315
80.44
```

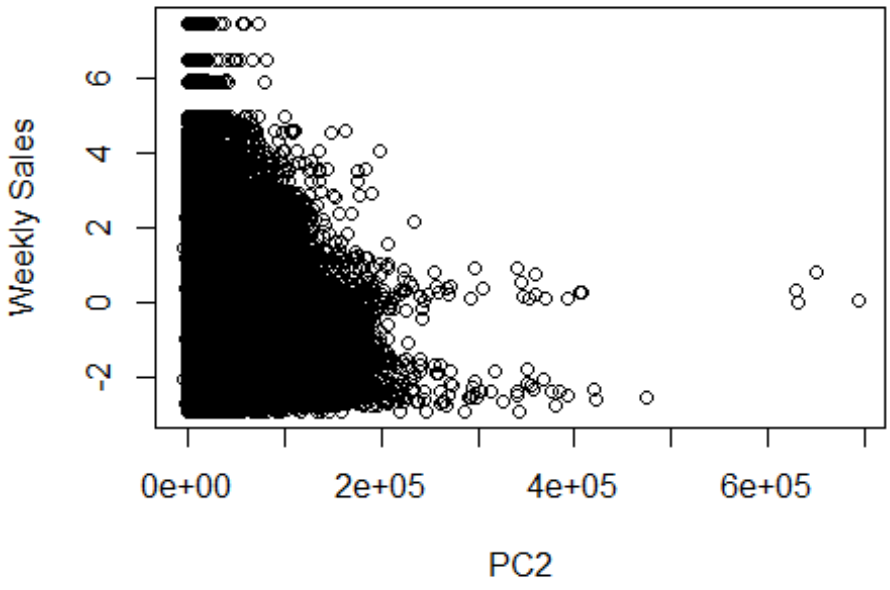
```
##     [18,]     1     1           0       1       0       0 151315
80.69
##     [19,]     1     1           0       1       0       0 151315
80.43
##     [20,]     1     1           0       1       0       0 151315
84.11
##     [21,]     1     1           0       1       0       0 151315
84.34
##     [22,]     1     1           0       1       0       0 151315
80.91
##     [23,]     1     1           0       1       0       0 151315
80.48
##     [24,]     1     1           0       1       0       0 151315
83.15
##     [25,]     1     1           0       1       0       0 151315
83.36
##     [26,]     1     1           0       1       0       0 151315
81.84
##     [27,]     1     1           0       1       0       0 151315
87.16
##     [28,]     1     1           0       1       0       0 151315
87.00
##     [29,]     1     1           0       1       0       0 151315
86.65
##     [30,]     1     1           0       1       0       0 151315
85.22
##     [31,]     1     1           0       1       0       0 151315
81.21
##     [32,]     1     1           1       1       0       0 151315
78.69
##     [33,]     1     1           0       1       0       0 151315
82.11
##     [34,]     1     1           0       1       0       0 151315
80.94
##     [35,]     1     1           0       1       0       0 151315
71.89
##     [36,]     1     1           0       1       0       0 151315
63.93
##     [37,]     1     1           0       1       0       0 151315
67.18
##     [38,]     1     1           0       1       0       0 151315
69.86
##     [39,]     1     1           0       1       0       0 151315
69.64
##     [40,]     1     1           0       1       0       0 151315
58.74
```

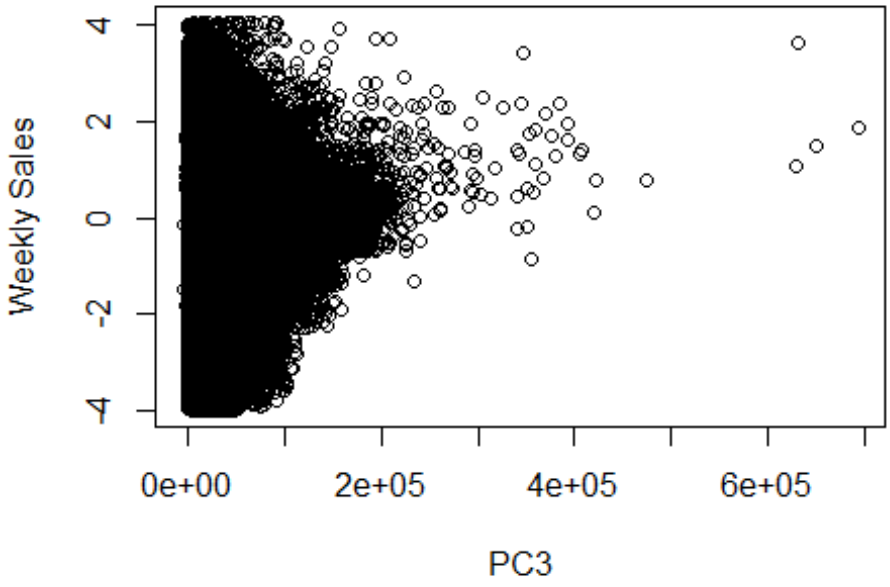
```
##     [41,]     1     1          0       1       0       0 151315
59.61
##     [42,]     1     1          0       1       0       0 151315
51.41
##     [43,]     1     1          1       1       0       0 151315
64.52
##     [44,]     1     1          0       1       0       0 151315
49.27
##     [45,]     1     1          0       1       0       0 151315
46.33
##     [46,]     1     1          0       1       0       0 151315
49.84
##     [47,]     1     1          0       1       0       0 151315
52.33
##     [48,]     1     1          1       1       0       0 151315
48.43
##     [49,]     1     1          0       1       0       0 151315
48.27
##     [50,]     1     1          0       1       0       0 151315
35.40
[ reached getOption("max.print") -- omitted 421518 rows ]
drop(scale(new_dataset,center=center, scale=scale)%*%dataset_pca$rotation[,1]
)
##     [1]  4.762275e-01  5.815413e-01  6.032438e-01  6.297072e-01
4.725706e-01
##     [6]  5.069916e-01  5.194372e-01  5.566463e-01  4.101165e-01
4.311499e-01
##    [11]  4.565230e-01  5.103173e-01  5.696842e-01  4.101833e-01
4.486905e-01
##    [16]  5.144091e-01  6.060818e-01  4.995199e-01  5.685729e-01
6.386813e-01
##    [21]  6.769947e-01  5.298341e-01  5.932666e-01  6.550843e-01
7.116378e-01
##    [26]  7.380897e-01  6.125793e-01  6.206750e-01  6.846803e-01
7.577325e-01
##    [31]  6.398203e-01  7.395695e-01  7.328218e-01  7.537308e-01
6.290861e-01
##    [36]  6.498755e-01  6.485333e-01  6.958640e-01  7.484750e-01
6.139947e-01
[ reached getOption("max.print") -- omitted 420570 entries ]
predict(dataset_pca)[,1]
##     [1]  4.762275e-01  5.815413e-01  6.032438e-01  6.297072e-01
4.725706e-01
##     [6]  5.069916e-01  5.194372e-01  5.566463e-01  4.101165e-01
4.311499e-01
##    [11]  4.565230e-01  5.103173e-01  5.696842e-01  4.101833e-01
```

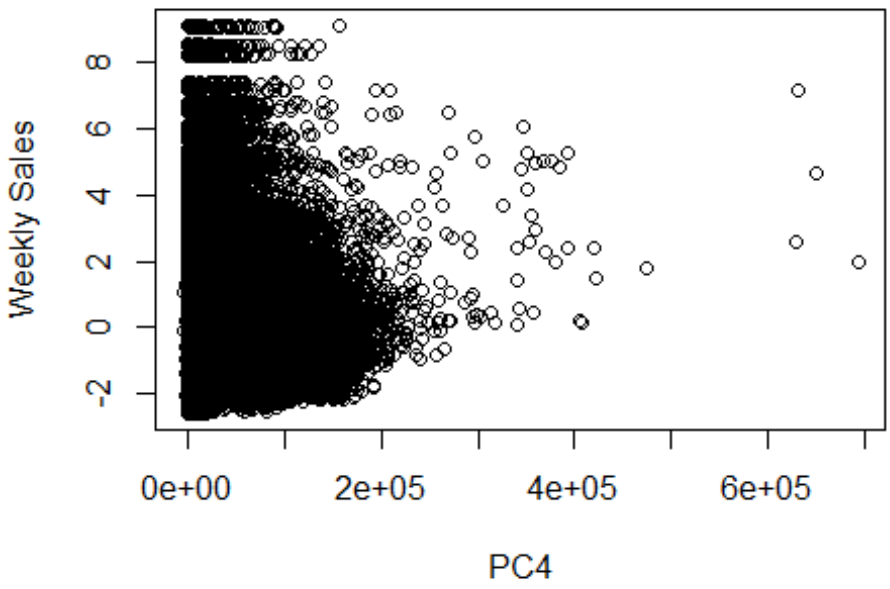
```
4.486905e-01
##    [16]  5.144091e-01  6.060818e-01  4.995199e-01  5.685729e-01
6.386813e-01
##    [21]  6.769947e-01  5.298341e-01  5.932666e-01  6.550843e-01
7.116378e-01
##    [26]  7.380897e-01  6.125793e-01  6.206750e-01  6.846803e-01
7.577325e-01
##    [31]  6.398203e-01  7.395695e-01  7.328218e-01  7.537308e-01
6.290861e-01
##    [36]  6.498755e-01  6.485333e-01  6.958640e-01  7.484750e-01
6.139947e-01
##    [41]  6.389470e-01  6.519410e-01  7.831291e-01  6.033162e-01
5.667590e-01
##    [46]  6.025265e-01  6.425123e-01  6.992698e-01 -2.926828e-01 -
2.633440e-01
##    [51] -2.268668e-01 -1.765128e-01 -3.049825e-01 -2.364790e-01 -
2.282997e-01
##    [56] -1.872402e-01 -4.437075e-01 -5.058350e-01 -4.661798e-01 -
4.022193e-01
##    [61] -5.892467e-01 -5.915931e-01 -6.133832e-01 -6.027058e-01 -
5.582764e-01
##    [66] -7.562775e-01 -6.929001e-01 -6.585080e-01 -5.270865e-01 -
6.076588e-01
[ reached getOption("max.print") -- omitted 420570 entries ]
```

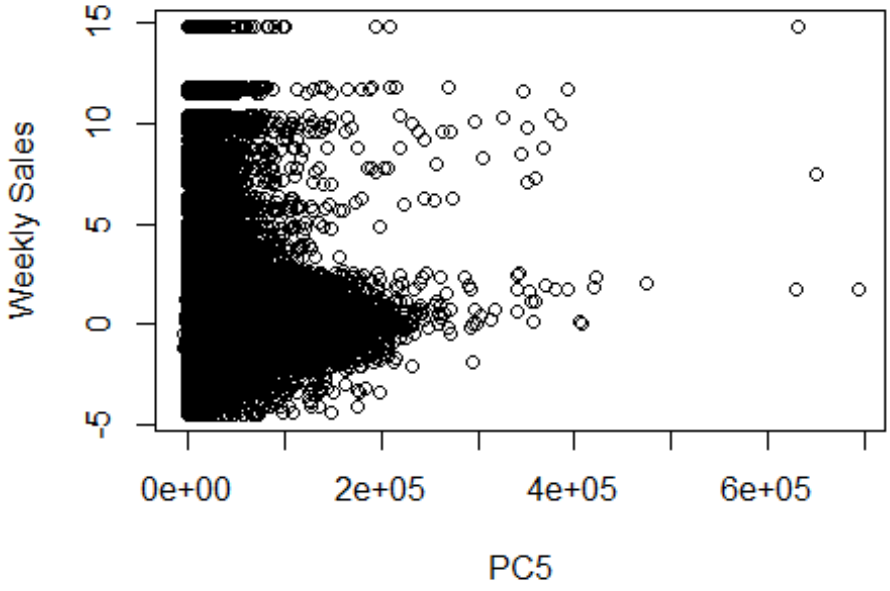
```
out <- sapply(1:13, function(i){plot(dataset$weeklySales,dataset_pca$x[,i],xl
ab=paste("PC",i,sep=""),ylab="Weekly Sales")})
```

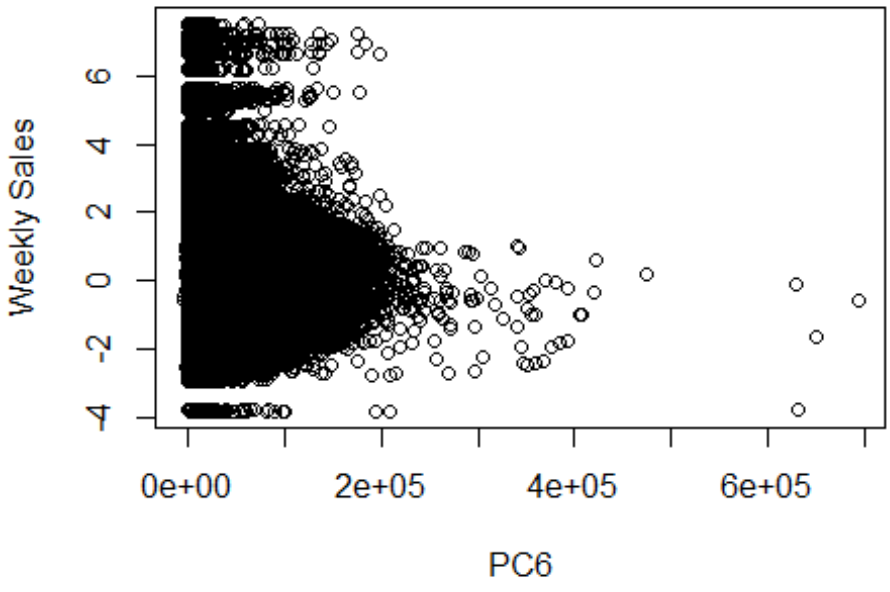

Weekly Sales
0
-5
-10
0e+00
2e+05
4e+05
6e+05
PC1

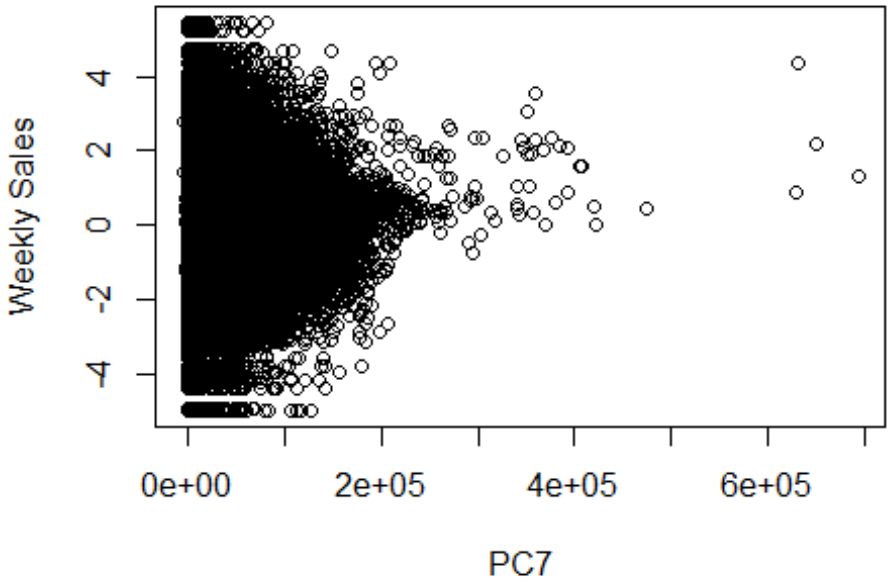

Weekly Sales
6
4
2
0
-2
0e+00
2e+05
4e+05
6e+05
PC2

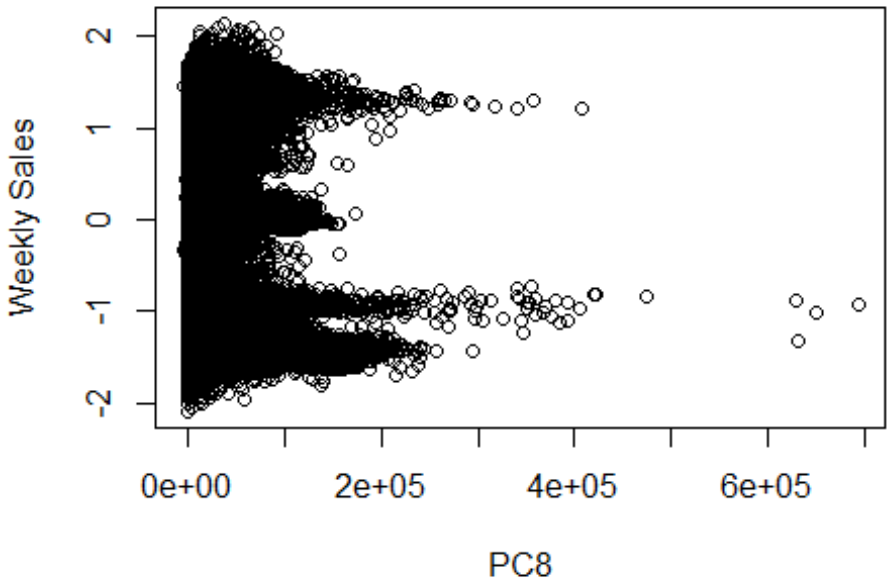

Weekly Sales
4
2
0
-2
-4
0e+00
2e+05
4e+05
6e+05
PC3

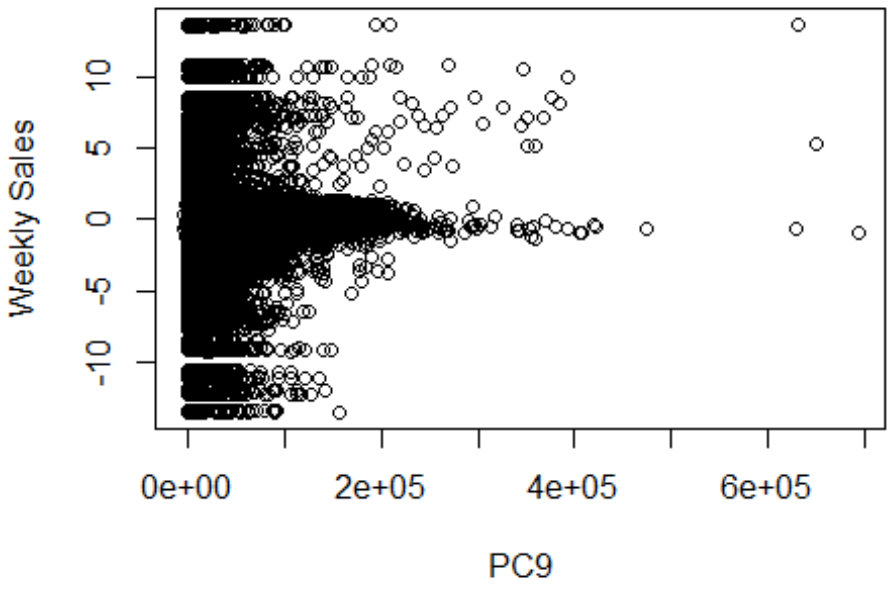

Weekly Sales
8
6
4
2
0
-2
0e+00
2e+05
4e+05
6e+05
PC4

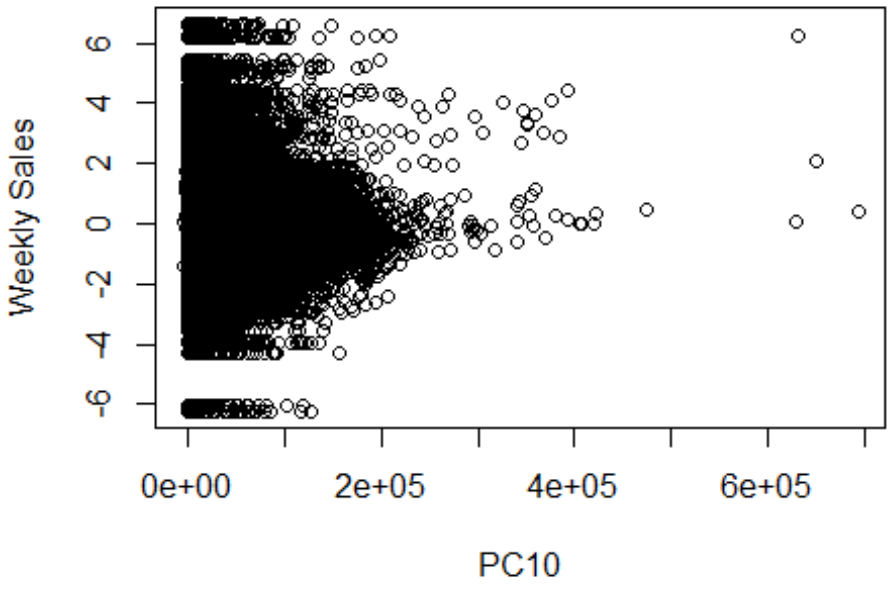

Weekly Sales
15
10
5
0
-5
0e+00
2e+05
4e+05
6e+05
PC5

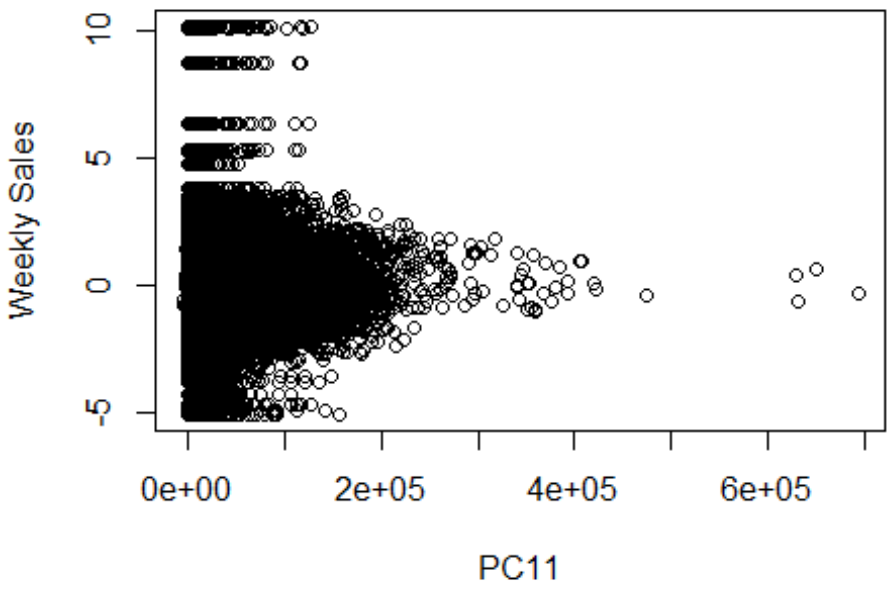

Weekly Sales
6
4
2
0
-2
-4
0e+00
2e+05
4e+05
6e+05
PC6

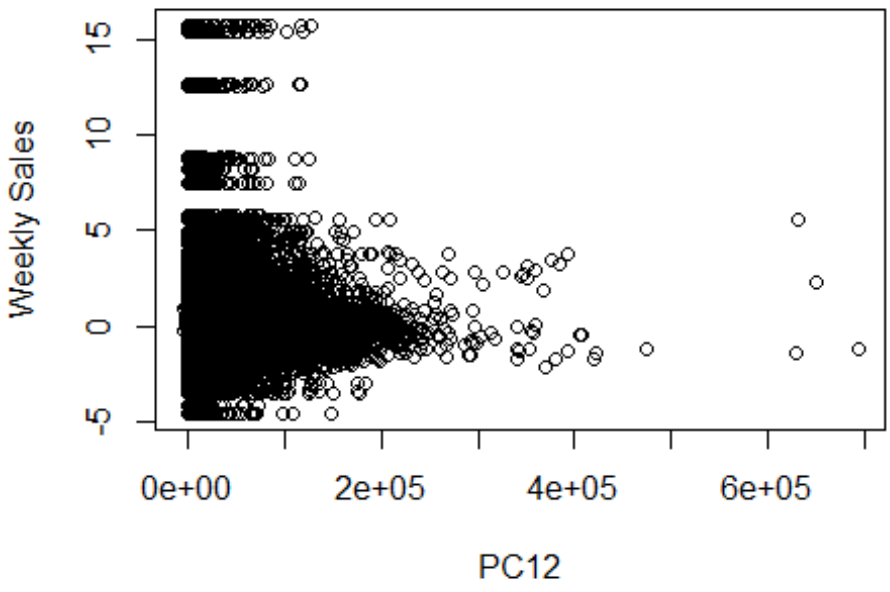

Weekly Sales
4
2
0
-2
-4
0e+00
2e+05
4e+05
6e+05
PC7

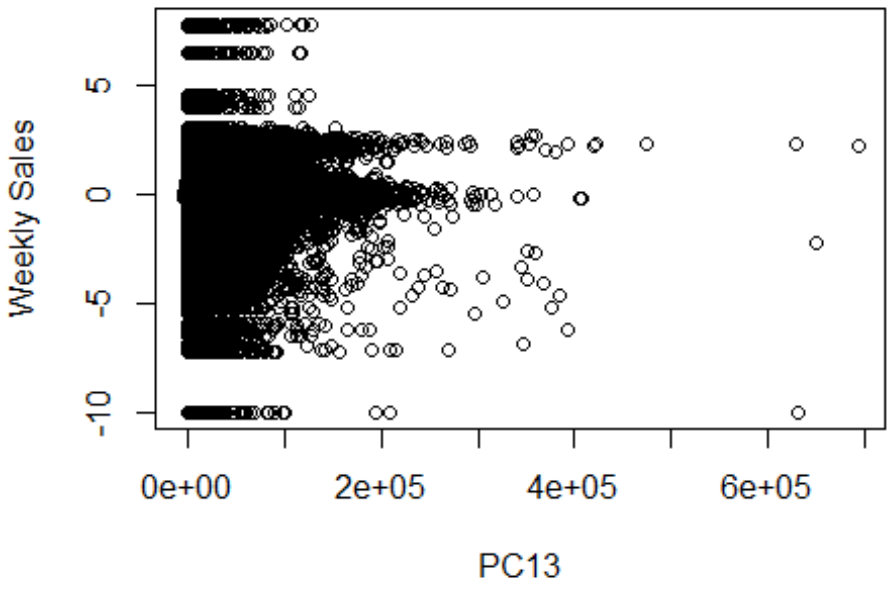

Weekly Sales
2
1
0
-1
-2
0e+00
2e+05
4e+05
6e+05
PC8


Weekly Sales
10
5
0
-5
-10
0e+00
2e+05
4e+05
6e+05
PC9


Weekly Sales
6
4
2
0
-2
-4
-6
0e+00
2e+05
4e+05
6e+05
PC10


Weekly Sales
10
5
0
-5
0e+00
2e+05
4e+05
6e+05
PC11


Weekly Sales
15
10
5
0
-5
0e+00
2e+05
4e+05
6e+05
PC12




```
#pairs(dataset_pca$x[,1:13], ylim = c(-6,4),xlim = c(-6,4),panel=function(x,y
,...){text(x,y,dataset$weeklySales)})
```