Midterm_data_project.R

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```
## I chose Leading Cause of Death to be my dataset
## from which I am trying to find patterns between different causes of deaths and regions
## Since lots of variables inside are of great amount of missing values (equal -1111 or -2222),
## I picked 65+ years old White with cancer(F_Wh_Cancer), 65+ years old White with Heart Disease(F_Wh_H
## 45-64 years old white with Heart Disease(E_Wh_HearDis), 45-64 years old white with Cancer(E_Wh_Cance


LCOD<-read.csv("C:/Users/Yangsu/Desktop/Homework/R/midterm project/chsi_dataset/LEADINGCAUSESOFDEATH.cs
attach(LCOD)
dim(LCOD)
```

```
## [1] 3141  235
```

```
## Build up a new data frame which includes variables I need to use
data<-data.frame(State_FIPS_Code,County_FIPS_Code,CHSI_County_Name,CHSI_State_Name,F_Wh_Cancer,F_Wh_Hea
attach(data)
```

```
## The following objects are masked from LCOD:
##
##     CHSI_County_Name, CHSI_State_Name, County_FIPS_Code,
##     E_Wh_Cancer, E_Wh_HeartDis, F_Wh_Cancer, F_Wh_HeartDis,
##     State_FIPS_Code
```

```
dim(data)
```

```
## [1] 3141    8
```

```
library(plyr)
count(F_Wh_Cancer)
```

```
##        x freq
## 1  -2222    1
## 2  -1111   17
## 3     11    2
## 4     13    1
## 5     14    5
## 6     15   19
## 7     16   36
## 8     17  104
## 9     18  202
## 10    19  373
## 11    20  526
## 12    21  575
## 13    22  531
## 14    23  335
```

```
## 15    24  199
## 16    25  100
## 17    26   31
## 18    27   31
## 19    28   17
## 20    29    7
## 21    30   11
## 22    31    3
## 23    32    3
## 24    33    3
## 25    34    3
## 26    37    3
## 27    39    1
## 28    42    1
## 29    43    1
```

```
## we find 18 missing values for F_Wh_Cancer

count(F_Wh_HeartDis)
```

```
##        x freq
## 1  -2222    1
## 2  -1111   17
## 3     16    1
## 4     17    1
## 5     18    1
## 6     19    4
## 7     21   10
## 8     22    9
## 9     23   13
## 10    24   28
## 11    25   52
## 12    26  100
## 13    27  139
## 14    28  191
## 15    29  238
## 16    30  260
## 17    31  289
## 18    32  293
## 19    33  262
## 20    34  240
## 21    35  224
## 22    36  177
## 23    37  165
## 24    38  116
## 25    39   81
## 26    40   59
## 27    41   43
## 28    42   33
## 29    43   30
## 30    44   13
## 31    45   12
## 32    46   11
## 33    47   10
```

```
## 34    48    4
## 35    49    4
## 36    50    1
## 37    51    1
## 38    52    1
## 39    53    2
## 40    54    1
## 41    55    2
## 42    56    1
## 43    57    1
```

```
## we find 18 missing values for F_Wh_HeartDis

count(E_Wh_HeartDis)
```

```
##         x freq
## 1  -2222    1
## 2  -1111   71
## 3     10    2
## 4     11    1
## 5     12    1
## 6     13    5
## 7     14    7
## 8     15   10
## 9     16   25
## 10    17   41
## 11    18   59
## 12    19   87
## 13    20  145
## 14    21  154
## 15    22  214
## 16    23  243
## 17    24  241
## 18    25  274
## 19    26  244
## 20    27  252
## 21    28  218
## 22    29  212
## 23    30  157
## 24    31  140
## 25    32  102
## 26    33   72
## 27    34   53
## 28    35   33
## 29    36   20
## 30    37   18
## 31    38    6
## 32    39   11
## 33    40    8
## 34    41    3
## 35    42    3
## 36    43    1
## 37    44    5
## 38    48    2
```

```
## we find 72 missing values for E_Wh_HeartDis

count(E_Wh_Cancer)
```

```
##        x freq
## 1  -2222    1
## 2  -1111   70
## 3     14    1
## 4     17    2
## 5     18    2
## 6     19    2
## 7     20    3
## 8     21    9
## 9     22    6
## 10    23   13
## 11    24   16
## 12    25   24
## 13    26   35
## 14    27   46
## 15    28   82
## 16    29  100
## 17    30  155
## 18    31  175
## 19    32  223
## 20    33  229
## 21    34  282
## 22    35  290
## 23    36  278
## 24    37  232
## 25    38  190
## 26    39  179
## 27    40  152
## 28    41   83
## 29    42   84
## 30    43   50
## 31    44   54
## 32    45   33
## 33    46   10
## 34    47    6
## 35    48    7
## 36    49    4
## 37    51    3
## 38    52    4
## 39    53    3
## 40    55    1
## 41    57    1
## 42    66    1
```

```
## we find 71 missing values for E_Wh_Cancer

## all variables above have quite low percentage of missing values so I assume they should work fine.
```

```r
## delete missing values, codes below credits to JiaYuan.Shi
delete1=which(F_Wh_Cancer=="-1111"|F_Wh_Cancer=="-2222"|F_Wh_HeartDis=="-1111"|
                F_Wh_HeartDis=="-2222"|E_Wh_Cancer=="-1111"|E_Wh_Cancer=="-2222"|
                E_Wh_HeartDis=="-1111"|E_Wh_HeartDis=="-2222")
data=data[-c(delete1),]
dim(data)
```

```
## [1] 3068    8
```

```r
attach(data)
```

```
## The following objects are masked from data (pos = 4):
##
##     CHSI_County_Name, CHSI_State_Name, County_FIPS_Code,
##     E_Wh_Cancer, E_Wh_HeartDis, F_Wh_Cancer, F_Wh_HeartDis,
##     State_FIPS_Code
##
## The following objects are masked from LCOD:
##
##     CHSI_County_Name, CHSI_State_Name, County_FIPS_Code,
##     E_Wh_Cancer, E_Wh_HeartDis, F_Wh_Cancer, F_Wh_HeartDis,
##     State_FIPS_Code
```

```r
count(F_Wh_Cancer)
```

```
##     x freq
## 1  11    1
## 2  13    1
## 3  14    4
## 4  15   16
## 5  16   35
## 6  17  102
## 7  18  200
## 8  19  371
## 9  20  523
## 10 21  572
## 11 22  526
## 12 23  333
## 13 24  198
## 14 25   98
## 15 26   27
## 16 27   29
## 17 28   12
## 18 29    5
## 19 30    8
## 20 31    2
## 21 32    2
## 22 34    2
## 23 39    1
```

```
count(F_Wh_HeartDis)
```

```
##     x freq
## 1  16    1
## 2  17    1
## 3  18    1
## 4  19    2
## 5  21    9
## 6  22    8
## 7  23   13
## 8  24   27
## 9  25   49
## 10 26   98
## 11 27  136
## 12 28  188
## 13 29  238
## 14 30  258
## 15 31  284
## 16 32  285
## 17 33  257
## 18 34  236
## 19 35  220
## 20 36  177
## 21 37  164
## 22 38  115
## 23 39   80
## 24 40   59
## 25 41   42
## 26 42   33
## 27 43   28
## 28 44   13
## 29 45   11
## 30 46    9
## 31 47    9
## 32 48    4
## 33 49    4
## 34 50    1
## 35 51    1
## 36 52    1
## 37 53    2
## 38 55    2
## 39 56    1
## 40 57    1
```

```
count(E_Wh_Cancer)
```

```
##     x freq
## 1  14    1
## 2  17    2
## 3  18    2
## 4  19    2
## 5  20    3
## 6  21    9
```

```
## 7  22    6
## 8  23   13
## 9  24   16
## 10 25   24
## 11 26   35
## 12 27   46
## 13 28   82
## 14 29  100
## 15 30  155
## 16 31  175
## 17 32  223
## 18 33  229
## 19 34  282
## 20 35  290
## 21 36  278
## 22 37  232
## 23 38  190
## 24 39  179
## 25 40  152
## 26 41   83
## 27 42   84
## 28 43   50
## 29 44   54
## 30 45   32
## 31 46   10
## 32 47    6
## 33 48    7
## 34 49    4
## 35 51    2
## 36 52    4
## 37 53    3
## 38 55    1
## 39 57    1
## 40 66    1
```

```
count(E_Wh_HeartDis)
```

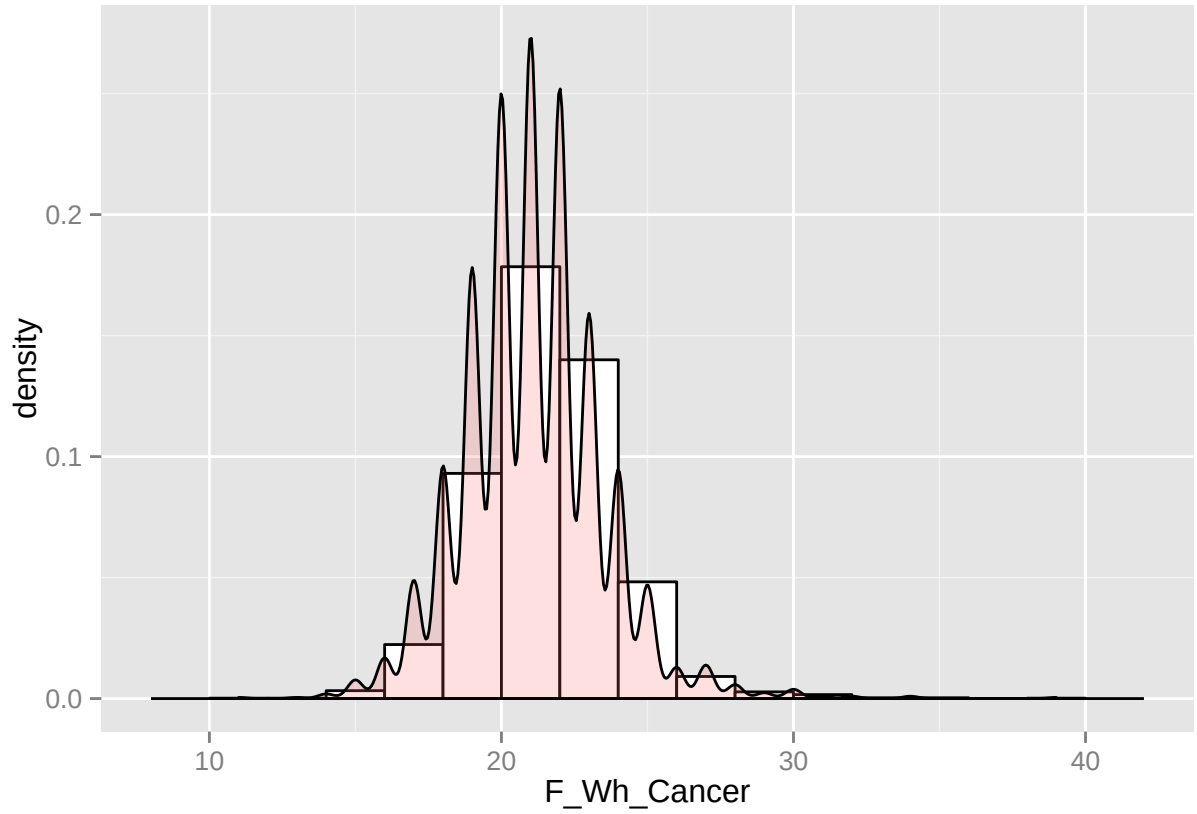
```
##     x freq
## 1  10    2
## 2  11    1
## 3  12    1
## 4  13    5
## 5  14    7
## 6  15   10
## 7  16   25
## 8  17   41
## 9  18   59
## 10 19   87
## 11 20  145
## 12 21  154
## 13 22  214
## 14 23  243
## 15 24  241
## 16 25  274
```

```
## 17 26  244
## 18 27  252
## 19 28  218
## 20 29  212
## 21 30  157
## 22 31  140
## 23 32  102
## 24 33   72
## 25 34   53
## 26 35   33
## 27 36   20
## 28 37   18
## 29 38    6
## 30 39   11
## 31 40    8
## 32 41    3
## 33 42    3
## 34 43    1
## 35 44    5
## 36 48    1
```

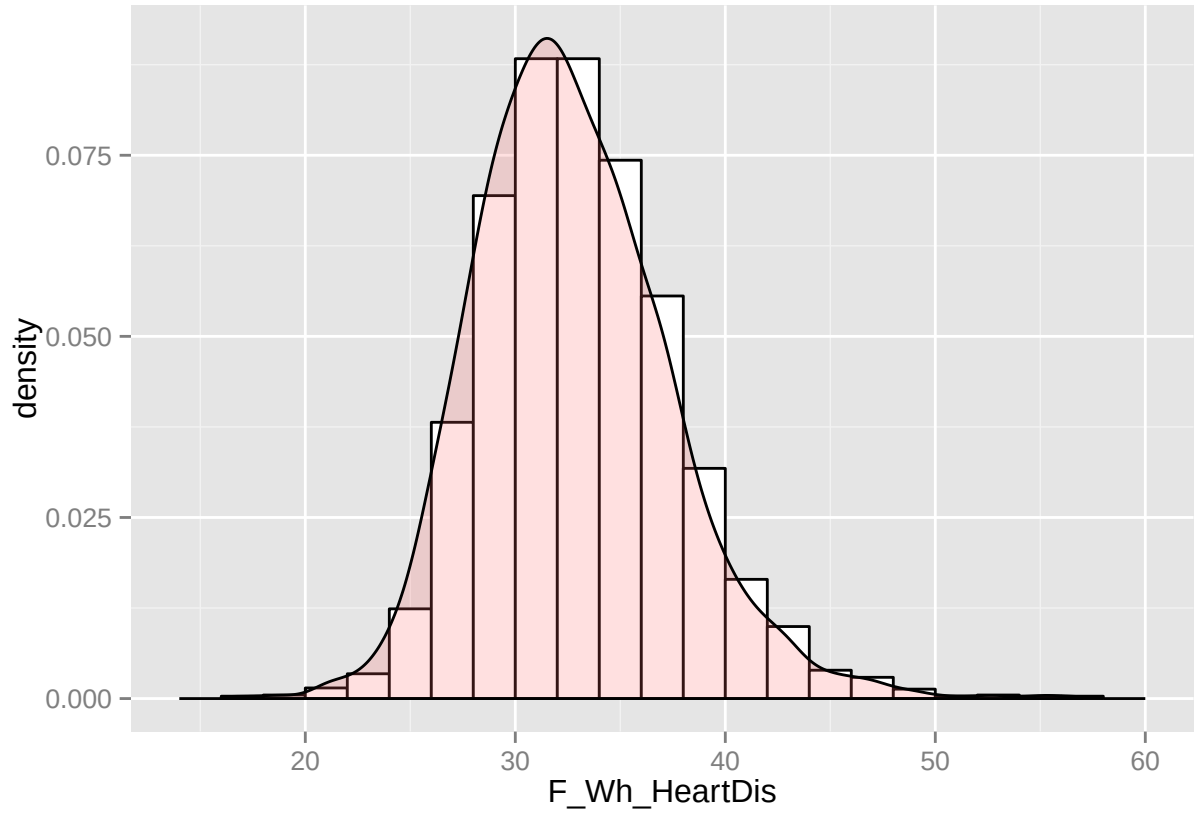
```
## so far we have no more extreme and missing values, so we can start do the analysis.

summary(data)
```

```
##  State_FIPS_Code County_FIPS_Code   CHSI_County_Name CHSI_State_Name
##  Min.   : 1.00   Min.   :  1.0    Washington:  32    Texas   : 245
##  1st Qu.:19.00   1st Qu.: 35.0    Jefferson :  26    Georgia : 157
##  Median :29.00   Median : 79.0    Franklin  :  25    Virginia: 134
##  Mean   :30.34   Mean   :103.7    Jackson   :  24    Kentucky: 120
##  3rd Qu.:45.00   3rd Qu.:133.0    Lincoln   :  24    Missouri: 115
##  Max.   :56.00   Max.   :840.0    Madison   :  20    Kansas  : 103
##                                   (Other)   :2917    (Other) :2194
##   F_Wh_Cancer    F_Wh_HeartDis   E_Wh_HeartDis    E_Wh_Cancer
##  Min.   :11.00   Min.   :16.00   Min.   :10.00   Min.   :14.00
##  1st Qu.:20.00   1st Qu.:29.00   1st Qu.:23.00   1st Qu.:32.00
##  Median :21.00   Median :32.00   Median :26.00   Median :35.00
##  Mean   :21.06   Mean   :32.68   Mean   :25.82   Mean   :34.98
##  3rd Qu.:22.00   3rd Qu.:35.00   3rd Qu.:29.00   3rd Qu.:38.00
##  Max.   :39.00   Max.   :57.00   Max.   :48.00   Max.   :66.00
##
```

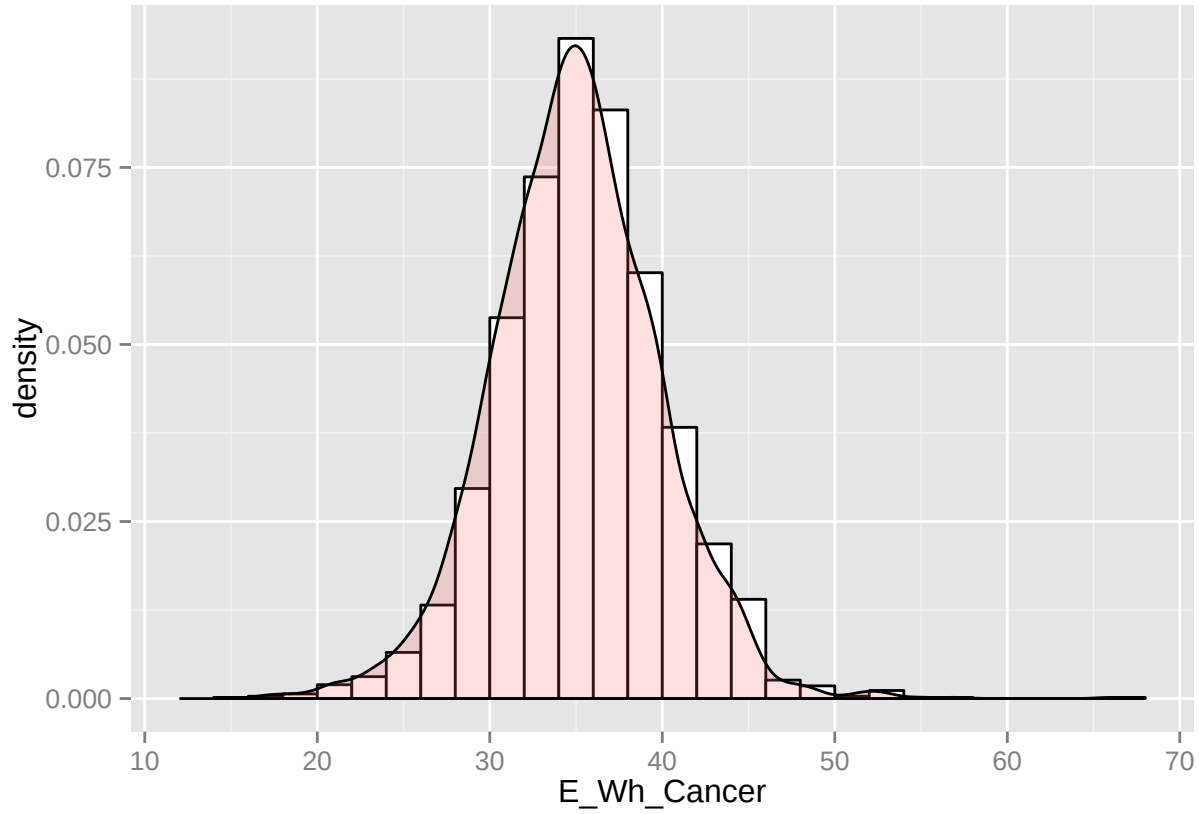
```
# mean value for F_Wh_Cancer is 21.04
# mean value for F_Wh_HeartDis is 32.7
# mean value for E_Wh_HeartDis is 25.83
# mean value for E_Wh_Cancer is 35.02

library(ggplot2)
ggplot(data,aes(x=F_Wh_Cancer))+geom_histogram(aes(y=..density..),binwidth=2,colour="black",fill="white
  geom_density(alpha=.2,fill="#FF6666")
```



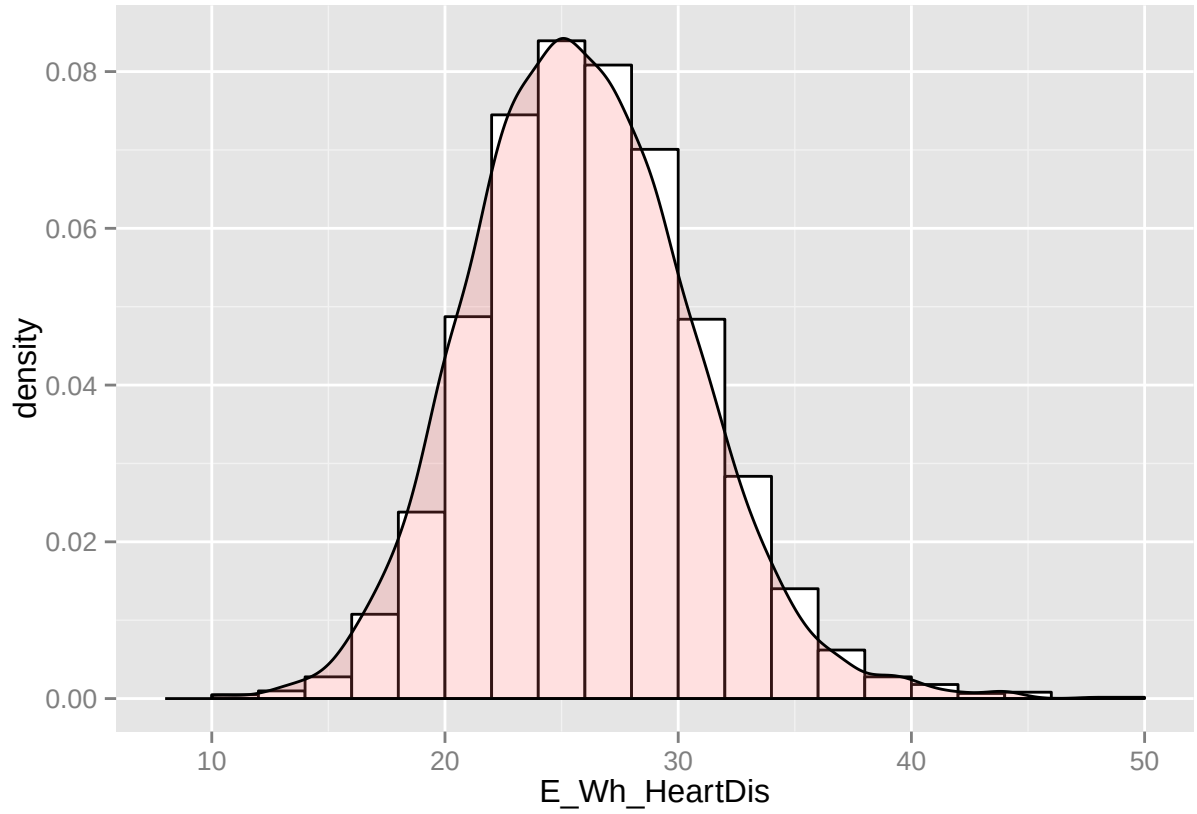

```
ggplot(data,aes(x=F_Wh_HeartDis))+geom_histogram(aes(y=..density..),binwidth=2,colour="black",fill="whi
  geom_density(alpha=.2,fill="#FF6666")
```



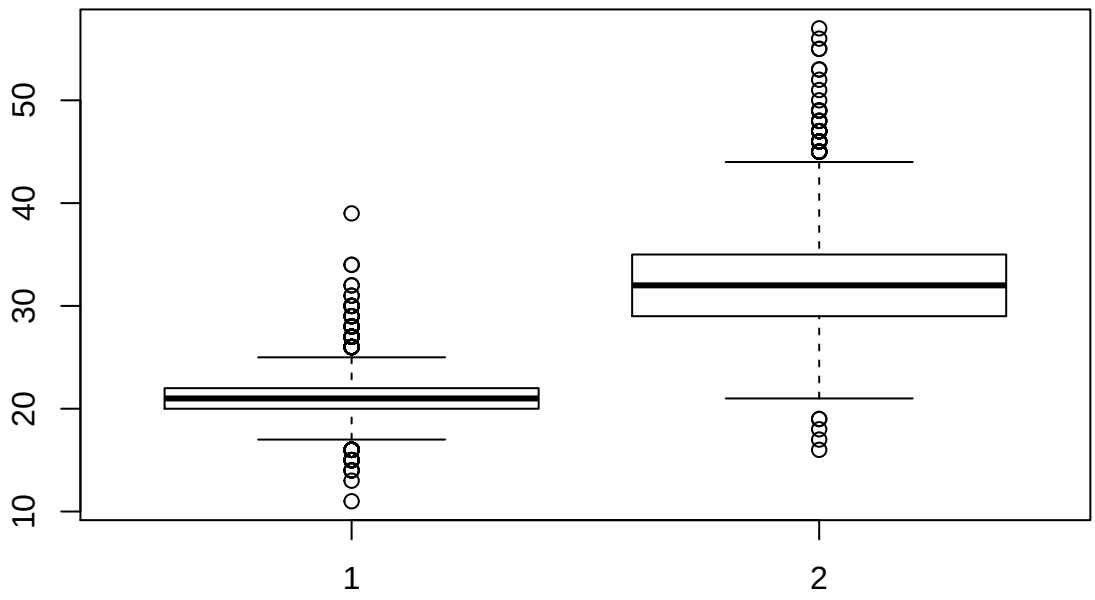

```
ggplot(data,aes(x=E_Wh_Cancer))+geom_histogram(aes(y=..density..),binwidth=2,colour="black",fill="white
  geom_density(alpha=.2,fill="#FF6666")
```




```
ggplot(data,aes(x=E_Wh_HeartDis))+geom_histogram(aes(y=..density..),binwidth=2,colour="black",fill="whi
  geom_density(alpha=.2,fill="#FF6666")
```



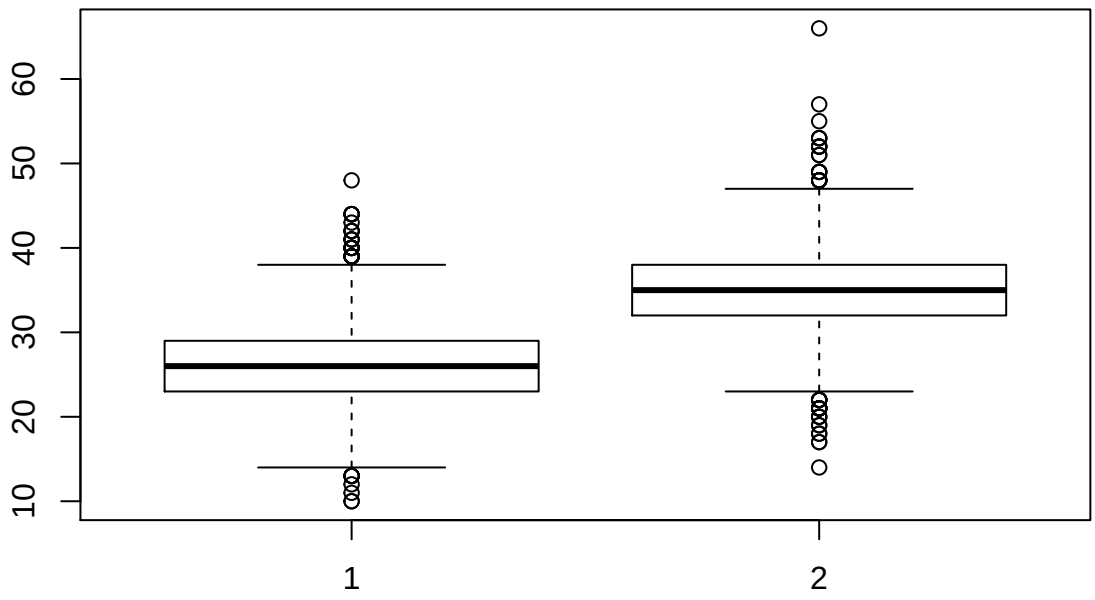

```
boxplot(F_Wh_Cancer,F_Wh_HeartDis)
```




```
t.test(F_Wh_Cancer,F_Wh_HeartDis,alternative="two.sided")
```

```
##
##  Welch Two Sample t-test
##
## data:  F_Wh_Cancer and F_Wh_HeartDis
## t = -123.83, df = 4534.8, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -11.80392 -11.43598
## sample estimates:
## mean of x mean of y
##  21.05834  32.67829
```

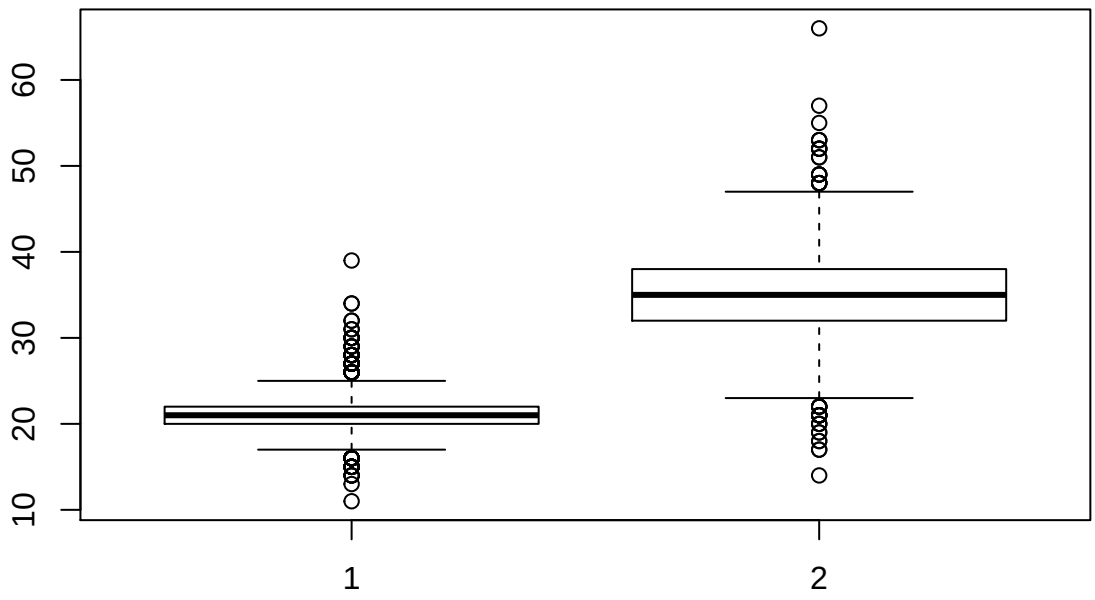
```
# Those above 65 years old die of Heart disease significantly more than Cancer

boxplot(E_Wh_HeartDis,E_Wh_Cancer)
```




```
t.test(E_Wh_Cancer,E_Wh_HeartDis,alternative="two.sided")
```

```
##
##  Welch Two Sample t-test
##
## data:  E_Wh_Cancer and E_Wh_HeartDis
## t = 75.329, df = 6131.5, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  8.929595 9.406781
## sample estimates:
## mean of x mean of y
##  34.98403  25.81584
```

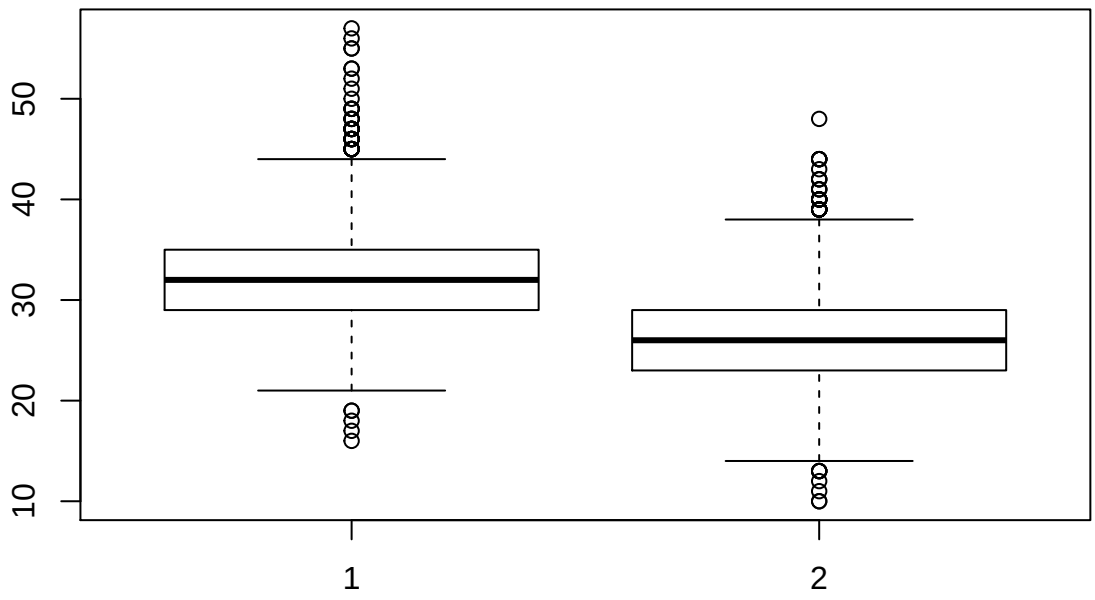
```
# Those 45-64 years old die of Cancer significantly more than Heart disease

boxplot(F_Wh_Cancer,E_Wh_Cancer)
```




```
t.test(F_Wh_Cancer,E_Wh_Cancer,alternative="two.sided")
```

```
##
##  Welch Two Sample t-test
##
## data:  F_Wh_Cancer and E_Wh_Cancer
## t = -144.06, df = 4441.7, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -14.11520 -13.73617
## sample estimates:
## mean of x mean of y
##  21.05834  34.98403
```

```
# Those who die of cancer by 45-64 years old are significantly more than above 65 years old

boxplot(F_Wh_HeartDis,E_Wh_HeartDis)
```




```
t.test(F_Wh_HeartDis,E_Wh_HeartDis,alternative="two.sided")
```

```
##
##  Welch Two Sample t-test
##
## data:  F_Wh_HeartDis and E_Wh_HeartDis
## t = 57.438, df = 6132.3, p-value < 2.2e-16
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  6.628235 7.096667
## sample estimates:
## mean of x mean of y
##  32.67829  25.81584
```

```
# Those who die of Heart Disease at the age above 65 years old are significantly more than 45-64 years
```

```
## compare Worcester data with other counties in US

wor<-data[data$CHSI_County_Name=="Worcester" & data$CHSI_State_Name=="Massachusetts", ]
wor
```

```
##      State_FIPS_Code County_FIPS_Code CHSI_County_Name CHSI_State_Name
## 1229              25               27        Worcester   Massachusetts
```

```
##      F_Wh_Cancer F_Wh_HeartDis E_Wh_HeartDis E_Wh_Cancer
## 1229          22            29            21          36
```

```
# Worcester value for F_wh_Cancer is 22
# Worcester value for F_wh_HeartDis is 29
# Worcester value for E_wh_Cancer is 36
# Worcester value for E_wh_HeartDis is 21

## from above, we can see that for Worcester, two age groups whites are having higher death rate of can
## than mean of the whole country, but for heart disease, it shows lower rate.



## next we do kmeans

data1<-data[c(5:8)]
head(data1)
```

```
##   F_Wh_Cancer F_Wh_HeartDis E_Wh_HeartDis E_Wh_Cancer
## 1          20            32            23          36
## 2          23            30            22          37
## 3          20            33            29          31
## 4          18            31            23          33
## 5          20            34            23          37
## 6          16            39            31          25
```

```
set.seed(10000)
datakmean <- kmeans(x = data1, centers = 5)
datakmean
```

```
## K-means clustering with 5 clusters of sizes 375, 519, 791, 591, 792
##
## Cluster means:
##   F_Wh_Cancer F_Wh_HeartDis E_Wh_HeartDis E_Wh_Cancer
## 1    19.40533      40.37867      29.79467    33.26933
## 2    20.68401      33.59923      31.41426    30.28324
## 3    21.13527      29.79646      23.52718    32.17193
## 4    22.20305      28.74788      20.99831    40.14213
## 5    21.15530      34.23990      26.14394    37.83586
##
## Clustering vector:
##    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15
##    5    4    2    3    5    2    1    2    2    2    2    2    2    1    3
##   16   17   18   19   20   21   22   23   24   25   26   27   28   29   30
##    2    3    1    2    2    1    2    5    3    1    3    2    2    1    2
##   31   32   33   34   35   36   37   38   39   40   41   42   43   44   45
##    5    1    2    5    3    1    3    2    3    5    3    1    1    1    3
##   46   47   48   49   50   51   52   53   54   55   56   57   58   59   60
##    2    1    2    3    4    3    2    4    1    1    2    3    5    3    5
##   61   62   63   64   65   66   67   70   75   76   77   78   79   80   82
##    2    3    3    2    1    4    2    3    3    4    4    3    3    3    3
##   83   86   87   88   89   90   92   94   95   96   97   98   99  100  101
##    3    1    2    3    3    3    4    2    3    3    3    4    3    3    2
```

```
##  102  103  104  105  106  107  108  109  110  111  112  113  114  115  116
##    3    3    3    3    3    4    3    4    5    2    3    1    1    1    2
##  117  118  119  120  121  122  123  124  125  126  127  128  129  130  131
##    5    3    2    1    3    2    3    5    2    5    3    5    1    1    2
##  132  133  134  135  136  137  138  139  140  141  142  143  144  145  146
##    3    2    5    3    2    1    2    3    1    5    5    1    3    3    5
##  147  148  149  150  151  152  153  154  155  156  157  158  159  160  161
##    5    2    1    5    5    4    3    4    3    1    1    5    4    5    2
##  162  163  164  165  166  167  168  169  170  171  172  173  174  175  176
##    3    2    3    1    1    4    3    3    5    1    3    1    1    5    1
##  177  178  179  180  181  182  183  184  185  187  188  189  190  191  192
##    2    2    3    5    3    3    5    5    3    3    3    3    5    4    3
##  193  194  195  196  197  198  199  200  201  202  203  204  205  206  207
##    4    3    3    3    3    5    2    3    3    2    5    3    4    4    3
##  208  209  210  211  212  213  214  215  216  217  218  219  220  221  222
##    3    2    3    3    4    4    5    4    4    3    3    3    3    3    3
##  223  224  225  226  227  228  229  230  231  232  233  234  235  236  237
##    3    4    4    3    4    4    3    4    3    4    4    1    3    3    3
##  238  239  240  241  242  243  244  245  246  247  248  249  251  252  253
##    3    4    4    3    2    3    3    3    4    5    2    4    3    3    4
##  254  255  256  257  258  259  260  261  262  263  264  265  266  267  268
##    3    3    2    3    3    3    3    4    4    3    3    3    3    3    3
##  269  271  272  273  275  276  277  278  279  280  281  282  284  285  286
##    4    3    3    4    4    3    3    3    3    3    5    3    3    3    4
##  287  288  289  290  291  292  293  294  295  296  297  298  300  301  302
##    3    3    4    3    4    4    4    3    3    3    4    3    4    5    3
##  303  304  305  306  307  308  309  310  311  312  313  314  315  316  317
##    4    1    3    3    4    5    4    4    4    4    5    3    3    4    4
##  318  319  320  321  322  323  324  325  326  327  328  329  330  331  332
##    5    3    3    3    3    4    5    1    5    3    4    4    3    3    3
##  333  334  335  336  337  338  339  340  341  342  343  344  345  346  347
##    3    3    4    4    4    3    5    2    2    5    1    3    5    3    1
##  348  349  350  351  352  353  354  355  356  357  358  359  360  361  362
##    4    2    4    2    4    5    4    3    4    2    5    5    4    1    3
##  363  364  365  366  367  368  369  370  371  372  373  374  375  376  377
##    3    4    5    3    4    4    4    3    5    4    4    5    3    4    4
##  378  379  380  381  382  383  384  385  386  387  388  389  390  391  392
##    5    4    5    4    3    3    5    5    2    1    2    2    3    5    3
##  393  394  395  396  397  398  399  400  401  402  403  404  405  406  407
##    3    4    2    3    5    5    1    4    3    3    2    3    2    3    3
##  408  409  410  411  412  413  414  415  416  417  418  419  420  421  422
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##  423  424  425  426  427  428  429  430  431  432  433  434  435  436  437
##    4    5    3    5    5    5    3    2    2    3    2    2    3    5    5
##  438  439  440  441  442  443  444  445  446  447  448  449  450  451  452
##    3    2    3    4    3    5    2    3    5    3    3    3    2    1    3
##  453  454  455  456  457  458  459  460  461  462  463  464  465  466  467
##    5    3    2    2    3    5    2    4    3    3    3    5    2    2    2
##  468  469  470  471  472  473  474  475  476  477  478  479  480  481  482
##    2    3    2    2    2    5    5    1    5    5    3    3    2    3    5
##  483  484  485  486  487  488  489  490  491  492  493  494  495  496  497
##    2    1    5    5    5    2    1    3    3    3    5    2    3    5    1
##  498  499  500  501  502  503  504  505  506  507  508  509  510  511  512
##    2    2    1    5    3    2    2    2    3    3    5    2    2    3    3
```

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##  513  514  515  517  518  519  520  521  522  523  524  525  526  527  528
##    3    3    1    5    2    1    5    3    3    2    4    2    2    2    2
##  529  530  531  532  533  534  535  536  538  539  540  541  542  543  544
##    5    3    5    3    3    5    5    2    3    5    3    5    4    2    1
##  545  546  548  549  550  551  552  553  554  555  556  557  558  559  560
##    3    3    4    3    4    2    3    2    3    3    3    5    4    3    5
##  561  563  564  565  567  568  569  570  571  572  573  574  575  576  577
##    3    3    3    3    3    2    3    2    3    3    3    3    3    3    4
##  578  579  580  581  582  583  584  585  586  587  588  589  590  591  592
##    4    3    2    2    4    2    4    3    3    5    5    3    4    3    3
##  593  594  595  596  597  598  599  600  601  602  603  604  605  606  607
##    2    4    2    3    5    4    4    1    5    5    4    5    1    5    5
##  608  609  610  611  612  613  614  615  616  617  618  619  620  621  622
##    3    5    2    5    4    5    1    4    5    5    3    1    5    4    3
##  623  624  625  626  627  628  629  630  631  632  633  634  635  636  637
##    2    1    4    1    5    2    1    4    2    3    5    2    1    5    5
##  638  639  640  641  642  643  644  645  646  647  648  649  650  651  652
##    4    2    4    3    4    5    3    5    1    4    4    4    4    5    5
##  653  654  655  656  657  658  659  660  661  662  663  664  665  666  667
##    5    2    5    5    5    5    5    3    3    5    4    2    4    1    5
##  668  669  670  671  672  673  674  675  676  677  678  679  680  681  682
##    4    1    2    3    3    3    5    4    5    5    1    5    5    5    3
##  683  684  685  686  687  688  689  690  691  692  693  694  695  696  697
##    4    5    5    5    1    1    1    1    5    5    4    3    5    5    3
##  698  699  700  701  702  703  704  705  706  707  708  709  710  711  712
##    3    5    5    4    4    3    5    5    3    2    5    3    4    5    3
##  713  714  715  716  717  718  719  720  721  722  723  724  725  726  727
##    3    2    5    3    5    5    5    5    2    3    5    4    5    5    4
##  728  729  730  731  732  733  734  735  736  737  738  739  740  741  742
##    4    5    5    5    4    5    2    3    5    3    3    5    5    5    5
##  743  744  745  746  747  748  749  750  751  752  753  754  755  756  757
##    3    3    5    5    5    3    5    2    5    5    4    5    2    1    2
##  758  759  760  761  762  763  764  765  766  767  768  769  770  771  772
##    1    4    5    2    5    5    3    5    5    2    4    5    5    5    2
##  773  774  775  776  777  778  779  780  781  782  783  784  785  786  787
##    5    4    5    1    3    1    2    3    5    4    2    3    4    3    5
##  788  789  790  791  792  793  794  795  796  797  798  799  800  801  802
##    2    2    5    1    2    1    3    5    5    1    5    5    2    4    5
##  803  804  805  806  807  808  809  810  811  812  813  814  815  816  817
##    5    5    5    1    5    5    5    1    5    5    5    1    5    4    5
##  818  819  820  821  822  823  824  825  826  827  828  829  830  831  832
##    5    5    5    5    2    4    5    5    4    5    5    5    5    5    5
##  833  834  835  836  837  838  839  840  841  842  843  844  845  846  847
##    2    1    4    4    5    5    4    4    4    4    4    4    5    1    1
##  848  849  850  851  852  853  854  855  856  857  858  859  860  861  862
##    4    5    3    5    1    5    5    5    4    4    4    1    5    4    5
##  863  864  865  866  867  868  869  870  871  872  873  874  875  876  877
##    2    5    5    3    1    2    3    5    4    5    5    5    1    2    5
##  878  879  880  881  882  883  884  885  886  887  888  889  890  891  892
##    4    3    2    2    4    4    3    1    4    5    5    5    3    3    5
##  893  894  895  896  897  898  899  900  901  902  903  904  905  906  907
##    1    3    5    5    1    2    5    3    1    5    5    3    1    4    5
##  908  909  910  911  912  913  914  915  916  917  918  919  920  921  923
##    5    3    5    2    3    1    3    3    3    4    5    1    4    4    5
```

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##  924  925  926  927  928  929  930  931  932  933  934  935  936  937  938
##    3    2    3    1    5    5    5    5    4    3    4    2    2    5    5
##  939  940  941  942  943  944  945  946  947  948  949  950  951  952  953
##    1    1    5    3    4    4    5    5    3    5    3    5    2    5    3
##  954  955  956  957  958  959  960  961  962  963  964  965  966  967  968
##    5    4    3    1    1    5    2    5    5    5    3    2    2    4    4
##  969  970  971  972  973  974  975  976  977  978  979  980  981  982  983
##    4    5    3    3    3    1    3    2    2    5    5    2    3    4    5
##  984  985  986  987  989  990  991  992  993  994  995  996  997  998  999
##    5    3    3    5    2    2    3    2    2    4    1    5    5    2    4
## 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014
##    5    4    4    2    1    5    5    5    5    5    3    1    2    3    2
## 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029
##    2    5    2    5    1    1    4    5    4    1    3    2    3    3    1
## 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1041 1042 1043 1044
##    5    5    5    3    5    5    5    2    5    3    1    5    5    2    1
## 1045 1046 1047 1048 1049 1050 1051 1052 1053 1054 1055 1056 1057 1058 1059
##    2    5    3    4    2    4    1    2    2    5    5    5    3    2    3
## 1060 1061 1062 1063 1064 1065 1066 1067 1068 1069 1070 1071 1072 1073 1074
##    5    1    5    5    1    5    5    2    2    5    5    1    2    4    2
## 1075 1076 1077 1078 1079 1080 1081 1082 1083 1084 1085 1086 1087 1088 1089
##    5    5    1    5    1    2    4    4    5    4    5    2    1    1    1
## 1090 1091 1092 1093 1094 1095 1096 1097 1098 1099 1100 1101 1102 1103 1104
##    3    5    2    2    5    5    4    5    1    1    3    5    5    2    2
## 1105 1106 1107 1108 1109 1110 1111 1112 1113 1114 1115 1116 1117 1118 1119
##    5    2    2    2    2    2    5    3    2    5    1    2    2    5    4
## 1120 1121 1122 1123 1124 1125 1126 1127 1128 1129 1130 1131 1132 1133 1134
##    3    3    5    5    2    1    5    4    2    3    1    3    1    2    5
## 1135 1136 1137 1138 1139 1140 1141 1142 1143 1144 1145 1146 1147 1148 1149
##    3    1    3    3    4    2    2    3    3    1    2    2    3    3    3
## 1150 1151 1152 1153 1154 1155 1156 1157 1158 1159 1160 1161 1162 1163 1164
##    1    5    2    2    2    3    5    2    5    3    3    5    3    3    2
## 1165 1166 1167 1168 1169 1170 1171 1172 1173 1174 1175 1176 1177 1178 1179
##    1    4    2    5    4    2    5    4    1    5    5    4    5    4    4
## 1180 1181 1182 1183 1184 1185 1186 1187 1188 1189 1190 1191 1192 1193 1194
##    4    4    4    4    4    4    4    4    4    3    3    4    1    4    5
## 1195 1196 1197 1198 1199 1200 1201 1202 1203 1204 1205 1206 1207 1208 1209
##    4    4    4    5    5    5    5    1    5    4    4    4    5    4    5
## 1210 1211 1212 1213 1214 1215 1216 1217 1218 1219 1220 1221 1222 1223 1224
##    5    4    5    5    5    3    4    4    5    4    4    3    3    4    4
## 1225 1226 1227 1228 1229 1230 1231 1232 1233 1234 1235 1236 1237 1238 1239
##    4    4    4    3    4    2    5    3    2    5    1    2    5    5    5
## 1240 1241 1242 1243 1244 1245 1246 1247 1248 1249 1250 1251 1252 1253 1254
##    3    5    3    5    5    5    5    2    4    2    5    2    5    3    2
## 1255 1256 1257 1258 1259 1260 1261 1262 1263 1264 1265 1266 1267 1268 1269
##    5    5    4    1    5    5    3    3    4    2    1    5    3    4    5
## 1270 1271 1272 1273 1274 1275 1276 1277 1278 1279 1280 1281 1282 1283 1284
##    4    2    2    5    4    5    4    4    5    5    5    3    5    5    1
## 1285 1286 1287 1288 1289 1290 1291 1292 1293 1294 1295 1296 1297 1298 1299
##    5    4    5    2    5    5    4    5    2    5    1    1    1    4    4
## 1300 1301 1302 1303 1304 1305 1306 1307 1308 1309 1310 1311 1312 1313 1314
##    1    1    5    5    5    3    5    5    5    3    4    1    3    5    4
## 1315 1316 1317 1318 1319 1320 1321 1322 1323 1324 1325 1326 1327 1328 1329
##    3    4    5    5    4    4    4    4    4    3    4    4    2    4    4
```

```
## 1330 1331 1332 1333 1334 1335 1336 1337 1338 1339 1340 1341 1342 1343 1344
##    4    4    3    4    5    4    4    3    5    4    4    4    4    4    4
## 1345 1346 1347 1348 1349 1350 1351 1352 1353 1354 1355 1356 1357 1358 1359
##    4    4    1    5    4    3    4    4    4    5    4    4    5    5    3
## 1360 1361 1362 1363 1364 1365 1366 1367 1368 1369 1370 1371 1372 1373 1374
##    4    3    4    2    4    5    2    4    4    2    5    4    4    5    4
## 1375 1376 1377 1378 1379 1380 1381 1382 1383 1384 1385 1386 1387 1388 1389
##    2    5    4    4    4    2    4    4    4    4    4    4    4    4    4
## 1390 1391 1392 1393 1394 1395 1396 1397 1398 1399 1400 1401 1402 1403 1404
##    5    4    2    4    4    5    2    4    4    5    5    5    5    2    1
## 1405 1406 1407 1408 1409 1410 1411 1412 1413 1414 1415 1416 1417 1418 1419
##    1    2    1    1    1    1    1    1    1    2    1    3    3    1    2
## 1420 1421 1422 1423 1424 1425 1426 1427 1428 1429 1430 1431 1432 1433 1434
##    5    2    1    1    2    2    5    3    1    3    1    2    1    2    1
## 1435 1436 1437 1438 1439 1440 1441 1442 1443 1444 1445 1446 1447 1448 1449
##    5    5    2    1    1    2    1    3    2    4    5    3    2    2    1
## 1450 1451 1452 1453 1454 1455 1456 1457 1458 1459 1460 1461 1462 1463 1464
##    1    1    5    2    3    1    1    2    2    1    1    1    2    3    1
## 1465 1466 1467 1468 1469 1470 1471 1472 1473 1474 1475 1476 1477 1478 1479
##    1    2    1    5    1    1    2    1    1    1    1    1    2    2    1
## 1480 1481 1482 1483 1484 1485 1486 1487 1488 1489 1490 1491 1492 1493 1494
##    2    3    1    5    5    4    5    5    5    4    1    4    3    3    1
## 1495 1496 1497 1498 1499 1500 1501 1502 1503 1504 1505 1506 1507 1508 1509
##    3    5    1    1    1    5    2    5    4    2    4    5    5    2    1
## 1510 1511 1512 1513 1514 1515 1516 1517 1518 1519 1520 1521 1522 1523 1524
##    5    3    1    5    1    3    5    2    1    2    3    2    1    1    5
## 1525 1526 1527 1528 1529 1530 1531 1532 1533 1534 1535 1536 1537 1538 1539
##    2    4    3    2    3    1    5    5    5    1    1    3    1    2    5
## 1540 1541 1542 1543 1544 1545 1546 1547 1548 1549 1550 1551 1552 1553 1554
##    1    2    5    5    5    2    2    1    1    1    4    5    5    1    5
## 1555 1556 1557 1558 1559 1560 1561 1562 1563 1564 1565 1566 1567 1568 1569
##    5    1    5    3    1    1    3    2    3    4    4    5    5    2    3
## 1570 1571 1572 1573 1574 1575 1576 1577 1578 1579 1580 1581 1582 1583 1584
##    1    2    2    4    5    5    2    5    1    3    3    5    2    2    5
## 1585 1586 1587 1588 1589 1590 1591 1592 1593 1594 1595 1596 1597 1598 1599
##    5    2    5    1    1    5    1    5    1    2    1    2    3    3    2
## 1600 1601 1602 1603 1604 1605 1606 1607 1608 1609 1610 1611 1612 1614 1616
##    3    4    2    3    3    3    2    3    2    2    3    3    3    3    3
## 1617 1618 1619 1620 1621 1623 1625 1626 1627 1628 1629 1630 1632 1633 1634
##    5    3    5    3    4    3    3    4    5    3    5    4    5    4    4
## 1635 1637 1638 1639 1640 1641 1642 1643 1644 1645 1646 1647 1649 1650 1652
##    3    4    1    5    2    3    4    3    3    4    3    3    4    1    3
## 1653 1654 1658 1659 1660 1661 1662 1663 1664 1665 1666 1667 1668 1669 1670
##    5    4    2    1    1    2    3    2    5    5    5    5    3    3    5
## 1671 1672 1673 1674 1675 1676 1677 1678 1679 1680 1681 1682 1683 1684 1685
##    5    1    1    2    2    5    2    1    4    4    2    1    4    4    3
## 1686 1687 1688 1689 1691 1692 1693 1694 1696 1697 1699 1700 1701 1702 1703
##    3    5    4    3    2    3    5    4    4    5    2    1    4    5    5
## 1705 1706 1707 1708 1712 1713 1714 1715 1716 1717 1718 1719 1720 1721 1722
##    5    1    4    5    5    1    4    2    5    5    4    2    3    5    1
## 1723 1724 1725 1726 1727 1728 1729 1730 1731 1732 1733 1734 1736 1737 1739
##    3    4    2    3    3    5    4    4    3    5    3    1    2    5    2
## 1740 1741 1742 1743 1745 1746 1747 1748 1749 1750 1751 1752 1753 1754 1755
##    4    4    2    1    1    3    3    4    3    2    2    3    2    2    3
```

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## 1756 1757 1758 1759 1760 1761 1762 1763 1764 1765 1766 1767 1768 1769 1770
##    3    3    2    4    3    2    3    4    3    3    4    5    4    4    4
## 1771 1772 1773 1774 1775 1776 1777 1778 1779 1780 1781 1782 1783 1784 1785
##    4    4    5    5    4    4    5    3    5    4    5    4    4    5    4
## 1786 1787 1788 1789 1790 1791 1792 1793 1794 1795 1796 1797 1798 1799 1800
##    4    5    5    5    4    5    5    4    3    2    3    3    3    1    5
## 1801 1802 1803 1804 1806 1807 1808 1809 1810 1811 1812 1813 1814 1815 1816
##    3    3    3    2    1    2    3    4    2    3    3    3    1    3    3
## 1817 1818 1819 1820 1821 1822 1823 1824 1825 1826 1827 1828 1829 1830 1831
##    4    3    3    3    3    3    3    3    1    3    5    5    1    3    5
## 1832 1833 1834 1835 1836 1837 1838 1839 1840 1841 1842 1843 1844 1845 1846
##    4    1    4    1    5    5    5    5    5    5    4    3    5    5    2
## 1847 1848 1849 1850 1851 1852 1853 1854 1855 1856 1857 1858 1859 1860 1861
##    5    5    5    1    5    4    4    4    1    5    5    1    5    4    4
## 1862 1863 1864 1865 1866 1867 1868 1869 1870 1871 1872 1873 1874 1875 1876
##    5    5    5    5    5    1    5    1    5    3    5    5    5    5    5
## 1877 1878 1879 1880 1881 1882 1883 1884 1885 1886 1887 1888 1889 1890 1891
##    3    5    5    4    4    5    4    4    4    5    4    5    4    3    3
## 1892 1893 1894 1895 1896 1897 1898 1899 1900 1901 1902 1903 1904 1905 1906
##    1    3    2    1    3    3    3    4    3    3    3    4    4    5    3
## 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921
##    4    2    5    4    3    2    3    3    4    4    5    3    3    4    3
## 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934 1935 1936
##    4    3    3    3    3    3    2    3    3    3    4    4    5    4    5
## 1937 1938 1939 1940 1941 1942 1943 1944 1945 1946 1947 1948 1949 1950 1951
##    5    3    5    3    5    3    3    3    4    3    2    4    5    5    4
## 1952 1953 1954 1955 1956 1957 1958 1959 1960 1961 1962 1963 1964 1965 1966
##    4    4    5    3    4    3    4    4    5    3    3    3    4    5    3
## 1967 1968 1969 1970 1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981
##    3    2    3    3    2    5    4    3    2    4    2    3    3    4    2
## 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1993 1994 1995 1996 1997
##    1    5    5    3    4    3    3    2    4    2    2    4    5    5    4
## 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
##    5    4    4    1    3    5    4    5    3    5    5    4    5    3    4
## 2013 2014 2015 2016 2017 2018 2019 2020 2022 2023 2024 2025 2026 2027 2028
##    5    4    5    5    5    4    1    5    2    4    2    2    3    5    2
## 2029 2030 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045
##    4    5    5    2    3    2    2    1    4    5    4    3    5    3    4
## 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060
##    5    5    5    3    3    5    3    3    3    4    5    3    3    1    5
## 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075
##    4    4    3    3    3    3    5    2    4    4    5    3    5    5    1
## 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090
##    4    2    5    5    5    2    5    5    5    5    3    4    4    5    3
## 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105
##    5    2    5    2    5    5    1    3    5    5    4    2    5    5    4
## 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120
##    3    3    4    5    5    3    3    3    1    1    1    3    3    5    5
## 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135
##    4    5    2    4    4    4    3    5    2    5    2    2    2    1    1
## 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150
##    5    1    5    1    2    1    3    1    1    3    1    5    1    2    1
## 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165
##    3    2    3    1    2    1    2    1    1    1    1    2    2    1    2
```

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## 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180
##    1    2    2    2    2    3    1    1    1    1    1    1    5    1    2
## 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195
##    2    5    1    2    1    5    2    5    2    1    2    1    1    1    5
## 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210
##    1    2    2    2    3    2    5    5    1    1    1    3    4    4    3
## 2211 2212 2213 2214 2215 2216 2218 2219 2220 2221 2222 2223 2224 2225 2226
##    4    3    3    4    4    3    4    5    4    3    3    3    4    4    4
## 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2242
##    3    3    2    4    4    3    4    4    3    4    4    4    4    4    4
## 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257
##    5    5    2    5    5    3    2    5    4    5    2    5    5    5    4
## 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272
##    1    5    5    1    4    5    5    4    4    5    5    2    4    5    2
## 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287
##    3    2    1    2    5    4    5    5    5    1    5    3    5    1    4
## 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302
##    4    5    5    2    5    3    5    5    1    2    1    3    5    5    5
## 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317
##    5    5    4    5    5    5    4    4    5    4    5    5    2    3    1
## 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332
##    3    3    5    4    3    2    4    3    2    2    4    3    3    3    4
## 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347
##    2    1    5    5    3    3    1    3    2    3    1    3    5    3    3
## 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2362 2363
##    2    2    3    3    3    3    3    2    3    4    3    3    4    5    4
## 2364 2365 2366 2367 2369 2370 2371 2372 2373 2374 2376 2377 2378 2379 2381
##    1    5    1    5    2    5    5    3    1    5    3    5    1    2    3
## 2382 2383 2384 2385 2386 2387 2388 2389 2390 2392 2393 2394 2395 2396 2398
##    4    2    3    2    5    5    2    4    5    5    5    1    1    5    2
## 2399 2400 2401 2402 2403 2404 2405 2406 2408 2409 2410 2411 2412 2413 2414
##    2    5    5    4    1    1    3    5    4    4    1    3    3    2    1
## 2415 2417 2418 2419 2420 2421 2422 2423 2424 2425 2427 2428 2429 2430 2431
##    3    2    4    5    2    5    2    2    1    2    3    2    1    3    3
## 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446
##    3    5    1    1    3    5    4    1    1    2    2    1    5    3    1
## 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461
##    2    2    1    1    5    3    2    5    3    5    2    3    3    5    1
## 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476
##    2    5    1    2    5    3    2    5    1    3    3    3    1    1    3
## 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491
##    5    2    3    3    1    5    3    3    4    3    2    3    3    4    2
## 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506
##    2    5    5    1    5    5    3    3    3    5    2    5    1    2    1
## 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521
##    5    3    4    5    3    2    5    2    2    3    1    3    3    5    5
## 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536
##    4    5    3    4    5    4    3    1    2    4    3    5    3    5    3
## 2537 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552
##    3    2    2    3    4    4    3    1    3    5    4    4    2    1    3
## 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567
##    5    3    2    2    5    2    2    1    3    5    2    4    2    2    4
## 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582
##    5    4    3    5    5    3    3    3    2    2    3    3    3    4    3
```

```
## 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597
##    5    3    3    5    2    2    3    2    3    3    3    1    2    5    1
## 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2609 2610 2611 2612 2613
##    2    2    5    3    3    2    2    3    1    4    3    3    2    2    2
## 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628
##    2    3    3    1    5    2    4    5    3    5    4    1    3    3    2
## 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2640 2641 2642 2643 2644
##    2    3    3    4    5    3    3    4    2    2    2    5    2    2    2
## 2645 2646 2647 2648 2649 2650 2651 2654 2655 2657 2658 2659 2660 2661 2662
##    2    1    3    1    3    3    4    4    2    2    2    2    3    2    1
## 2663 2664 2665 2666 2667 2668 2669 2670 2671 2673 2674 2675 2676 2678 2679
##    2    1    1    5    2    2    2    2    4    3    3    2    3    1    2
## 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694
##    1    4    3    2    3    2    3    3    5    3    3    5    3    5    2
## 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709
##    5    3    1    5    3    1    1    1    2    5    3    5    3    2    3
## 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724
##    2    5    3    3    2    2    3    2    4    2    5    5    2    2    1
## 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2738 2739 2740
##    4    3    1    3    3    5    5    4    5    2    2    2    5    3    3
## 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755
##    3    3    3    2    1    3    3    3    2    1    2    1    4    3    1
## 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770
##    3    3    2    3    5    3    3    2    3    2    2    4    3    1    1
## 2771 2772 2773 2774 2775 2776 2777 2778 2779 2781 2782 2783 2784 2785 2786
##    2    2    2    1    2    1    3    3    3    3    3    3    3    4    3
## 2787 2788 2789 2790 2791 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802
##    3    3    3    3    4    3    2    3    3    4    3    4    3    3    4
## 2803 2804 2805 2806 2807 2808 2809 2810 2811 2812 2813 2814 2815 2816 2817
##    3    3    4    4    4    4    2    5    5    4    3    4    4    4    4
## 2818 2819 2820 2821 2822 2823 2824 2825 2826 2827 2828 2829 2830 2831 2832
##    4    5    4    2    4    5    5    4    3    1    4    2    5    2    2
## 2833 2834 2835 2836 2837 2838 2839 2840 2841 2842 2843 2844 2845 2846 2847
##    2    4    5    3    5    5    4    4    1    3    2    3    4    5    4
## 2848 2849 2850 2851 2852 2853 2854 2855 2856 2857 2858 2859 2860 2861 2862
##    4    3    2    2    4    3    3    4    5    3    5    3    4    3    2
## 2863 2864 2865 2866 2867 2868 2869 2870 2871 2872 2873 2874 2875 2876 2877
##    3    4    4    2    4    5    4    1    4    3    5    4    5    5    5
## 2878 2879 2880 2881 2882 2883 2884 2885 2886 2887 2888 2889 2890 2891 2892
##    3    5    5    5    4    3    4    2    5    5    4    5    3    4    3
## 2893 2894 2895 2896 2897 2898 2899 2900 2901 2902 2903 2904 2905 2906 2907
##    3    4    3    5    4    3    5    4    5    5    4    4    5    5    2
## 2908 2909 2910 2911 2912 2913 2914 2915 2916 2917 2918 2919 2920 2921 2922
##    4    3    4    3    3    4    4    3    5    2    3    4    4    5    2
## 2923 2924 2925 2926 2927 2928 2929 2930 2931 2932 2933 2934 2935 2936 2937
##    1    4    3    5    5    2    3    3    3    4    3    4    4    2    3
## 2938 2939 2940 2941 2942 2943 2944 2945 2946 2947 2948 2949 2950 2951 2952
##    3    2    3    5    5    3    3    2    5    2    5    3    3    4    5
## 2953 2954 2955 2956 2957 2958 2959 2960 2961 2962 2963 2964 2965 2966 2967
##    3    4    3    3    4    4    4    3    4    3    3    4    3    3    4
## 2968 2969 2970 2971 2972 2973 2974 2975 2976 2977 2978 2979 2980 2981 2982
##    4    4    4    4    3    3    2    4    3    3    3    3    4    4    3
## 2983 2984 2985 2986 2987 2988 2989 2990 2991 2992 2993 2994 2995 2996 2997
##    4    4    5    4    5    4    4    5    3    4    3    3    4    5    3
```

```
## 2998 2999 3000 3001 3002 3003 3004 3005 3006 3007 3008 3009 3010 3011 3012
##    5    2    1    3    2    1    3    2    1    2    2    4    5    3    1
## 3013 3014 3015 3016 3017 3018 3019 3020 3021 3022 3023 3024 3025 3026 3027
##    5    2    1    2    2    2    3    5    3    5    5    3    3    5    1
## 3028 3029 3030 3031 3032 3033 3034 3035 3036 3037 3038 3039 3040 3041 3042
##    2    2    1    3    1    5    1    1    2    2    2    1    2    5    5
## 3043 3044 3045 3046 3047 3048 3049 3050 3051 3052 3053 3054 3055 3056 3057
##    1    1    5    3    5    2    4    3    5    5    5    4    4    3    4
## 3058 3059 3060 3061 3062 3063 3064 3065 3066 3067 3068 3069 3070 3071 3072
##    5    4    5    5    4    3    3    1    5    2    5    4    5    5    5
## 3073 3074 3075 3076 3077 3078 3079 3080 3081 3082 3083 3084 3085 3087 3088
##    5    5    5    4    5    4    5    2    3    3    4    5    4    3    4
## 3089 3090 3091 3092 3093 3094 3095 3096 3097 3098 3099 3100 3101 3102 3103
##    4    5    4    4    5    5    5    5    5    4    5    4    5    4    5
## 3104 3105 3106 3107 3108 3109 3110 3111 3112 3113 3114 3115 3116 3117 3118
##    4    5    5    5    3    5    5    5    5    4    4    3    1    4    4
## 3119 3120 3121 3122 3123 3124 3125 3126 3127 3128 3129 3130 3131 3132 3133
##    3    2    3    2    3    4    3    3    3    4    3    3    3    5    4
## 3134 3135 3136 3137 3138 3139 3140 3141
##    4    3    3    3    4    3    4    4
##
## Within cluster sum of squares by cluster:
## [1] 15001.61 18966.12 22500.54 21048.13 21398.57
##  (between_SS / total_SS =  55.5 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"
## [5] "tot.withinss" "betweenss"    "size"         "iter"
## [9] "ifault"
```

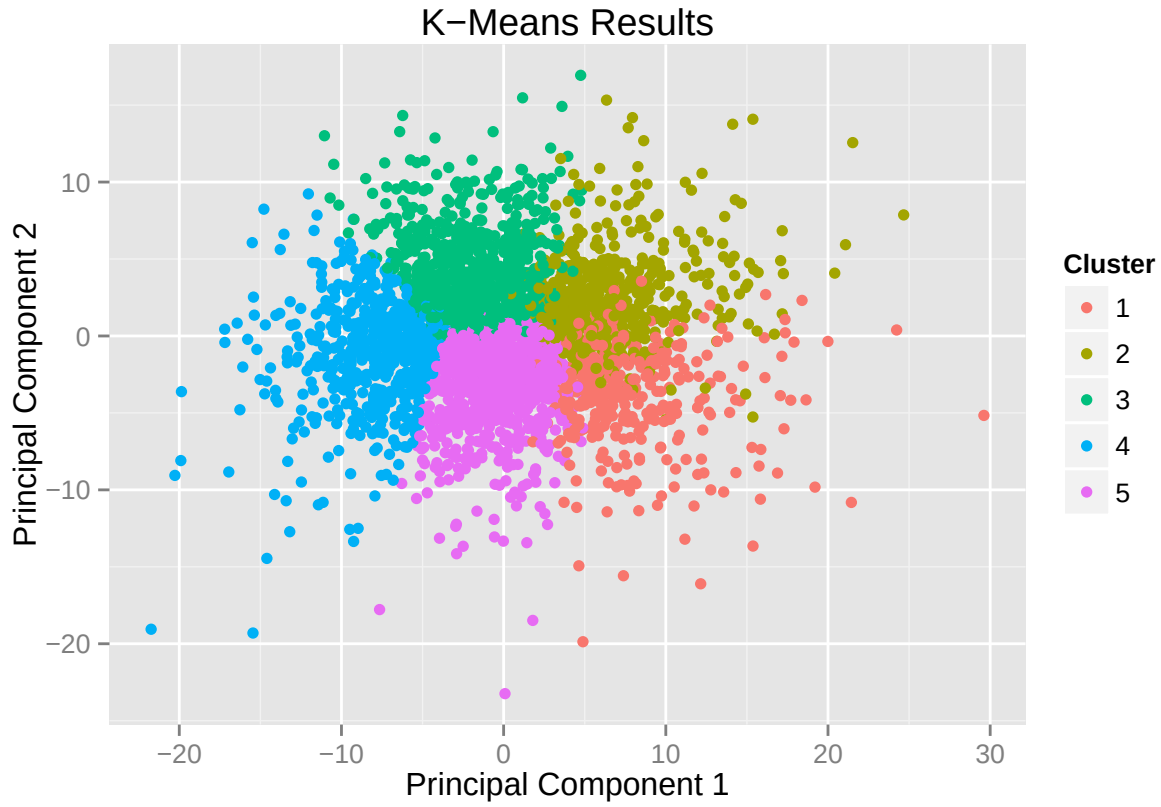
```
## from which we got clusters:
## K-means clustering with 5 clusters of sizes 585, 428, 510, 897, 576

## Cluster means:
##  F_Wh_Cancer F_Wh_HeartDis E_Wh_HeartDis E_Wh_Cancer
##    20.98632      29.10940      22.52308    31.71282
##    19.67757      39.74065      28.40654    35.74766
##    20.34706      34.86471      31.57647    29.56863
##    21.42698      32.51951      26.52843    36.24638
##    22.06424      29.50347      21.07986    40.67882

require(useful)
```

```
## Loading required package: useful
```

```
plot(datakmean,data=data1)
```



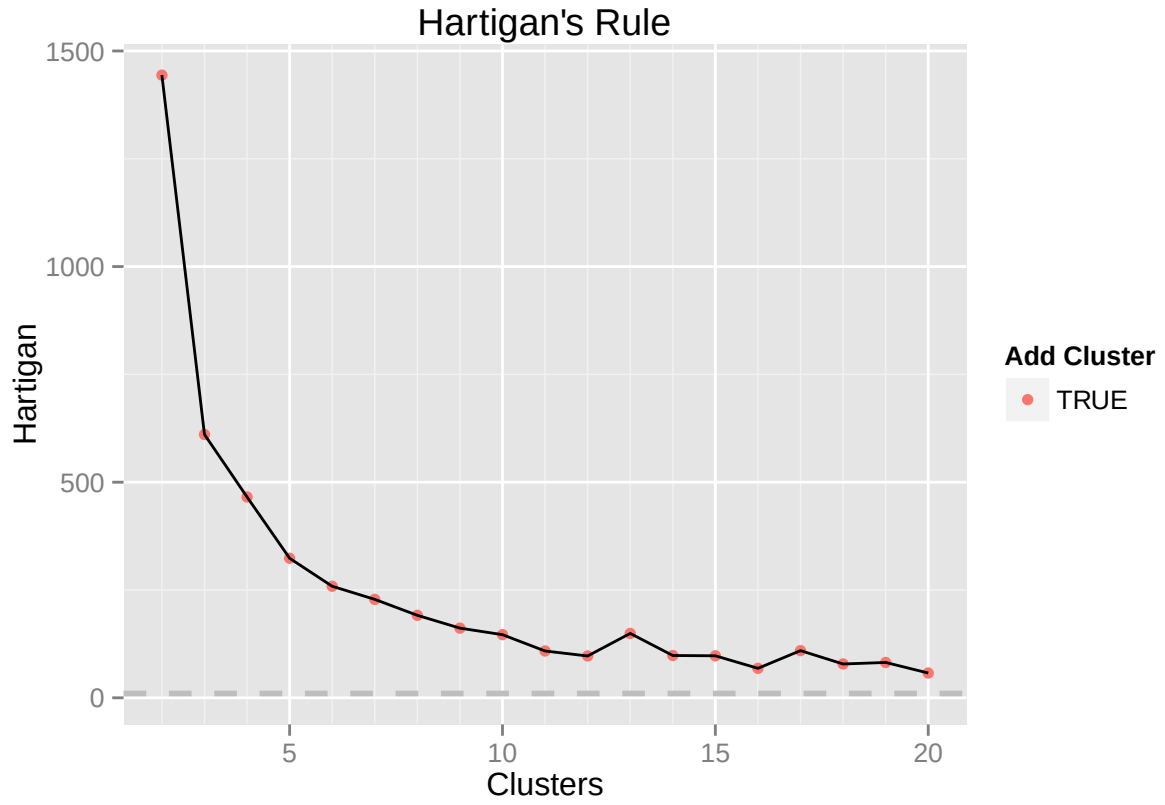

```
## Worcester belongs to the first cluster.
## It shows that Worcester do have higher rate in death of Cancer for middle age whites.
## But lower rate in death of Heart disease.


## to find best fit cluster numbers
dataBest <- FitKMeans(data1, max.clusters=20, seed=10000)
dataBest
```

```
##    Clusters   Hartigan AddCluster
## 1         2 1443.92903       TRUE
## 2         3  610.60121       TRUE
## 3         4  465.74784       TRUE
## 4         5  323.62437       TRUE
## 5         6  258.65254       TRUE
## 6         7  228.25454       TRUE
## 7         8  191.30412       TRUE
## 8         9  161.57811       TRUE
## 9        10  146.40481       TRUE
## 10       11  108.52879       TRUE
## 11       12   96.99529       TRUE
## 12       13  149.27726       TRUE
## 13       14   98.06500       TRUE
## 14       15   97.38634       TRUE
## 15       16   68.32086       TRUE
## 16       17  109.37653       TRUE
```

```
## 17       18   78.42984       TRUE
## 18       19   81.92354       TRUE
## 19       20   57.47629       TRUE
```

```
PlotHartigan(dataBest)
```




```
## I think clusters of 10 works the best because after 10, Hartigan do not drop a lot


## Conclusion: I would strongly suggest leader of Worcester in Massachusetts put more effort on
## caring about cancer risk for middle age whites and try to find out the reasons for causing the cancer
```