MA Assignment 1

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```
require(conjoint)
```

```
## Loading required package: conjoint
```

```
##
## This is package 'modeest' written by P. PONCET.
## For a complete list of functions, use 'library(help = "modeest")' or 'help.start()'.
```

```
slevn = read.csv("D:/Business Analytics/LIBA Class Room Materials/Prof Rajesh/assignment/slevn.c
sv", header = TRUE)
sprefm = read.csv("D:/Business Analytics/LIBA Class Room Materials/Prof Rajesh/assignment/spref
m.csv", header = TRUE)
sprof = read.csv("D:/Business Analytics/LIBA Class Room Materials/Prof Rajesh/assignment/sprof.c
sv", header = TRUE)
```

```
slevn
```

```
##           levels
## 1          >$250
## 2    $100 - $250
## 3          <$100
## 4          large
## 5         medium
## 6          small
## 7      polyester
## 8  polycarbonate
## 9          nylon
## 10           yes
## 11            no
```

```
sprof
```

```
##    price size material sets
## 1      3    2        1    1
## 2      3    2        3    2
## 3      3    3        1    1
## 4      1    3        2    1
## 5      3    2        3    1
## 6      3    1        1    1
## 7      1    2        3    2
## 8      2    1        2    1
## 9      3    2        3    1
## 10     3    1        3    1
```

```
sprefm
```

```
##     profil1 profil2 profil3 profil4 profil5 profil6 profil7 profil8
## 1        10       6       5       3       8      10       7       1
## 2         1       5       6       4       3       6      10       8
## 3         8      10       8       6       7       4       3       2
## 4         9       2       3       1       2      10       2       2
## 5         5       5      10      10       2       3       4       4
## 6         6       7       4       8       8       6      10       4
## 7         1       4       9       7       1       5       4       7
## 8         2       6      10       1       4       1       2       8
## 9         1       4       9       1       4       5       1       2
## 10        6       2       2      10       1       5       7       3
## 11        7      10       9       5       2       6       3       2
## 12       10       2       2       4       7       7       6       1
## 13        4       7       7       4       9      10       4       4
## 14        7       5       3       5       8       3       6       4
## 15        8       8       6       2       9       2       9       1
## 16        8       5       7       4       8       4       5       5
## 17        3       8       1       1       7       2       6       5
## 18       10       2       3       4       2       9       2       4
## 19        6       2       7       3       6       1       1       5
## 20       10       6       2       4       9       1       1       2
## 21        1       8       6       2       1       3       2       3
## 22        3       4       1       9       4       2       9       4
## 23        4       1       5       7       1       8       5       4
## 24        4       7       2       3      10       7       7       2
## 25        8       1       1       9       5      10       6       2
## 26        6       5       6      10      10       2       9      10
## 27        9      10       4       3       6       8       1       9
## 28        3       6       4       6       6       9       3       5
## 29       10       5       3       1       7       9       4       2
## 30        7       8       7      10       8      10       1       8
## 31        8       1       4      10       4       9       7       9
## 32        6       1      10       3       8       6       4       9
## 33        3       3       2       4       9       3       2       5
## 34       10       4       3      10       1       2       1       3
## 35        7       7       3       9       4      10       6      10
## 36        9       3       3       1      10       7       6       4
## 37        8       2       7       6       1       1       7       8
## 38       10       2       1       2       6       1       4      10
## 39       10       2       8       9       8       7       4       2
## 40        8       6       9       2       8       2       9       2
## 41        8       4       5       2       8       9       4       1
## 42        3      10       4       9      10       9       9       9
## 43        8       8       1       1       5       2      10      10
## 44        9       1       5       5       7       3       2       3
## 45        9       9       3       4       8       8       4       3
## 46        4       9       1      10       2       3       6       9
## 47        6       4       3       4       1       4       4       2
## 48        1       3       8       2       8       1       7       3
## 49        6       4       2       5      10       6       2      10
## 50        4      10       7       2      10       3       5       3
## 51        6       9       2       1       6       5       9       4
## 52        3       3       6      10       7       8       8       9
```

```
## 53       6       8       1       1       8       4       8       4
## 54       1       9       4      10      10       8       2       5
## 55       3       2       4       2       7       5       2       1
## 56       6       1       4      10       5       2       6       1
## 57       8       3       6       8       5       4       5       2
## 58       3       9       5       7       6       2       6       8
## 59       4       5       4       3       4       2       4       2
## 60       2       3       9       1       3       4       5       6
## 61       8       6       4       7       7      10      10       9
## 62       1       4       1       6       9       9       8       3
## 63       6       5       3       3       9       2       1      10
## 64       4      10       9       2       9       5       8       9
## 65       4       4       6       1       6       4       6      10
## 66       6       4       8      10      10       5       2       3
## 67       6       2       8       9       6       1       3       7
## 68       6       8       1       8       2      10       6       4
## 69       8       6      10       3       4       1       5       7
## 70       6      10       7       5       9       4       7       1
## 71       7       3       8       8       3      10       7      10
## 72       4       3       2       8       1       4       4      10
## 73       6      10       8       5       4       8       6       8
## 74       2       8       5       6       1       5       1       2
## 75       2       7       1       4       9       5       7       3
## 76       5       8       4       5       7       6       4       4
## 77       2      10      10       8       1       4       4       2
## 78       3       3       7       4       9       8       1       9
## 79       5       9       7       8       8       9      10       6
## 80       3       1       1       9      10       6      10       4
## 81       1       9       3       1      10       2       4       7
## 82       4       6       9       5       1       7       5       1
## 83       9       5       6       9       5       9       7      10
## 84       6       2       2       6       9       3       3       1
## 85       2       9       3       3       5       1       5       5
## 86       3       1       5       3       1       1       2       4
## 87       1       9       4       3       9       2       5      10
## 88       6      10       2       1       3       6      10       9
## 89       8       9       8       1       9       6       9       1
## 90       8       4       6       7       7       6       3       1
## 91       5       2       2       1       5      10       7      10
## 92       1       1       8       3       5       9       7       1
## 93       9       5       2       4       6       7       6       8
## 94       4       6       3       7       6       4       7       1
## 95      10       7       5      10       7       2       5       2
## 96       6       7       8       6       1       1      10       8
## 97      10       7       7       4       4       3       1       9
## 98       7       9       8      10      10       8       6       3
## 99       4       7       5       8       9       5       2       8
## 100      2       8       9       2       9      10       4       4
## 101      5      10       8       2       6       2      10       7
## 102      9       4       7       7       3       2       2       1
## 103      9       2       2       4       2       9       2      10
## 104      6       9       7       9       1      10       7       9
## 105      4       6       3       4       6       6       6       5
## 106     10       9       4       2       5       7       5       5
```

```
## 107      7       9       2       9       2       6       6       3
## 108      9       2      10       1       8       5       9       1
## 109      8       8       2       9       7       1       7       2
## 110      7       6       2      10       9       5       4       2
## 111     10       4       4       7       8       2       1       2
## 112      6       4       1       1       3       6       1       9
## 113      8       4       6       7      10       5       5       5
## 114      6       6       7       4       1       5       6       9
## 115      4       9       9       5       5       2       2      10
## 116      7       9       7       6       3       4       6       1
## 117      6       7       3      10       4       4       5       6
## 118      5       7       5       2       2       8       5       1
## 119      9       4       9       5       2       2      10       6
## 120      2       4       2       9       1      10       7       5
## 121      6       4       2       1      10       3       2       3
## 122      5       3       7       1       7       8       7       2
## 123      8       7       4      10       5       1       9       8
## 124      1       6       2       3       2       7       3       1
## 125     10       4       9       3       5      10       9       6
## 126     10       2       1       7       2       3       8       4
## 127      4       4       3       7       5      10       1       8
## 128      2       3       1       7       9       5      10       1
## 129      9       1       6       1       9       7      10       9
## 130      4       5       7       3       3       7       2       2
## 131      3       8       5       5       5       5       3       7
## 132      4       2       6       2       1       5       1       9
## 133      8       8       7      10       5       7       2       7
## 134      5       6       5       8       8       6       1       1
## 135     10      10       7       7       1       6       9       2
## 136      2      10       7       2       4       3       6       6
## 137      9       1       7       6       2       3       2       4
## 138      4       9       1       6       1       8       7       8
## 139      3       5      10       6       7       8       9       7
## 140      9       6       9       6       5       4       6       6
## 141      3       4       5      10       1      10       6       4
## 142     10       7       2       6       2       3      10       3
## 143      9       5       2       2      10       4       6       8
## 144      4       7       1       2       9       1       4       8
## 145     10      10       8       8       6      10       6       5
## 146      9       8       5       5      10       4       2       3
## 147      2       8       1       6       8       1       3      10
## 148      1       7       2       1       3       8       9       5
## 149      4       7       4       8       6       5       5       2
## 150      8       2       3       2      10      10       1       8
## 151      6      10       7       3       4       1       5      10
## 152      3       2       6       4       1       6       6       3
## 153      6       6       2       2       5       1       6       8
## 154      8       6       2       5       3       4      10       8
## 155      1       4       9       3       2       2       1       5
## 156      6       5       6      10      10       3      10       5
## 157     10       8       6       1       5       9       3       4
## 158      2       2       4       7      10       5       2       5
## 159      7       5       1      10       2       2       3       3
## 160      6       4       2       6       6       9       8       5
```

```
## 161      10       1       6       9       8       9       6       7
## 162       6       7       4       9       1       2       6       8
## 163       5       7       6       3       4       2       3       1
## 164      10       4       2       2       8       8       8       7
## 165       8       3       5       1       8       5       8       6
## 166       6      10       8      10       5       5       5       8
## 167       3       9      10       7       6       4       8       7
## 168       5       2       4       8       2       9       7       9
## 169       4       4       5      10       4       2      10       2
## 170      10       4       4       7       7       8       2       6
## 171       9       5       6       3       4       3       8       4
## 172       1       4       6       2      10       1       7       7
## 173       6       8       5       1       2      10       2       7
## 174       5      10       8       3       8      10       6       7
## 175      10       8       9       8       4       8       9       3
## 176       5       3       2       1       6       6      10       2
## 177       7       9       5       2       6       2       8       7
## 178      10       8       8       3       7       6       3       6
## 179       5       3       5      10       1       4       6       2
## 180       8       7       7      10       8       5       1       7
## 181       3       2       5       6      10       9      10       6
## 182      10       8       4       9      10       6       7       2
## 183       5       4       9       3       7       6       1       3
## 184       4       8       4       3       4       2       5      10
## 185       1      10       7       1       3       6       4       9
## 186       5       3      10       4       7       7       5       5
## 187       9       4      10       9      10       4       6       4
## 188       4       9       5       2       3       8      10       4
## 189       9       2       2       9       2       4       8       6
## 190      10       7       4      10       3       3       1       8
## 191      10      10       9       1       9       3       3      10
## 192       9       7       3       2      10       6       3      10
## 193       8       9       6       8       8       6       9       5
## 194       8       7       5       1       5       5       4       5
## 195       8       9       7       6       8       7       7       5
## 196       3       8       1       4       1       7       2       9
## 197       1       9      10       4       3       4       8      10
## 198       2       6      10       6       6       1       7       1
## 199       3       9      10       5      10       6       3       5
## 200       5       7       5       8       6       5      10       8
##     profil9 profil10
## 1         1       10
## 2         4        4
## 3         9        9
## 4         9        5
## 5         5        4
## 6         2        7
## 7        10        3
## 8         4        3
## 9        10        3
## 10        1        7
## 11        5        4
## 12        8       10
## 13        7        6
```

```
## 14        9        7
## 15        6        1
## 16       10        3
## 17        1        3
## 18        5        7
## 19        2        8
## 20        7        4
## 21        7        5
## 22        3        3
## 23        9        5
## 24        8        5
## 25        8        2
## 26        9        8
## 27        7       10
## 28        1        8
## 29        4        8
## 30        9        3
## 31        4        6
## 32        1        5
## 33        3        8
## 34        4        1
## 35        8        8
## 36        1        3
## 37        7        2
## 38       10       10
## 39        6        9
## 40        9        8
## 41        2        2
## 42       10        9
## 43        4        5
## 44        1        4
## 45        9        8
## 46        5        5
## 47        9        4
## 48        9        7
## 49        5        6
## 50        8       10
## 51        9        4
## 52        1        1
## 53        1       10
## 54        7        7
## 55        4        9
## 56        5        3
## 57        5        4
## 58        3        6
## 59        6        1
## 60        2        1
## 61        5        6
## 62        9        3
## 63        6        6
## 64        1        7
## 65       10        5
## 66        1        4
## 67        5        1
```

```
## 68       10        7
## 69        5        3
## 70       10        6
## 71        3        1
## 72        5        6
## 73        1        2
## 74        7        2
## 75        1        6
## 76        2        5
## 77        5        3
## 78        6        4
## 79        9        8
## 80        7        2
## 81        5        4
## 82        3        3
## 83        9       10
## 84        7        4
## 85        2        3
## 86        5        5
## 87        4        6
## 88       10       10
## 89       10        3
## 90        9        8
## 91        6        3
## 92        6        2
## 93        6        6
## 94       10        7
## 95       10        6
## 96       10        2
## 97        3        9
## 98        1        8
## 99        6       10
## 100       2        1
## 101      10        8
## 102       2        1
## 103       2        2
## 104       4       10
## 105       5        5
## 106       7        5
## 107       7        5
## 108       9        3
## 109       9       10
## 110       2        2
## 111       6       10
## 112       9        7
## 113       3        4
## 114      10        1
## 115      10        5
## 116       6        9
## 117       2        8
## 118      10        8
## 119      10        7
## 120       4        8
## 121       2        4
```

```
## 122       7        2
## 123       4        3
## 124       8        7
## 125       7        5
## 126       1        9
## 127       8        6
## 128       3        4
## 129       1        3
## 130       8        3
## 131       6       10
## 132       7        6
## 133       8        8
## 134      10        6
## 135      10        1
## 136      10        7
## 137       2        7
## 138      10        9
## 139       2        2
## 140       4        7
## 141       4        3
## 142       4        5
## 143       6        2
## 144       2        6
## 145       1       10
## 146       4        8
## 147      10        2
## 148       1        4
## 149       8       10
## 150       4        7
## 151       5        8
## 152       2        6
## 153       6        4
## 154       2        2
## 155       4        3
## 156       2        2
## 157       5        5
## 158       9        5
## 159       2        3
## 160       5        5
## 161       4        1
## 162       7        1
## 163       9        4
## 164       4        7
## 165       7        9
## 166       1        2
## 167      10        3
## 168       1        8
## 169       2        1
## 170       5        3
## 171       7        8
## 172      10        8
## 173       6       10
## 174      10        1
## 175       8        9
```

```
## 176       4        3
## 177       8        7
## 178      10        3
## 179       6        5
## 180       7        2
## 181       5        5
## 182      10        5
## 183       6        7
## 184       7        7
## 185       1        1
## 186       5        4
## 187       5        4
## 188      10        3
## 189       1        1
## 190       1        3
## 191       3        6
## 192       1        7
## 193       1        4
## 194      10        5
## 195       7        9
## 196       7        2
## 197       9        2
## 198       3       10
## 199       2        7
## 200       3        2
```

```
caModel(y=sprefm[1,], x=sprof) # all attribute levels with intercept
```

```
##
## Call:
## lm(formula = frml)
##
## Residuals:
##          1          2          3          4          5          6
##  1.571e+00 -2.921e-16  1.262e-15 -5.697e-16  2.714e+00 -1.571e+00
##          7          8          9         10
##  5.406e-16  1.520e-16 -4.286e+00  1.571e+00
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          4.45238    2.48624   1.791    0.215
## factor(x$price)1     3.19048    3.24369   0.984    0.429
## factor(x$price)2    -5.38095    5.57123  -0.966    0.436
## factor(x$size)1      3.23810    2.51255   1.289    0.326
## factor(x$size)2      0.09524    2.51255   0.038    0.973
## factor(x$material)1  2.04762    2.99054   0.685    0.564
## factor(x$material)2 -0.95238    5.57123  -0.171    0.880
## factor(x$sets)1     -0.35714    2.43277  -0.147    0.897
##
## Residual standard error: 4.071 on 2 degrees of freedom
## Multiple R-squared:  0.7064, Adjusted R-squared:  -0.321
## F-statistic: 0.6876 on 7 and 2 DF,  p-value: 0.7037
```

```
Conjoint(y=sprefm, x=sprof, z=slevn) # parameters
```

```
##
## Call:
## lm(formula = frml)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4,8186 -2,3550 -0,1686  2,3393  4,8700
##
## Coefficients:
##                     Estimate Std. Error t value Pr(>|t|)
## (Intercept)          5,26488    0,12450  42,289  < 2e-16 ***
## factor(x$price)1    -0,08952    0,16243  -0,551  0,58158
## factor(x$price)2    -0,20595    0,27898  -0,738  0,46046
## factor(x$size)1     -0,09857    0,12582  -0,783  0,43345
## factor(x$size)2      0,39357    0,12582   3,128  0,00178 **
## factor(x$material)1 -0,09571    0,14975  -0,639  0,52279
## factor(x$material)2  0,34929    0,27898   1,252  0,21071
## factor(x$sets)1     -0,03964    0,12182  -0,325  0,74490
## ---
## Signif. codes:  0 '***' 0,001 '**' 0,01 '*' 0,05 '.' 0,1 ' ' 1
##
## Residual standard error: 2,883 on 1992 degrees of freedom
## Multiple R-squared:  0,007332,   Adjusted R-squared:  0,003844
## F-statistic: 2,102 on 7 and 1992 DF,  p-value: 0,04035
```

```
## [1] "Part worths (utilities) of levels (model parameters for whole sample):"
##           levnms    utls
## 1      intercept  5,2649
## 2          >$250 -0,0895
## 3    $100 - $250  -0,206
## 4          <$100  0,2955
## 5          large -0,0986
## 6         medium  0,3936
## 7          small  -0,295
## 8      polyester -0,0957
## 9  polycarbonate  0,3493
## 10         nylon -0,2536
## 11           yes -0,0396
## 12            no  0,0396
## [1] "Average importance of factors (attributes):"
## [1] 35,50 23,14 26,86 14,50
## [1] Sum of average importance:  100
## [1] "Chart of average factors importance"
```

```
caTotalUtilities(y=sprefm, x=sprof) # compare respondents
```

```
##         [,1] [,2] [,3] [,4]  [,5]   [,6] [,7] [,8]  [,9]  [,10]
##   [1,]  8.429    6    5    3 5.286 11.571    7    1 5.286  8.429
##   [2,]  2.286    5    6    4 2.857  4.714   10    8 2.857  5.286
##   [3,]  6.571   10    8    6 8.714  5.429    3    2 8.714  7.571
##   [4,]  9.429    2    3    1 5.286  9.571    2    2 5.286  5.429
##   [5,]  4.286    5   10   10 3.857  3.714    4    4 3.857  3.286
##   [6,]  5.429    7    4    8 5.286  6.571   10    4 5.286  6.429
##   [7,]  2.857    4    9    7 4.571  3.143    4    7 4.571  4.857
##   [8,]  2.000    6   10    1 4.000  1.000    2    8 4.000  3.000
##   [9,]  3.286    4    9    1 5.857  2.714    1    2 5.857  5.286
##  [10,]  4.000    2    2   10 2.000  7.000    7    3 2.000  5.000
##  [11,]  6.571   10    9    5 3.714  6.429    3    2 3.714  3.571
##  [12,]  8.429    2    2    4 8.286  8.571    6    1 8.286  8.429
##  [13,]  6.286    7    7    4 6.857  7.714    4    4 6.857  8.286
##  [14,]  6.286    5    3    5 8.857  3.714    6    4 8.857  6.286
##  [15,]  8.143    8    6    2 7.429  1.857    9    1 7.429  1.143
##  [16,]  8.571    5    7    4 8.714  3.429    5    5 8.714  3.571
##  [17,]  3.000    8    1    1 4.000  2.000    6    5 4.000  3.000
##  [18,]  8.714    2    3    4 4.143 10.286    2    4 4.143  5.714
##  [19,]  3.429    2    7    3 5.286  3.571    1    5 5.286  5.429
##  [20,]  8.571    6    2    4 8.714  2.429    1    2 8.714  2.571
##  [21,]  1.286    8    6    2 3.857  2.714    2    3 3.857  5.286
##  [22,]  2.857    4    1    9 3.571  2.143    9    4 3.571  2.857
##  [23,]  5.143    1    5    7 4.429  6.857    5    4 4.429  6.143
##  [24,]  6.000    7    2    3 8.000  5.000    7    2 8.000  7.000
##  [25,]  9.857    1    1    9 5.571  8.143    6    2 5.571  3.857
##  [26,]  5.286    5    6   10 9.857  2.714    9   10 9.857  7.286
##  [27,]  7.714   10    4    3 7.143  9.286    1    9 7.143  8.714
##  [28,]  3.429    6    4    6 3.286  8.571    3    5 3.286  8.429
##  [29,]  9.000    5    3    1 6.000 10.000    4    2 6.000  7.000
##  [30,]  9.429    8    7   10 7.286  7.571    1    8 7.286  5.429
##  [31,]  7.714    1    4   10 4.143  9.286    7    9 4.143  5.714
##  [32,]  5.857    1   10    3 4.571  6.143    4    9 4.571  4.857
##  [33,]  2.429    3    2    4 6.286  3.571    2    5 6.286  7.429
##  [34,]  8.143    4    3   10 3.429  3.857    1    3 3.429 -0.857
##  [35,]  7.286    7    3    9 5.857  9.714    6   10 5.857  8.286
##  [36,]  9.143    3    3    1 5.429  6.857    6    4 5.429  3.143
##  [37,]  6.571    2    7    6 4.714  2.429    7    8 4.714  0.571
##  [38,]  6.857    2    1    2 9.571  4.143    4   10 9.571  6.857
##  [39,]  8.571    2    8    9 7.714  8.429    4    2 7.714  7.571
##  [40,]  6.429    6    9    2 9.286  3.571    9    2 9.286  6.429
##  [41,]  9.143    4    5    2 4.429  7.857    4    1 4.429  3.143
##  [42,]  5.000   10    4    9 9.000  7.000    9    9 9.000 11.000
##  [43,]  6.143    8    1    1 5.429  3.857   10   10 5.429  3.143
##  [44,]  7.286    1    5    5 4.857  4.714    2    3 4.857  2.286
##  [45,]  8.857    9    3    4 8.571  8.143    4    3 8.571  7.857
##  [46,]  3.286    9    1   10 3.857  3.714    6    9 3.857  4.286
##  [47,]  5.714    4    3    4 5.143  4.286    4    2 5.143  3.714
##  [48,]  1.429    3    8    2 8.286  0.571    7    3 8.286  7.429
##  [49,]  6.429    4    2    5 7.286  5.571    2   10 7.286  6.429
##  [50,]  3.429   10    7    2 9.286  3.571    5    3 9.286  9.429
##  [51,]  6.714    9    2    1 7.143  4.286    9    4 7.143  4.714
##  [52,]  5.286    3    6   10 2.857  5.714    8    9 2.857  3.286
```

```
##  [53,]  3.857    8    1    1 5.571  6.143    8    4 5.571  7.857
##  [54,]  3.429    9    4   10 7.286  5.571    2    5 7.286  9.429
##  [55,]  2.571    2    4    2 5.714  5.429    2    1 5.714  8.571
##  [56,]  5.429    1    4   10 5.286  2.571    6    1 5.286  2.429
##  [57,]  7.143    3    6    8 5.429  4.857    5    2 5.429  3.143
##  [58,]  2.286    9    5    7 4.857  2.714    6    8 4.857  5.286
##  [59,]  4.571    5    4    3 4.714  1.429    4    2 4.714  1.571
##  [60,]  3.000    3    9    1 2.000  3.000    5    6 2.000  2.000
##  [61,]  8.571    6    4    7 5.714  9.429   10    9 5.714  6.571
##  [62,]  5.000    4    1    6 7.000  5.000    8    3 7.000  7.000
##  [63,]  5.286    5    3    3 7.857  2.714    1   10 7.857  5.286
##  [64,]  3.714   10    9    2 5.143  5.286    8    9 5.143  6.714
##  [65,]  4.857    4    6    1 7.571  3.143    6   10 7.571  5.857
##  [66,]  6.143    4    8   10 5.429  4.857    2    3 5.429  4.143
##  [67,]  5.857    2    8    9 5.571  1.143    3    7 5.571  0.857
##  [68,]  6.857    8    1    8 5.571  9.143    6    4 5.571  7.857
##  [69,]  6.429    6   10    3 5.286  2.571    5    7 5.286  1.429
##  [70,]  6.429   10    7    5 9.286  3.571    7    1 9.286  6.429
##  [71,]  8.429    3    8    8 2.286  8.571    7   10 2.286  2.429
##  [72,]  3.143    3    2    8 3.429  4.857    4   10 3.429  5.143
##  [73,]  6.714   10    8    5 2.143  7.286    6    8 2.143  2.714
##  [74,]  3.429    8    5    6 3.286  3.571    1    2 3.286  3.429
##  [75,]  2.571    7    1    4 4.714  4.429    7    3 4.714  6.571
##  [76,]  5.143    8    4    5 4.429  5.857    4    4 4.429  5.143
##  [77,]  2.571   10   10    8 2.714  3.429    4    2 2.714  3.571
##  [78,]  5.429    3    7    4 6.286  5.571    1    9 6.286  6.429
##  [79,]  6.286    9    7    8 7.857  7.714   10    6 7.857  9.286
##  [80,]  5.714    1    1    9 7.143  3.286   10    4 7.143  4.714
##  [81,]  2.286    9    3    1 6.857  0.714    4    7 6.857  5.286
##  [82,]  4.571    6    9    5 1.714  6.429    5    1 1.714  3.571
##  [83,]  8.143    5    6    9 7.429  9.857    7   10 7.429  9.143
##  [84,]  6.286    2    2    6 7.857  2.714    3    1 7.857  4.286
##  [85,]  1.857    9    3    3 3.571  1.143    5    5 3.571  2.857
##  [86,]  1.857    1    5    3 3.571  2.143    2    4 3.571  3.857
##  [87,]  1.429    9    4    3 6.286  1.571    5   10 6.286  6.429
##  [88,]  5.000   10    2    1 7.000  7.000   10    9 7.000  9.000
##  [89,]  9.286    9    8    1 8.857  4.714    9    1 8.857  4.286
##  [90,]  7.429    4    6    7 8.286  6.571    3    1 8.286  7.429
##  [91,]  7.143    2    2    1 4.429  7.857    7   10 4.429  5.143
##  [92,]  4.286    1    8    3 3.857  5.714    7    1 3.857  5.286
##  [93,]  8.429    5    2    4 6.286  7.571    6    8 6.286  5.429
##  [94,]  4.286    6    3    7 7.857  3.714    7    1 7.857  7.286
##  [95,]  8.429    7    5   10 9.286  3.571    5    2 9.286  4.429
##  [96,]  5.571    7    8    6 5.714  1.429   10    8 5.714  1.571
##  [97,]  6.429    7    7    4 5.286  6.571    1    9 5.286  5.429
##  [98,]  6.571    9    8   10 5.714  8.429    6    3 5.714  7.571
##  [99,]  3.571    7    5    8 7.714  5.429    2    8 7.714  9.571
## [100,]  5.571    8    9    2 3.714  6.429    4    4 3.714  4.571
## [101,]  4.143   10    8    2 8.429  2.857   10    7 8.429  7.143
## [102,]  7.429    4    7    7 3.286  3.571    2    1 3.286 -0.571
## [103,]  9.000    2    2    4 2.000  9.000    2   10 2.000  2.000
## [104,]  5.000    9    7    9 3.000 11.000    7    9 3.000  9.000
## [105,]  4.714    6    3    4 5.143  5.286    6    5 5.143  5.714
## [106,]  9.429    9    4    2 6.286  7.571    5    5 6.286  4.429
```

```
## [107,]  6.571    9    2    9 4.714  6.429    6    3 4.714  4.571
## [108,]  9.429    2   10    1 8.286  4.571    9    1 8.286  3.429
## [109,]  5.429    8    2    9 9.286  3.571    7    2 9.286  7.429
## [110,]  7.429    6    2   10 5.286  4.571    4    2 5.286  2.429
## [111,]  6.857    4    4    7 8.571  5.143    1    2 8.571  6.857
## [112,]  5.714    4    1    1 6.143  6.286    1    9 6.143  6.714
## [113,]  7.857    4    6    7 6.571  5.143    5    5 6.571  3.857
## [114,]  7.000    6    7    4 5.000  4.000    6    9 5.000  2.000
## [115,]  4.143    9    9    5 7.429  1.857    2   10 7.429  5.143
## [116,]  4.857    9    7    6 5.571  6.143    6    1 5.571  6.857
## [117,]  4.000    7    3   10 4.000  6.000    5    6 4.000  6.000
## [118,]  5.286    7    5    2 5.857  7.714    5    1 5.857  8.286
## [119,]  6.714    4    9    5 7.143  4.286   10    6 7.143  4.714
## [120,]  2.714    4    2    9 2.143  9.286    7    5 2.143  8.714
## [121,]  5.714    4    2    1 6.143  3.286    2    3 6.143  3.714
## [122,]  7.286    3    7    1 5.857  5.714    7    2 5.857  4.286
## [123,]  6.429    7    4   10 5.286  2.571    9    8 5.286  1.429
## [124,]  2.143    6    2    3 4.429  5.857    3    1 4.429  8.143
## [125,] 10.286    4    9    3 5.857  9.714    9    6 5.857  5.286
## [126,]  5.857    2    1    7 3.571  7.143    8    4 3.571  4.857
## [127,]  5.857    4    3    7 5.571  8.143    1    8 5.571  7.857
## [128,]  3.429    3    1    7 5.286  3.571   10    1 5.286  5.429
## [129,]  9.000    1    6    1 5.000  7.000   10    9 5.000  3.000
## [130,]  5.571    5    7    3 4.714  5.429    2    2 4.714  4.571
## [131,]  2.286    8    5    5 5.857  5.714    3    7 5.857  9.286
## [132,]  3.714    2    6    2 4.143  5.286    1    9 4.143  5.714
## [133,]  7.286    8    7   10 6.857  7.714    2    7 6.857  7.286
## [134,]  6.143    6    5    8 8.429  4.857    1    1 8.429  7.143
## [135,] 10.143   10    7    7 5.429  5.857    9    2 5.429  1.143
## [136,]  2.286   10    7    2 6.857  2.714    6    6 6.857  7.286
## [137,]  5.857    1    7    6 3.571  6.143    2    4 3.571  3.857
## [138,]  4.143    9    1    6 5.429  7.857    7    8 5.429  9.143
## [139,]  5.143    5   10    6 3.429  5.857    9    7 3.429  4.143
## [140,]  6.857    6    9    6 5.571  6.143    6    6 5.571  4.857
## [141,]  4.857    4    5   10 1.571  8.143    6    4 1.571  4.857
## [142,]  7.429    7    2    6 4.286  5.571   10    3 4.286  2.429
## [143,]  9.286    5    2    2 7.857  3.714    6    8 7.857  2.286
## [144,]  3.000    7    1    2 6.000  2.000    4    8 6.000  5.000
## [145,]  8.143   10    8    8 4.429 11.857    6    5 4.429  8.143
## [146,]  7.286    8    5    5 7.857  5.714    2    3 7.857  6.286
## [147,]  3.714    8    1    6 8.143 -0.714    3   10 8.143  3.714
## [148,]  2.429    7    2    1 1.286  6.571    9    5 1.286  5.429
## [149,]  3.429    7    4    8 7.286  5.571    5    2 7.286  9.429
## [150,]  8.571    2    3    2 6.714  9.429    1    8 6.714  7.571
## [151,]  3.571   10    7    3 5.714  3.429    5   10 5.714  5.571
## [152,]  2.571    2    6    4 1.714  6.429    6    3 1.714  5.571
## [153,]  5.000    6    2    2 6.000  2.000    6    8 6.000  3.000
## [154,]  7.000    6    2    5 3.000  5.000   10    8 3.000  1.000
## [155,]  1.286    4    9    3 2.857  1.714    1    5 2.857  3.286
## [156,]  6.286    5    6   10 5.857  2.714   10    5 5.857  2.286
## [157,]  9.714    8    6    1 5.143  9.286    3    4 5.143  4.714
## [158,]  4.143    2    4    7 8.429  2.857    2    5 8.429  7.143
## [159,]  5.286    5    1   10 2.857  3.714    3    3 2.857  1.286
## [160,]  7.000    4    2    6 5.000  8.000    8    5 5.000  6.000
```

```
## [161,] 11.143    1    6    9 5.429  7.857    6    7 5.429  2.143
## [162,]  5.714    7    4    9 4.143  2.286    6    8 4.143  0.714
## [163,]  4.857    7    6    3 6.571  2.143    3    1 6.571  3.857
## [164,]  9.143    4    2    2 6.429  8.857    8    7 6.429  6.143
## [165,]  6.714    3    5    1 8.143  6.286    8    6 8.143  7.714
## [166,]  6.000   10    8   10 3.000  5.000    5    8 3.000  2.000
## [167,]  4.714    9   10    7 7.143  2.286    8    7 7.143  4.714
## [168,]  4.286    2    4    8 1.857  9.714    7    9 1.857  7.286
## [169,]  4.000    4    5   10 3.000  2.000   10    2 3.000  1.000
## [170,] 10.286    4    4    7 5.857  7.714    2    6 5.857  3.286
## [171,]  6.571    5    6    3 6.714  5.429    8    4 6.714  5.571
## [172,]  1.571    4    6    2 9.714  0.429    7    7 9.714  8.571
## [173,]  5.429    8    5    1 4.286 10.571    2    7 4.286  9.429
## [174,]  8.714   10    8    3 7.143  6.286    6    7 7.143  4.714
## [175,]  8.571    8    9    8 6.714  9.429    9    3 6.714  7.571
## [176,]  5.857    3    2    1 4.571  5.143   10    2 4.571  3.857
## [177,]  5.571    9    5    2 7.714  3.429    8    7 7.714  5.571
## [178,] 10.429    8    8    3 8.286  5.571    3    6 8.286  3.429
## [179,]  4.286    3    5   10 3.857  4.714    6    2 3.857  4.286
## [180,]  8.714    7    7   10 7.143  4.286    1    7 7.143  2.714
## [181,]  5.429    2    5    6 6.286  6.571   10    6 6.286  7.429
## [182,] 10.286    8    4    9 9.857  5.714    7    2 9.857  5.286
## [183,]  5.143    4    9    3 6.429  5.857    1    3 6.429  7.143
## [184,]  3.000    8    4    3 6.000  3.000    5   10 6.000  6.000
## [185,]  2.714   10    7    1 1.143  4.286    4    9 1.143  2.714
## [186,]  6.143    3   10    4 5.429  5.857    5    5 5.429  5.143
## [187,]  8.571    4   10    9 7.714  4.429    6    4 7.714  3.571
## [188,]  6.143    9    5    2 5.429  5.857   10    4 5.429  5.143
## [189,]  7.714    2    2    9 2.143  5.286    8    6 2.143 -0.286
## [190,]  7.714    7    4   10 3.143  5.286    1    8 3.143  0.714
## [191,]  8.000   10    9    1 7.000  5.000    3   10 7.000  4.000
## [192,]  7.714    7    3    2 6.143  7.286    3   10 6.143  5.714
## [193,]  7.571    9    6    8 4.714  6.429    9    5 4.714  3.571
## [194,]  7.857    7    5    1 7.571  5.143    4    5 7.571  4.857
## [195,]  7.286    9    7    6 7.857  7.714    7    5 7.857  8.286
## [196,]  4.714    8    1    4 3.143  5.286    2    9 3.143  3.714
## [197,]  3.000    9   10    4 5.000  2.000    8   10 5.000  4.000
## [198,]  0.143    6   10    6 5.429  2.857    7    1 5.429  8.143
## [199,]  3.571    9   10    5 5.714  5.429    3    5 5.714  7.571
## [200,]  5.714    7    5    8 4.143  4.286   10    8 4.143  2.714
```

```
caSegmentation(y=sprefm, x=sprof, c=3) # clusters
```

```
## K-means clustering with 3 clusters of sizes 67, 62, 71
##
## Cluster means:
##       [,1]     [,2]     [,3]     [,4]     [,5]     [,6]     [,7]     [,8]
## 1 4.238806 6.194030 4.865672 3.059701 5.537313 4.283582 4.014925 6.865672
## 2 6.000016 4.338710 4.612903 7.612903 4.032258 5.661274 6.403226 5.306452
## 3 7.150986 6.535211 5.830986 5.084507 7.199239 6.018028 5.704225 3.732394
##       [,9]    [,10]
## 1 5.537313 5.582090
## 2 4.032258 3.693565
## 3 7.199239 6.066479
##
## Clustering vector:
##   [1] 3 2 3 3 2 2 1 1 1 2 3 3 3 3 3 3 1 2 1 3 1 2 2 3 2 3 1 1 3 3 2 1 1 2 2
##  [36] 3 2 1 3 3 3 3 1 2 3 2 2 1 1 3 3 2 1 3 1 2 2 1 1 1 2 3 1 1 1 2 2 3 1 3
##  [71] 2 2 2 1 1 1 2 1 3 2 1 2 3 3 1 1 1 1 3 3 1 2 3 3 3 2 1 3 1 1 3 2 2 2 1
## [106] 3 2 3 3 2 3 1 3 1 1 3 2 3 3 2 1 3 2 1 3 2 1 2 2 1 1 1 3 3 3 1 2 1 2 3
## [141] 2 2 1 1 3 3 1 1 3 1 1 2 1 2 1 2 3 1 2 2 2 2 3 3 3 2 3 2 2 2 3 1 1 3 3
## [176] 2 1 3 2 3 2 3 3 1 1 3 3 3 2 2 1 1 2 3 3 1 1 3 1 2
##
## Within cluster sum of squares by cluster:
## [1] 3529.905 3290.644 3670.672
##  (between_SS / total_SS =  20.6 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"
## [5] "tot.withinss" "betweenss"    "size"         "iter"
## [9] "ifault"
```

```
library(arules)
```

```
## Loading required package: Matrix
```

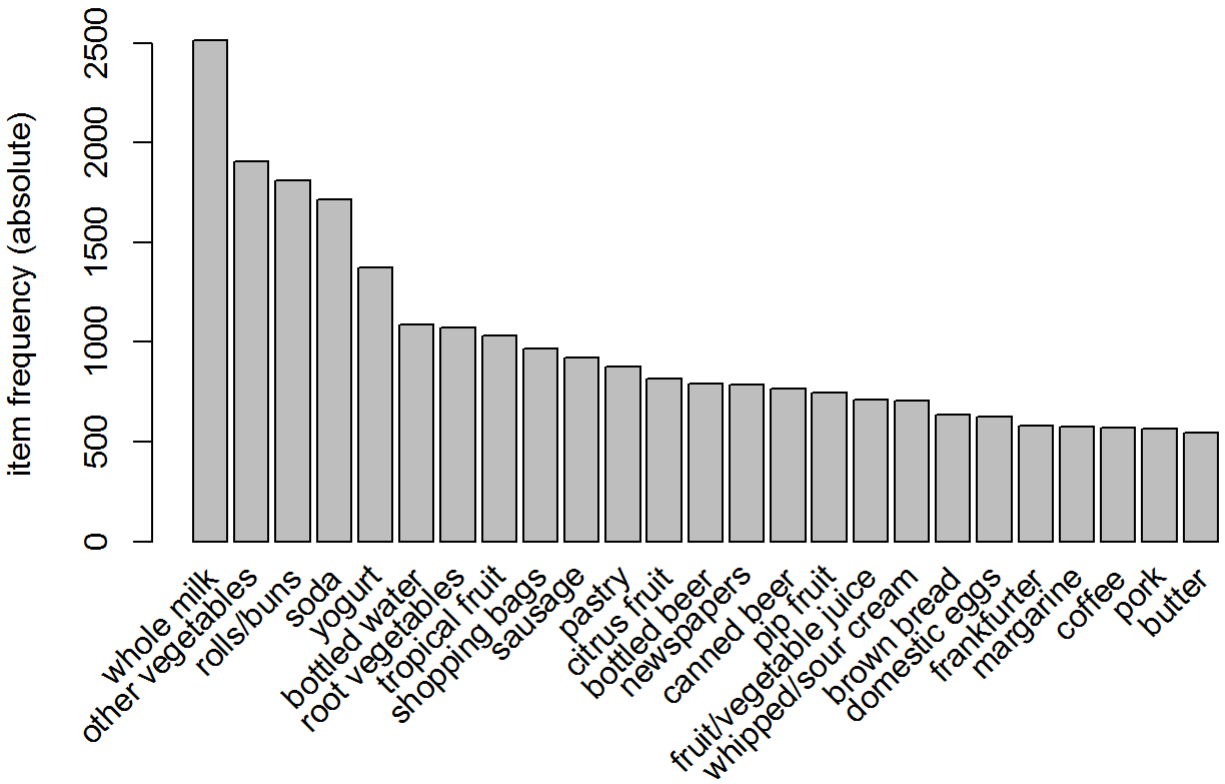
```
##
## Attaching package: 'arules'
```

```
## The following objects are masked from 'package:base':
##
##     abbreviate, write
```

```
library(arulesViz)
```

```
## Loading required package: grid
```

```
library(datasets)
data(Groceries)
itemFrequencyPlot(Groceries,topN=25,type="absolute")
```




```
rules <- apriori(Groceries, parameter = list(supp = 0.001, conf = 0.8))
```

```
## Apriori
##
## Parameter specification:
##  confidence minval smax arem  aval originalSupport maxtime support minlen
##         0.8    0.1    1 none FALSE            TRUE       5   0.001      1
##  maxlen target   ext
##      10  rules FALSE
##
## Algorithmic control:
##  filter tree heap memopt load sort verbose
##     0.1 TRUE TRUE  FALSE TRUE    2    TRUE
##
## Absolute minimum support count: 9
##
## set item appearances ...[0 item(s)] done [0.00s].
## set transactions ...[169 item(s), 9835 transaction(s)] done [0.00s].
## sorting and recoding items ... [157 item(s)] done [0.00s].
## creating transaction tree ... done [0.00s].
## checking subsets of size 1 2 3 4 5 6 done [0.01s].
## writing ... [410 rule(s)] done [0.00s].
## creating S4 object  ... done [0.00s].
```

```
options(digits=2)
inspect(rules[1:5])
```

```
##     lhs                          rhs            support confidence lift
## [1] {liquor,red/blush wine} => {bottled beer} 0.0019  0.90       11.2
## [2] {curd,cereals}          => {whole milk}   0.0010  0.91        3.6
## [3] {yogurt,cereals}        => {whole milk}   0.0017  0.81        3.2
## [4] {butter,jam}            => {whole milk}   0.0010  0.83        3.3
## [5] {soups,bottled beer}    => {whole milk}   0.0011  0.92        3.6
```

```
rules<-sort(rules, by="confidence", decreasing=TRUE)


subset.matrix <- is.subset(rules, rules)
subset.matrix[lower.tri(subset.matrix, diag=T)] <- NA
redundant <- colSums(subset.matrix, na.rm=T) >= 1
rules.pruned <- rules[!redundant]
rules<-rules.pruned

rules<-apriori(data=Groceries, parameter=list(supp=0.001,conf = 0.08),
               appearance = list(default="lhs",rhs="soda"),
               control = list(verbose=F))
rules<-sort(rules, decreasing=TRUE,by="confidence")
inspect(rules[1:5])
```

```
##     lhs                   rhs    support confidence lift
## [1] {coffee,
##      misc. beverages} => {soda}  0.0010       0.77  4.4
## [2] {yogurt,
##      rolls/buns,
##      bottled water,
##      newspapers}      => {soda}  0.0010       0.77  4.4
## [3] {sausage,
##      bottled water,
##      bottled beer}    => {soda}  0.0011       0.73  4.2
## [4] {sausage,
##      white bread,
##      shopping bags}   => {soda}  0.0010       0.67  3.8
## [5] {rolls/buns,
##      bottled water,
##      chocolate}       => {soda}  0.0013       0.65  3.7
```

```
rules<-apriori(data=Groceries, parameter=list(supp=0.001,conf = 0.15,minlen=2),
               appearance = list(default="rhs",lhs="soda"),
               control = list(verbose=F))
rules<-sort(rules, decreasing=TRUE,by="confidence")
inspect(rules[1:5])
```

```
##     lhs       rhs                support confidence lift
## [1] {soda} => {whole milk}       0.040   0.23       0.90
## [2] {soda} => {rolls/buns}       0.038   0.22       1.20
## [3] {soda} => {other vegetables} 0.033   0.19       0.97
## [4] {soda} => {bottled water}    0.029   0.17       1.50
## [5] {soda} => {yogurt}           0.027   0.16       1.12
```

```
library(arulesViz)
plot(rules,method="graph",interactive=TRUE,shading=NA)
```

```
require(ggplot2)
```

```
## Loading required package: ggplot2
```

```
bank = read.csv("D:/Business Analytics/LIBA Class Room Materials/Prof Rajesh/assignment/bank.cs
v", header = TRUE, stringsAsFactors = FALSE)
str(bank)
```

```
## 'data.frame':    4521 obs. of  9 variables:
##  $ age      : int  30 33 35 30 59 35 36 39 41 43 ...
##  $ Jobtype  : int  3 2 1 1 2 1 1 2 1 2 ...
##  $ marital  : chr  "married" "married" "single" "married" ...
##  $ education: chr  "primary" "secondary" "tertiary" "tertiary" ...
##  $ default  : chr  "no" "no" "no" "no" ...
##  $ balance  : int  1787 4789 1350 1476 0 747 307 147 221 -88 ...
##  $ housing  : chr  "no" "yes" "yes" "yes" ...
##  $ loan     : chr  "no" "yes" "no" "yes" ...
##  $ response : chr  "no" "no" "no" "no" ...
```

```
bank$jobtype=as.factor(bank$Jobtype)
bank$jobtype = factor(bank$jobtype, levels = c(1, 2, 3),
                      labels = c("1", "2", "3"))
bank$marital = factor(bank$marital,
    labels = c("Divorced", "Married", "Single"))
bank$education = factor(bank$education,
    labels = c("Primary", "Secondary", "Tertiary", "Unknown"))
bank$default = factor(bank$default, labels = c("No", "Yes"))
bank$housing = factor(bank$housing, labels = c("No", "Yes"))
bank$loan = factor(bank$loan, labels = c("No", "Yes"))
bank$response = factor(bank$response, labels = c("No", "Yes"))
bank2 = subset(bank, select = c("response", "age", "jobtype", "marital", "education","default",
"balance", "housing", "loan"))
str(bank2 )
```

```
## 'data.frame':    4521 obs. of  9 variables:
##  $ response : Factor w/ 2 levels "No","Yes": 1 1 1 1 1 1 1 1 1 1 ...
##  $ age      : int  30 33 35 30 59 35 36 39 41 43 ...
##  $ jobtype  : Factor w/ 3 levels "1","2","3": 3 2 1 1 2 1 1 2 1 2 ...
##  $ marital  : Factor w/ 3 levels "Divorced","Married",..: 2 2 3 2 2 3 2 2 2 2 ...
##  $ education: Factor w/ 4 levels "Primary","Secondary",..: 1 2 3 3 2 3 3 2 3 1 ...
##  $ default  : Factor w/ 2 levels "No","Yes": 1 1 1 1 1 1 1 1 1 1 ...
##  $ balance  : int  1787 4789 1350 1476 0 747 307 147 221 -88 ...
##  $ housing  : Factor w/ 2 levels "No","Yes": 1 2 2 2 2 1 2 2 2 2 ...
##  $ loan     : Factor w/ 2 levels "No","Yes": 1 2 1 2 1 1 1 1 1 2 ...
```

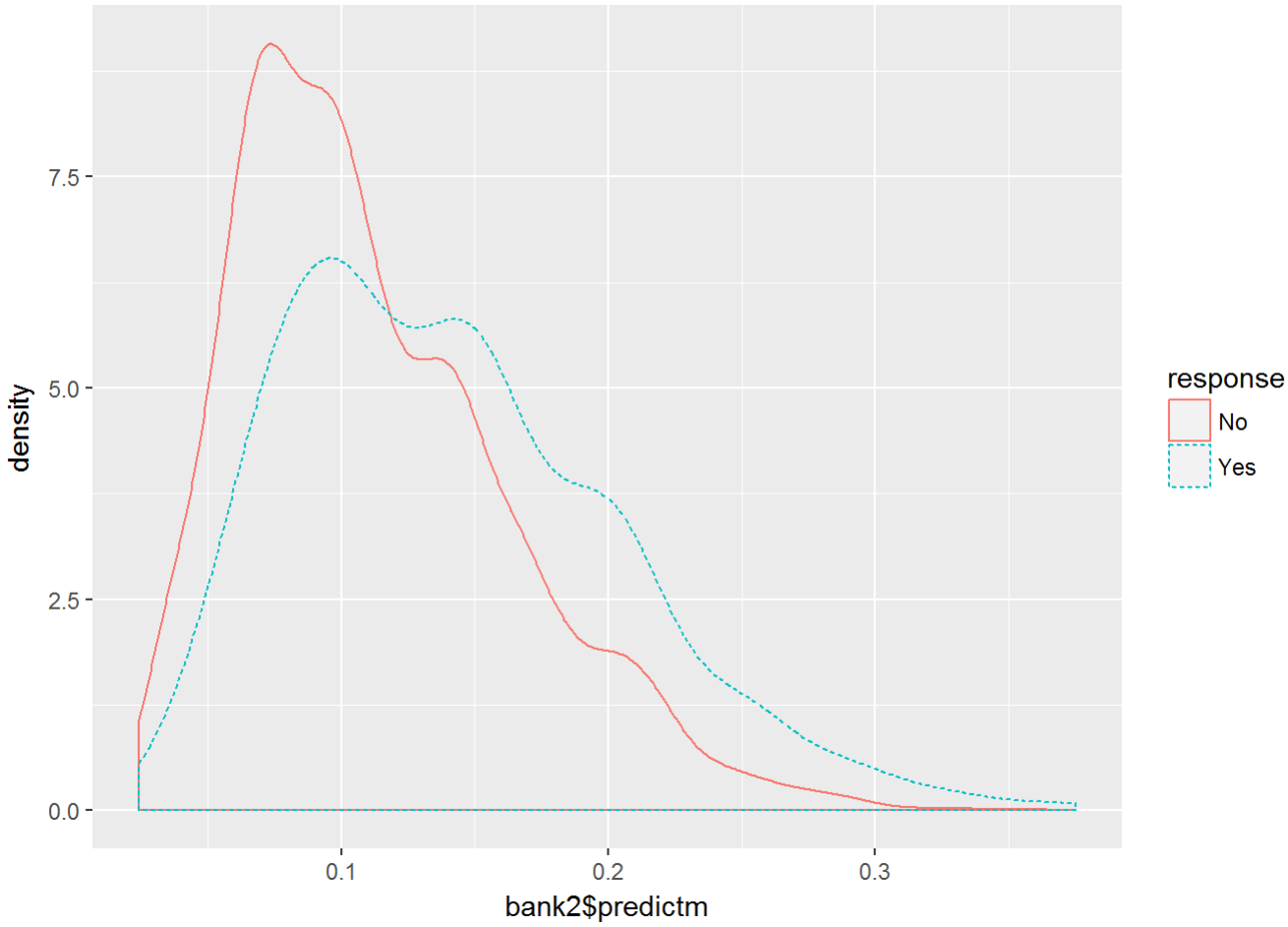
```
summary(bank2 )
```

```
##  response        age           jobtype      marital         education
##  No :4000   Min.   :19   1:1798   Divorced: 528   Primary  : 678
##  Yes: 521   1st Qu.:33   2:2131   Married :2797   Secondary:2306
##             Median :39   3: 592   Single  :1196   Tertiary :1350
##             Mean   :41                            Unknown  : 187
##             3rd Qu.:49
##             Max.   :87
##  default       balance      housing     loan
##  No :4445   Min.   :-3313   No :1962   No :3830
##  Yes:  76   1st Qu.:   69   Yes:2559   Yes: 691
##             Median :  444
##             Mean   : 1423
##             3rd Qu.: 1480
##             Max.   :71188
```

```
bankf = {response ~ age + jobtype + education + marital + default + balance + housing + loan}
bankmodel = glm(bankf, family=binomial, data=bank2 )
summary(bankmodel)
```

```
##
## Call:
## glm(formula = bankf, family = binomial, data = bank2)
##
## Deviance Residuals:
##    Min      1Q  Median      3Q     Max
## -0.939  -0.543  -0.444  -0.361   2.622
##
## Coefficients:
##              Estimate Std. Error z value Pr(>|z|)
## (Intercept) -2.71e+00   2.98e-01   -9.07  < 2e-16 ***
## age          1.25e-02   5.04e-03    2.47   0.0133 *
## jobtype1    -5.37e-02   7.41e-02   -0.73   0.4680
## jobtype2    -2.36e-01   7.32e-02   -3.22   0.0013 **
## education1  -1.59e-01   1.25e-01   -1.27   0.2039
## education2   1.24e-01   9.14e-02    1.36   0.1743
## education3   2.92e-01   1.03e-01    2.84   0.0045 **
## marital1     1.22e-01   9.39e-02    1.30   0.1936
## marital2    -2.77e-01   6.82e-02   -4.06  4.9e-05 ***
## default1    -7.90e-02   1.82e-01   -0.43   0.6649
## balance      9.46e-07   1.47e-05    0.06   0.9487
## housing1     2.47e-01   4.99e-02    4.95  7.6e-07 ***
## loan1        3.60e-01   8.37e-02    4.30  1.7e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 3231.0  on 4520  degrees of freedom
## Residual deviance: 3108.1  on 4508  degrees of freedom
## AIC: 3134
##
## Number of Fisher Scoring iterations: 5
```

```
bank2$predictm = predict.glm(bankmodel, type = "response")
ggplot(bank2,aes(x=bank2$predictm, color=response, linetype=response))+ geom_density()
```




```
bank2$Predictm =ifelse((bank2 $predictm > 0.1), 1, 0) #@10% cutoff
bank2$Predictm = factor(bank2$Predictm,levels = c(0, 1), labels = c("NO", "YES"))
confusion_matrix = table(bank2$Predictm, bank2$response)
print(confusion_matrix)
```

```
##
##         No  Yes
##   NO  1978  160
##   YES 2022  361
```