Appendix IV

ISyE 6414-Group Project

Part 1: Data Loading

```
> #Read dataframe
> whole.df = read.csv('ESS8e02.1_F1.csv', head=T)
>
> # focus on how political attitude and behavior influence subjective happiness
> # include basic demographic variables as control variables (e.g gender, age, education level etc.)
> variables = c("happy","gndr","agea","edulvlb",
+               "hinctnta","pdwrk","health","psppsgva",
+               "actrolga","psppipla","cptppola","trstprl",
+               "trstlgl","trstplc","trstplt","trstprt","trstep",
+               "trstun", "stflife","stfeco","stfgov","stfdem","stfedu",
+               "stfhlth", "contplt","wrkprty","wrkorg","badge",
+               "sgnptit","pbldmn","bctprd","pstplonl")
> target.df = whole.df[,variables]
```

Part 2: Data Cleaning

Explore the Missing Value

```
> # response variable
> target.df[target.df$happy == 77, 'happy'] = -1
> target.df[target.df$happy == 88, 'happy'] = -1
> target.df[target.df$happy == 99, 'happy'] = -1
> target.df[target.df$happy == -1, 'happy'] = NA
>
> # gender
> target.df[target.df$gndr == 9, 'gndr'] = NA
>
> # age
> target.df[target.df$agea == 999, 'agea'] = NA
>
> # level of education
> target.df[target.df$edulvlb == 5555, 'edulvlb'] = -1
> target.df[target.df$edulvlb == 7777, 'edulvlb'] = -1
> target.df[target.df$edulvlb == 8888, 'edulvlb'] = -1
> target.df[target.df$edulvlb == 9999, 'edulvlb'] = -1
> target.df[target.df$edulvlb == -1, 'edulvlb'] = NA
>
> # household income
> target.df[target.df$hinctnta == 77, 'hinctnta'] = -1
> target.df[target.df$hinctnta == 88, 'hinctnta'] = -1
> target.df[target.df$hinctnta == 99, 'hinctnta'] = -1
> target.df[target.df$hinctnta == -1, 'hinctnta'] = NA
>
> # health
> target.df[target.df$health == 7, 'health'] = -1
> target.df[target.df$health == 8, 'health'] = -1
> target.df[target.df$health == 9, 'health'] = -1
> target.df[target.df$health == -1, 'health'] = NA
```

```
>
> # political related behavior
> politicalBehavior_feature = c("contplt","wrkprty","wrkorg",
+                                "badge","sgnptit","pbldmn",
+                                "bctprd","pstplonl")
> for (feature in politicalBehavior_feature) {
+   print(feature)
+   print(table(target.df[feature]))
+   target.df[target.df[feature] == 7, feature] = -1
+   target.df[target.df[feature] == 8, feature] = -1
+   target.df[target.df[feature] == 9, feature] = -1
+   target.df[target.df[feature] == -1, feature] = NA
+ }
```

```
[1] "contplt"

    1     2     7     8     9
 6774 37491    56    62     4
[1] "wrkprty"

    1     2     7     8     9
 1884 42391    56    48     8
[1] "wrkorg"

    1     2     7     8     9
 7159 37099    53    65    11
[1] "badge"

    1     2     7     8     9
 3795 40466    59    60     7
[1] "sgnptit"

    1     2     7     8     9
10664 33535    58   124     6
[1] "pbldmn"

    1     2     7     8     9
 3408 40844    60    64    11
[1] "bctprd"

    1     2     7     8     9
 7954 36219    57   148     9
[1] "pstplonl"

    1     2     7     8     9
 7270 36941    65   105     6
```

```
> # 5 points scale(1-5) variables; missing values: 7, 8, 9
> var_5points = c("psppsgva","actrolga","psppipla","cptppola")
> for (feature in var_5points) {
+   target.df[target.df[feature] == 7, feature] = -1
+   target.df[target.df[feature] == 8, feature] = -1
+   target.df[target.df[feature] == 9, feature] = -1
+   target.df[target.df[feature] == -1, feature] = NA
```

```
+ }
>
> # 11 points scale(0-10) variables; missing values: 77, 88, 99
> var_11points = c("trstprl","trstlgl","trstplc","trstplt",
+                  "trstprt","trstep","trstun","stflife",
+                  "stfeco","stfgov","stfdem","stfedu","stfhlth")
> for (feature in var_11points) {
+   target.df[target.df[feature] == 77, feature] = -1
+   target.df[target.df[feature] == 88, feature] = -1
+   target.df[target.df[feature] == 99, feature] = -1
+   target.df[target.df[feature] == -1, feature] = NA
+ }
```

```
> # number of missing value in each features
> sapply(target.df, function(x) sum(is.na(x)))
```

```
   happy     gndr     agea  edulvlb hinctnta    pdwrk   health psppsgva
     215        9      155      217     7942        0       59      958
actrolga psppipla cptppola  trstprl  trstlgl  trstplc  trstplt  trstprt
     935      842      998      873      849      320      646      855
  trstep   trstun  stflife   stfeco   stfgov   stfdem   stfedu  stfhlth
    3463     3459      187      886     1161     1491     1569      317
 contplt  wrkprty   wrkorg    badge  sgnptit   pbldmn   bctprd pstplonl
     122      112      129      126      188      135      214      176
```

```
> # number of missing value for each participant
> target.df$na_count = apply(target.df, 1, function(x) sum(is.na(x)))
> table(target.df$na_count)
```

```
    0     1     2     3     4     5     6     7     8     9    10    11
29738  8779  2725  1290   655   371   239   157   129    84    62    49
   12    13    14    15    16    17    18    19    20    24    25    26
   33    28    15     9     8     4     3     4     1     1     1     1
   28
    1
```

Data Cleaning

```
> # omit the participants whose number of missing value is larger than 5
> target.df = target.df[target.df$na_count <= 5,]
```

```
> # Feature Exploration/Reduction and Modification -
> # "psppsgva","actrolga","psppipla","cptppola"
>
> var_5points = c("psppsgva","actrolga","psppipla","cptppola")
>
> # impute missing value by mode
> getmode = function(v) {
+   uniqv = unique(v)
+   uniqv[which.max(tabulate(match(v,uniqv)))]
+ }
>
> for (feature in var_5points) {
+   v = target.df[is.na(target.df[feature]) == F, feature]
```

```
+   target.df[is.na(target.df[feature]) == T, feature] = getmode(v)
+ }
>
> library(plyr)
> target.df$psppsgva = factor(target.df$psppsgva)
> target.df$psppsgva = revalue(target.df$psppsgva, c('1'='Not at all',
+                                                     '2'='Very little',
+                                                     '3'='Some',
+                                                     '4'='A lot',
+                                                     '5'='A great deal'))
>
> target.df$actrolga = factor(target.df$actrolga)
> target.df$actrolga = revalue(target.df$actrolga, c('1'='Not at all able',
+                                                     '2'='Very little able',
+                                                     '3'='Quite able',
+                                                     '4'='Very able',
+                                                     '5'='Completely able'))
>
> target.df$psppipla = factor(target.df$psppipla)
> target.df$psppipla = revalue(target.df$psppipla, c('1'='Not at all',
+                                                     '2'='Very little',
+                                                     '3'='Some',
+                                                     '4'='A lot',
+                                                     '5'='A great deal'))
>
> target.df$cptppola = factor(target.df$cptppola)
> target.df$cptppola = revalue(target.df$cptppola, c('1'='Not at all confident',
+                                                     '2'='a little confident',
+                                                     '3'='Quite confident',
+                                                     '4'='Very confident',
+                                                     '5'='Completely confident'))
```

```
> # Feature Exploration/Reduction and Modification -
> # 11 points scale(0-10) variables
>
> # Following other researches using European Social Survey data,
> # "trstprl","trstlgl","trstplc","trstplt","trstprt","trstep",
> # and "trstun" are scores measuring individual's trust
> # to different political entities. And the total score is
> # considered as the general score of political trust
>
> # Similar, "stflife","stfeco","stfgov","stfdem","stfedu",
> # and "stfhlth" are scores measuring individual's satisfaction
> # to different political issues. And the total score is
> # considered as the general score of political satisfaction
>
> var_11points = c("trstprl","trstlgl","trstplc","trstplt",
+                  "trstprt","trstep","trstun","stflife",
+                  "stfeco","stfgov","stfdem","stfedu","stfhlth")
>
> # impute the missing value by useing mean
> for (feature in var_11points) {
+   v = target.df[is.na(target.df[feature]) == F, feature]
+   target.df[is.na(target.df[feature]) == T, feature] = mean(v)
```

```
+ }
>
> # calculate the total score
> trust_feature = c("trstprl","trstlgl","trstplc",
+                   "trstplt","trstprt","trstep","trstun")
> satisfaction_feature = c("stflife","stfeco","stfgov",
+                          "stfdem","stfedu","stfhlth")
> target.df['generaltrust'] = rowSums(target.df[trust_feature])
> target.df['generalsatisfaction'] = rowSums(target.df[satisfaction_feature])
```

```
> # Feature Exploration/Reduction and Modification-household income
>
> # add a new category called "missing"
> target.df[is.na(target.df$hinctnta)==T,'hinctnta'] = -1
> target.df$hinctnta = factor(target.df$hinctnta)
> target.df$hinctnta = revalue(target.df$hinctnta, c('1'='0-10 percentile',
+                                                     '2'='10-20 percentile',
+                                                     '3'='20-30 percentile',
+                                                     '4'='30-40 percentile',
+                                                     '5'='40-50 percentile',
+                                                     '6'='50-60 percentile',
+                                                     '7'='60-70 percentile',
+                                                     '8'='70-80 percentile',
+                                                     '9'='80-90 percentile',
+                                                     '10'='90-100 percentile',
+                                                     '-1'='missing'))
> summary(target.df$hinctnta)
```

```
          missing   0-10 percentile  10-20 percentile  20-30 percentile
             7511              3586              3936              4077
 30-40 percentile  40-50 percentile  50-60 percentile  60-70 percentile
             3978              3924              3834              3896
 70-80 percentile  80-90 percentile 90-100 percentile
             3662              2669              2485
```

```
> # Feature Exploration/Reduction and Modification - gender
>
> target.df = target.df[is.na(target.df$gndr) == F,] # remove missing values
> target.df$gndr = factor(target.df$gndr)
> target.df$gndr = revalue(target.df$gndr, c('1'= 'Male', '2' = 'Female'))
> summary(target.df$gndr)
```

```
  Male Female
 20753  22800
```

```
> # Feature Exploration/Reduction and Modification - age
> target.df = target.df[is.na(target.df$agea) == F,] # remove missing values
> labs = c(paste(seq(0,80, by=10), seq(0+10-1, 90-1, by=10), sep='-'), paste(90,'+',sep ='' ))
> target.df$agegroup = cut(target.df$agea, breaks = c(seq(0,90, by=10), Inf), labels = labs, right = FA
> target.df$agegroup = factor(target.df$agegroup)
> summary(target.df$agegroup)
```

```
10-19 20-29 30-39 40-49 50-59 60-69 70-79 80-89   90+
 2185  5669  6719  7235  7502  7427  4624  1836   217
```

```
> # Feature Exploration/Reduction and Modification - education
> target.df = target.df[is.na(target.df$edulvlb) == F,]
> target.df$edulvlb = factor(target.df$edulvlb)
> target.df$edulvlb = revalue(target.df$edulvlb, c('0'='Pre-Primary',
+                                                  '113'='Primary',
+                                                  '129'='Primary',
+                                                  '212'='Lower Secondary',
+                                                  '213'='Lower Secondary',
+                                                  '221'='Lower Secondary',
+                                                  '222'='Lower Secondary',
+                                                  '223'='Lower Secondary',
+                                                  '229'='Lower Secondary',
+                                                  '311'='Upper Secondary',
+                                                  '312'='Upper Secondary',
+                                                  '313'='Upper Secondary',
+                                                  '321'='Upper Secondary',
+                                                  '322'='Upper Secondary',
+                                                  '323'='Upper Secondary',
+                                                  '412'='Vocational',
+                                                  '413'='Vocational',
+                                                  '421'='Vocational',
+                                                  '422'='Vocational',
+                                                  '423'='Vocational',
+                                                  '510'='Associate',
+                                                  '520'='Associate',
+                                                  '610'='Bachelor',
+                                                  '620'='Bachelor',
+                                                  '710'='Master',
+                                                  '720'='Master',
+                                                  '800'='Doctoral'))
> summary(target.df$edulvlb)
```

```
    Pre-Primary         Primary Lower Secondary Upper Secondary
            463            3222            7135           15591
     Vocational       Associate        Bachelor          Master
           2657            3532            4715            5488
       Doctoral
            437
```

```
> # Feature Exploration/Reduction and Modification - paid work
> target.df$pdwrk = factor(target.df$pdwrk)
> target.df$pdwrk = revalue(target.df$pdwrk, c('0' = 'No', '1' = 'Yes'))
> summary(target.df$pdwrk)
```

```
   No   Yes
19516 23724
```

```
> # Feature Exploration/Reduction and Modification - health self report
> target.df = target.df[is.na(target.df$health) == F,]
> target.df$health = factor(target.df$health)
> target.df$health = revalue(target.df$health, c('1'='Very Good',
+                                                '2'='Good',
+                                                '3'='Fair',
+                                                '4'='Bad',
+                                                '5'='Very Bad'))
```

```
> summary(target.df$health)
```

```
Very Good      Good      Fair       Bad  Very Bad
    10295     18092     11488      2754       573
```

```
> # Feature Exploration/Reduction and Modification - Polical Involvement
> # how many political related behavior the person conducted in past one year
> # yes-1 or no-2
> politicalBehavior_feature = c("contplt","wrkprty","wrkorg",
+                               "badge","sgnptit","pbldmn",
+                               "bctprd","pstplonl")
>
> for (feature in politicalBehavior_feature) {
+   target.df = target.df[is.na(target.df[feature]) ==F,]
+   target.df[target.df[feature]==2, feature] = 0
+ }
>
> target.df['behaviorinvolvment'] = rowSums(target.df[politicalBehavior_feature])
>
> target.df$behaviorinvolvment = factor(target.df$behaviorinvolvment)
> target.df$behaviorinvolvment = revalue(target.df$behaviorinvolvment,
+                                        c('0'='Not at all',
+                                          '1'='Low level',
+                                          '2'='Low level',
+                                          '3'='Median level',
+                                          '4'='Median level',
+                                          '5'='Median level',
+                                          '6'='High level',
+                                          '7'='High level',
+                                          '8'='High level'))
```

```
> # Feature Exploration/Reduction and Modification - response variable
> # 11 points scale(0-10)
> target.df = target.df[is.na(target.df$happy) == F,]
> target.df$happy = factor(target.df$happy)
> summary(target.df$happy)
```

```
    0     1     2     3     4     5     6     7     8     9    10
  202   164   411   915  1213  3453  3631  7916 12400  7610  4732
```

```
> final_variable_list = c("happy","gndr","agegroup","edulvlb",
+                         "hinctnta","pdwrk","health","psppsgva","actrolga",
+                         "psppipla","cptppola","generaltrust",
+                         "generalsatisfaction", "behaviorinvolvment")
>
> data = target.df[final_variable_list]
```

Descriptive statistics of the final cleaned data is per following:

```
> summary(data)
```

```
     happy           gndr          agegroup                edulvlb
 8      :12400   Male   :20322   50-59  :7374   Upper Secondary:15382
 7      : 7916   Female:22325   60-69  :7307   Lower Secondary: 7034
 9      : 7610                  40-49  :7108   Master         : 5404
 10     : 4732                  30-39  :6595   Bachelor       : 4669
```

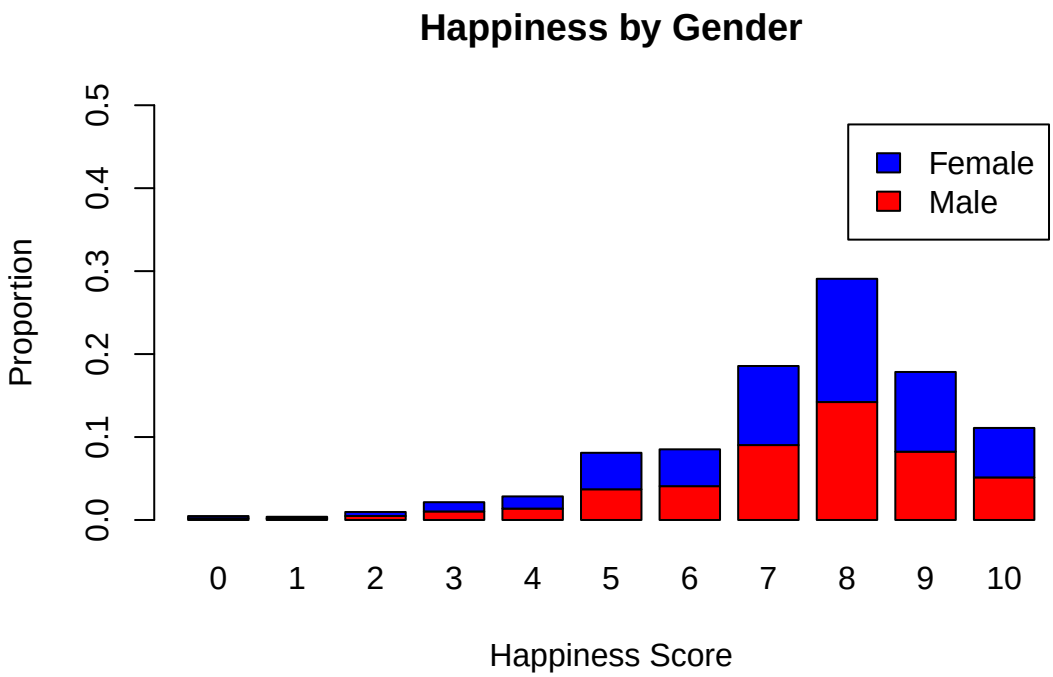
```
6      : 3631                  20-29  :5579   Associate      : 3489
5      : 3453                  70-79  :4522   Primary        : 3171
(Other): 2905                  (Other):4162   (Other)        : 3498
            hinctnta     pdwrk             health
missing         : 7194   No :19242   Very Good:10196
20-30 percentile: 4010   Yes:23405   Good     :17877
30-40 percentile: 3913               Fair     :11316
40-50 percentile: 3868               Bad      : 2700
10-20 percentile: 3865               Very Bad :  558
60-70 percentile: 3836
(Other)         :15961
        psppsgva                 actrolga             psppipla
Not at all  :10632   Not at all able :15745   Not at all  :11680
Very little :16468   Very little able:13644   Very little :16501
Some        :12089   Quite able      : 9163   Some        :11252
A lot       : 2940   Very able       : 2944   A lot       : 2830
A great deal:  518   Completely able : 1151   A great deal:  384


                cptppola      generaltrust   generalsatisfaction
Not at all confident:14863   Min.   : 0.00   Min.   : 0.00
a little confident  :13662   1st Qu.:24.00   1st Qu.:27.00
Quite confident     : 9826   Median :34.00   Median :34.00
Very confident      : 3186   Mean   :33.05   Mean   :33.35
Completely confident: 1110   3rd Qu.:43.00   3rd Qu.:41.00
                             Max.   :70.00   Max.   :60.00

   behaviorinvolvment
Not at all  :21953
Low level   :13429
Median level: 6372
High level  :  893
```

Part 3: Exploratory Data Analysis

```
> # Exploratory data analysis: Response vs Categorical Predictors-gender
> attach(data)
> tb = xtabs(~gndr+happy)
> barplot(prop.table(tb),axes=T,space=0.3,legend.text=TRUE,ylim=c(0,0.5),
+         xlab="Happiness Score", ylab = "Proportion",
+         horiz=F, col=c("red","blue"),main="Happiness by Gender")
```

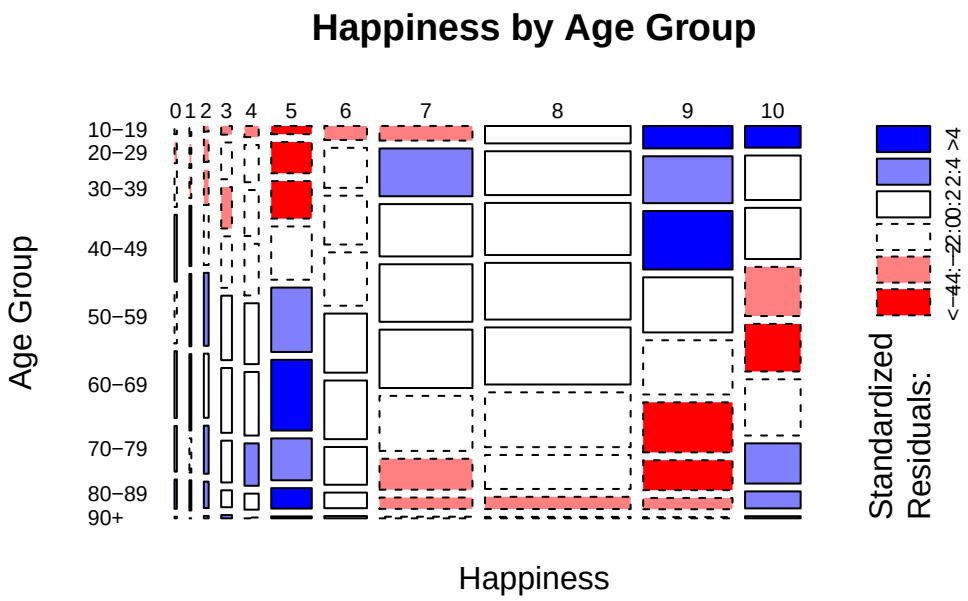



```
> # Exploratory data analysis: Response vs Categorical Predictors-age group
> library(vcd)
```

```
Loading required package: grid
```

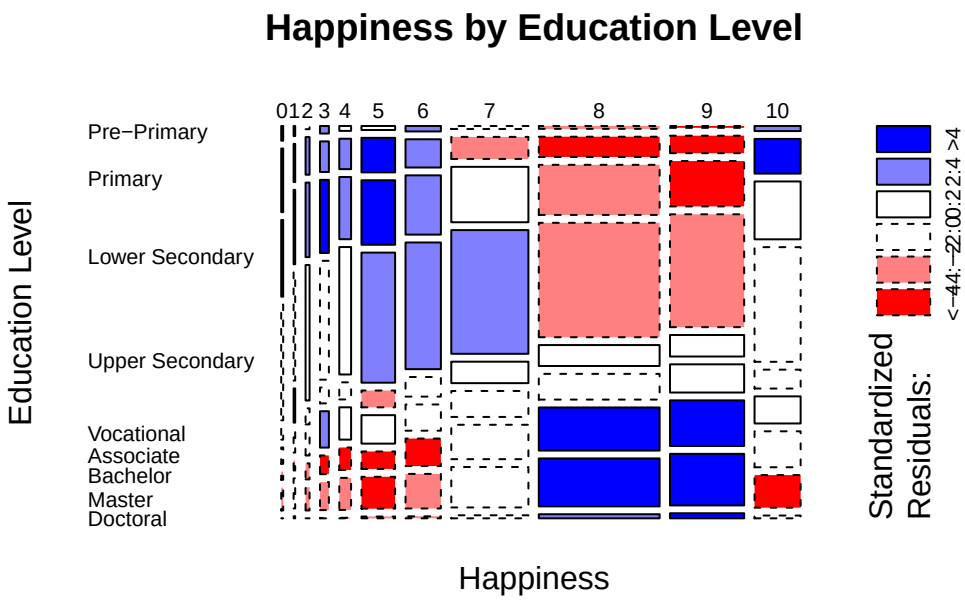
```
> tb = xtabs(~happy+agegroup)
> mosaicplot(tb, xlab="Happiness", ylab="Age Group",
+            main="Happiness by Age Group",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Age Group",
    main = "Happiness by Age Group", color = TRUE, legend = T,
    shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```



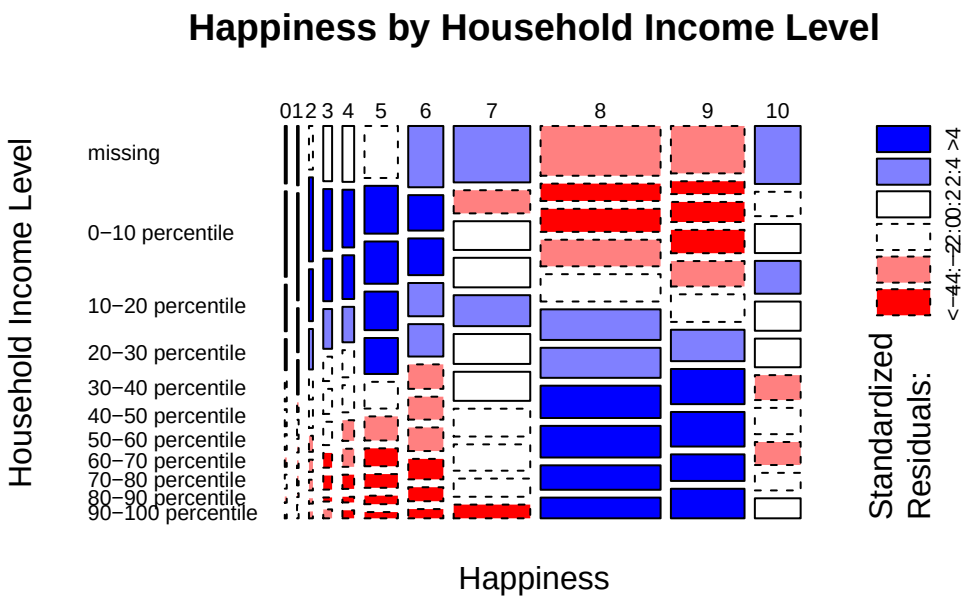

```
> # Exploratory data analysis: Response vs Categorical Predictors-education level
> tb = xtabs(~happy+edulvlb)
> mosaicplot(tb, xlab="Happiness", ylab="Education Level",
+            main="Happiness by Education Level",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Education Level",
    main = "Happiness by Education Level", color = TRUE, legend = T,
    shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```

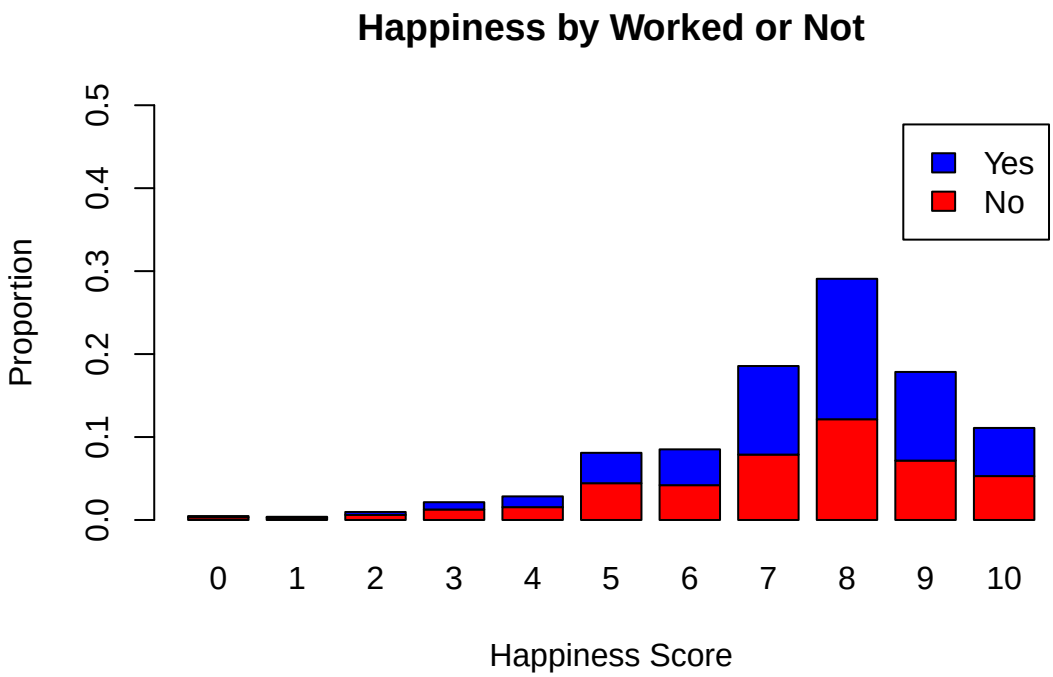



```
> # Exploratory data analysis: Response vs Categorical Predictors-household income
> tb = xtabs(~happy+hinctnta)
> mosaicplot(tb, xlab="Happiness", ylab="Household Income Level",
+            main="Happiness by Household Income Level",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Household Income Level",
    main = "Happiness by Household Income Level", color = TRUE,
    legend = T, shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```

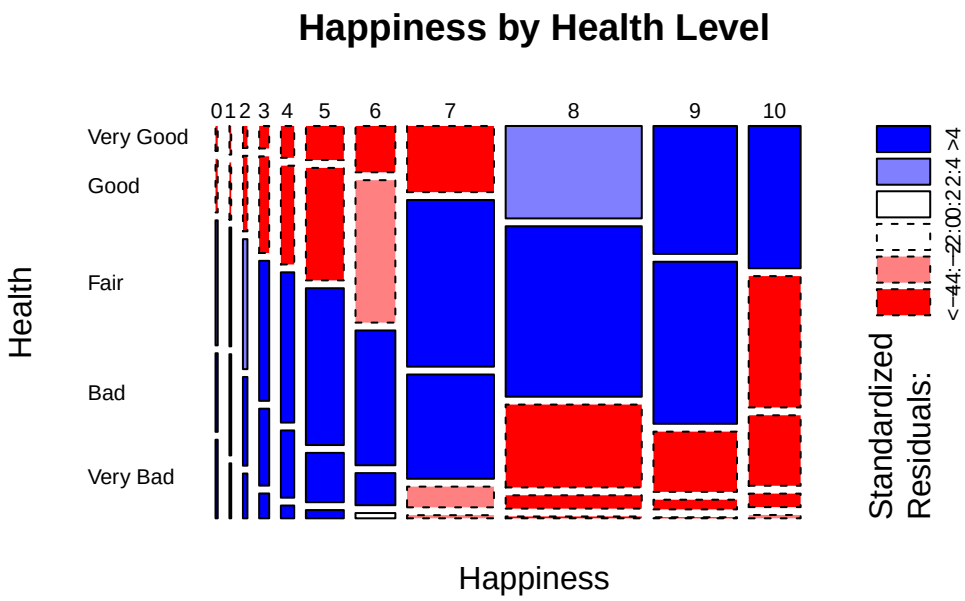



```
> # Exploratory data analysis: Response vs Categorical Predictors-worked or not
> tb = xtabs(~pdwrk+happy)
> barplot(prop.table(tb),axes=T,space=0.3,legend.text=TRUE,ylim=c(0,0.5),
+         xlab="Happiness Score", ylab = "Proportion",
+         horiz=F, col=c("red","blue"),main="Happiness by Worked or Not")
```



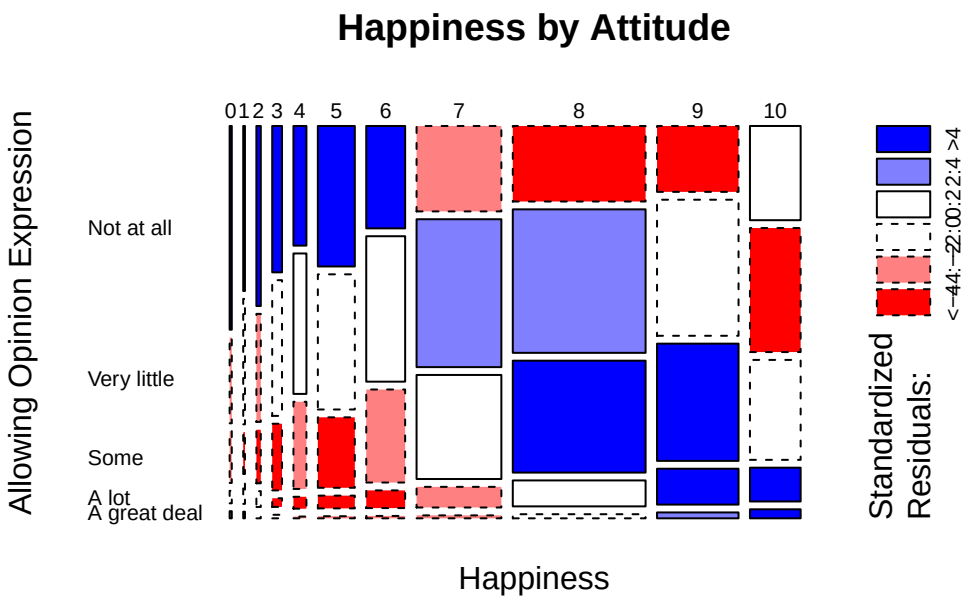

```
> # Exploratory data analysis: Response vs Categorical Predictors-health
> tb = xtabs(~happy+health)
> mosaicplot(tb, xlab="Happiness", ylab="Health",
+            main="Happiness by Health Level",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Health", main = "Happiness by Health Leve
    color = TRUE, legend = T, shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```



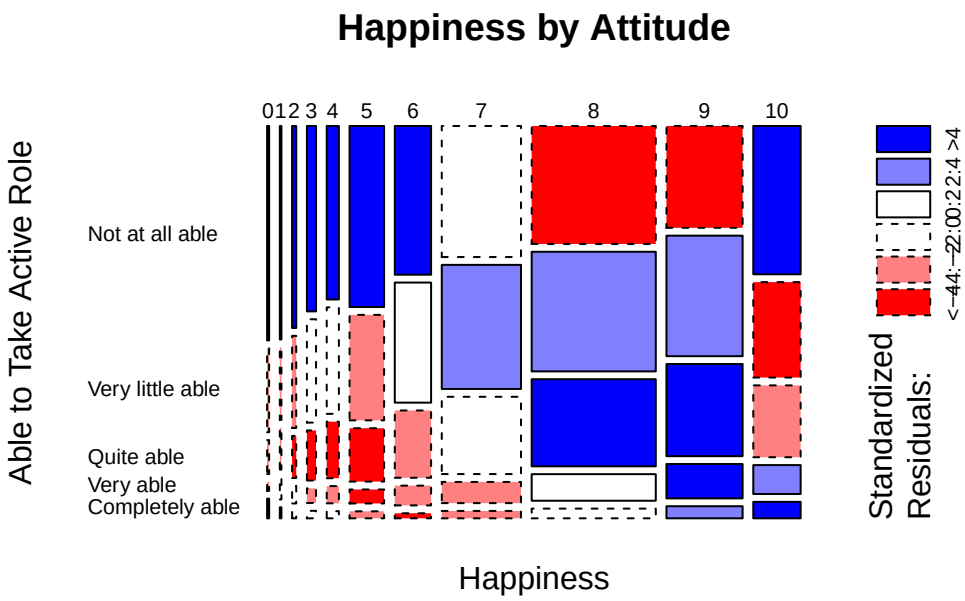

```
> # Exploratory data analysis: Response vs Categorical Predictors
> # item: Political system allows people to have a say in what government does
> tb = xtabs(~happy+psppsgva)
> mosaicplot(tb, xlab="Happiness", ylab="Allowing Opinion Expression",
+            main="Happiness by Attitude",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Allowing Opinion Expression",
    main = "Happiness by Attitude", color = TRUE, legend = T,
    shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```



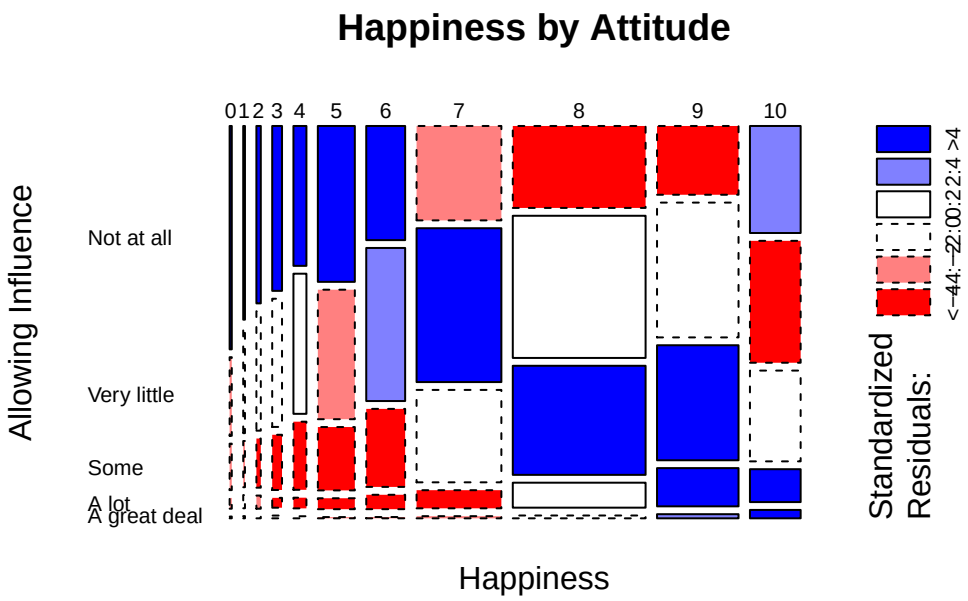

```
> # Exploratory data analysis: Response vs Categorical Predictors
> # item: Able to take active role in political group
> tb = xtabs(~happy+actrolga)
> mosaicplot(tb, xlab="Happiness", ylab="Able to Take Active Role",
+            main="Happiness by Attitude",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Able to Take Active Role",
    main = "Happiness by Attitude", color = TRUE, legend = T,
    shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```



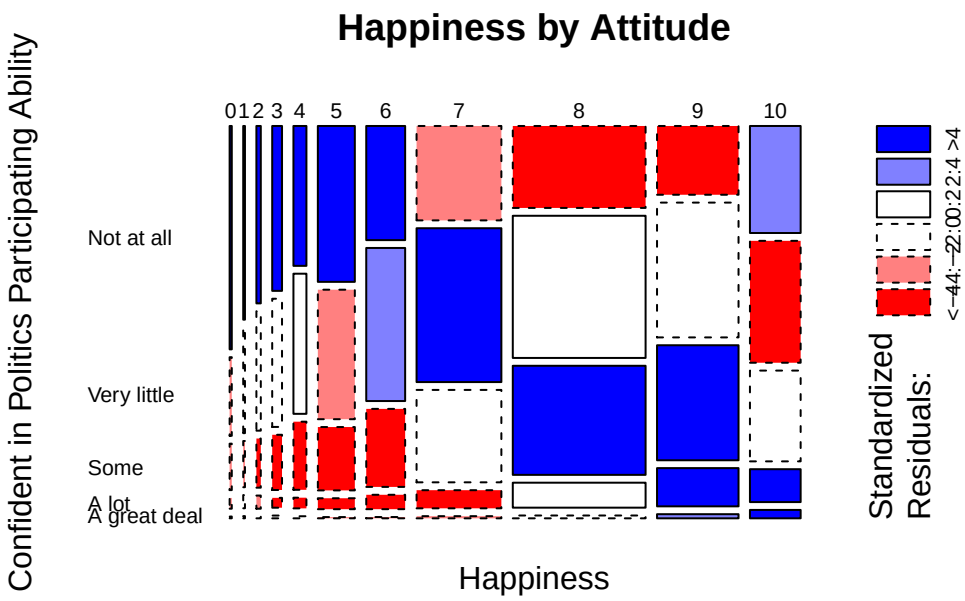

```
> # Exploratory data analysis: Response vs Categorical Predictors
> # item: Political system allows people to have influence on politics
> tb = xtabs(~happy+psppipla)
> mosaicplot(tb, xlab="Happiness", ylab="Allowing Influence",
+            main="Happiness by Attitude",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Allowing Influence",
    main = "Happiness by Attitude", color = TRUE, legend = T,
    shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```



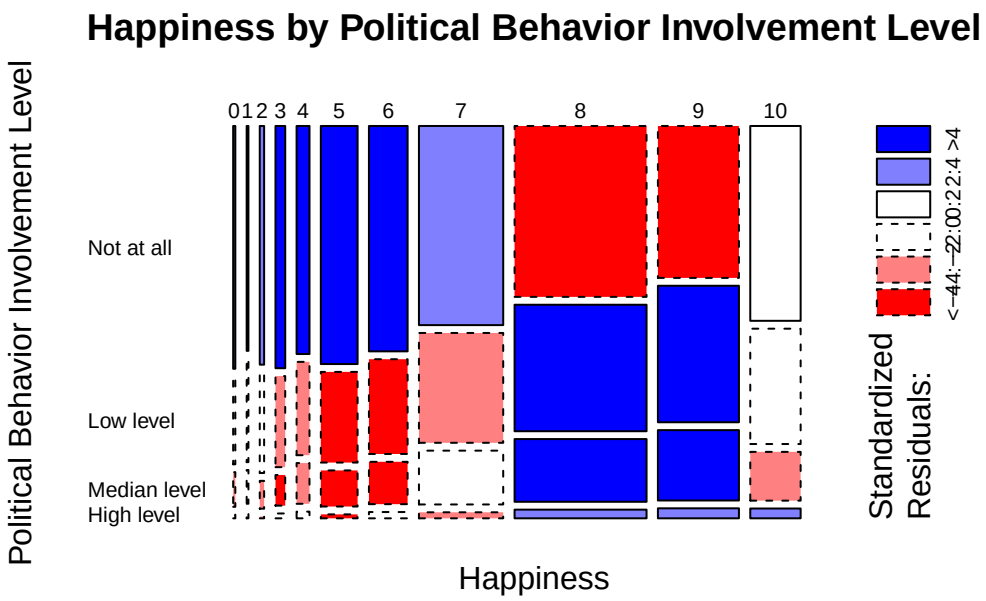

```
> # Exploratory data analysis: Response vs Categorical Predictors
> # item: Confident in own ability to participate in politics
> tb = xtabs(~happy+psppipla)
> mosaicplot(tb, xlab="Happiness", ylab="Confident in Politics Participating Ability",
+            main="Happiness by Attitude",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Confident in Politics Participating Abili
    main = "Happiness by Attitude", color = TRUE, legend = T,
    shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```

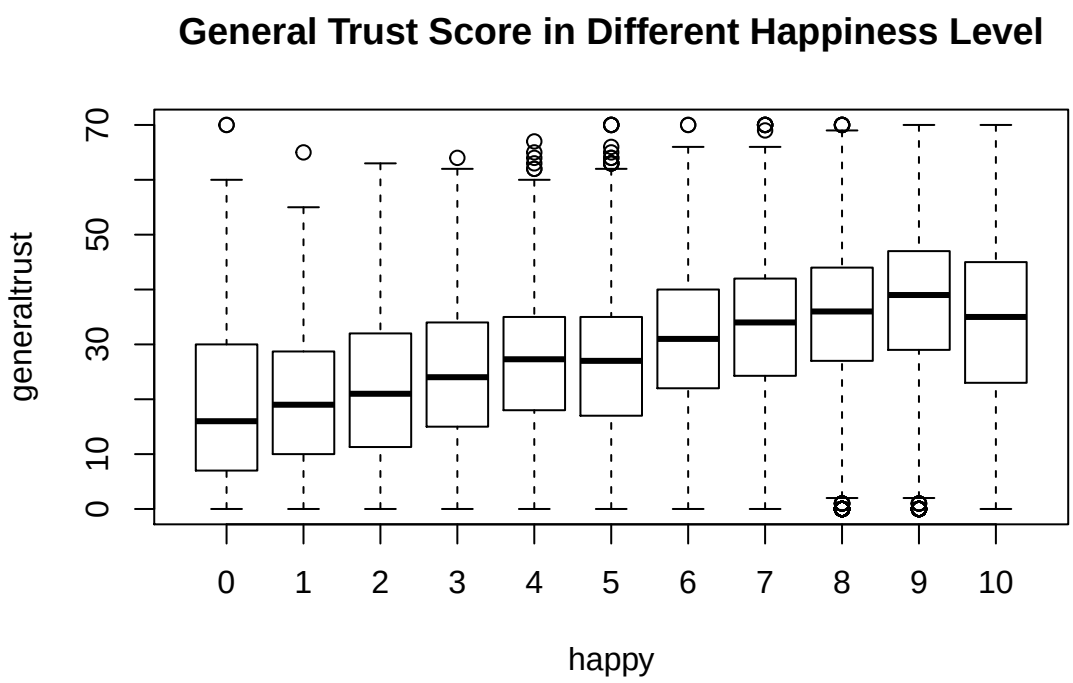



```
> # Exploratory data analysis: Response vs Categorical Predictors
> # political behavior involvement
> tb = xtabs(~happy+behaviorinvolvment)
> mosaicplot(tb, xlab="Happiness", ylab="Political Behavior Involvement Level",
+            main="Happiness by Political Behavior Involvement Level",
+            color=TRUE, legend=T, shade=T, las=1)
```

```
Warning: In mosaicplot.default(tb, xlab = "Happiness", ylab = "Political Behavior Involvement Level",
    main = "Happiness by Political Behavior Involvement Level",
    color = TRUE, legend = T, shade = T, las = 1) :
 extra argument 'legend' will be disregarded
```

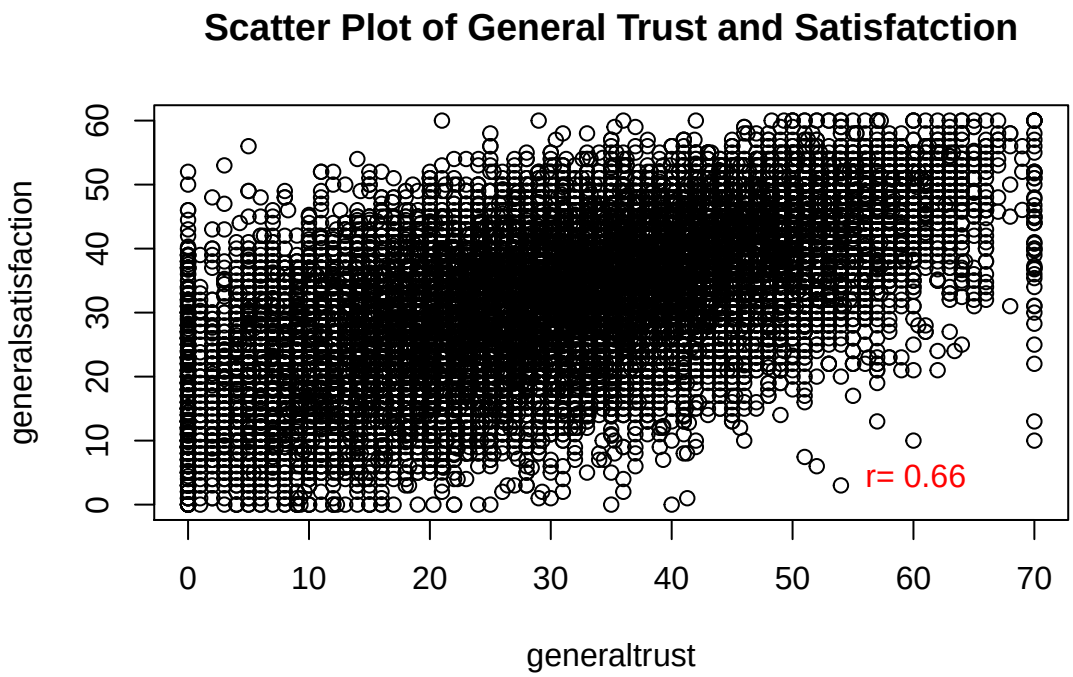



```
> # Exploratory data analysis: Response vs Numeric Predictors-generaltrust
> boxplot(generaltrust~happy,
+         main="General Trust Score in Different Happiness Level")
```



```
> # Exploratory data analysis: Response vs Numeric Predictors-generalsatisfaction
> boxplot(generalsatisfaction~happy,
+         main="General Satisfaction Score in Different Happiness Level")
```

```
> # Exploratory data analysis:
> # scatter plot between generaltrust and generalsatisfaction
> plot(generaltrust,generalsatisfaction,
+         main="Scatter Plot of General Trust and Satisfatction")
> r = round(cor(generaltrust,generalsatisfaction), digits=2)
> txt = paste('r=',r)
> par(usr = c(0, 0.6, 0.3, 6))
> text(0.5, 0.9, txt, col='red')
```




```
> #Correlation score:
> cor(as.matrix(cbind(generaltrust,generalsatisfaction)))
```

```
                    generaltrust generalsatisfaction
generaltrust           1.0000000           0.6570999
generalsatisfaction    0.6570999           1.0000000
```

```
> # !!!!!If it's not necessary, don't run this part. It may take about half an hour.
> # Exploratory data analysis:
> # pairedwise correlation coefficients between ordinal features
> # Kendall's Tau-b
>
> m = cbind(as.numeric(data$health), as.numeric(data$psppsgva),
+           as.numeric(data$actrolga), as.numeric(data$psppipla),
+           as.numeric(data$cptppola), as.numeric(data$behaviorinvolvment))
> colnames(m) = c("health", "psppsgva",
+                 "actrolga", "psppipla",
+                 "cptppola", "behaviorinvolvment")
>
> cor(m, method="kendall", use="pairwise")
```

```
                       health   psppsgva   actrolga   psppipla   cptppola
health              1.00000000 -0.1195113 -0.1511615 -0.1388144 -0.1399172
psppsgva           -0.11951131  1.0000000  0.3024944  0.5995412  0.2831028
actrolga           -0.15116146  0.3024944  1.0000000  0.3846225  0.6269533
psppipla           -0.13881444  0.5995412  0.3846225  1.0000000  0.3690859
cptppola           -0.13991716  0.2831028  0.6269533  0.3690859  1.0000000
behaviorinvolvment -0.08955163  0.1799734  0.3380190  0.2465001  0.3392313
                    behaviorinvolvment
health                     -0.08955163
```

```
psppsgva                  0.17997339
actrolga                  0.33801904
psppipla                  0.24650005
cptppola                  0.33923134
behaviorinvolvment        1.00000000
```

Most of the coefficients is under 0.4. The largest one is around 0.6.

Part 4: Model Fitting

In this project, the response variable is a ordinal discreet variable (categorical variable with multiple levels) and predicting variables include both qualitative and quantitative variavles. In addition, the response variable follows an order from low to high in which a score of 10 is extremely happy while score of 0 is extremely sad. Hence, We will use ordinal logistic regression to estimate/ predict the multi-class ordered variable "happy".

There are several link functions in ordinal logistic regression. We will test the following 4 most common link functions, including probit, logistic, loglog and cloglog.

```
> library(MASS)
> library(PResiduals)
> library(sure)
> library(ggplot2)
```

```
> attach(data)
> # Fit models with various link functions to the simulated data
> fit.probit <- polr(happy ~ ., data = data, method = "probit")
> fit.logistic <- polr(happy ~ ., data = data, method = "logistic")
```

```
> fit.loglog <- polr(happy ~ ., data = data, method = "loglog")
> fit.cloglog <- polr(happy ~ ., data = data, method = "cloglog")
>
> # Construct Q-Q plots of the surrogate residuals for each model
> set.seed(1056)  # for reproducibility
> p1 <- autoplot(fit.probit, nsim = 100, what = "qq", main = 'abc')
> p2 <- autoplot(fit.logistic, nsim = 100, what = "qq")
> p3 <- autoplot(fit.loglog, nsim = 100, what = "qq")
> p4 <- autoplot(fit.cloglog, nsim = 100, what = "qq")
>
> # plot
> gridExtra::grid.arrange(p1, p2, p3, p4, ncol = 2)
```

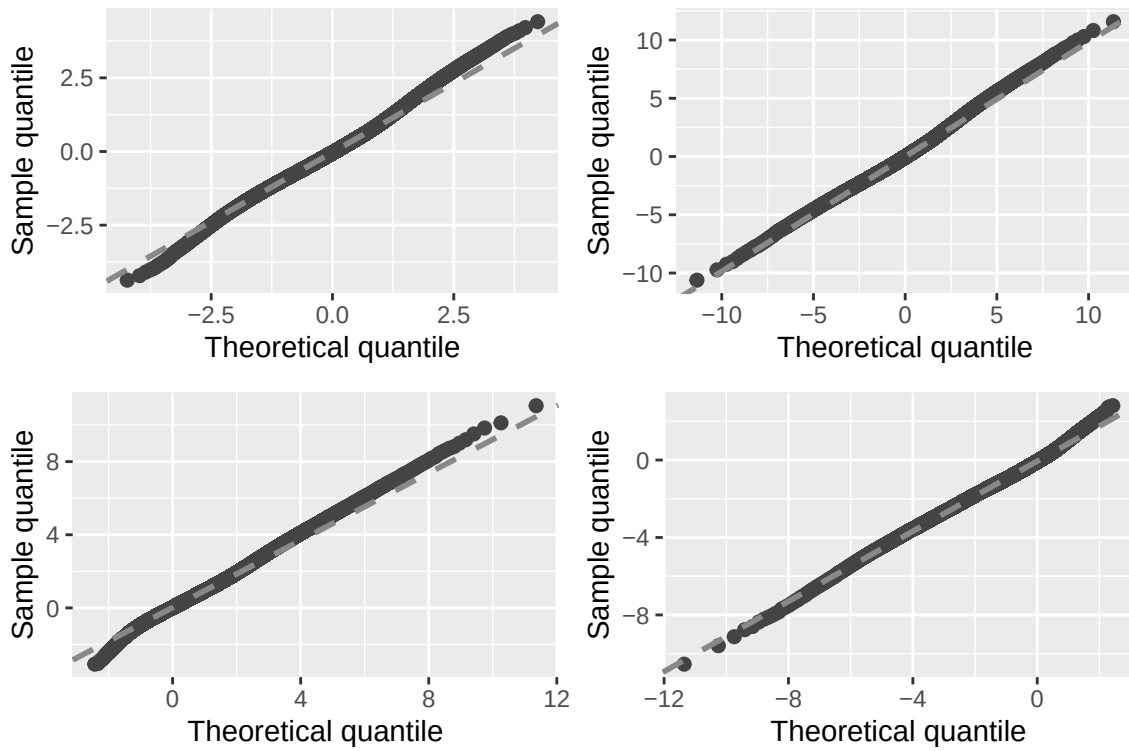


Figure: Q-Q plots of the residuals for various cumulative link models fit to simulated data with Gumbel (max) errors. Top left: A model with probit link. Top right: A model with logit link. Bottom left: A model with log-log link. Bottom right: A model with complementary log-log link.

From the Q-Q plots, we can see that there is not much differences between different link functions. We choose model with logit link function as it shows residuals follow closely normal distribution.

```
> # Fit the full model using Ordinal Logistic Regression and logit function
> full.model = polr(as.ordered(happy)~., data = data, Hess = TRUE, method = "logistic")
> summary(full.model)
```

```
Call:
polr(formula = as.ordered(happy) ~ ., data = data, Hess = TRUE,
    method = "logistic")

Coefficients:
                                    Value Std. Error  t value
```

gndrFemale	0.239918	0.0177539	13.5135
agegroup20-29	-0.056902	0.0492082	-1.1564
agegroup30-39	-0.005355	0.0495664	-0.1080
agegroup40-49	-0.066024	0.0494025	-1.3365
agegroup50-59	-0.018014	0.0488630	-0.3687
agegroup60-69	0.123289	0.0471401	2.6154
agegroup70-79	0.256147	0.0501420	5.1084
agegroup80-89	0.276164	0.0613355	4.5025
agegroup90+	0.236529	0.1341504	1.7632
edulvlbPrimary	0.032695	0.0941666	0.3472
edulvlbLower Secondary	-0.183848	0.0915618	-2.0079
edulvlbUpper Secondary	-0.244938	0.0907464	-2.6991
edulvlbVocational	-0.189611	0.0963741	-1.9675
edulvlbAssociate	-0.242635	0.0947153	-2.5617
edulvlbBachelor	-0.180511	0.0940801	-1.9187
edulvlbMaster	-0.315443	0.0936189	-3.3694
edulvlbDoctoral	-0.319059	0.1231306	-2.5912
hinctnta0-10 percentile	-0.555354	0.0390749	-14.2125
hinctnta10-20 percentile	-0.253342	0.0368081	-6.8828
hinctnta20-30 percentile	-0.100865	0.0360703	-2.7963
hinctnta30-40 percentile	-0.032135	0.0359165	-0.8947
hinctnta40-50 percentile	0.063502	0.0359926	1.7643
hinctnta50-60 percentile	0.103063	0.0361760	2.8489
hinctnta60-70 percentile	0.197169	0.0360053	5.4761
hinctnta70-80 percentile	0.195515	0.0366302	5.3375
hinctnta80-90 percentile	0.232891	0.0410381	5.6750
hinctnta90-100 percentile	0.354714	0.0429202	8.2645
pdwrkYes	0.014537	0.0234626	0.6196
healthGood	-0.544832	0.0228540	-23.8396
healthFair	-1.050635	0.0274000	-38.3444
healthBad	-1.661228	0.0433214	-38.3466
healthVery Bad	-2.402819	0.0869205	-27.6439
psppsgvaVery little	-0.091075	0.0266607	-3.4161
psppsgvaSome	-0.229958	0.0313501	-7.3352
psppsgvaA lot	-0.233393	0.0466355	-5.0046
psppsgvaA great deal	-0.092604	0.0895598	-1.0340
actrolgaVery little able	-0.058787	0.0251148	-2.3407
actrolgaQuite able	-0.058394	0.0310987	-1.8777
actrolgaVery able	-0.044142	0.0445736	-0.9903
actrolgaCompletely able	0.022244	0.0673220	0.3304
psppiplaVery little	-0.039137	0.0263547	-1.4850
psppiplaSome	-0.103920	0.0322737	-3.2200
psppiplaA lot	-0.071930	0.0483507	-1.4877
psppiplaA great deal	0.136713	0.1067929	1.2802
cptppolaa little confident	0.121502	0.0251632	4.8286
cptppolaQuite confident	0.274998	0.0306920	8.9599
cptppolaVery confident	0.400255	0.0436140	9.1772
cptppolaCompletely confident	0.631379	0.0682183	9.2553
generaltrust	-0.016082	0.0009208	-17.4652
generalsatisfaction	0.096583	0.0013140	73.5031
behaviorinvolvmentLow level	0.227250	0.0204148	11.1316
behaviorinvolvmentMedian level	0.269640	0.0275660	9.7816
behaviorinvolvmentHigh level	0.565998	0.0644559	8.7812

```
Intercepts:
     Value    Std. Error t value
0|1   -4.0122   0.1267   -31.6675
1|2   -3.3876   0.1176   -28.8037
2|3   -2.5724   0.1113   -23.1205
3|4   -1.6902   0.1081   -15.6296
4|5   -1.0422   0.1071    -9.7311
5|6    0.0007   0.1065     0.0067
6|7    0.6980   0.1065     6.5529
7|8    1.7826   0.1068    16.6871
8|9    3.2788   0.1075    30.4924
9|10   4.6122   0.1085    42.5253

Residual Deviance: 149425.19
AIC: 149551.19
```

```r
> # Statistical Inference of coefficients
> summary_table <- coef(summary(full.model))
> pval <- pnorm(abs(summary_table[, "t value"]),lower.tail = FALSE)* 2
> summary_table <- cbind(summary_table, "p value" = round(pval,3))
> summary_table
```

```
                                        Value   Std. Error       t value
gndrFemale                       0.2399176833 0.0177539077  13.513514135
agegroup20-29                   -0.0569024939 0.0492082125  -1.156361733
agegroup30-39                   -0.0053551740 0.0495664091  -0.108040387
agegroup40-49                   -0.0660244668 0.0494025464  -1.336458777
agegroup50-59                   -0.0180139111 0.0488629681  -0.368661826
agegroup60-69                    0.1232894263 0.0471401418   2.615380894
agegroup70-79                    0.2561469636 0.0501419660   5.108434789
agegroup80-89                    0.2761640987 0.0613354714   4.502518569
agegroup90+                      0.2365288306 0.1341503928   1.763161670
edulvlbPrimary                   0.0326953286 0.0941665678   0.347207394
edulvlbLower Secondary          -0.1838483123 0.0915618174  -2.007914625
edulvlbUpper Secondary          -0.2449377330 0.0907464313  -2.699144522
edulvlbVocational               -0.1896114441 0.0963740576  -1.967453160
edulvlbAssociate                -0.2426346221 0.0947153464  -2.561724487
edulvlbBachelor                 -0.1805108344 0.0940801253  -1.918692538
edulvlbMaster                   -0.3154428420 0.0936189382  -3.369434093
edulvlbDoctoral                 -0.3190593489 0.1231305871  -2.591227383
hinctnta0-10 percentile         -0.5553540934 0.0390749111 -14.212549103
hinctnta10-20 percentile        -0.2533418862 0.0368081398  -6.882767986
hinctnta20-30 percentile        -0.1008646058 0.0360702723  -2.796336138
hinctnta30-40 percentile        -0.0321350681 0.0359164584  -0.894717063
hinctnta40-50 percentile         0.0635019053 0.0359926351   1.764302755
hinctnta50-60 percentile         0.1030634105 0.0361759650   2.848947095
hinctnta60-70 percentile         0.1971690327 0.0360053188   5.476108507
hinctnta70-80 percentile         0.1955147953 0.0366301827   5.337532629
hinctnta80-90 percentile         0.2328905022 0.0410380500   5.674989478
hinctnta90-100 percentile        0.3547139383 0.0429202152   8.264495807
pdwrkYes                         0.0145370533 0.0234625548   0.619585267
healthGood                      -0.5448316255 0.0228540231 -23.839637430
healthFair                      -1.0506353927 0.0273999861 -38.344376827
healthBad                       -1.6612278780 0.0433213967 -38.346590938
healthVery Bad                  -2.4028193770 0.0869204853 -27.643878988
```

psppsgvaVery little	-0.0910752831	0.0266606889	-3.416088885
psppsgvaSome	-0.2299584146	0.0313500852	-7.335176696
psppsgvaA lot	-0.2333928838	0.0466354851	-5.004620047
psppsgvaA great deal	-0.0926037470	0.0895598230	-1.033987606
actrolgaVery little able	-0.0587866607	0.0251148485	-2.340713330
actrolgaQuite able	-0.0583938644	0.0310987473	-1.877691849
actrolgaVery able	-0.0441415774	0.0445735673	-0.990308384
actrolgaCompletely able	0.0222441760	0.0673219968	0.330414679
psppiplaVery little	-0.0391371972	0.0263546843	-1.485018632
psppiplaSome	-0.1039203194	0.0322736758	-3.219971599
psppiplaA lot	-0.0719300388	0.0483507128	-1.487672769
psppiplaA great deal	0.1367128403	0.1067929086	1.280167776
cptppolaa little confident	0.1215023823	0.0251632212	4.828570283
cptppolaQuite confident	0.2749983079	0.0306919663	8.959944288
cptppolaVery confident	0.4002546796	0.0436140054	9.177205262
cptppolaCompletely confident	0.6313792037	0.0682183230	9.255273013
generaltrust	-0.0160822854	0.0009208168	-17.465238335
generalsatisfaction	0.0965826076	0.0013139937	73.503099080
behaviorinvolvmentLow level	0.2272504891	0.0204148448	11.131629524
behaviorinvolvmentMedian level	0.2696396572	0.0275659995	9.781602778
behaviorinvolvmentHigh level	0.5659982223	0.0644559321	8.781165735
0|1	-4.0121762327	0.1266971294	-31.667459642
1|2	-3.3875942147	0.1176096816	-28.803701940
2|3	-2.5723522751	0.1112586152	-23.120477182
3|4	-1.6902002813	0.1081409679	-15.629601935
4|5	-1.0421709594	0.1070972075	-9.731075013
5|6	0.0007083205	0.1065004484	0.006650869
6|7	0.6979835073	0.1065158919	6.552857933
7|8	1.7826058352	0.1068254687	16.687086488
8|9	3.2788356628	0.1075297099	30.492369651
9|10	4.6121526823	0.1084565582	42.525346161

	p value
gndrFemale	0.000
agegroup20-29	0.248
agegroup30-39	0.914
agegroup40-49	0.181
agegroup50-59	0.712
agegroup60-69	0.009
agegroup70-79	0.000
agegroup80-89	0.000
agegroup90+	0.078
edulvlbPrimary	0.728
edulvlbLower Secondary	0.045
edulvlbUpper Secondary	0.007
edulvlbVocational	0.049
edulvlbAssociate	0.010
edulvlbBachelor	0.055
edulvlbMaster	0.001
edulvlbDoctoral	0.010
hinctnta0-10 percentile	0.000
hinctnta10-20 percentile	0.000
hinctnta20-30 percentile	0.005
hinctnta30-40 percentile	0.371
hinctnta40-50 percentile	0.078

```
hinctnta50-60 percentile         0.004
hinctnta60-70 percentile         0.000
hinctnta70-80 percentile         0.000
hinctnta80-90 percentile         0.000
hinctnta90-100 percentile        0.000
pdwrkYes                         0.536
healthGood                       0.000
healthFair                       0.000
healthBad                        0.000
healthVery Bad                   0.000
psppsgvaVery little              0.001
psppsgvaSome                     0.000
psppsgvaA lot                    0.000
psppsgvaA great deal             0.301
actrolgaVery little able         0.019
actrolgaQuite able               0.060
actrolgaVery able                0.322
actrolgaCompletely able          0.741
psppiplaVery little              0.138
psppiplaSome                     0.001
psppiplaA lot                    0.137
psppiplaA great deal             0.200
cptppolaa little confident       0.000
cptppolaQuite confident          0.000
cptppolaVery confident           0.000
cptppolaCompletely confident     0.000
generaltrust                     0.000
generalsatisfaction              0.000
behaviorinvolvmentLow level      0.000
behaviorinvolvmentMedian level   0.000
behaviorinvolvmentHigh level     0.000
0|1                              0.000
1|2                              0.000
2|3                              0.000
3|4                              0.000
4|5                              0.000
5|6                              0.995
6|7                              0.000
7|8                              0.000
8|9                              0.000
9|10                             0.000
```

If a variable has p-value < 0.05, we conclude that the variable is statistically significant at 95% CI.

Based on the results, most variables are statistically significant at 95% CI except for the following 14 variables: 1) agegroup20-29 2) agegroup30-39 3) agegroup40-49 4) agegroup50-59 5) agegroup60-69 6) agegroup90+ 7) edulvlbPrimary 8) pdwrkYes 9) psppsgvaA great deal 10) actrolgaVery able 11) actrolgaCompletely able 12) psppiplaVery little 13) psppiplaA lot 14) psppiplaA great deal

Coefficient Interpretation: 1) gender (categorical) 2) general trust (numerical)

Part 5: Goodness of Fit

Method 1: Visual Analysis - Assumption Evaluation

Assumption 3: Multicollinearity

```
> regression.line = lm(as.numeric(happy) ~ ., data = data)
> #summary(regression.line)
>
> library(car)
```

```
Loading required package: carData
```

```
> max(10,1/(1-summary(regression.line)$r.squared))
```

```
[1] 10
```

```
> vif(regression.line)
```

```
                        GVIF Df GVIF^(1/(2*Df))
gndr                1.052123  1        1.025731
agegroup            2.339822  8        1.054566
edulvlb             1.618627  8        1.030556
hinctnta            1.430714 10        1.018070
pdwrk               1.806872  1        1.344200
health              1.383585  4        1.041420
psppsgva            2.853176  4        1.140029
actrolga            3.399365  4        1.165265
psppipla            3.335230  4        1.162494
cptppola            3.274478  4        1.159826
generaltrust        1.955568  1        1.398416
generalsatisfaction 1.931039  1        1.389618
behaviorinvolvment  1.332098  3        1.048953
```

Assumption 4: Proportional Odds/ Parallel Lines

```
> library(brant)
> brant(full.model,by.var=F)
```

```
-------------------------------------------------------------------
Test for                X2  df  probability
-------------------------------------------------------------------
Omnibus                 3165.61 477 0
gndrFemale              16.55   9   0.06
agegroup20-29               11.94   9   0.22
agegroup30-39               8.53    9   0.48
agegroup40-49               12.31   9   0.2
agegroup50-59               13.66   9   0.14
agegroup60-69               20.74   9   0.01
agegroup70-79               19.89   9   0.02
agegroup80-89               17.7    9   0.04
agegroup90+             16.75   9   0.05
edulvlbPrimary              16.91   9   0.05
edulvlbLower Secondary      25.38   9   0
edulvlbUpper Secondary      38.11   9   0
edulvlbVocational           26.42   9   0
edulvlbAssociate            29.7    9   0
edulvlbBachelor         32.72   9   0
edulvlbMaster               45.92   9   0
edulvlbDoctoral         24.75   9   0
hinctnta0-10 percentile     53.69   9   0
hinctnta10-20 percentile        19.68   9   0.02
```

```
hinctnta20-30 percentile        17.03   9   0.05
hinctnta30-40 percentile        23.62   9   0
hinctnta40-50 percentile        22.02   9   0.01
hinctnta50-60 percentile        41.7    9   0
hinctnta60-70 percentile        44.85   9   0
hinctnta70-80 percentile        58.13   9   0
hinctnta80-90 percentile        59.71   9   0
hinctnta90-100 percentile       53.47   9   0
pdwrkYes                12.84   9   0.17
healthGood              18.63   9   0.03
healthFair              38.66   9   0
healthBad               62.84   9   0
healthVery Bad              89.72   9   0
psppsgvaVery little         14.67   9   0.1
psppsgvaSome                24.22   9   0
psppsgvaA lot               21.74   9   0.01
psppsgvaA great deal            14.12   9   0.12
actrolgaVery little able        33.41   9   0
actrolgaQuite able          24.35   9   0
actrolgaVery able           8.13    9   0.52
actrolgaCompletely able     7.44    9   0.59
psppiplaVery little         27.18   9   0
psppiplaSome                14.85   9   0.1
psppiplaA lot               12.76   9   0.17
psppiplaA great deal            9.05    9   0.43
cptppolaa little confident      21.45   9   0.01
cptppolaQuite confident     14.32   9   0.11
cptppolaVery confident      13.74   9   0.13
cptppolaCompletely confident        14  9   0.12
generaltrust                110.26  9   0
generalsatisfaction         182.01  9   0
behaviorinvolvmentLow level     85.25   9   0
behaviorinvolvmentMedian level  81.37   9   0
behaviorinvolvmentHigh level        21.39   9   0.01
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(full.model, by.var = F): 490008816 combinations in
table(dv,ivs) do not occur. Because of that, the test results might be
invalid.

                                        X2  df  probability
Omnibus                        3165.605965 477 0.000000e+00
gndrFemale                       16.547866   9 5.628543e-02
agegroup20-29                    11.942407   9 2.165756e-01
agegroup30-39                     8.533354   9 4.814141e-01
agegroup40-49                    12.309447   9 1.964209e-01
agegroup50-59                    13.655253   9 1.351279e-01
agegroup60-69                    20.742383   9 1.384472e-02
agegroup70-79                    19.890114   9 1.860279e-02
agegroup80-89                    17.702044   9 3.879200e-02
agegroup90+                      16.754332   9 5.270500e-02
edulvlbPrimary                   16.913085   9 5.009458e-02
edulvlbLower Secondary           25.381076   9 2.577326e-03
```

```
edulvlbUpper Secondary          38.106008   9 1.668431e-05
edulvlbVocational               26.424594   9 1.740329e-03
edulvlbAssociate                29.700294   9 4.933081e-04
edulvlbBachelor                 32.723265   9 1.492050e-04
edulvlbMaster                   45.924872   9 6.218583e-07
edulvlbDoctoral                 24.746587   9 3.264670e-03
hinctnta0-10 percentile         53.686457   9 2.165417e-08
hinctnta10-20 percentile        19.680305   9 1.999118e-02
hinctnta20-30 percentile        17.032352   9 4.821174e-02
hinctnta30-40 percentile        23.624778   9 4.935657e-03
hinctnta40-50 percentile        22.015282   9 8.830669e-03
hinctnta50-60 percentile        41.702923   9 3.723993e-06
hinctnta60-70 percentile        44.849203   9 9.838453e-07
hinctnta70-80 percentile        58.133452   9 3.064122e-09
hinctnta80-90 percentile        59.705774   9 1.527580e-09
hinctnta90-100 percentile       53.469383   9 2.381013e-08
pdwrkYes                        12.844519   9 1.697688e-01
healthGood                      18.632872   9 2.850190e-02
healthFair                      38.655569   9 1.328999e-05
healthBad                       62.837729   9 3.792881e-10
healthVery Bad                  89.715658   9 1.856598e-15
psppsgvaVery little             14.671337   9 1.003685e-01
psppsgvaSome                    24.215218   9 3.973714e-03
psppsgvaA lot                   21.744831   9 9.723827e-03
psppsgvaA great deal            14.117386   9 1.182104e-01
actrolgaVery little able        33.408334   9 1.133602e-04
actrolgaQuite able              24.349527   9 3.781612e-03
actrolgaVery able                8.125561   9 5.215439e-01
actrolgaCompletely able          7.443529   9 5.910439e-01
psppiplaVery little             27.184069   9 1.303977e-03
psppiplaSome                    14.847150   9 9.522097e-02
psppiplaA lot                   12.759124   9 1.738120e-01
psppiplaA great deal             9.053167   9 4.323810e-01
cptppolaa little confident      21.453008   9 1.078399e-02
cptppolaQuite confident         14.323707   9 1.112673e-01
cptppolaVery confident          13.735603   9 1.320461e-01
cptppolaCompletely confident    14.002318   9 1.222428e-01
generaltrust                   110.258320   9 1.302684e-19
generalsatisfaction            182.011554   9 1.925877e-34
behaviorinvolvmentLow level     85.247524   9 1.455936e-14
behaviorinvolvmentMedian level  81.374714   9 8.613803e-14
behaviorinvolvmentHigh level    21.385034   9 1.104628e-02
```

The omnibus p-value of 0 indicates that we can reject the null hypothesis. Hence, we conclude that the proportional odd assumption does not hold.

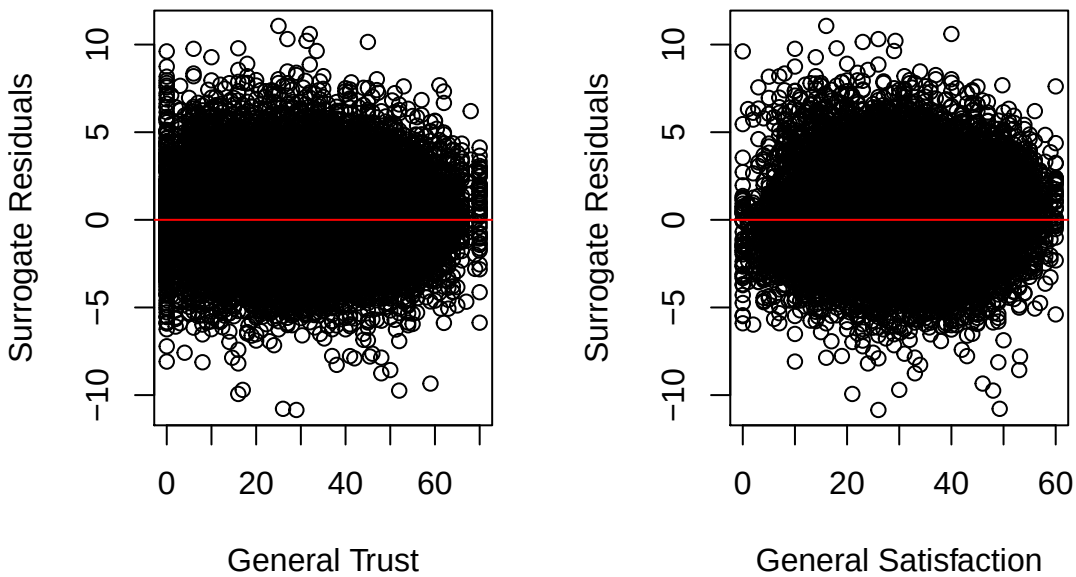
Others

Residual Computation

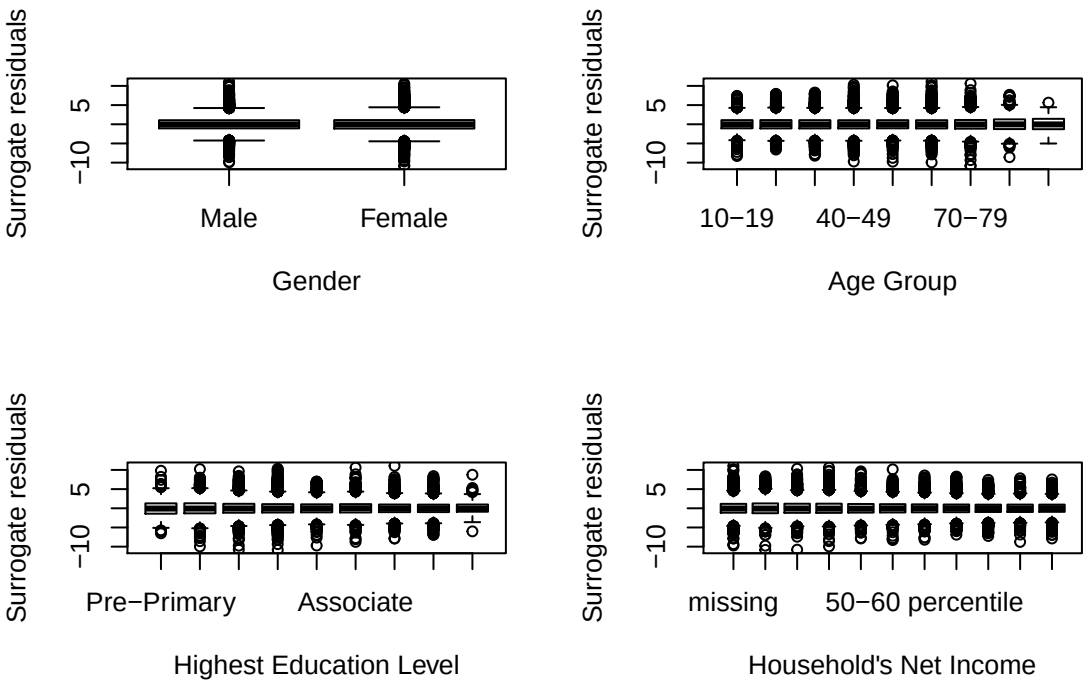
```
> # for residual function and sample data sets
> library(sure)
>
> # for reproducibility
> set.seed(1056)
> sres <- resids(full.model) #Residual Computation
```

Independence & Linearity - Residuals vs each predictor

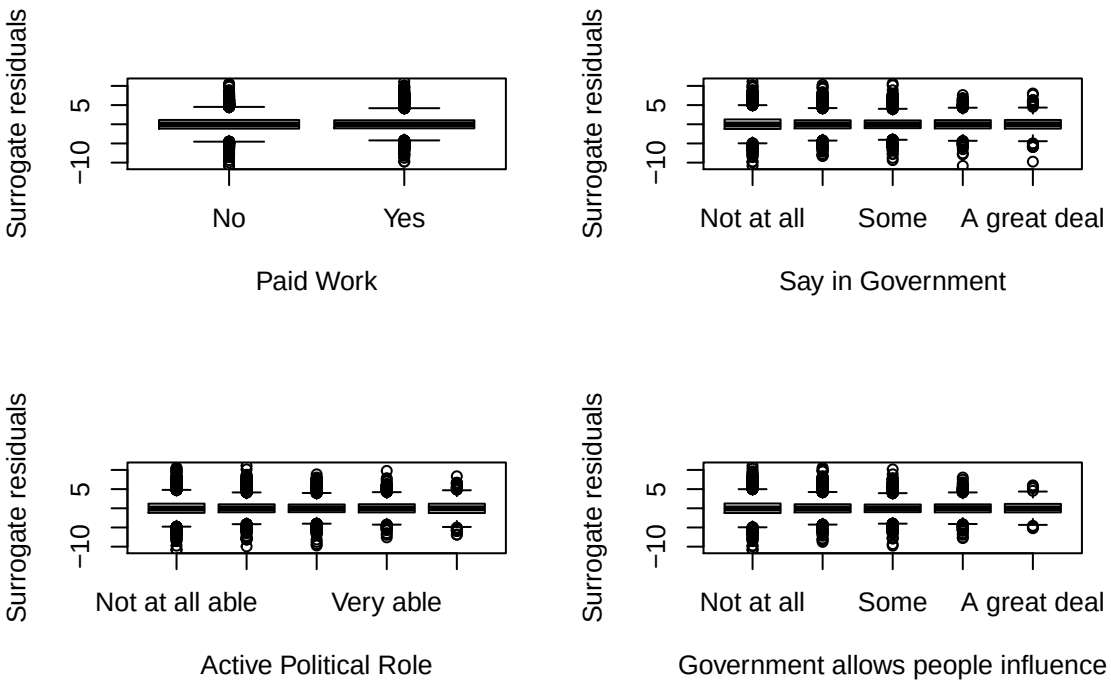
```
> par(mfrow=c(1,2))
> # Scatter plot of numerical variable "General Trust"
> plot(generaltrust,sres,xlab="General Trust",ylab="Surrogate Residuals")
> abline(0,0,col="red")
>
> # Scatter plot of numerical variable "General Satisfaction"
> plot(generalsatisfaction,sres,xlab="General Satisfaction",ylab="Surrogate Residuals")
> abline(0,0,col="red")
```



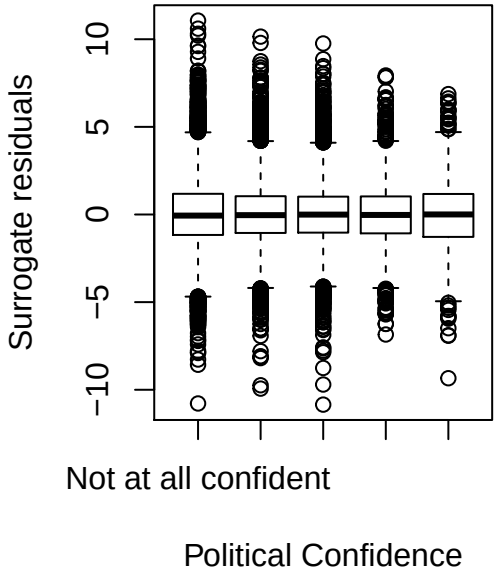

```
> par(mfrow=c(2,2))
> ## Box plot of residual vs categorical variable "gender"
> boxplot(sres~gndr,ylab = "Surrogate residuals",xlab='Gender')
>
> ## Box plot of residual vs categorical variable "Age group"
> boxplot(sres~agegroup,ylab = "Surrogate residuals",xlab='Age Group')
>
> ## Box plot of residual vs categorical variable "Highest education level"
> boxplot(sres~edulvlb,ylab = "Surrogate residuals",xlab='Highest Education Level')
>
> ## Box plot of residual vs categorical variable "Household's Net Income"
> boxplot(sres~hinctnta,ylab = "Surrogate residuals",xlab="Household's Net Income")
```

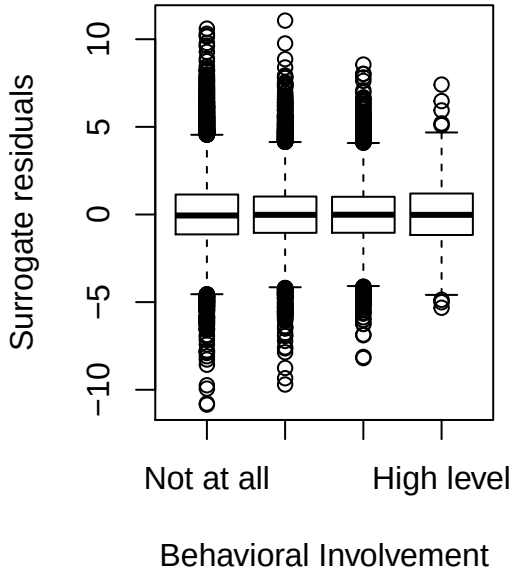



```
> par(mfrow=c(2,2))
> ## Box plot of residual vs categorical variable "Paid Work"
> boxplot(sres~pdwrk, ylab = "Surrogate residuals", xlab='Paid Work')
>
> ## Box plot of residual vs categorical variable "Say in Government"
> boxplot(sres~psppsgva, ylab = "Surrogate residuals", xlab='Say in Government')
>
> ## Box plot of residual vs categorical variable "Active Political Role"
> boxplot(sres~actrolga, ylab = "Surrogate residuals", xlab='Active Political Role')
>
> ## Box plot of residual vs categorical variable "Government allows people influence"
> boxplot(sres~psppipla, ylab = "Surrogate residuals", xlab="Government allows people influence")
```




```
> par(mfrow=c(1,2))
> ## Box plot of residual vs categorical variable "Political Confidence"
> boxplot(sres~cptppola, ylab = "Surrogate residuals", xlab='Political Confidence')
>
> ## Box plot of residual vs categorical variable "Behavioral Involvement"
> boxplot(sres~behaviorinvolvment, ylab = "Surrogate residuals", xlab='Behavioral Involvement')
```

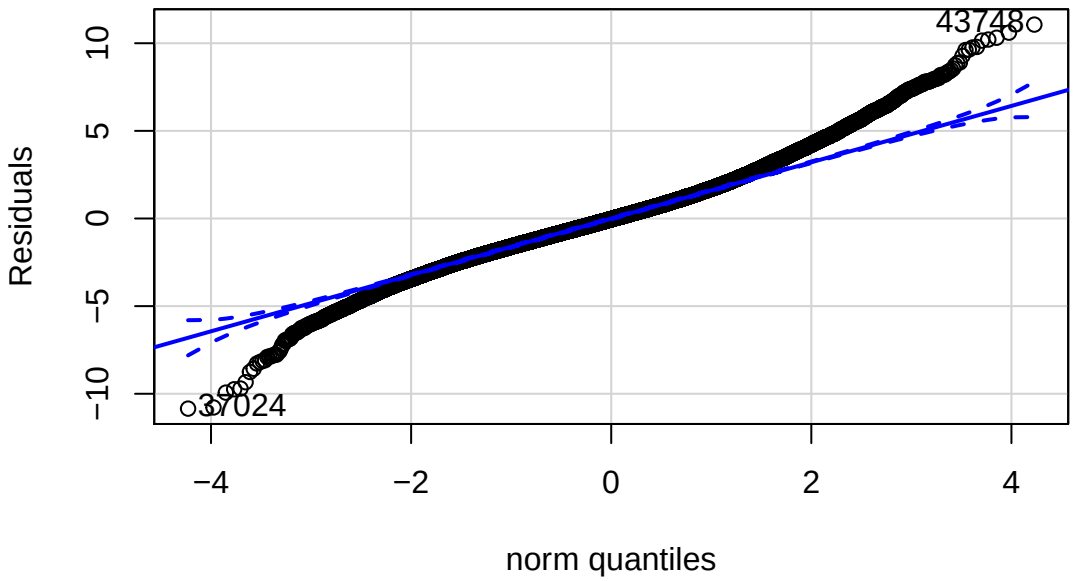




The residual centers around 0 across the ranges of all predictors. There is no clear pattern. Hence, the independence and linearity assumptions hold.

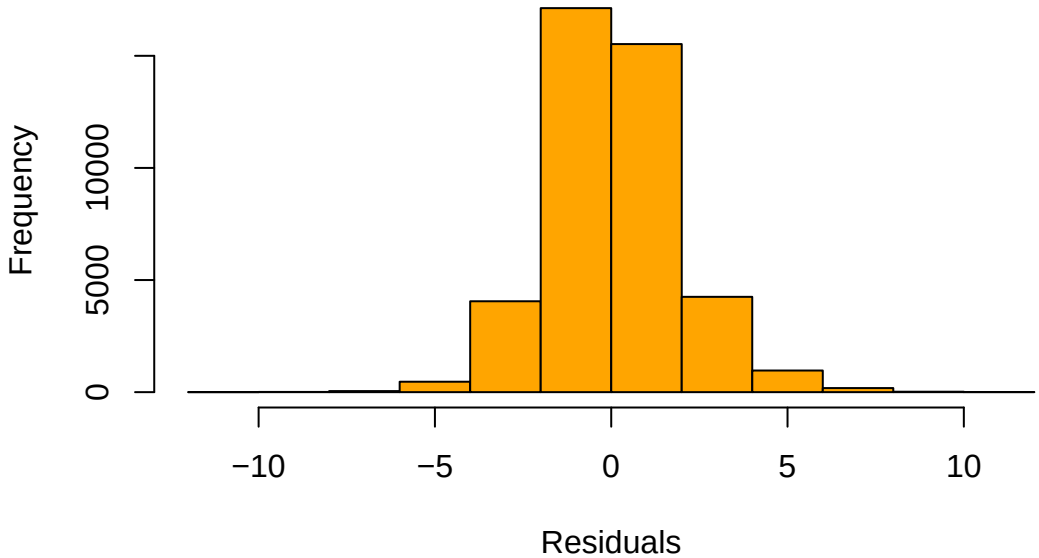
Normality - Q-Q plot & histogram of residuals

```
> qqPlot(sres, ylab="Residuals", main = "")
```




```
43748 37024
42035 35682
```

```
> hist(sres, xlab="Residuals", main = "",nclass=10,col="orange")
```



The residuals has approximately normal distribution with light tails. Hence, the normality asssumption holds.

Method 2: Hypothesis Test

```
> #With deviance residuals
> 1-pchisq(full.model$deviance,full.model$df.residual)
```

```
[1] 0
```

Using deviance residuals: p-value ~ 0, indicating this model is not a good fit.

Part 6: Variable Selection

Different methods for variable selection

Forward Stepwise Regression

```
> # Apply Stepwise Forward Regression for variable selection
> #minmod = polr(happy~1, data = data, Hess = TRUE)
> minmod = polr(happy~gndr+agegroup+edulvlb+hinctnta+pdwrk+health, data = data, Hess = TRUE)
> forward.model=step(minmod, scope = list(lower=minmod,upper=full.model), direction = "forward",trace=T
```

```
Start:  AIC=156834
happy ~ gndr + agegroup + edulvlb + hinctnta + pdwrk + health

                      Df    AIC
+ generalsatisfaction  1 150487
+ generaltrust         1 155563
+ psppipla             4 156285
+ cptppola             4 156437
+ psppsgva             4 156464
+ behaviorinvolvment   3 156546
+ actrolga             4 156657
<none>                   156834

Step:  AIC=150487.5
happy ~ gndr + agegroup + edulvlb + hinctnta + pdwrk + health +
    generalsatisfaction

                     Df    AIC
+ generaltrust        1 150153
+ behaviorinvolvment  3 150225
+ cptppola            4 150247
+ psppsgva            4 150360
+ actrolga            4 150391
+ psppipla            4 150427
<none>                   150487

Step:  AIC=150153
happy ~ gndr + agegroup + edulvlb + hinctnta + pdwrk + health +
    generalsatisfaction + generaltrust

                     Df    AIC
+ behaviorinvolvment  3 149836
+ cptppola            4 149849
+ actrolga            4 150021
```

```
+ psppsgva            4 150093
+ psppipla            4 150118
<none>                  150153

Step:  AIC=149835.6
happy ~ gndr + agegroup + edulvlb + hinctnta + pdwrk + health +
    generalsatisfaction + generaltrust + behaviorinvolvment

           Df    AIC
+ cptppola  4 149678
+ psppsgva  4 149747
+ psppipla  4 149786
+ actrolga  4 149791
<none>        149836

Step:  AIC=149677.7
happy ~ gndr + agegroup + edulvlb + hinctnta + pdwrk + health +
    generalsatisfaction + generaltrust + behaviorinvolvment +
    cptppola

           Df    AIC
+ psppsgva  4 149560
+ psppipla  4 149606
+ actrolga  4 149667
<none>        149678

Step:  AIC=149559.9
happy ~ gndr + agegroup + edulvlb + hinctnta + pdwrk + health +
    generalsatisfaction + generaltrust + behaviorinvolvment +
    cptppola + psppsgva

           Df    AIC
+ psppipla  4 149550
+ actrolga  4 149559
<none>        149560

Step:  AIC=149550.3
happy ~ gndr + agegroup + edulvlb + hinctnta + pdwrk + health +
    generalsatisfaction + generaltrust + behaviorinvolvment +
    cptppola + psppsgva + psppipla

           Df    AIC
<none>        149550
+ actrolga  4 149551
```

```
> summary(forward.model)
```

```
Call:
polr(formula = happy ~ gndr + agegroup + edulvlb + hinctnta +
    pdwrk + health + generalsatisfaction + generaltrust + behaviorinvolvment +
    cptppola + psppsgva + psppipla, data = data, Hess = TRUE)

Coefficients:
                                   Value Std. Error   t value
gndrFemale                      0.242227  0.0177111  13.67658
```

```
agegroup20-29                  -0.055587  0.0491984  -1.12985
agegroup30-39                  -0.003401  0.0495502  -0.06864
agegroup40-49                  -0.063995  0.0493895  -1.29572
agegroup50-59                  -0.016385  0.0488530  -0.33539
agegroup60-69                   0.125947  0.0471208   2.67285
agegroup70-79                   0.259446  0.0501160   5.17692
agegroup80-89                   0.281502  0.0612865   4.59322
agegroup90+                     0.244436  0.1341340   1.82233
edulvlbPrimary                  0.032472  0.0941742   0.34481
edulvlbLower Secondary         -0.186540  0.0915630  -2.03729
edulvlbUpper Secondary         -0.248925  0.0907398  -2.74328
edulvlbVocational              -0.195064  0.0963596  -2.02433
edulvlbAssociate               -0.248440  0.0946934  -2.62362
edulvlbBachelor                -0.186083  0.0940539  -1.97847
edulvlbMaster                  -0.321173  0.0935813  -3.43202
edulvlbDoctoral                -0.321018  0.1231092  -2.60759
hinctnta0-10 percentile        -0.554369  0.0390698 -14.18920
hinctnta10-20 percentile       -0.252343  0.0368032  -6.85656
hinctnta20-30 percentile       -0.099867  0.0360663  -2.76897
hinctnta30-40 percentile       -0.032125  0.0359161  -0.89444
hinctnta40-50 percentile        0.064222  0.0359891   1.78448
hinctnta50-60 percentile        0.103571  0.0361717   2.86332
hinctnta60-70 percentile        0.197025  0.0360010   5.47275
hinctnta70-80 percentile        0.195641  0.0366288   5.34118
hinctnta80-90 percentile        0.233201  0.0410410   5.68215
hinctnta90-100 percentile       0.355853  0.0429123   8.29258
pdwrkYes                        0.013983  0.0234611   0.59600
healthGood                     -0.544747  0.0228437 -23.84668
healthFair                     -1.049784  0.0273823 -38.33806
healthBad                      -1.659575  0.0433046 -38.32333
healthVery Bad                 -2.398019  0.0869032 -27.59414
generalsatisfaction             0.096635  0.0013130  73.59645
generaltrust                   -0.016130  0.0009205 -17.52263
behaviorinvolvmentLow level     0.224955  0.0203780  11.03907
behaviorinvolvmentMedian level  0.266594  0.0273441   9.74962
behaviorinvolvmentHigh level    0.570113  0.0638089   8.93468
cptppolaa little confident      0.095060  0.0227046   4.18680
cptppolaQuite confident         0.244078  0.0262979   9.28130
cptppolaVery confident          0.378536  0.0385886   9.80953
cptppolaCompletely confident    0.635150  0.0612741  10.36571
psppsgvaVery little            -0.095489  0.0265974  -3.59016
psppsgvaSome                   -0.234838  0.0312907  -7.50503
psppsgvaA lot                  -0.237490  0.0465922  -5.09722
psppsgvaA great deal           -0.092526  0.0894922  -1.03390
psppiplaVery little            -0.046191  0.0261835  -1.76413
psppiplaSome                   -0.112242  0.0320308  -3.50418
psppiplaA lot                  -0.077723  0.0480974  -1.61595
psppiplaA great deal            0.138990  0.1063545   1.30685

Intercepts:
     Value    Std. Error t value
0|1   -4.0052   0.1267   -31.6208
1|2   -3.3806   0.1176   -28.7571
2|3   -2.5652   0.1112   -23.0695
```

```
3|4   -1.6828   0.1081   -15.5711
4|5   -1.0349   0.1070    -9.6699
5|6    0.0080   0.1064     0.0756
6|7    0.7053   0.1064     6.6262
7|8    1.7899   0.1068    16.7661
8|9    3.2860   0.1075    30.5782
9|10   4.6191   0.1084    42.6151

Residual Deviance: 149432.33
AIC: 149550.33
```

Using forward stepwise regression, all 13 variables were selected.

Backward Stepwise Regression

```
> # Apply Stepwise Backward Regression for variable selection
> #minmod = polr(happy~1, data = data, Hess = TRUE)
> minmod = polr(happy~gndr+agegroup+edulvlb+hinctnta+pdwrk+health, data = data, Hess = TRUE)
> backward.model=step(full.model, scope = list(lower=minmod,upper=full.model), direction = "backward",t
```

```
Start:  AIC=149551.2
as.ordered(happy) ~ gndr + agegroup + edulvlb + hinctnta + pdwrk +
    health + psppsgva + actrolga + psppipla + cptppola + generaltrust +
    generalsatisfaction + behaviorinvolvment

                      Df    AIC
- actrolga             4 149550
<none>                   149551
- psppipla             4 149559
- psppsgva             4 149605
- cptppola             4 149689
- behaviorinvolvment   3 149744
- generaltrust         1 149855
- generalsatisfaction  1 155141

Step:  AIC=149550.3
as.ordered(happy) ~ gndr + agegroup + edulvlb + hinctnta + pdwrk +
    health + psppsgva + psppipla + cptppola + generaltrust +
    generalsatisfaction + behaviorinvolvment

                      Df    AIC
<none>                   149550
- psppipla             4 149560
- psppsgva             4 149606
- cptppola             4 149736
- behaviorinvolvment   3 149744
- generaltrust         1 149856
- generalsatisfaction  1 155155
```

```
> summary(backward.model)
```

```
Call:
polr(formula = as.ordered(happy) ~ gndr + agegroup + edulvlb +
    hinctnta + pdwrk + health + psppsgva + psppipla + cptppola +
    generaltrust + generalsatisfaction + behaviorinvolvment,
    data = data, Hess = TRUE, method = "logistic")
```

Coefficients:

	Value	Std. Error	t value
gndrFemale	0.242227	0.0177111	13.67658
agegroup20-29	-0.055587	0.0491984	-1.12985
agegroup30-39	-0.003401	0.0495502	-0.06864
agegroup40-49	-0.063995	0.0493895	-1.29572
agegroup50-59	-0.016385	0.0488530	-0.33539
agegroup60-69	0.125947	0.0471208	2.67285
agegroup70-79	0.259446	0.0501160	5.17692
agegroup80-89	0.281502	0.0612865	4.59322
agegroup90+	0.244436	0.1341340	1.82233
edulvlbPrimary	0.032472	0.0941742	0.34481
edulvlbLower Secondary	-0.186540	0.0915630	-2.03729
edulvlbUpper Secondary	-0.248925	0.0907398	-2.74328
edulvlbVocational	-0.195064	0.0963596	-2.02433
edulvlbAssociate	-0.248440	0.0946934	-2.62362
edulvlbBachelor	-0.186083	0.0940539	-1.97847
edulvlbMaster	-0.321173	0.0935813	-3.43202
edulvlbDoctoral	-0.321018	0.1231092	-2.60759
hinctnta0-10 percentile	-0.554369	0.0390698	-14.18920
hinctnta10-20 percentile	-0.252343	0.0368032	-6.85656
hinctnta20-30 percentile	-0.099867	0.0360663	-2.76897
hinctnta30-40 percentile	-0.032125	0.0359161	-0.89444
hinctnta40-50 percentile	0.064222	0.0359891	1.78448
hinctnta50-60 percentile	0.103571	0.0361717	2.86332
hinctnta60-70 percentile	0.197025	0.0360010	5.47275
hinctnta70-80 percentile	0.195641	0.0366288	5.34118
hinctnta80-90 percentile	0.233201	0.0410410	5.68215
hinctnta90-100 percentile	0.355853	0.0429123	8.29258
pdwrkYes	0.013983	0.0234611	0.59600
healthGood	-0.544747	0.0228437	-23.84668
healthFair	-1.049784	0.0273823	-38.33806
healthBad	-1.659575	0.0433046	-38.32333
healthVery Bad	-2.398019	0.0869032	-27.59414
psppsgvaVery little	-0.095489	0.0265974	-3.59016
psppsgvaSome	-0.234838	0.0312907	-7.50503
psppsgvaA lot	-0.237490	0.0465922	-5.09722
psppsgvaA great deal	-0.092526	0.0894922	-1.03390
psppiplaVery little	-0.046191	0.0261835	-1.76413
psppiplaSome	-0.112242	0.0320308	-3.50418
psppiplaA lot	-0.077723	0.0480974	-1.61595
psppiplaA great deal	0.138990	0.1063545	1.30685
cptppolaa little confident	0.095060	0.0227046	4.18680
cptppolaQuite confident	0.244078	0.0262979	9.28130
cptppolaVery confident	0.378536	0.0385886	9.80953
cptppolaCompletely confident	0.635150	0.0612741	10.36571
generaltrust	-0.016130	0.0009205	-17.52263
generalsatisfaction	0.096635	0.0013130	73.59645
behaviorinvolvmentLow level	0.224955	0.0203780	11.03907
behaviorinvolvmentMedian level	0.266594	0.0273441	9.74962
behaviorinvolvmentHigh level	0.570113	0.0638089	8.93468

Intercepts:

```
     Value    Std. Error t value
0|1   -4.0052   0.1267   -31.6208
1|2   -3.3806   0.1176   -28.7571
2|3   -2.5652   0.1112   -23.0695
3|4   -1.6828   0.1081   -15.5711
4|5   -1.0349   0.1070    -9.6699
5|6    0.0080   0.1064     0.0756
6|7    0.7053   0.1064     6.6262
7|8    1.7899   0.1068    16.7661
8|9    3.2860   0.1075    30.5782
9|10   4.6191   0.1084    42.6151

Residual Deviance: 149432.33
AIC: 149550.33
```

Using backward stepwise regression, all 13 variables were selected. This is consistent with what we have found in forward stepwise regression.

LASSO Regression

```
> # !!!!!!!If it's not necessary, don't run lasso regression here. It may take around one hour to run t
> # Apply LASSO for variable selection.
> # Perform Lasso regression. Find the optimal lambda value using 10 fold CV.
> library(ordinalNet)
> predictors = model.matrix(happy ~ ., data = data)
> predictors = predictors[,-1]
> response = as.factor(data$happy)
>
> # This function automatically scales the predicotrs.
> lasso.cv = ordinalNetTune(predictors,response,
+                           alpha = 1,nFolds = 10,
+                           family = c("cumulative"), link = c("logit"))
```

```
Fitting ordinalNet on full training data
Fitting ordinalNet on fold 1 of 10
Fitting ordinalNet on fold 2 of 10
Fitting ordinalNet on fold 3 of 10
Fitting ordinalNet on fold 4 of 10
Fitting ordinalNet on fold 5 of 10
Fitting ordinalNet on fold 6 of 10
Fitting ordinalNet on fold 7 of 10
Fitting ordinalNet on fold 8 of 10
Fitting ordinalNet on fold 9 of 10
Fitting ordinalNet on fold 10 of 10
Done
```

```
> # find the lambda value with lowest BIC
> minbic = which(lasso.cv[["fit"]][["bic"]] == min(lasso.cv[["fit"]][["bic"]]))
> lambdavalue = lasso.cv[["lambdaVals"]][minbic]
> lasso = ordinalNet(predictors, response,
+                    alpha = 1, lambdaVals = c(lambdavalue),
+                    family = c("cumulative"), link = c("logit"))
```

Results of Lasso regression indicates that no variables should be omitted. In the meantime, there is no need to run elastic net.

```r
> # coefficients of lasso regression model
> lasso[["coefs"]]
```

```
     (Intercept):1 (Intercept):2 (Intercept):3 (Intercept):4 (Intercept):5
[1,]     -3.794435     -3.171439     -2.359495     -1.482054    -0.8384083
     (Intercept):6 (Intercept):7 (Intercept):8 (Intercept):9
[1,]     0.1963222     0.8874641      1.961418      3.443308
     (Intercept):10 gndrFemale agegroup20-29 agegroup30-39 agegroup40-49
[1,]       4.767735 -0.2097975    0.03719475             0    0.04581729
     agegroup50-59 agegroup60-69 agegroup70-79 agegroup80-89 agegroup90+
[1,]   0.007464936   -0.08455403    -0.2024338    -0.2037553 -0.07474312
     edulvlbPrimary edulvlbLower Secondary edulvlbUpper Secondary
[1,]     -0.1997278                      0             0.03423331
     edulvlbVocational edulvlbAssociate edulvlbBachelor edulvlbMaster
[1,]                 0      0.006729487     -0.02067456    0.07117735
     edulvlbDoctoral hinctnta0-10 percentile hinctnta10-20 percentile
[1,]     0.004346273               0.5375508                0.2401748
     hinctnta20-30 percentile hinctnta30-40 percentile
[1,]                 0.091946                0.0294749
     hinctnta40-50 percentile hinctnta50-60 percentile
[1,]              -0.01511573              -0.04890565
     hinctnta60-70 percentile hinctnta70-80 percentile
[1,]               -0.1413759               -0.1352098
     hinctnta80-90 percentile hinctnta90-100 percentile pdwrkYes
[1,]               -0.1666208                 -0.283066        0
     healthGood healthFair healthBad healthVery Bad psppsgvaVery little
[1,]  0.4866397  0.9760671  1.558494       2.236377          0.04520831
     psppsgvaSome psppsgvaA lot psppsgvaA great deal
[1,]    0.1790895     0.1619662                    0
     actrolgaVery little able actrolgaQuite able actrolgaVery able
[1,]              0.01575153                  0                 0
     actrolgaCompletely able psppiplaVery little psppiplaSome
[1,]              -0.0454194                    0   0.05331776
     psppiplaA lot psppiplaA great deal cptppolaa little confident
[1,]   0.001562172          -0.09517836                -0.03251274
     cptppolaQuite confident cptppolaVery confident
[1,]              -0.1669559             -0.2830169
     cptppolaCompletely confident generaltrust generalsatisfaction
[1,]                   -0.5088325   0.01461924         -0.09369315
     behaviorinvolvmentLow level behaviorinvolvmentMedian level
[1,]                  -0.2011279                       -0.23396
     behaviorinvolvmentHigh level
[1,]                   -0.4919569
```

```r
> summary(lasso)
```

```
   lambdaVals nNonzero    loglik     devPct      aic      bic
1 0.002368994       55 -74751.68 0.08310526 149613.4 150089.7
```

```
> library(MASS)
> full.model=polr(happy~., data=data, Hess=TRUE, method='logistic')
```

Part 7: Subsampling

```
> #Confidence Intervals with subsampling
>
> library(MASS)
> n= nrow(data)
> subsample = sample(n, ceiling(n*0.2), replace = FALSE)
> subdata = data[subsample,]
> submodel = polr(happy~., data = subdata, Hess = TRUE, method = "logistic")
>
>
>
>
> summary(submodel)
```

```
Call:
polr(formula = happy ~ ., data = subdata, Hess = TRUE, method = "logistic")

Coefficients:
                                  Value Std. Error   t value
gndrFemale                     0.231560   0.039916   5.80115
agegroup20-29                 -0.075391   0.111581  -0.67566
agegroup30-39                 -0.066009   0.111875  -0.59003
agegroup40-49                 -0.089261   0.112039  -0.79669
agegroup50-59                 -0.075787   0.111027  -0.68260
agegroup60-69                  0.179550   0.107170   1.67537
agegroup70-79                  0.321094   0.114240   2.81071
agegroup80-89                  0.370089   0.138688   2.66850
agegroup90+                   -0.077489   0.327223  -0.23681
edulvlbPrimary                 0.008732   0.223204   0.03912
edulvlbLower Secondary        -0.257697   0.217453  -1.18507
edulvlbUpper Secondary        -0.359453   0.215090  -1.67118
edulvlbVocational             -0.267623   0.226911  -1.17942
edulvlbAssociate              -0.238650   0.223635  -1.06714
edulvlbBachelor               -0.264675   0.222097  -1.19170
edulvlbMaster                 -0.384533   0.220901  -1.74075
edulvlbDoctoral               -0.616851   0.282521  -2.18338
hinctnta0-10 percentile       -0.610186   0.086560  -7.04928
hinctnta10-20 percentile      -0.123671   0.082144  -1.50554
hinctnta20-30 percentile      -0.123251   0.079688  -1.54666
hinctnta30-40 percentile       0.027766   0.080917   0.34314
hinctnta40-50 percentile       0.067262   0.081475   0.82555
hinctnta50-60 percentile       0.136795   0.081615   1.67609
hinctnta60-70 percentile       0.292503   0.079880   3.66176
hinctnta70-80 percentile       0.254411   0.082922   3.06808
hinctnta80-90 percentile       0.209412   0.093666   2.23573
hinctnta90-100 percentile      0.423404   0.094747   4.46879
pdwrkYes                       0.055144   0.052236   1.05567
healthGood                    -0.598927   0.051106 -11.71922
healthFair                    -1.069457   0.061343 -17.43415
healthBad                     -1.670382   0.096045 -17.39169
healthVery Bad                -2.207940   0.214167 -10.30941
psppsgvaVery little           -0.140076   0.059530  -2.35304
psppsgvaSome                  -0.366244   0.070214  -5.21608
psppsgvaA lot                 -0.414954   0.102867  -4.03390
psppsgvaA great deal          -0.117842   0.200818  -0.58681
actrolgaVery little able      -0.001296   0.056220  -0.02305
actrolgaQuite able            -0.031575   0.069699  -0.45302
actrolgaVery able             -0.053100   0.101133  -0.52505
actrolgaCompletely able        0.006995   0.148115   0.04723
psppiplaVery little           -0.046073   0.058170  -0.79205
psppiplaSome                  -0.104667   0.071187  -1.47031
psppiplaA lot                 -0.099347   0.107340  -0.92554
psppiplaA great deal           0.213421   0.225649   0.94581
cptppolaa little confident     0.081911   0.055929   1.46456
cptppolaQuite confident        0.216487   0.068746   3.14908
cptppolaVery confident         0.365490   0.097758   3.73874
cptppolaCompletely confident   0.535710   0.156668   3.41940
generaltrust                  -0.013898   0.002050  -6.77943
```

```
generalsatisfaction             0.098419   0.002941  33.46461
behaviorinvolvmentLow level     0.246191   0.045895   5.36419
behaviorinvolvmentMedian level  0.368225   0.062028   5.93643
behaviorinvolvmentHigh level    0.573536   0.142847   4.01502

Intercepts:
     Value    Std. Error t value
0|1   -3.7971   0.2842   -13.3628
1|2   -3.2442   0.2692   -12.0527
2|3   -2.5689   0.2586    -9.9336
3|4   -1.7117   0.2521    -6.7904
4|5   -1.0557   0.2498    -4.2268
5|6    0.0192   0.2483     0.0773
6|7    0.6749   0.2482     2.7190
7|8    1.7790   0.2488     7.1500
8|9    3.2961   0.2504    13.1642
9|10   4.6585   0.2525    18.4466

Residual Deviance: 29753.07
AIC: 29879.07
```

```
> CI = confint(submodel)
```

```
Waiting for profiling to be done...
```

```
> CI
```

```
                                     2.5 %       97.5 %
gndrFemale                      0.15337872  0.309779615
agegroup20-29                  -0.29397959  0.142978510
agegroup30-39                  -0.28520553  0.153122413
agegroup40-49                  -0.30881768  0.130169276
agegroup50-59                  -0.29326481  0.141605557
agegroup60-69                  -0.03045734  0.389457128
agegroup70-79                   0.09725425  0.544730570
agegroup80-89                   0.09869450  0.640882133
agegroup90+                    -0.71715349  0.568269022
edulvlbPrimary                 -0.43130979  0.443643376
edulvlbLower Secondary         -0.68577826  0.166183684
edulvlbUpper Secondary         -0.78387127  0.060171216
edulvlbVocational              -0.71495605  0.174767406
edulvlbAssociate               -0.67970497  0.197500160
edulvlbBachelor                -0.70264199  0.168543998
edulvlbMaster                  -0.81987397  0.045746011
edulvlbDoctoral                -1.17284572 -0.066599811
hinctnta0-10 percentile        -0.77963929 -0.440555818
hinctnta10-20 percentile       -0.28467725  0.037158375
hinctnta20-30 percentile       -0.27939858  0.032650753
hinctnta30-40 percentile       -0.13065664  0.186423961
hinctnta40-50 percentile       -0.09238550  0.226684468
hinctnta50-60 percentile       -0.02182799  0.296662696
hinctnta60-70 percentile        0.13621259  0.449079758
hinctnta70-80 percentile        0.09325730  0.416719310
hinctnta80-90 percentile        0.02594137  0.392708072
hinctnta90-100 percentile       0.23782165  0.608827281
pdwrkYes                       -0.04710893  0.157437766
```

```
healthGood                      -0.69910985 -0.498983985
healthFair                      -1.18970559 -0.949554032
healthBad                       -1.85864754 -1.482432520
healthVery Bad                  -2.62584509 -1.787788984
psppsgvaVery little             -0.25639928 -0.023404791
psppsgvaSome                    -0.50387597 -0.228709133
psppsgvaA lot                   -0.61654849 -0.213393504
psppsgvaA great deal            -0.51063264  0.275905736
actrolgaVery little able        -0.11137854  0.108747646
actrolgaQuite able              -0.16815665  0.104933554
actrolgaVery able               -0.25120137  0.144862923
actrolgaCompletely able         -0.28315519  0.297424831
psppiplaVery little             -0.16000320  0.067851080
psppiplaSome                    -0.24418115  0.034739808
psppiplaA lot                   -0.30952712  0.110893213
psppiplaA great deal            -0.22586664  0.657396011
cptppolaa little confident      -0.02765298  0.191521564
cptppolaQuite confident          0.08184140  0.351186635
cptppolaVery confident           0.17407103  0.557123895
cptppolaCompletely confident     0.22932893  0.843140351
generaltrust                    -0.01792170 -0.009914932
generalsatisfaction              0.09266839  0.104173187
behaviorinvolvmentLow level      0.15628384  0.336135597
behaviorinvolvmentMedian level   0.24678329  0.489762397
behaviorinvolvmentHigh level     0.29373549  0.853061651
```

```r
> library(MASS)
> n= nrow(data)
> subsample2 = sample(n, ceiling(n*0.2), replace = FALSE)
> subdata2 = data[subsample2,]
> second.submodel = polr(happy~., data = subdata2, Hess = TRUE, method = "logistic")
>
>
>
>
> summary(second.submodel)
```

```
Call:
polr(formula = happy ~ ., data = subdata2, Hess = TRUE, method = "logistic")

Coefficients:
                                   Value Std. Error   t value
gndrFemale                      0.312381   0.039956   7.81819
agegroup20-29                  -0.014262   0.110917  -0.12859
agegroup30-39                  -0.009642   0.111449  -0.08652
agegroup40-49                  -0.036522   0.111560  -0.32737
agegroup50-59                  -0.012873   0.110811  -0.11617
agegroup60-69                   0.098251   0.107161   0.91685
agegroup70-79                   0.268336   0.113509   2.36400
agegroup80-89                   0.321859   0.142332   2.26132
agegroup90+                     0.357480   0.276476   1.29299
edulvlbPrimary                 -0.164981   0.202071  -0.81645
edulvlbLower Secondary         -0.325945   0.194906  -1.67231
edulvlbUpper Secondary         -0.442385   0.193137  -2.29053
edulvlbVocational              -0.320316   0.206910  -1.54810
```

edulvlbAssociate	-0.420308	0.202250	-2.07816
edulvlbBachelor	-0.350610	0.201485	-1.74013
edulvlbMaster	-0.469308	0.199585	-2.35141
edulvlbDoctoral	-0.550820	0.278728	-1.97619
hinctnta0-10 percentile	-0.540986	0.087764	-6.16408
hinctnta10-20 percentile	-0.267244	0.082647	-3.23357
hinctnta20-30 percentile	-0.139787	0.080935	-1.72716
hinctnta30-40 percentile	0.004078	0.080561	0.05062
hinctnta40-50 percentile	-0.070095	0.081355	-0.86159
hinctnta50-60 percentile	0.126521	0.080579	1.57015
hinctnta60-70 percentile	0.223494	0.079077	2.82626
hinctnta70-80 percentile	0.190951	0.081784	2.33481
hinctnta80-90 percentile	0.160598	0.093057	1.72582
hinctnta90-100 percentile	0.378716	0.096951	3.90627
pdwrkYes	-0.008140	0.052311	-0.15562
healthGood	-0.496885	0.051440	-9.65952
healthFair	-1.133777	0.061576	-18.41254
healthBad	-1.633065	0.095725	-17.06000
healthVery Bad	-2.548551	0.203070	-12.55012
psppsgvaVery little	-0.098308	0.058755	-1.67318
psppsgvaSome	-0.313247	0.069597	-4.50086
psppsgvaA lot	-0.228233	0.102681	-2.22274
psppsgvaA great deal	0.062021	0.179811	0.34492
actrolgaVery little able	-0.134249	0.056326	-2.38341
actrolgaQuite able	-0.044420	0.070077	-0.63386
actrolgaVery able	-0.028690	0.103074	-0.27835
actrolgaCompletely able	-0.026374	0.153099	-0.17227
psppiplaVery little	0.019336	0.058340	0.33144
psppiplaSome	-0.101488	0.071133	-1.42673
psppiplaA lot	-0.101874	0.106603	-0.95564
psppiplaA great deal	-0.231486	0.224255	-1.03224
cptppolaa little confident	0.179883	0.056754	3.16951
cptppolaQuite confident	0.282429	0.068819	4.10395
cptppolaVery confident	0.427984	0.099969	4.28116
cptppolaCompletely confident	0.658073	0.154275	4.26558
generaltrust	-0.017439	0.002052	-8.49874
generalsatisfaction	0.097756	0.002928	33.39144
behaviorinvolvmentLow level	0.227666	0.045860	4.96434
behaviorinvolvmentMedian level	0.299124	0.062217	4.80779
behaviorinvolvmentHigh level	0.646937	0.141550	4.57037

Intercepts:

	Value	Std. Error	t value
0|1	-4.0682	0.2721	-14.9491
1|2	-3.4442	0.2534	-13.5922
2|3	-2.7054	0.2411	-11.2199
3|4	-1.8883	0.2345	-8.0525
4|5	-1.2468	0.2320	-5.3745
5|6	-0.2110	0.2304	-0.9160
6|7	0.5181	0.2302	2.2502
7|8	1.6106	0.2308	6.9797
8|9	3.1380	0.2324	13.5004
9|10	4.4879	0.2347	19.1234

```
Residual Deviance: 29731.02
AIC: 29857.02
```

```
> second.CI = confint(second.submodel)
```

```
Waiting for profiling to be done...
```

```
> second.CI
```

```
                                     2.5 %       97.5 %
gndrFemale                      0.23418099  0.390660321
agegroup20-29                  -0.23107623  0.202141536
agegroup30-39                  -0.22785771  0.208667068
agegroup40-49                  -0.25513866  0.181857094
agegroup50-59                  -0.22985322  0.204204234
agegroup60-69                  -0.11172051  0.308022903
agegroup70-79                   0.04602046  0.490538170
agegroup80-89                   0.04325783  0.600775563
agegroup90+                    -0.18326005  0.900991501
edulvlbPrimary                 -0.56113028  0.228142798
edulvlbLower Secondary         -0.70937046  0.054866802
edulvlbUpper Secondary         -0.82186387 -0.065108828
edulvlbVocational              -0.72698839  0.082795314
edulvlbAssociate               -0.81701868 -0.025060420
edulvlbBachelor                -0.74523461  0.042865764
edulvlbMaster                  -0.86200451 -0.079130751
edulvlbDoctoral                -1.09702034 -0.005250027
hinctnta0-10 percentile        -0.71083848 -0.369016203
hinctnta10-20 percentile       -0.42907269 -0.105331939
hinctnta20-30 percentile       -0.29822831  0.018860580
hinctnta30-40 percentile       -0.15369487  0.161989807
hinctnta40-50 percentile       -0.22919689  0.089343478
hinctnta50-60 percentile       -0.03118189  0.284434166
hinctnta60-70 percentile        0.06865247  0.373094477
hinctnta70-80 percentile        0.03077015  0.351222446
hinctnta80-90 percentile       -0.02143170  0.343001122
hinctnta90-100 percentile       0.18889929  0.568804285
pdwrkYes                       -0.11052089  0.094297078
healthGood                     -0.59749301 -0.396201388
healthFair                     -1.25435082 -1.013235976
healthBad                      -1.82069985 -1.445605917
healthVery Bad                 -2.94681808 -2.150695152
psppsgvaVery little            -0.21341217  0.016835964
psppsgvaSome                   -0.44955304 -0.177022300
psppsgvaA lot                  -0.42940026 -0.027082503
psppsgvaA great deal           -0.28995328  0.414935340
actrolgaVery little able       -0.24464109 -0.023973486
actrolgaQuite able             -0.18166380  0.092417643
actrolgaVery able              -0.23063592  0.171983654
actrolgaCompletely able        -0.32649792  0.273713128
psppiplaVery little            -0.09500425  0.133587516
psppiplaSome                   -0.24078814  0.037839780
psppiplaA lot                  -0.31079783  0.106939987
psppiplaA great deal           -0.67002467  0.209180981
cptppolaa little confident      0.06891629  0.291119210
cptppolaQuite confident         0.14809546  0.417104757
```

```
cptppolaVery confident          0.23220638  0.623936783
cptppolaCompletely confident    0.35688898  0.956956819
generaltrust                   -0.02146290 -0.013422175
generalsatisfaction             0.09202949  0.103504232
behaviorinvolvmentLow level     0.13784372  0.317512176
behaviorinvolvmentMedian level  0.17728282  0.421061467
behaviorinvolvmentHigh level    0.36980223  0.924464316
```

```
> library(MASS)
> n= nrow(data)
> subsample3 = sample(n, ceiling(n*0.2), replace = FALSE)
> subdata3 = data[subsample3,]
> third.submodel = polr(happy~., data = subdata3, Hess = TRUE, method = "logistic")
>
>
>
>
> summary(third.submodel)
```

```
Call:
polr(formula = happy ~ ., data = subdata3, Hess = TRUE, method = "logistic")

Coefficients:
                                    Value Std. Error    t value
gndrFemale                      2.578e-01   0.039778  6.480e+00
agegroup20-29                   2.756e-02   0.108027  2.552e-01
agegroup30-39                   8.927e-02   0.109570  8.148e-01
agegroup40-49                   1.355e-01   0.110050  1.231e+00
agegroup50-59                   7.951e-02   0.108558  7.325e-01
agegroup60-69                   2.809e-01   0.103952  2.702e+00
agegroup70-79                   4.086e-01   0.110849  3.686e+00
agegroup80-89                   2.973e-01   0.137807  2.157e+00
agegroup90+                     7.195e-01   0.305836  2.353e+00
edulvlbPrimary                  1.915e-02   0.204596  9.358e-02
edulvlbLower Secondary         -2.560e-01   0.198501 -1.290e+00
edulvlbUpper Secondary         -2.383e-01   0.196742 -1.211e+00
edulvlbVocational              -2.097e-01   0.209524 -1.001e+00
edulvlbAssociate               -1.308e-01   0.206249 -6.342e-01
edulvlbBachelor                -2.466e-01   0.204374 -1.207e+00
edulvlbMaster                  -2.824e-01   0.203408 -1.388e+00
edulvlbDoctoral                -2.504e-01   0.265118 -9.444e-01
hinctnta0-10 percentile        -4.230e-01   0.086962 -4.864e+00
hinctnta10-20 percentile       -2.710e-01   0.082263 -3.295e+00
hinctnta20-30 percentile       -1.007e-01   0.080591 -1.249e+00
hinctnta30-40 percentile       -1.382e-02   0.080419 -1.719e-01
hinctnta40-50 percentile        8.874e-02   0.081446  1.090e+00
hinctnta50-60 percentile        8.556e-02   0.081537  1.049e+00
hinctnta60-70 percentile        1.691e-01   0.081420  2.077e+00
hinctnta70-80 percentile        1.498e-01   0.083853  1.787e+00
hinctnta80-90 percentile        1.254e-01   0.090457  1.386e+00
hinctnta90-100 percentile       3.002e-01   0.095245  3.151e+00
pdwrkYes                       -2.181e-02   0.052930 -4.121e-01
healthGood                     -5.973e-01   0.051357 -1.163e+01
healthFair                     -1.162e+00   0.061262 -1.896e+01
healthBad                      -1.846e+00   0.098854 -1.867e+01
```

```
healthVery Bad                 -2.589e+00   0.186718 -1.387e+01
psppsgvaVery little            -7.870e-02   0.059310 -1.327e+00
psppsgvaSome                   -2.413e-01   0.069837 -3.455e+00
psppsgvaA lot                  -1.794e-01   0.104828 -1.711e+00
psppsgvaA great deal            2.995e-01   0.198819  1.507e+00
actrolgaVery little able       -4.492e-02   0.055698 -8.064e-01
actrolgaQuite able             -3.544e-05   0.069691 -5.086e-04
actrolgaVery able               1.041e-01   0.100786  1.033e+00
actrolgaCompletely able         3.748e-02   0.156047  2.402e-01
psppiplaVery little            -7.031e-02   0.058932 -1.193e+00
psppiplaSome                   -1.414e-01   0.071955 -1.965e+00
psppiplaA lot                  -1.794e-01   0.107600 -1.668e+00
psppiplaA great deal            1.568e-02   0.246205  6.369e-02
cptppolaa little confident      8.257e-02   0.055774  1.481e+00
cptppolaQuite confident         1.491e-01   0.069090  2.158e+00
cptppolaVery confident          2.228e-01   0.098656  2.258e+00
cptppolaCompletely confident    4.231e-01   0.157295  2.690e+00
generaltrust                   -1.718e-02   0.002043 -8.406e+00
generalsatisfaction             1.029e-01   0.002967  3.467e+01
behaviorinvolvmentLow level     2.352e-01   0.045791  5.135e+00
behaviorinvolvmentMedian level  3.025e-01   0.062233  4.861e+00
behaviorinvolvmentHigh level    6.024e-01   0.141373  4.261e+00

Intercepts:
     Value    Std. Error t value
0|1   -4.1473   0.2900   -14.3018
1|2   -3.4971   0.2638   -13.2552
2|3   -2.4767   0.2437   -10.1634
3|4   -1.5894   0.2365    -6.7204
4|5   -0.8984   0.2339    -3.8410
5|6    0.1235   0.2324     0.5316
6|7    0.8561   0.2323     3.6848
7|8    1.9589   0.2330     8.4072
8|9    3.4616   0.2348    14.7442
9|10   4.7653   0.2371    20.0961

Residual Deviance: 29764.66
AIC: 29890.66
```

```
> third.CI = confint(third.submodel)
```

```
Waiting for profiling to be done...
```

```
> third.CI
```

```
                                    2.5 %        97.5 %
gndrFemale                    0.179967969  0.3357441743
agegroup20-29                -0.184206895  0.2389214333
agegroup30-39                -0.125449148  0.3039094431
agegroup40-49                -0.080004450  0.3508132545
agegroup50-59                -0.133326694  0.2921631610
agegroup60-69                 0.077257134  0.4845889324
agegroup70-79                 0.191381023  0.6257072000
agegroup80-89                 0.027245299  0.5672567797
agegroup90+                   0.123441830  1.3247957976
edulvlbPrimary               -0.382786040  0.4181599147
```

```
edulvlbLower Secondary         -0.645726315  0.1326890350
edulvlbUpper Secondary         -0.625077270  0.1470921374
edulvlbVocational              -0.621177478  0.2007054606
edulvlbAssociate               -0.534860643  0.2730474559
edulvlbBachelor                -0.648283399  0.1536104845
edulvlbMaster                  -0.682035416  0.1159272586
edulvlbDoctoral                -0.770151226  0.2689024550
hinctnta0-10 percentile        -0.593394293 -0.2530658052
hinctnta10-20 percentile       -0.432204187 -0.1097831586
hinctnta20-30 percentile       -0.258411982  0.0569030127
hinctnta30-40 percentile       -0.170805193  0.1438429637
hinctnta40-50 percentile       -0.070859748  0.2483582600
hinctnta50-60 percentile       -0.073980390  0.2453094182
hinctnta60-70 percentile        0.009678547  0.3288192135
hinctnta70-80 percentile       -0.014381248  0.3141168676
hinctnta80-90 percentile       -0.051812623  0.3027660246
hinctnta90-100 percentile       0.113603925  0.4865228264
pdwrkYes                       -0.125548816  0.0819116509
healthGood                     -0.697988507 -0.4968656682
healthFair                     -1.281807826 -1.0418398285
healthBad                      -2.039735932 -1.6524481367
healthVery Bad                 -2.955766807 -2.2236368435
psppsgvaVery little            -0.194975225  0.0374959829
psppsgvaSome                   -0.378192038 -0.1044785778
psppsgvaA lot                  -0.384682848  0.0259783320
psppsgvaA great deal           -0.089281168  0.6896266102
actrolgaVery little able       -0.153797296  0.0642053432
actrolgaQuite able             -0.136542628  0.1366128910
actrolgaVery able              -0.093339168  0.3017088329
actrolgaCompletely able        -0.268337211  0.3433469117
psppiplaVery little            -0.185653662  0.0451853171
psppiplaSome                   -0.282387088 -0.0004372864
psppiplaA lot                  -0.390022666  0.0315124741
psppiplaA great deal           -0.465203120  0.5005655847
cptppolaa little confident     -0.026428204  0.1918706910
cptppolaQuite confident         0.013708996  0.2844122686
cptppolaVery confident          0.030080503  0.4161799222
cptppolaCompletely confident    0.115046716  0.7317142305
generaltrust                   -0.021185892 -0.0131740875
generalsatisfaction             0.097076016  0.1086951385
behaviorinvolvmentLow level     0.145450654  0.3247235594
behaviorinvolvmentMedian level  0.180593063  0.4244751602
behaviorinvolvmentHigh level    0.326015609  0.8798524618
```

```
> library(MASS)
> n= nrow(data)
> subsample4 = sample(n, ceiling(n*0.2), replace = FALSE)
> subdata4 = data[subsample4,]
> fourth.submodel = polr(happy~., data = subdata4, Hess = TRUE, method = "logistic")
>
>
>
>
> summary(fourth.submodel)
```

```
Call:
polr(formula = happy ~ ., data = subdata4, Hess = TRUE, method = "logistic")

Coefficients:
                                   Value Std. Error   t value
gndrFemale                      0.254071   0.039767   6.38892
agegroup20-29                  -0.127164   0.108974  -1.16693
agegroup30-39                   0.076378   0.109879   0.69511
agegroup40-49                  -0.054876   0.109894  -0.49935
agegroup50-59                  -0.071143   0.108706  -0.65445
agegroup60-69                   0.272583   0.104240   2.61497
agegroup70-79                   0.315160   0.111128   2.83601
agegroup80-89                   0.298377   0.132392   2.25374
agegroup90+                     0.206555   0.298176   0.69273
edulvlbPrimary                 -0.333282   0.216275  -1.54101
edulvlbLower Secondary         -0.620344   0.210102  -2.95258
edulvlbUpper Secondary         -0.578878   0.208423  -2.77742
edulvlbVocational              -0.598256   0.220624  -2.71166
edulvlbAssociate               -0.566540   0.218079  -2.59786
edulvlbBachelor                -0.615956   0.216282  -2.84793
edulvlbMaster                  -0.713660   0.214792  -3.32256
edulvlbDoctoral                -0.760543   0.279723  -2.71891
hinctnta0-10 percentile        -0.539938   0.089504  -6.03259
hinctnta10-20 percentile       -0.245930   0.082182  -2.99251
hinctnta20-30 percentile       -0.005173   0.081225  -0.06369
hinctnta30-40 percentile       -0.038879   0.080862  -0.48082
hinctnta40-50 percentile        0.135755   0.080230   1.69207
hinctnta50-60 percentile        0.221627   0.079967   2.77147
hinctnta60-70 percentile        0.221554   0.081250   2.72680
hinctnta70-80 percentile        0.308691   0.083185   3.71090
hinctnta80-90 percentile        0.280360   0.091292   3.07104
hinctnta90-100 percentile       0.382100   0.097298   3.92712
pdwrkYes                        0.083622   0.053301   1.56886
healthGood                     -0.465737   0.051138  -9.10740
healthFair                     -0.997412   0.061242 -16.28647
healthBad                      -1.648371   0.097937 -16.83094
healthVery Bad                 -2.718411   0.196628 -13.82515
psppsgvaVery little            -0.138264   0.060159  -2.29831
psppsgvaSome                   -0.286167   0.070657  -4.05012
psppsgvaA lot                  -0.210278   0.102400  -2.05350
psppsgvaA great deal           -0.329135   0.199245  -1.65191
actrolgaVery little able       -0.031365   0.056177  -0.55833
actrolgaQuite able             -0.011574   0.069529  -0.16646
actrolgaVery able               0.015729   0.099618   0.15789
actrolgaCompletely able        -0.001922   0.155787  -0.01234
psppiplaVery little             0.021816   0.059545   0.36638
psppiplaSome                   -0.118376   0.072765  -1.62682
psppiplaA lot                  -0.058240   0.107535  -0.54159
psppiplaA great deal            0.373855   0.240334   1.55556
cptppolaa little confident      0.136222   0.056722   2.40159
cptppolaQuite confident         0.275815   0.068998   3.99742
cptppolaVery confident          0.442743   0.098087   4.51378
cptppolaCompletely confident    0.732415   0.156142   4.69070
generaltrust                   -0.013199   0.002078  -6.35148
```

```
generalsatisfaction             0.097024   0.002988  32.46718
behaviorinvolvmentLow level     0.186566   0.046036   4.05258
behaviorinvolvmentMedian level  0.178624   0.061775   2.89151
behaviorinvolvmentHigh level    0.598793   0.137436   4.35688

Intercepts:
     Value    Std. Error t value
0|1   -4.2768   0.2924   -14.6248
1|2   -3.6251   0.2694   -13.4580
2|3   -2.7277   0.2530   -10.7804
3|4   -1.8412   0.2459    -7.4867
4|5   -1.1729   0.2435    -4.8175
5|6   -0.1147   0.2420    -0.4742
6|7    0.5821   0.2418     2.4068
7|8    1.6842   0.2425     6.9467
8|9    3.1938   0.2441    13.0840
9|10   4.5605   0.2463    18.5163

Residual Deviance: 29772.41
AIC: 29898.41
```

```
> fourth.CI = confint(fourth.submodel)
```

```
Waiting for profiling to be done...
```

```
> fourth.CI
```

```
                                     2.5 %       97.5 %
gndrFemale                      0.17619497  0.331957768
agegroup20-29                  -0.34060229  0.086211628
agegroup30-39                  -0.13876949  0.291670612
agegroup40-49                  -0.27017923  0.160453799
agegroup50-59                  -0.28408444  0.141608516
agegroup60-69                   0.06864218  0.476932324
agegroup70-79                   0.09851484  0.532973770
agegroup80-89                   0.03916830  0.554056270
agegroup90+                    -0.37521447  0.793083135
edulvlbPrimary                 -0.75900547  0.088938688
edulvlbLower Secondary         -1.03399442 -0.211590758
edulvlbUpper Secondary         -0.98975334 -0.172473982
edulvlbVocational              -1.03261139 -0.167733272
edulvlbAssociate               -0.99586007 -0.141230429
edulvlbBachelor                -1.04187242 -0.193518038
edulvlbMaster                  -1.13640477 -0.294694528
edulvlbDoctoral                -1.30962147 -0.216131607
hinctnta0-10 percentile        -0.71526782 -0.364648126
hinctnta10-20 percentile       -0.40665220 -0.084916127
hinctnta20-30 percentile       -0.16428324  0.153852616
hinctnta30-40 percentile       -0.19723010  0.119499444
hinctnta40-50 percentile       -0.02094128  0.292904832
hinctnta50-60 percentile        0.06502959  0.378279991
hinctnta60-70 percentile        0.06244122  0.380346328
hinctnta70-80 percentile        0.14592508  0.471703161
hinctnta80-90 percentile        0.10158141  0.459150716
hinctnta90-100 percentile       0.19186850  0.572641138
pdwrkYes                       -0.02080815  0.187548890
```

```
healthGood                      -0.56604350 -0.365776704
healthFair                      -1.11755668 -0.877607161
healthBad                       -1.84032889 -1.457084840
healthVery Bad                  -3.10370741 -2.332992927
psppsgvaVery little             -0.25613964 -0.020424515
psppsgvaSome                    -0.42451615 -0.147790054
psppsgvaA lot                   -0.41076879 -0.009664823
psppsgvaA great deal            -0.71778218  0.060765292
actrolgaVery little able        -0.14134397  0.078614688
actrolgaQuite able              -0.14762317  0.124500386
actrolgaVery able               -0.17943192  0.210931514
actrolgaCompletely able         -0.30688292  0.303765372
psppiplaVery little             -0.09486966  0.138353057
psppiplaSome                    -0.26092578  0.024082312
psppiplaA lot                   -0.26887188  0.152479830
psppiplaA great deal            -0.09536563  0.847213242
cptppolaa little confident       0.02516882  0.247134948
cptppolaQuite confident          0.14070627  0.411037519
cptppolaVery confident           0.25079211  0.634937694
cptppolaCompletely confident     0.42691536  1.038828021
generaltrust                    -0.01727417 -0.009131613
generalsatisfaction              0.09117865  0.102886164
behaviorinvolvmentLow level      0.09639305  0.276736958
behaviorinvolvmentMedian level   0.05864949  0.299694503
behaviorinvolvmentHigh level     0.33008738  0.868497167
```

```
> library(MASS)
> n= nrow(data)
> subsample5 = sample(n, ceiling(n*0.2), replace = FALSE)
> subdata5 = data[subsample5,]
> fifth.submodel = polr(happy~., data = subdata5, Hess = TRUE, method = "logistic")
>
>
>
>
> summary(fifth.submodel)
```

```
Call:
polr(formula = happy ~ ., data = subdata5, Hess = TRUE, method = "logistic")

Coefficients:
                                   Value Std. Error  t value
gndrFemale                      0.263289   0.039720   6.6287
agegroup20-29                  -0.140032   0.106918  -1.3097
agegroup30-39                  -0.141077   0.108060  -1.3055
agegroup40-49                  -0.243576   0.107824  -2.2590
agegroup50-59                  -0.168432   0.106212  -1.5858
agegroup60-69                  -0.030349   0.102264  -0.2968
agegroup70-79                   0.107536   0.110609   0.9722
agegroup80-89                   0.289986   0.137892   2.1030
agegroup90+                     0.043149   0.309846   0.1393
edulvlbPrimary                 -0.096190   0.222491  -0.4323
edulvlbLower Secondary         -0.425455   0.216409  -1.9660
edulvlbUpper Secondary         -0.425374   0.214667  -1.9816
edulvlbVocational              -0.466879   0.226864  -2.0580
```

edulvlbAssociate	-0.420937	0.223121	-1.8866
edulvlbBachelor	-0.443648	0.222057	-1.9979
edulvlbMaster	-0.489153	0.220840	-2.2150
edulvlbDoctoral	-0.342342	0.284925	-1.2015
hinctnta0-10 percentile	-0.593893	0.086015	-6.9045
hinctnta10-20 percentile	-0.337529	0.081641	-4.1343
hinctnta20-30 percentile	0.009649	0.081122	0.1189
hinctnta30-40 percentile	0.008539	0.079157	0.1079
hinctnta40-50 percentile	0.132445	0.081691	1.6213
hinctnta50-60 percentile	0.117088	0.081731	1.4326
hinctnta60-70 percentile	0.209386	0.079013	2.6500
hinctnta70-80 percentile	0.348427	0.081330	4.2841
hinctnta80-90 percentile	0.275533	0.092460	2.9800
hinctnta90-100 percentile	0.319385	0.096858	3.2974
pdwrkYes	0.038608	0.052592	0.7341
healthGood	-0.566660	0.051190	-11.0697
healthFair	-1.078545	0.061672	-17.4883
healthBad	-1.676012	0.098975	-16.9337
healthVery Bad	-1.965289	0.187477	-10.4828
psppsgvaVery little	-0.147065	0.058397	-2.5184
psppsgvaSome	-0.309962	0.069163	-4.4816
psppsgvaA lot	-0.232662	0.104196	-2.2329
psppsgvaA great deal	-0.098680	0.204065	-0.4836
actrolgaVery little able	-0.083599	0.057080	-1.4646
actrolgaQuite able	-0.077437	0.070082	-1.1049
actrolgaVery able	-0.013764	0.102532	-0.1342
actrolgaCompletely able	0.271988	0.159051	1.7101
psppiplaVery little	0.044485	0.058608	0.7590
psppiplaSome	-0.055627	0.071897	-0.7737
psppiplaA lot	-0.059451	0.107737	-0.5518
psppiplaA great deal	0.355428	0.237317	1.4977
cptppolaa little confident	0.135597	0.057093	2.3750
cptppolaQuite confident	0.261903	0.068761	3.8089
cptppolaVery confident	0.390689	0.098536	3.9649
cptppolaCompletely confident	0.588280	0.156754	3.7529
generaltrust	-0.017041	0.002050	-8.3127
generalsatisfaction	0.097352	0.002933	33.1949
behaviorinvolvmentLow level	0.218759	0.046106	4.7447
behaviorinvolvmentMedian level	0.182374	0.061214	2.9793
behaviorinvolvmentHigh level	0.578952	0.140645	4.1164

Intercepts:

	Value	Std. Error	t value
0|1	-4.2174	0.2860	-14.7451
1|2	-3.6252	0.2687	-13.4899
2|3	-2.8753	0.2566	-11.2043
3|4	-1.9640	0.2500	-7.8551
4|5	-1.3623	0.2481	-5.4916
5|6	-0.3508	0.2467	-1.4221
6|7	0.3849	0.2466	1.5607
7|8	1.4672	0.2472	5.9362
8|9	2.9620	0.2485	11.9200
9|10	4.3169	0.2503	17.2457

```
Residual Deviance: 29881.67
AIC: 30007.67
```

```
> fifth.CI = confint(fifth.submodel)
```

```
Waiting for profiling to be done...
```

```
> fifth.CI
```

```
                                    2.5 %       97.5 %
gndrFemale                     0.18554066  0.341134223
agegroup20-29                 -0.34957935  0.069378083
agegroup30-39                 -0.35279801  0.070065368
agegroup40-49                 -0.45479033 -0.032328302
agegroup50-59                 -0.37652257  0.039600758
agegroup60-69                 -0.23035521  0.169728399
agegroup70-79                 -0.10925170  0.323765948
agegroup80-89                  0.01994789  0.560246834
agegroup90+                   -0.56003365  0.654612103
edulvlbPrimary                -0.53236855  0.339064520
edulvlbLower Secondary        -0.85063642 -0.002365942
edulvlbUpper Secondary        -0.84716780 -0.005435740
edulvlbVocational             -0.90959477 -0.022912061
edulvlbAssociate              -0.85869942  0.015688467
edulvlbBachelor               -0.88008132 -0.009105813
edulvlbMaster                 -0.92303198 -0.058332271
edulvlbDoctoral               -0.90112592  0.215896939
hinctnta0-10 percentile       -0.76241449 -0.425541929
hinctnta10-20 percentile      -0.49751191 -0.179692761
hinctnta20-30 percentile      -0.14921984  0.168535088
hinctnta30-40 percentile      -0.14633577  0.163566404
hinctnta40-50 percentile      -0.02744349  0.292500893
hinctnta50-60 percentile      -0.04297197  0.277177127
hinctnta60-70 percentile       0.05463043  0.364191851
hinctnta70-80 percentile       0.18942855  0.507833676
hinctnta80-90 percentile       0.09479416  0.456784557
hinctnta90-100 percentile      0.12965583  0.509286101
pdwrkYes                      -0.06414742  0.141570395
healthGood                    -0.66696556 -0.466434625
healthFair                    -1.19950372 -0.957877368
healthBad                     -1.87016828 -1.482368696
healthVery Bad                -2.33232184 -1.597255349
psppsgvaVery little           -0.26141225 -0.032610238
psppsgvaSome                  -0.44549499 -0.174565762
psppsgvaA lot                 -0.43671991 -0.028494120
psppsgvaA great deal          -0.49784678  0.302286945
actrolgaVery little able      -0.19541446  0.028131453
actrolgaQuite able            -0.21110386  0.059901378
actrolgaVery able             -0.21434617  0.187141987
actrolgaCompletely able       -0.03927791  0.583894124
psppiplaVery little           -0.07013283  0.159410494
psppiplaSome                  -0.19633474  0.085181571
psppiplaA lot                 -0.27055268  0.151571345
psppiplaA great deal          -0.10625968  0.822393412
cptppolaa little confident     0.02389960  0.247435834
cptppolaQuite confident        0.12737949  0.396676802
```

```
cptppolaVery confident          0.19783751  0.583767325
cptppolaCompletely confident    0.28167325  0.895874981
generaltrust                   -0.02105665 -0.013050009
generalsatisfaction             0.09161783  0.103114249
behaviorinvolvmentLow level     0.12848840  0.309120793
behaviorinvolvmentMedian level  0.06247199  0.302247422
behaviorinvolvmentHigh level    0.30365738  0.855005647
```

```
> #Variable Selection using Subsampling
>
>
> library(rlist)
> variable.df=(names(full.model$coefficients))
>
> n = nrow(data)
> i=1
> while (i<101) {
+
+   set.seed(Sys.time())
+
+   subsample.vs = sample(n, ceiling(n*0.2), replace = FALSE)
+   subdata.vs = data[subsample.vs,]
+   submodel.vs = polr(happy~., data = subdata.vs, Hess = TRUE, method = "logistic")
+
+   minmod.sub = polr(happy~gndr+agegroup+edulvlb+hinctnta+pdwrk+health, data = subdata.vs, Hess = TRUE
+
+   model.forwardvs=step(minmod.sub, scope = list(lower=minmod.sub,upper=submodel.vs), direction = "for
+
+
+   variable.df=list.append(variable.df, names(model.forwardvs$coefficients))
+
+   print(i)
+
+   i = i+1
+ }
```

```
[1] 1
[1] 2
[1] 3
[1] 4
[1] 5
[1] 6
[1] 7
[1] 8
[1] 9
[1] 10
[1] 11
[1] 12

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
[1] 13
[1] 14
[1] 15
[1] 16
[1] 17
[1] 18
[1] 19
[1] 20
[1] 21
[1] 22
[1] 23
[1] 24
[1] 25
[1] 26
[1] 27
[1] 28
[1] 29
[1] 30
[1] 31
[1] 32
Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

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Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
```

```
[1] 37
[1] 38
[1] 39
[1] 40
[1] 41
[1] 42
[1] 43
[1] 44
[1] 45
[1] 46
[1] 47
[1] 48
[1] 49
[1] 50
[1] 51
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[1] 53
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[1] 74
[1] 75
[1] 76
[1] 77
[1] 78
[1] 79
[1] 80
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[1] 82
[1] 83
[1] 84
[1] 85
[1] 86
[1] 87
[1] 88
[1] 89
[1] 90
```

```
[1] 91
[1] 92
[1] 93
[1] 94
Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred
[1] 95
[1] 96
[1] 97
[1] 98
[1] 99
[1] 100
```

```
> names(model.forwardvs$coefficients)
```

```
 [1] "gndrFemale"                      "agegroup20-29"
 [3] "agegroup30-39"                   "agegroup40-49"
 [5] "agegroup50-59"                   "agegroup60-69"
 [7] "agegroup70-79"                   "agegroup80-89"
 [9] "agegroup90+"                     "edulvlbPrimary"
[11] "edulvlbLower Secondary"          "edulvlbUpper Secondary"
[13] "edulvlbVocational"               "edulvlbAssociate"
[15] "edulvlbBachelor"                 "edulvlbMaster"
[17] "edulvlbDoctoral"                 "hinctnta0-10 percentile"
[19] "hinctnta10-20 percentile"        "hinctnta20-30 percentile"
[21] "hinctnta30-40 percentile"        "hinctnta40-50 percentile"
[23] "hinctnta50-60 percentile"        "hinctnta60-70 percentile"
[25] "hinctnta70-80 percentile"        "hinctnta80-90 percentile"
[27] "hinctnta90-100 percentile"       "pdwrkYes"
[29] "healthGood"                      "healthFair"
[31] "healthBad"                       "healthVery Bad"
[33] "generalsatisfaction"             "generaltrust"
[35] "behaviorinvolvmentLow level"     "behaviorinvolvmentMedian level"
[37] "behaviorinvolvmentHigh level"    "cptppolaa little confident"
[39] "cptppolaQuite confident"         "cptppolaVery confident"
```

```
[41] "cptppolaCompletely confident"   "psppsgvaVery little"
[43] "psppsgvaSome"                   "psppsgvaA lot"
[45] "psppsgvaA great deal"
```

```
> names(full.model$coefficients)
```

```
 [1] "gndrFemale"                     "agegroup20-29"
 [3] "agegroup30-39"                  "agegroup40-49"
 [5] "agegroup50-59"                  "agegroup60-69"
 [7] "agegroup70-79"                  "agegroup80-89"
 [9] "agegroup90+"                    "edulvlbPrimary"
[11] "edulvlbLower Secondary"         "edulvlbUpper Secondary"
[13] "edulvlbVocational"              "edulvlbAssociate"
[15] "edulvlbBachelor"                "edulvlbMaster"
[17] "edulvlbDoctoral"                "hinctnta0-10 percentile"
[19] "hinctnta10-20 percentile"       "hinctnta20-30 percentile"
[21] "hinctnta30-40 percentile"       "hinctnta40-50 percentile"
[23] "hinctnta50-60 percentile"       "hinctnta60-70 percentile"
[25] "hinctnta70-80 percentile"       "hinctnta80-90 percentile"
[27] "hinctnta90-100 percentile"      "pdwrkYes"
[29] "healthGood"                     "healthFair"
[31] "healthBad"                      "healthVery Bad"
[33] "psppsgvaVery little"            "psppsgvaSome"
[35] "psppsgvaA lot"                  "psppsgvaA great deal"
[37] "actrolgaVery little able"       "actrolgaQuite able"
[39] "actrolgaVery able"              "actrolgaCompletely able"
[41] "psppiplaVery little"            "psppiplaSome"
[43] "psppiplaA lot"                  "psppiplaA great deal"
[45] "cptppolaa little confident"     "cptppolaQuite confident"
[47] "cptppolaVery confident"         "cptppolaCompletely confident"
[49] "generaltrust"                   "generalsatisfaction"
[51] "behaviorinvolvmentLow level"    "behaviorinvolvmentMedian level"
[53] "behaviorinvolvmentHigh level"
```

```
> library(rlist)
> variable.df=list.append(variable.df, names(model.forwardvs$coefficients))
> variable.df
```

```
  [1] "gndrFemale"                     "agegroup20-29"
  [3] "agegroup30-39"                  "agegroup40-49"
  [5] "agegroup50-59"                  "agegroup60-69"
  [7] "agegroup70-79"                  "agegroup80-89"
  [9] "agegroup90+"                    "edulvlbPrimary"
 [11] "edulvlbLower Secondary"         "edulvlbUpper Secondary"
 [13] "edulvlbVocational"              "edulvlbAssociate"
 [15] "edulvlbBachelor"                "edulvlbMaster"
 [17] "edulvlbDoctoral"                "hinctnta0-10 percentile"
 [19] "hinctnta10-20 percentile"       "hinctnta20-30 percentile"
 [21] "hinctnta30-40 percentile"       "hinctnta40-50 percentile"
 [23] "hinctnta50-60 percentile"       "hinctnta60-70 percentile"
 [25] "hinctnta70-80 percentile"       "hinctnta80-90 percentile"
 [27] "hinctnta90-100 percentile"      "pdwrkYes"
 [29] "healthGood"                     "healthFair"
 [31] "healthBad"                      "healthVery Bad"
 [33] "psppsgvaVery little"            "psppsgvaSome"
 [35] "psppsgvaA lot"                  "psppsgvaA great deal"
```

```
 [37] "actrolgaVery little able"       "actrolgaQuite able"
 [39] "actrolgaVery able"              "actrolgaCompletely able"
 [41] "psppiplaVery little"            "psppiplaSome"
 [43] "psppiplaA lot"                  "psppiplaA great deal"
 [45] "cptppolaa little confident"     "cptppolaQuite confident"
 [47] "cptppolaVery confident"         "cptppolaCompletely confident"
 [49] "generaltrust"                   "generalsatisfaction"
 [51] "behaviorinvolvmentLow level"    "behaviorinvolvmentMedian level"
 [53] "behaviorinvolvmentHigh level"   "gndrFemale"
 [55] "agegroup20-29"                  "agegroup30-39"
 [57] "agegroup40-49"                  "agegroup50-59"
 [59] "agegroup60-69"                  "agegroup70-79"
 [61] "agegroup80-89"                  "agegroup90+"
 [63] "edulvlbPrimary"                 "edulvlbLower Secondary"
 [65] "edulvlbUpper Secondary"         "edulvlbVocational"
 [67] "edulvlbAssociate"               "edulvlbBachelor"
 [69] "edulvlbMaster"                  "edulvlbDoctoral"
 [71] "hinctnta0-10 percentile"        "hinctnta10-20 percentile"
 [73] "hinctnta20-30 percentile"       "hinctnta30-40 percentile"
 [75] "hinctnta40-50 percentile"       "hinctnta50-60 percentile"
 [77] "hinctnta60-70 percentile"       "hinctnta70-80 percentile"
 [79] "hinctnta80-90 percentile"       "hinctnta90-100 percentile"
 [81] "pdwrkYes"                       "healthGood"
 [83] "healthFair"                     "healthBad"
 [85] "healthVery Bad"                 "generalsatisfaction"
 [87] "generaltrust"                   "cptppolaa little confident"
 [89] "cptppolaQuite confident"        "cptppolaVery confident"
 [91] "cptppolaCompletely confident"   "behaviorinvolvmentLow level"
 [93] "behaviorinvolvmentMedian level" "behaviorinvolvmentHigh level"
 [95] "psppsgvaVery little"            "psppsgvaSome"
 [97] "psppsgvaA lot"                  "psppsgvaA great deal"
 [99] "actrolgaVery little able"       "actrolgaQuite able"
[101] "actrolgaVery able"              "actrolgaCompletely able"
[103] "gndrFemale"                     "agegroup20-29"
[105] "agegroup30-39"                  "agegroup40-49"
[107] "agegroup50-59"                  "agegroup60-69"
[109] "agegroup70-79"                  "agegroup80-89"
[111] "agegroup90+"                    "edulvlbPrimary"
[113] "edulvlbLower Secondary"         "edulvlbUpper Secondary"
[115] "edulvlbVocational"              "edulvlbAssociate"
[117] "edulvlbBachelor"                "edulvlbMaster"
[119] "edulvlbDoctoral"                "hinctnta0-10 percentile"
[121] "hinctnta10-20 percentile"       "hinctnta20-30 percentile"
[123] "hinctnta30-40 percentile"       "hinctnta40-50 percentile"
[125] "hinctnta50-60 percentile"       "hinctnta60-70 percentile"
[127] "hinctnta70-80 percentile"       "hinctnta80-90 percentile"
[129] "hinctnta90-100 percentile"      "pdwrkYes"
[131] "healthGood"                     "healthFair"
[133] "healthBad"                      "healthVery Bad"
[135] "generalsatisfaction"            "generaltrust"
[137] "behaviorinvolvmentLow level"    "behaviorinvolvmentMedian level"
[139] "behaviorinvolvmentHigh level"   "psppsgvaVery little"
[141] "psppsgvaSome"                   "psppsgvaA lot"
[143] "psppsgvaA great deal"           "cptppolaa little confident"
```

```
[145] "cptppolaQuite confident"        "cptppolaVery confident"
[147] "cptppolaCompletely confident"   "gndrFemale"
[149] "agegroup20-29"                  "agegroup30-39"
[151] "agegroup40-49"                  "agegroup50-59"
[153] "agegroup60-69"                  "agegroup70-79"
[155] "agegroup80-89"                  "agegroup90+"
[157] "edulvlbPrimary"                 "edulvlbLower Secondary"
[159] "edulvlbUpper Secondary"         "edulvlbVocational"
[161] "edulvlbAssociate"               "edulvlbBachelor"
[163] "edulvlbMaster"                  "edulvlbDoctoral"
[165] "hinctnta0-10 percentile"        "hinctnta10-20 percentile"
[167] "hinctnta20-30 percentile"       "hinctnta30-40 percentile"
[169] "hinctnta40-50 percentile"       "hinctnta50-60 percentile"
[171] "hinctnta60-70 percentile"       "hinctnta70-80 percentile"
[173] "hinctnta80-90 percentile"       "hinctnta90-100 percentile"
[175] "pdwrkYes"                       "healthGood"
[177] "healthFair"                     "healthBad"
[179] "healthVery Bad"                 "generalsatisfaction"
[181] "generaltrust"                   "behaviorinvolvmentLow level"
[183] "behaviorinvolvmentMedian level" "behaviorinvolvmentHigh level"
[185] "cptppolaa little confident"     "cptppolaQuite confident"
[187] "cptppolaVery confident"         "cptppolaCompletely confident"
[189] "psppsgvaVery little"            "psppsgvaSome"
[191] "psppsgvaA lot"                  "psppsgvaA great deal"
[193] "gndrFemale"                     "agegroup20-29"
[195] "agegroup30-39"                  "agegroup40-49"
[197] "agegroup50-59"                  "agegroup60-69"
[199] "agegroup70-79"                  "agegroup80-89"
[201] "agegroup90+"                    "edulvlbPrimary"
[203] "edulvlbLower Secondary"         "edulvlbUpper Secondary"
[205] "edulvlbVocational"              "edulvlbAssociate"
[207] "edulvlbBachelor"                "edulvlbMaster"
[209] "edulvlbDoctoral"                "hinctnta0-10 percentile"
[211] "hinctnta10-20 percentile"       "hinctnta20-30 percentile"
[213] "hinctnta30-40 percentile"       "hinctnta40-50 percentile"
[215] "hinctnta50-60 percentile"       "hinctnta60-70 percentile"
[217] "hinctnta70-80 percentile"       "hinctnta80-90 percentile"
[219] "hinctnta90-100 percentile"      "pdwrkYes"
[221] "healthGood"                     "healthFair"
[223] "healthBad"                      "healthVery Bad"
[225] "generalsatisfaction"            "generaltrust"
[227] "behaviorinvolvmentLow level"    "behaviorinvolvmentMedian level"
[229] "behaviorinvolvmentHigh level"   "cptppolaa little confident"
[231] "cptppolaQuite confident"        "cptppolaVery confident"
[233] "cptppolaCompletely confident"   "psppsgvaVery little"
[235] "psppsgvaSome"                   "psppsgvaA lot"
[237] "psppsgvaA great deal"           "gndrFemale"
[239] "agegroup20-29"                  "agegroup30-39"
[241] "agegroup40-49"                  "agegroup50-59"
[243] "agegroup60-69"                  "agegroup70-79"
[245] "agegroup80-89"                  "agegroup90+"
[247] "edulvlbPrimary"                 "edulvlbLower Secondary"
[249] "edulvlbUpper Secondary"         "edulvlbVocational"
[251] "edulvlbAssociate"               "edulvlbBachelor"
```

```
[253] "edulvlbMaster"                  "edulvlbDoctoral"
[255] "hinctnta0-10 percentile"        "hinctnta10-20 percentile"
[257] "hinctnta20-30 percentile"       "hinctnta30-40 percentile"
[259] "hinctnta40-50 percentile"       "hinctnta50-60 percentile"
[261] "hinctnta60-70 percentile"       "hinctnta70-80 percentile"
[263] "hinctnta80-90 percentile"       "hinctnta90-100 percentile"
[265] "pdwrkYes"                       "healthGood"
[267] "healthFair"                     "healthBad"
[269] "healthVery Bad"                 "generalsatisfaction"
[271] "behaviorinvolvmentLow level"    "behaviorinvolvmentMedian level"
[273] "behaviorinvolvmentHigh level"   "generaltrust"
[275] "cptppolaa little confident"     "cptppolaQuite confident"
[277] "cptppolaVery confident"         "cptppolaCompletely confident"
[279] "psppsgvaVery little"            "psppsgvaSome"
[281] "psppsgvaA lot"                  "psppsgvaA great deal"
[283] "psppiplaVery little"            "psppiplaSome"
[285] "psppiplaA lot"                  "psppiplaA great deal"
[287] "gndrFemale"                     "agegroup20-29"
[289] "agegroup30-39"                  "agegroup40-49"
[291] "agegroup50-59"                  "agegroup60-69"
[293] "agegroup70-79"                  "agegroup80-89"
[295] "agegroup90+"                    "edulvlbPrimary"
[297] "edulvlbLower Secondary"         "edulvlbUpper Secondary"
[299] "edulvlbVocational"              "edulvlbAssociate"
[301] "edulvlbBachelor"                "edulvlbMaster"
[303] "edulvlbDoctoral"                "hinctnta0-10 percentile"
[305] "hinctnta10-20 percentile"       "hinctnta20-30 percentile"
[307] "hinctnta30-40 percentile"       "hinctnta40-50 percentile"
[309] "hinctnta50-60 percentile"       "hinctnta60-70 percentile"
[311] "hinctnta70-80 percentile"       "hinctnta80-90 percentile"
[313] "hinctnta90-100 percentile"      "pdwrkYes"
[315] "healthGood"                     "healthFair"
[317] "healthBad"                      "healthVery Bad"
[319] "generalsatisfaction"            "generaltrust"
[321] "cptppolaa little confident"     "cptppolaQuite confident"
[323] "cptppolaVery confident"         "cptppolaCompletely confident"
[325] "behaviorinvolvmentLow level"    "behaviorinvolvmentMedian level"
[327] "behaviorinvolvmentHigh level"   "psppsgvaVery little"
[329] "psppsgvaSome"                   "psppsgvaA lot"
[331] "psppsgvaA great deal"           "gndrFemale"
[333] "agegroup20-29"                  "agegroup30-39"
[335] "agegroup40-49"                  "agegroup50-59"
[337] "agegroup60-69"                  "agegroup70-79"
[339] "agegroup80-89"                  "agegroup90+"
[341] "edulvlbPrimary"                 "edulvlbLower Secondary"
[343] "edulvlbUpper Secondary"         "edulvlbVocational"
[345] "edulvlbAssociate"               "edulvlbBachelor"
[347] "edulvlbMaster"                  "edulvlbDoctoral"
[349] "hinctnta0-10 percentile"        "hinctnta10-20 percentile"
[351] "hinctnta20-30 percentile"       "hinctnta30-40 percentile"
[353] "hinctnta40-50 percentile"       "hinctnta50-60 percentile"
[355] "hinctnta60-70 percentile"       "hinctnta70-80 percentile"
[357] "hinctnta80-90 percentile"       "hinctnta90-100 percentile"
[359] "pdwrkYes"                       "healthGood"
```

```
[361] "healthFair"                      "healthBad"
[363] "healthVery Bad"                  "generalsatisfaction"
[365] "generaltrust"                    "behaviorinvolvmentLow level"
[367] "behaviorinvolvmentMedian level" "behaviorinvolvmentHigh level"
[369] "cptppolaa little confident"      "cptppolaQuite confident"
[371] "cptppolaVery confident"          "cptppolaCompletely confident"
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[4711] "healthBad"                       "healthVery Bad"
[4713] "generalsatisfaction"             "generaltrust"
[4715] "behaviorinvolvmentLow level"     "behaviorinvolvmentMedian level"
[4717] "behaviorinvolvmentHigh level"    "cptppolaa little confident"
[4719] "cptppolaQuite confident"         "cptppolaVery confident"
[4721] "cptppolaCompletely confident"    "psppsgvaVery little"
[4723] "psppsgvaSome"                    "psppsgvaA lot"
[4725] "psppsgvaA great deal"            "gndrFemale"
[4727] "agegroup20-29"                   "agegroup30-39"
[4729] "agegroup40-49"                   "agegroup50-59"
[4731] "agegroup60-69"                   "agegroup70-79"
[4733] "agegroup80-89"                   "agegroup90+"
[4735] "edulvlbPrimary"                  "edulvlbLower Secondary"
[4737] "edulvlbUpper Secondary"          "edulvlbVocational"
[4739] "edulvlbAssociate"                "edulvlbBachelor"
[4741] "edulvlbMaster"                   "edulvlbDoctoral"
[4743] "hinctnta0-10 percentile"         "hinctnta10-20 percentile"
[4745] "hinctnta20-30 percentile"        "hinctnta30-40 percentile"
[4747] "hinctnta40-50 percentile"        "hinctnta50-60 percentile"
[4749] "hinctnta60-70 percentile"        "hinctnta70-80 percentile"
[4751] "hinctnta80-90 percentile"        "hinctnta90-100 percentile"
[4753] "pdwrkYes"                        "healthGood"
[4755] "healthFair"                      "healthBad"
[4757] "healthVery Bad"                  "generalsatisfaction"
[4759] "generaltrust"                    "behaviorinvolvmentLow level"
[4761] "behaviorinvolvmentMedian level" "behaviorinvolvmentHigh level"
[4763] "cptppolaa little confident"      "cptppolaQuite confident"
[4765] "cptppolaVery confident"          "cptppolaCompletely confident"
[4767] "psppsgvaVery little"             "psppsgvaSome"
[4769] "psppsgvaA lot"                   "psppsgvaA great deal"
```
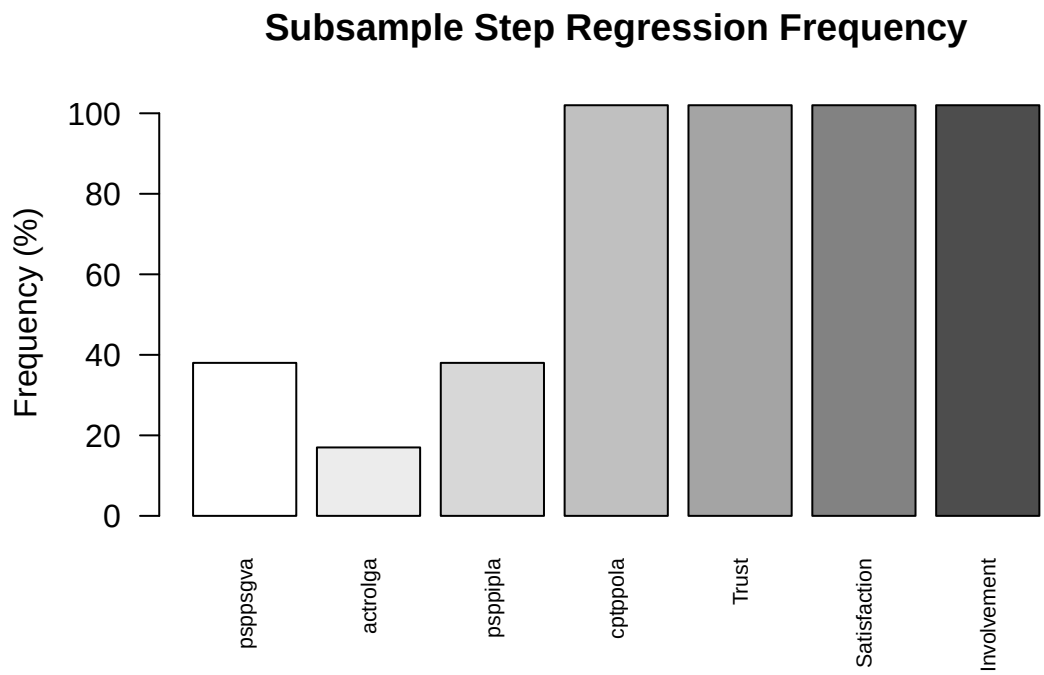

```
> gndrFemale.count = length(which(variable.df == 'gndrFemale'))
>
> agegroup20.count = length(which(variable.df == 'agegroup20-29'))
>
> agegroup30.count = length(which(variable.df == 'agegroup30-39'))
>
> agegroup40.count = length(which(variable.df == 'agegroup40-49'))
>
```

```
> agegroup50.count = length(which(variable.df == 'agegroup50-59'))
>
> agegroup60.count = length(which(variable.df == 'agegroup60-69'))
>
> agegroup70.count = length(which(variable.df == 'agegroup70-79'))
>
> agegroup80.count = length(which(variable.df == 'agegroup80-89'))
>
> agegroup90.count = length(which(variable.df == 'agegroup90+'))
>
> edulvlPrimary.count = length(which(variable.df == 'edulvlbPrimary'))
>
> edulvlLowerSecondary.count = length(which(variable.df =='edulvlbLower Secondary'))
>
> edulvlUpperSecondary.count = length(which(variable.df =='edulvlbUpper Secondary'))
>
> edulvlVocation.count = length(which(variable.df =='edulvlbVocational'))
>
> edulvlAssociate.count = length(which(variable.df == 'edulvlbAssociate'))
>
> edulvlBachelor.count = length(which(variable.df =='edulvlbBachelor'))
>
> edulvlMaster.count = length(which(variable.df =='edulvlbMaster'))
>
> edulvlDoctoral.count = length(which(variable.df=='edulvlbDoctoral'))
>
> hinctnta10.count = length(which(variable.df=='hinctnta10-20 percentile'))
>
> hinctnta20.count = length(which(variable.df == 'hinctnta20-30 percentile'))
>
> hinctnta30.count = length(which(variable.df == 'hinctnta30-40 percentile'))
>
> hinctnta40.count = length(which(variable.df == 'hinctnta40-50 percentile'))
>
> hinctnta50.count = length(which(variable.df == 'hinctnta50-60 percentile'))
>
> hinctnta60.count = length(which(variable.df == 'hinctnta60-70 percentile'))
>
> hinctnta70.count = length(which(variable.df == 'hinctnta70-80 percentile'))
>
> hinctnta80.count = length(which(variable.df == 'hinctnta80-90 percentile'))
>
> hinctnta90.count = length(which(variable.df == 'hinctnta90-100 percentile'))
>
> hinctntamissing.count = length(which(variable.df == 'hinctntamissing'))
>
> pdwrkYes.count = length(which(variable.df == 'pdwrkYes'))
>
> healthGood.count = length(which(variable.df == 'healthGood'))
>
> healthFair.count = length(which(variable.df == 'healthFair'))
>
> healthBad.count = length(which(variable.df == 'healthBad'))
```

```
>
> healthVeryBad.count = length(which(variable.df == 'healthVery Bad'))
>
> psppsgvaLittle.count = length(which(variable.df == 'psppsgvaVery little' ))
>
> psppsgvaSome.count = length(which(variable.df == 'psppsgvaSome'))
>
> psppsgvaAlot.count = length(which(variable.df == 'psppsgvaA lot'))
>
> psppsgvaGreatDeal.count = length(which(variable.df == 'psppsgvaA great deal'))
>
> actrolgaVeryLittleAble.count = length(which(variable.df =='actrolgaVery little able'))
>
> actrolgaQuiteAble.count = length(which(variable.df =='actrolgaQuite able'))
>
> actrolgaVeryAble.count = length(which(variable.df == 'actrolgaVery able'))
>
> actrolgaCompletelyAble.count = length(which(variable.df == 'actrolgaCompletely able'))
>
> psppiplaVeryLittle.count = length(which(variable.df == 'psppiplaVery little'))
>
> psppiplaSome.count = length(which(variable.df == 'psppiplaSome'))
>
> psppiplaAlot.count = length(which(variable.df == 'psppiplaA lot'))
>
> psppiplaAgreatdeal.count = length(which(variable.df == 'psppiplaA great deal'))
>
> cptppolaLittleConfident.count = length(which(variable.df =='cptppolaa little confident'))
>
> cptppolaQuiteConfident.count = length(which(variable.df == 'cptppolaQuite confident'))
>
> cptppolaVeryConfident.count = length(which(variable.df == 'cptppolaVery confident'))
>
> cptppolaCompletelyConfident.count = length(which(variable.df =='cptppolaCompletely confident'))
>
> generalTrust.count = length(which(variable.df == 'generaltrust'))
>
> generalSatisfaction.count = length(which(variable.df == 'generalsatisfaction'))
>
> behaviorinvolvmentLow.count = length(which(variable.df == 'behaviorinvolvmentLow level'))
>
> behaviorinvolvmentMedian.count = length(which(variable.df == 'behaviorinvolvmentMedian level'))
>
> behaviorinvolvmentHigh.count = length(which(variable.df == 'behaviorinvolvmentHigh level'))
```

```
> psppsgva.count = max(psppsgvaAlot.count,
+                      psppsgvaGreatDeal.count,
+                      psppiplaSome.count,
+                      psppiplaVeryLittle.count)
>
>
> actrolga.count = max(actrolgaCompletelyAble.count,
+                      actrolgaQuiteAble.count,
+                      actrolgaVeryAble.count,
```

```
+                      actrolgaVeryLittleAble.count)
>
> psppipla.count = max(psppiplaAgreatdeal.count,
+                      psppiplaAlot.count,
+                      psppiplaSome.count,
+                      psppiplaVeryLittle.count,
+                      psppiplaVeryLittle.count)
>
>
> cptppola.count = max(cptppolaCompletelyConfident.count,
+                      cptppolaLittleConfident.count,
+                      cptppolaQuiteConfident.count,
+                      cptppolaVeryConfident.count)
>
> behaviorinvolvment.count = max(behaviorinvolvmentHigh.count,
+                                behaviorinvolvmentMedian.count,
+                                behaviorinvolvmentLow.count)
>
> subvariable.names = c('psppsgva',
+                       'actrolga',
+                       'psppipla',
+                       'cptppola',
+                       'Trust',
+                       'Satisfaction',
+                       'Involvement')
>
> subvariable.values = c(psppipla.count,
+                        actrolga.count,
+                        psppipla.count,
+                        cptppola.count,
+                        generalTrust.count,
+                        generalSatisfaction.count,
+                        behaviorinvolvment.count)
>
> names(subvariable.values) = subvariable.names
>
> barplot(subvariable.values, main='Subsample Step Regression Frequency', ylab ='Frequency (%)', las=2,
```

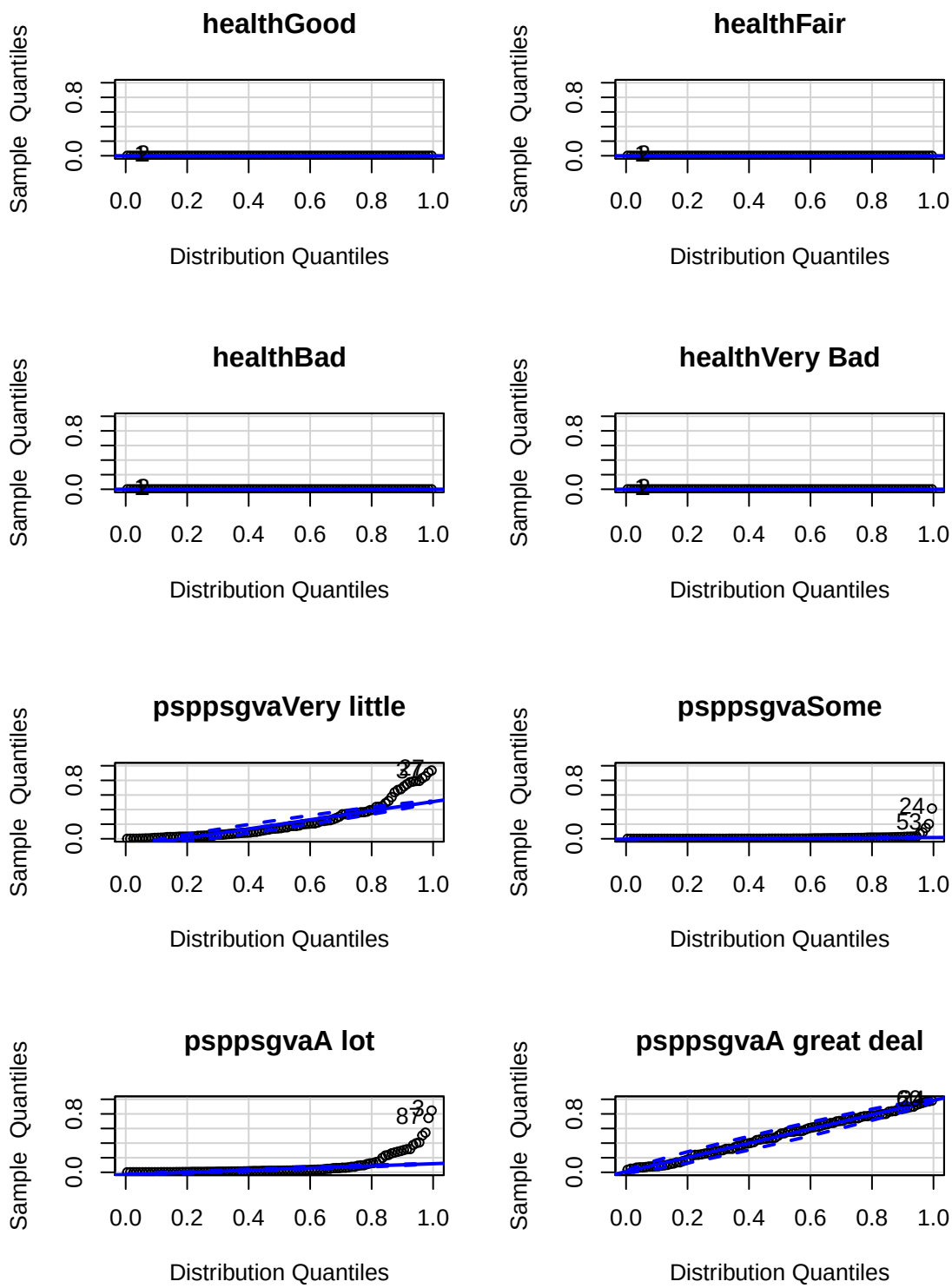


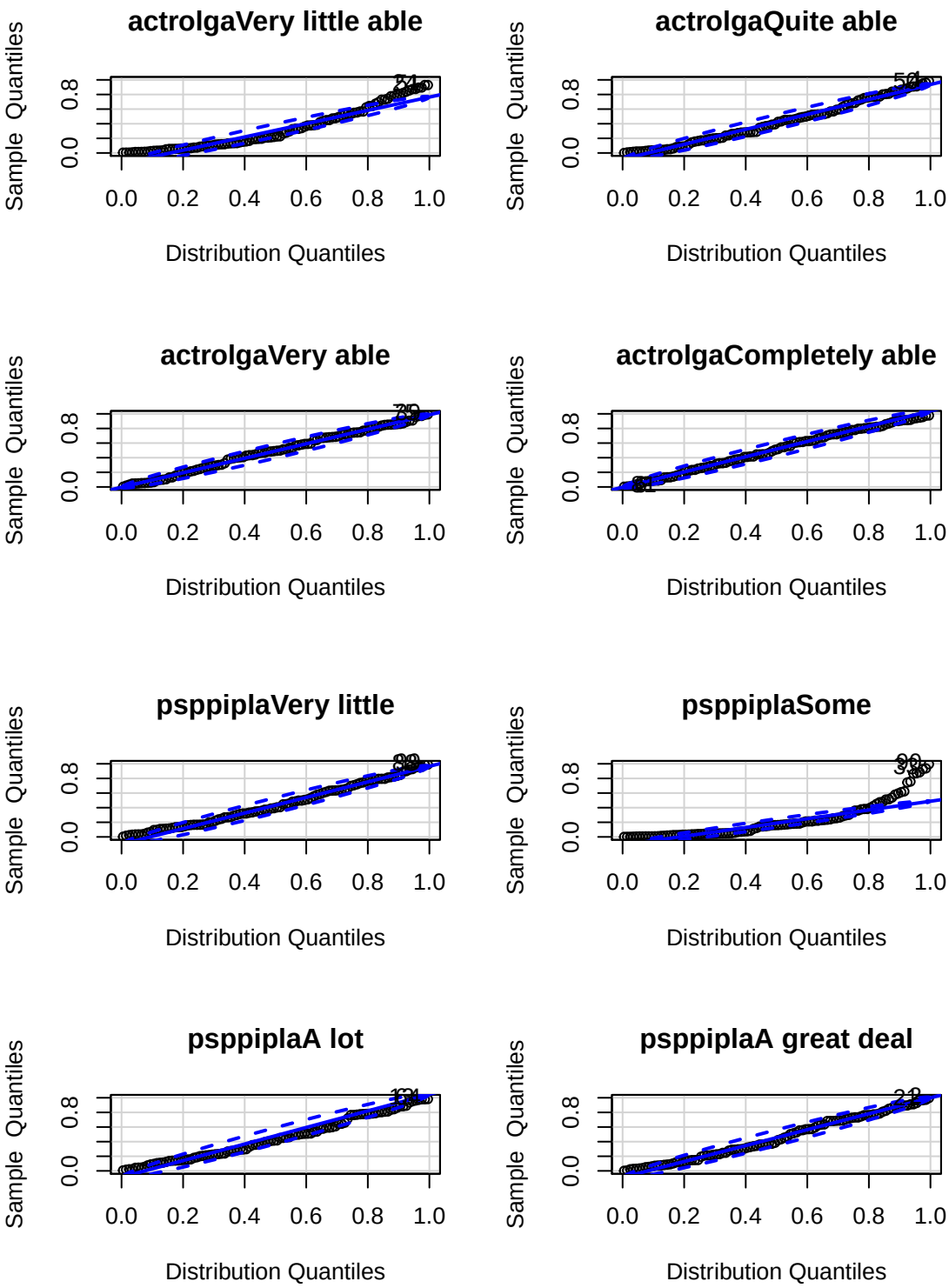

```
> #Subsampling for distribution of p-values
>
> pvalue.matrix = matrix(0,nrow = 53,ncol = 100)
>
> n = nrow(data)
> i=1
> while (i<101) {
+
+   set.seed(Sys.time())
+
+   subsample.p = sample(n, ceiling(n*0.2), replace = FALSE)
+   subdata.p = data[subsample.p,]
+   submodel.p = polr(happy~., data = subdata.p, Hess = TRUE, method = "logistic")
+
+   summary.p = coef(summary(submodel.p))
+   pval = pnorm(abs(summary.p[, "t value"]),lower.tail = FALSE)* 2
+   summary.p = cbind(summary.p, "p value" = round(pval,3))
+
+   pvalue.matrix[,i] = summary.p[1:53,4]
+
+
+   i = i+1
+ }
>
> submodel.pmatrix = cbind(names(coef(full.model)), pvalue.matrix)
```

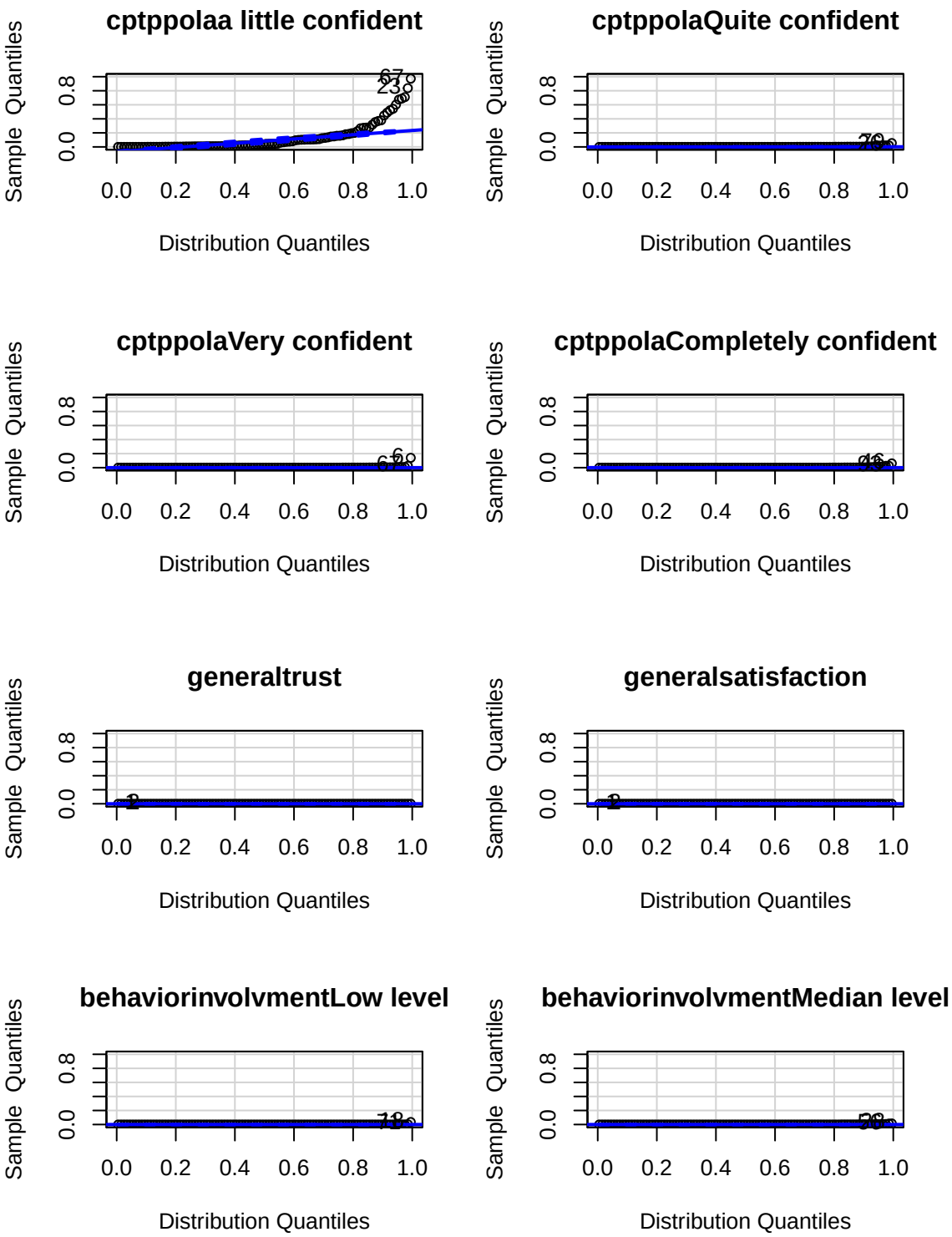
```
> library(car)
```

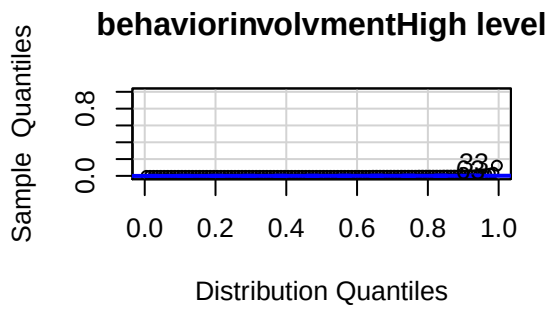
```
Loading required package: carData
```

```
> par(mfrow=c(2,2))
> for (i in 29:53) {
+   qqPlot(as.numeric(submodel.pmatrix[i,2:101]), distribution='unif', ylim=c(0,1), ylab='Sample  Quant
+ }
```




actrolgaVery little able
actrolgaQuite able
actrolgaVery able
actrolgaCompletely able
psppiplaVery little
psppiplaSome
psppiplaA lot
psppiplaA great deal
Sample Quantiles
Distribution Quantiles
0.0
0.8
0.0
0.2
0.4
0.6
0.8
1.0


cptppolaa little confident
cptppolaQuite confident
cptppolaVery confident
cptppolaCompletely confident
generaltrust
generalsatisfaction
behaviorinvolvmentLow level
behaviorinvolvmentMedian level
Sample Quantiles
Distribution Quantiles
0.0
0.8
0.0
0.2
0.4
0.6
0.8
1.0




```
> #Goodness of Fit
> library(brant)
>
> n = nrow(data)
> i=1
>
> set.seed(Sys.time())
> subsample.brant = sample(n, ceiling(n*0.2), replace = FALSE)
> subdata.brant = data[subsample.brant,]
> submodel.brant = polr(happy~., data = subdata.brant, Hess = TRUE, method = "logistic")
> brant.submodel = brant(submodel.brant)
```

```
Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

--------------------------------------------------------------------
Test for                X2  df  probability
--------------------------------------------------------------------
Omnibus                 1111.2  477 0
gndrFemale              9.55    9   0.39
agegroup20-29               4.2 9   0.9
agegroup30-39               5.15    9   0.82
agegroup40-49               4.4 9   0.88
agegroup50-59               11.59   9   0.24
agegroup60-69               10.09   9   0.34
agegroup70-79               9.64    9   0.38
agegroup80-89               12.71   9   0.18
agegroup90+             4.08    9   0.91
edulvlbPrimary              29.19   9   0
edulvlbLower Secondary      28.61   9   0
edulvlbUpper Secondary      31.67   9   0
```

```
edulvlbVocational           18.38   9   0.03
edulvlbAssociate            16.8    9   0.05
edulvlbBachelor         18.51   9   0.03
edulvlbMaster               27.64   9   0
edulvlbDoctoral         17.9    9   0.04
hinctnta0-10 percentile     24.31   9   0
hinctnta10-20 percentile        11.51   9   0.24
hinctnta20-30 percentile        8.72    9   0.46
hinctnta30-40 percentile        12.89   9   0.17
hinctnta40-50 percentile        5.09    9   0.83
hinctnta50-60 percentile        16.7    9   0.05
hinctnta60-70 percentile        22.47   9   0.01
hinctnta70-80 percentile        17.98   9   0.04
hinctnta80-90 percentile        13.32   9   0.15
hinctnta90-100 percentile       14.31   9   0.11
pdwrkYes                13.85   9   0.13
healthGood              5.8 9   0.76
healthFair              16.57   9   0.06
healthBad               23.14   9   0.01
healthVery Bad              21.64   9   0.01
psppsgvaVery little         2.95    9   0.97
psppsgvaSome                6.2 9   0.72
psppsgvaA lot               11.53   9   0.24
psppsgvaA great deal            7.27    9   0.61
actrolgaVery little able        16.38   9   0.06
actrolgaQuite able          6.22    9   0.72
actrolgaVery able           6.18    9   0.72
actrolgaCompletely able     26.73   9   0
psppiplaVery little         11.44   9   0.25
psppiplaSome                7.95    9   0.54
psppiplaA lot               10.52   9   0.31
psppiplaA great deal            6.95    9   0.64
cptppolaa little confident      9.35    9   0.41
cptppolaQuite confident     4.49    9   0.88
cptppolaVery confident      8.88    9   0.45
cptppolaCompletely confident        9.06    9   0.43
generaltrust                37.81   9   0
generalsatisfaction         42.23   9   0
behaviorinvolvmentLow level     17.54   9   0.04
behaviorinvolvmentMedian level  27.19   9   0
behaviorinvolvmentHigh level        19.32   9   0.02
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041530 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.
```

```
> brant.list=brant.submodel[1,3]
>
>
> while (i<11) {
+
+   set.seed(Sys.time())
+
```

```
+   subsample.brant = sample(n, ceiling(n*0.2), replace = FALSE)
+   subdata.brant = data[subsample.brant,]
+   submodel.brant = polr(happy~., data = subdata.brant, Hess = TRUE, method = "logistic")
+
+
+   brant.submodel = brant(submodel.brant)
+   brant.list = list.append(brant.list, brant.submodel[1,3])
+
+
+   i = i+1
+ }
```

```
Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

Warning: glm.fit: fitted probabilities numerically 0 or 1 occurred

--------------------------------------------------------------------
Test for                X2  df  probability
--------------------------------------------------------------------
Omnibus                 983.86  477 0
gndrFemale              11.75   9   0.23
agegroup20-29               3.25    9   0.95
agegroup30-39               5.24    9   0.81
agegroup40-49               7.68    9   0.57
agegroup50-59               5.31    9   0.81
agegroup60-69               12.39   9   0.19
agegroup70-79               12.16   9   0.2
agegroup80-89               10.39   9   0.32
agegroup90+             12.63   9   0.18
edulvlbPrimary              16.07   9   0.07
edulvlbLower Secondary      16.18   9   0.06
edulvlbUpper Secondary      22.76   9   0.01
edulvlbVocational           8.39    9   0.5
edulvlbAssociate            18.53   9   0.03
edulvlbBachelor         19.09   9   0.02
edulvlbMaster               26.87   9   0
edulvlbDoctoral         15.98   9   0.07
hinctnta0-10 percentile     15.95   9   0.07
hinctnta10-20 percentile        10.01   9   0.35
hinctnta20-30 percentile        14.74   9   0.1
hinctnta30-40 percentile        23.78   9   0
hinctnta40-50 percentile        13.59   9   0.14
hinctnta50-60 percentile        10.51   9   0.31
hinctnta60-70 percentile        14.35   9   0.11
hinctnta70-80 percentile        22.47   9   0.01
hinctnta80-90 percentile        12.64   9   0.18
hinctnta90-100 percentile       13.82   9   0.13
pdwrkYes                13.41   9   0.14
healthGood              4.31    9   0.89
healthFair              17.97   9   0.04
healthBad               11.85   9   0.22
healthVery Bad              53.09   9   0
```

```
psppsgvaVery little         16.93   9   0.05
psppsgvaSome                10.51   9   0.31
psppsgvaA lot               15.46   9   0.08
psppsgvaA great deal            17.78   9   0.04
actrolgaVery little able        10.01   9   0.35
actrolgaQuite able          8.6 9   0.47
actrolgaVery able           2.36    9   0.98
actrolgaCompletely able     10.32   9   0.33
psppiplaVery little         6.51    9   0.69
psppiplaSome                8.91    9   0.45
psppiplaA lot               10.05   9   0.35
psppiplaA great deal            5.57    9   0.78
cptppolaa little confident      15.4    9   0.08
cptppolaQuite confident     7.82    9   0.55
cptppolaVery confident      10.88   9   0.28
cptppolaCompletely confident        3.21    9   0.96
generaltrust                33.14   9   0
generalsatisfaction         41.67   9   0
behaviorinvolvmentLow level     29.15   9   0
behaviorinvolvmentMedian level  18.21   9   0.03
behaviorinvolvmentHigh level        11.29   9   0.26
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041547 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

---------------------------------------------------------------------
Test for                X2  df  probability
---------------------------------------------------------------------
Omnibus                 1084.56 477 0
gndrFemale              11.93   9   0.22
agegroup20-29               3.65    9   0.93
agegroup30-39               3.33    9   0.95
agegroup40-49               7.16    9   0.62
agegroup50-59               4.68    9   0.86
agegroup60-69               6.29    9   0.71
agegroup70-79               8.05    9   0.53
agegroup80-89               4.53    9   0.87
agegroup90+             8.09    9   0.52
edulvlbPrimary              16.23   9   0.06
edulvlbLower Secondary      20.89   9   0.01
edulvlbUpper Secondary      30.39   9   0
edulvlbVocational           6.78    9   0.66
edulvlbAssociate            5.48    9   0.79
```

```
edulvlbBachelor         15.73   9   0.07
edulvlbMaster               7.41    9   0.59
edulvlbDoctoral         6.07    9   0.73
hinctnta0-10 percentile     19.64   9   0.02
hinctnta10-20 percentile        6.65    9   0.67
hinctnta20-30 percentile        4.37    9   0.89
hinctnta30-40 percentile        9.99    9   0.35
hinctnta40-50 percentile        16.29   9   0.06
hinctnta50-60 percentile        22.93   9   0.01
hinctnta60-70 percentile        24.13   9   0
hinctnta70-80 percentile        22.21   9   0.01
hinctnta80-90 percentile        19.97   9   0.02
hinctnta90-100 percentile       21.44   9   0.01
pdwrkYes                4.15    9   0.9
healthGood              4.32    9   0.89
healthFair              9.94    9   0.36
healthBad               30.16   9   0
healthVery Bad              41.24   9   0
psppsgvaVery little         8.53    9   0.48
psppsgvaSome                17.22   9   0.05
psppsgvaA lot               10.37   9   0.32
psppsgvaA great deal            9.53    9   0.39
actrolgaVery little able        7.35    9   0.6
actrolgaQuite able          5.66    9   0.77
actrolgaVery able           7.13    9   0.62
actrolgaCompletely able     8.61    9   0.47
psppiplaVery little         11.12   9   0.27
psppiplaSome                9.21    9   0.42
psppiplaA lot               10.28   9   0.33
psppiplaA great deal            2.13    9   0.99
cptppolaa little confident      14.33   9   0.11
cptppolaQuite confident     3.05    9   0.96
cptppolaVery confident      12.21   9   0.2
cptppolaCompletely confident        9.24    9   0.42
generaltrust                26.58   9   0
generalsatisfaction         48.81   9   0
behaviorinvolvmentLow level     23.5    9   0.01
behaviorinvolvmentMedian level  11.79   9   0.23
behaviorinvolvmentHigh level        8.19    9   0.52
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041548 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

---------------------------------------------------------------------
Test for                X2  df  probability
---------------------------------------------------------------------
```

Omnibus	1065.53	477	0
gndrFemale	9.32	9	0.41
agegroup20-29	7.15	9	0.62
agegroup30-39	7.48	9	0.59
agegroup40-49	6.29	9	0.71
agegroup50-59	8.99	9	0.44
agegroup60-69	12.84	9	0.17
agegroup70-79	6.92	9	0.65
agegroup80-89	10.45	9	0.32
agegroup90+	12.8	9	0.17
edulvlbPrimary	8.95	9	0.44
edulvlbLower Secondary	11.63	9	0.23
edulvlbUpper Secondary	15.47	9	0.08
edulvlbVocational	13.68	9	0.13
edulvlbAssociate	17.35	9	0.04
edulvlbBachelor	16.59	9	0.06
edulvlbMaster	21.33	9	0.01
edulvlbDoctoral	11	9	0.28
hinctnta0-10 percentile	17.3	9	0.04
hinctnta10-20 percentile	16.99	9	0.05
hinctnta20-30 percentile	8.85	9	0.45
hinctnta30-40 percentile	28.11	9	0
hinctnta40-50 percentile	10.05	9	0.35
hinctnta50-60 percentile	24.45	9	0
hinctnta60-70 percentile	20.66	9	0.01
hinctnta70-80 percentile	31.59	9	0
hinctnta80-90 percentile	22.36	9	0.01
hinctnta90-100 percentile	21.07	9	0.01
pdwrkYes	16.44	9	0.06
healthGood	19.5	9	0.02
healthFair	17.98	9	0.04
healthBad	22.69	9	0.01
healthVery Bad	23.67	9	0
psppsgvaVery little	8.46	9	0.49
psppsgvaSome	21.26	9	0.01
psppsgvaA lot	13.69	9	0.13
psppsgvaA great deal	14.88	9	0.09
actrolgaVery little able	18.94	9	0.03
actrolgaQuite able	4.98	9	0.84
actrolgaVery able	12.17	9	0.2
actrolgaCompletely able	10.82	9	0.29
psppiplaVery little	13.62	9	0.14
psppiplaSome	14.7	9	0.1
psppiplaA lot	12.45	9	0.19
psppiplaA great deal	11.01	9	0.28
cptppolaa little confident	22.27	9	0.01
cptppolaQuite confident	21	9	0.01
cptppolaVery confident	23.66	9	0
cptppolaCompletely confident	3.95	9	0.91
generaltrust	30.22	9	0
generalsatisfaction	61.61	9	0
behaviorinvolvmentLow level	17.24	9	0.05
behaviorinvolvmentMedian level	27.73	9	0
behaviorinvolvmentHigh level	11.24	9	0.26

```
--------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041535 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

--------------------------------------------------------------------
Test for                X2  df  probability
--------------------------------------------------------------------
Omnibus                 838.72  477 0
gndrFemale              11.28   9   0.26
agegroup20-29               13.84   9   0.13
agegroup30-39               8.68    9   0.47
agegroup40-49               12.22   9   0.2
agegroup50-59               19.4    9   0.02
agegroup60-69               19.9    9   0.02
agegroup70-79               13.38   9   0.15
agegroup80-89               14.35   9   0.11
agegroup90+             5.95    9   0.75
edulvlbPrimary              18.84   9   0.03
edulvlbLower Secondary      28.79   9   0
edulvlbUpper Secondary      42.88   9   0
edulvlbVocational           13.95   9   0.12
edulvlbAssociate            21.57   9   0.01
edulvlbBachelor         7.12    9   0.62
edulvlbMaster               21.46   9   0.01
edulvlbDoctoral         17.7    9   0.04
hinctnta0-10 percentile     9.46    9   0.4
hinctnta10-20 percentile        8.16    9   0.52
hinctnta20-30 percentile        14.4    9   0.11
hinctnta30-40 percentile        13.17   9   0.16
hinctnta40-50 percentile        8.72    9   0.46
hinctnta50-60 percentile        26.16   9   0
hinctnta60-70 percentile        40.42   9   0
hinctnta70-80 percentile        21.6    9   0.01
hinctnta80-90 percentile        22.16   9   0.01
hinctnta90-100 percentile       19.22   9   0.02
pdwrkYes                12.76   9   0.17
healthGood              27.12   9   0
healthFair              23.98   9   0
healthBad               22.6    9   0.01
healthVery Bad              32.32   9   0
```

```
psppsgvaVery little         14.43   9   0.11
psppsgvaSome                33.11   9   0
psppsgvaA lot               23.67   9   0
psppsgvaA great deal            2.66    9   0.98
actrolgaVery little able        20.85   9   0.01
actrolgaQuite able          9.25    9   0.41
actrolgaVery able           7.95    9   0.54
actrolgaCompletely able     8.77    9   0.46
psppiplaVery little         12.73   9   0.18
psppiplaSome                25.04   9   0
psppiplaA lot               16.21   9   0.06
psppiplaA great deal            11.19   9   0.26
cptppolaa little confident      7.13    9   0.62
cptppolaQuite confident     5.65    9   0.77
cptppolaVery confident      9.81    9   0.37
cptppolaCompletely confident        20.21   9   0.02
generaltrust                28.12   9   0
generalsatisfaction         32.98   9   0
behaviorinvolvmentLow level     29.03   9   0
behaviorinvolvmentMedian level  12.66   9   0.18
behaviorinvolvmentHigh level        5.59    9   0.78
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041530 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

---------------------------------------------------------------------
Test for                X2  df  probability
---------------------------------------------------------------------
Omnibus                 776.67  477 0
gndrFemale              9.43    9   0.4
agegroup20-29               5.25    9   0.81
agegroup30-39               10.53   9   0.31
agegroup40-49               10.62   9   0.3
agegroup50-59               12.6    9   0.18
agegroup60-69               8.71    9   0.46
agegroup70-79               11.61   9   0.24
agegroup80-89               8.24    9   0.51
agegroup90+             7.1 9   0.63
edulvlbPrimary              11.79   9   0.23
edulvlbLower Secondary      16.16   9   0.06
edulvlbUpper Secondary      15  9   0.09
edulvlbVocational           13.19   9   0.15
edulvlbAssociate            12.61   9   0.18
```

```
edulvlbBachelor         4.31    9   0.89
edulvlbMaster               8.41    9   0.49
edulvlbDoctoral         2.75    9   0.97
hinctnta0-10 percentile     29.1    9   0
hinctnta10-20 percentile        10.81   9   0.29
hinctnta20-30 percentile        12.38   9   0.19
hinctnta30-40 percentile        7.33    9   0.6
hinctnta40-50 percentile        19.45   9   0.02
hinctnta50-60 percentile        8.2 9   0.51
hinctnta60-70 percentile        27.17   9   0
hinctnta70-80 percentile        23.82   9   0
hinctnta80-90 percentile        26.29   9   0
hinctnta90-100 percentile       26.1    9   0
pdwrkYes                5.91    9   0.75
healthGood              12.2    9   0.2
healthFair              40.82   9   0
healthBad               28.84   9   0
healthVery Bad              27.04   9   0
psppsgvaVery little         15.51   9   0.08
psppsgvaSome                13.83   9   0.13
psppsgvaA lot               12.36   9   0.19
psppsgvaA great deal            -24.48  9   1
actrolgaVery little able        9.46    9   0.4
actrolgaQuite able          8.61    9   0.47
actrolgaVery able           7.7 9   0.56
actrolgaCompletely able     3.79    9   0.92
psppiplaVery little         5.98    9   0.74
psppiplaSome                7.77    9   0.56
psppiplaA lot               28.42   9   0
psppiplaA great deal            57.23   9   0
cptppolaa little confident      10.04   9   0.35
cptppolaQuite confident     10.88   9   0.28
cptppolaVery confident      5.52    9   0.79
cptppolaCompletely confident        10.18   9   0.34
generaltrust                35.81   9   0
generalsatisfaction         49.03   9   0
behaviorinvolvmentLow level     9.41    9   0.4
behaviorinvolvmentMedian level  26.14   9   0
behaviorinvolvmentHigh level        6.06    9   0.73
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041522 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred
```

```
---------------------------------------------------------------------
Test for                X2  df  probability
---------------------------------------------------------------------
Omnibus                 54.99   477 1
gndrFemale              12.22   9   0.2
agegroup20-29               20.41   9   0.02
agegroup30-39               12.35   9   0.19
agegroup40-49               20.07   9   0.02
agegroup50-59               23.34   9   0.01
agegroup60-69               24.4    9   0
agegroup70-79               27.08   9   0
agegroup80-89               19.64   9   0.02
agegroup90+             18.52   9   0.03
edulvlbPrimary              12.1    9   0.21
edulvlbLower Secondary      18.63   9   0.03
edulvlbUpper Secondary      19.68   9   0.02
edulvlbVocational           8.82    9   0.45
edulvlbAssociate            13.44   9   0.14
edulvlbBachelor         11.42   9   0.25
edulvlbMaster               12.38   9   0.19
edulvlbDoctoral         8.18    9   0.52
hinctnta0-10 percentile     26.38   9   0
hinctnta10-20 percentile        12.23   9   0.2
hinctnta20-30 percentile        11.52   9   0.24
hinctnta30-40 percentile        20.05   9   0.02
hinctnta40-50 percentile        5.15    9   0.82
hinctnta50-60 percentile        15.73   9   0.07
hinctnta60-70 percentile        15.32   9   0.08
hinctnta70-80 percentile        11.69   9   0.23
hinctnta80-90 percentile        11.36   9   0.25
hinctnta90-100 percentile       11.1    9   0.27
pdwrkYes                7.9 9   0.54
healthGood              9.14    9   0.42
healthFair              15.46   9   0.08
healthBad               13.92   9   0.13
healthVery Bad              38.38   9   0
psppsgvaVery little         5.62    9   0.78
psppsgvaSome                10.09   9   0.34
psppsgvaA lot               14.49   9   0.11
psppsgvaA great deal            -162.66 9   1
actrolgaVery little able        14.21   9   0.11
actrolgaQuite able          8.71    9   0.46
actrolgaVery able           18.87   9   0.03
actrolgaCompletely able     7.22    9   0.61
psppiplaVery little         11.06   9   0.27
psppiplaSome                12.37   9   0.19
psppiplaA lot               6.46    9   0.69
psppiplaA great deal            17.07   9   0.05
cptppolaa little confident      8.9 9   0.45
cptppolaQuite confident     11.77   9   0.23
cptppolaVery confident      8.9 9   0.45
cptppolaCompletely confident        22.47   9   0.01
generaltrust                29.65   9   0
generalsatisfaction         37.38   9   0
```

```
behaviorinvolvmentLow level     24.42   9   0
behaviorinvolvmentMedian level  37.69   9   0
behaviorinvolvmentHigh level        37.2    9   0
--------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041549 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

--------------------------------------------------------------------
Test for                X2  df  probability
--------------------------------------------------------------------
Omnibus                 404.09  477 0.99
gndrFemale              11.05   9   0.27
agegroup20-29               10.27   9   0.33
agegroup30-39               16.54   9   0.06
agegroup40-49               24.32   9   0
agegroup50-59               18.98   9   0.03
agegroup60-69               21.35   9   0.01
agegroup70-79               20.85   9   0.01
agegroup80-89               14.57   9   0.1
agegroup90+             21.36   9   0.01
edulvlbPrimary              13.74   9   0.13
edulvlbLower Secondary      24.19   9   0
edulvlbUpper Secondary      24.72   9   0
edulvlbVocational           17.75   9   0.04
edulvlbAssociate            26.22   9   0
edulvlbBachelor         17.95   9   0.04
edulvlbMaster               26.62   9   0
edulvlbDoctoral         5.07    9   0.83
hinctnta0-10 percentile     9.02    9   0.44
hinctnta10-20 percentile        7.15    9   0.62
hinctnta20-30 percentile        6.69    9   0.67
hinctnta30-40 percentile        3.54    9   0.94
hinctnta40-50 percentile        5.81    9   0.76
hinctnta50-60 percentile        13.34   9   0.15
```

```
hinctnta60-70 percentile        9.95    9   0.35
hinctnta70-80 percentile        17.03   9   0.05
hinctnta80-90 percentile        26.07   9   0
hinctnta90-100 percentile       17.19   9   0.05
pdwrkYes                6.87    9   0.65
healthGood              3.86    9   0.92
healthFair              18.08   9   0.03
healthBad               14.41   9   0.11
healthVery Bad              33.64   9   0
psppsgvaVery little         12.58   9   0.18
psppsgvaSome                9.36    9   0.4
psppsgvaA lot               7.73    9   0.56
psppsgvaA great deal            71.5    9   0
actrolgaVery little able        22.57   9   0.01
actrolgaQuite able          12.87   9   0.17
actrolgaVery able           6.71    9   0.67
actrolgaCompletely able     4.45    9   0.88
psppiplaVery little         9.75    9   0.37
psppiplaSome                5.53    9   0.79
psppiplaA lot               17.5    9   0.04
psppiplaA great deal            0.89    9   1
cptppolaa little confident      11.5    9   0.24
cptppolaQuite confident     7.92    9   0.54
cptppolaVery confident      18.89   9   0.03
cptppolaCompletely confident        24.7    9   0
generaltrust                31.03   9   0
generalsatisfaction         50.79   9   0
behaviorinvolvmentLow level     23.08   9   0.01
behaviorinvolvmentMedian level  16.66   9   0.05
behaviorinvolvmentHigh level        28.44   9   0
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041537 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

---------------------------------------------------------------------
Test for                X2  df  probability
---------------------------------------------------------------------
Omnibus                 1001.16 477 0
gndrFemale              18.93   9   0.03
agegroup20-29               2.37    9   0.98
agegroup30-39               4.41    9   0.88
agegroup40-49               4.79    9   0.85
agegroup50-59               5.17    9   0.82
agegroup60-69               3.67    9   0.93
agegroup70-79               8.35    9   0.5
agegroup80-89               4.48    9   0.88
```

```
agegroup90+             5.76    9   0.76
edulvlbPrimary              18.37   9   0.03
edulvlbLower Secondary      10.86   9   0.29
edulvlbUpper Secondary      18.24   9   0.03
edulvlbVocational           16.97   9   0.05
edulvlbAssociate            16.31   9   0.06
edulvlbBachelor         14  9   0.12
edulvlbMaster               19.64   9   0.02
edulvlbDoctoral         7.29    9   0.61
hinctnta0-10 percentile     18.73   9   0.03
hinctnta10-20 percentile        19.07   9   0.02
hinctnta20-30 percentile        26.7    9   0
hinctnta30-40 percentile        31.34   9   0
hinctnta40-50 percentile        18.21   9   0.03
hinctnta50-60 percentile        41.54   9   0
hinctnta60-70 percentile        23.45   9   0.01
hinctnta70-80 percentile        35.95   9   0
hinctnta80-90 percentile        19.66   9   0.02
hinctnta90-100 percentile       27.77   9   0
pdwrkYes                5.39    9   0.8
healthGood              10.62   9   0.3
healthFair              15.27   9   0.08
healthBad               24.25   9   0
healthVery Bad              21.18   9   0.01
psppsgvaVery little         9.28    9   0.41
psppsgvaSome                9.9 9   0.36
psppsgvaA lot               15.26   9   0.08
psppsgvaA great deal            1.88    9   0.99
actrolgaVery little able        13.26   9   0.15
actrolgaQuite able          13.12   9   0.16
actrolgaVery able           11.67   9   0.23
actrolgaCompletely able     10.03   9   0.35
psppiplaVery little         25.66   9   0
psppiplaSome                21.21   9   0.01
psppiplaA lot               33.22   9   0
psppiplaA great deal            8.09    9   0.52
cptppolaa little confident      7.17    9   0.62
cptppolaQuite confident     9.87    9   0.36
cptppolaVery confident      14.55   9   0.1
cptppolaCompletely confident        26.94   9   0
generaltrust                29.45   9   0
generalsatisfaction         49.2    9   0
behaviorinvolvmentLow level     28.95   9   0
behaviorinvolvmentMedian level  27.14   9   0
behaviorinvolvmentHigh level        6.43    9   0.7
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041526 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred
```

```
Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

-------------------------------------------------------------------
Test for                X2  df  probability
-------------------------------------------------------------------
Omnibus                 367.71  477 1
gndrFemale              5.47    9   0.79
agegroup20-29               5.07    9   0.83
agegroup30-39               4.69    9   0.86
agegroup40-49               7.97    9   0.54
agegroup50-59               8.31    9   0.5
agegroup60-69               4.2 9   0.9
agegroup70-79               6.53    9   0.69
agegroup80-89               6.95    9   0.64
agegroup90+             6.77    9   0.66
edulvlbPrimary              28.31   9   0
edulvlbLower Secondary      42.06   9   0
edulvlbUpper Secondary      64.27   9   0
edulvlbVocational           24.09   9   0
edulvlbAssociate            23.81   9   0
edulvlbBachelor         21.93   9   0.01
edulvlbMaster               33.36   9   0
edulvlbDoctoral         11.32   9   0.25
hinctnta0-10 percentile     19.6    9   0.02
hinctnta10-20 percentile        8.94    9   0.44
hinctnta20-30 percentile        4.44    9   0.88
hinctnta30-40 percentile        14.87   9   0.09
hinctnta40-50 percentile        22  9   0.01
hinctnta50-60 percentile        5.55    9   0.78
hinctnta60-70 percentile        8.56    9   0.48
hinctnta70-80 percentile        20.73   9   0.01
hinctnta80-90 percentile        43.18   9   0
hinctnta90-100 percentile       6.84    9   0.65
pdwrkYes                20.04   9   0.02
healthGood              16.76   9   0.05
healthFair              11.6    9   0.24
healthBad               23.37   9   0.01
healthVery Bad              38.53   9   0
psppsgvaVery little         7.91    9   0.54
psppsgvaSome                5.36    9   0.8
psppsgvaA lot               13  9   0.16
psppsgvaA great deal            -33.96  9   1
actrolgaVery little able        12.04   9   0.21
actrolgaQuite able          7.89    9   0.55
actrolgaVery able           10.42   9   0.32
actrolgaCompletely able     4.26    9   0.89
psppiplaVery little         13.35   9   0.15
psppiplaSome                5.35    9   0.8
psppiplaA lot               6.92    9   0.65
```

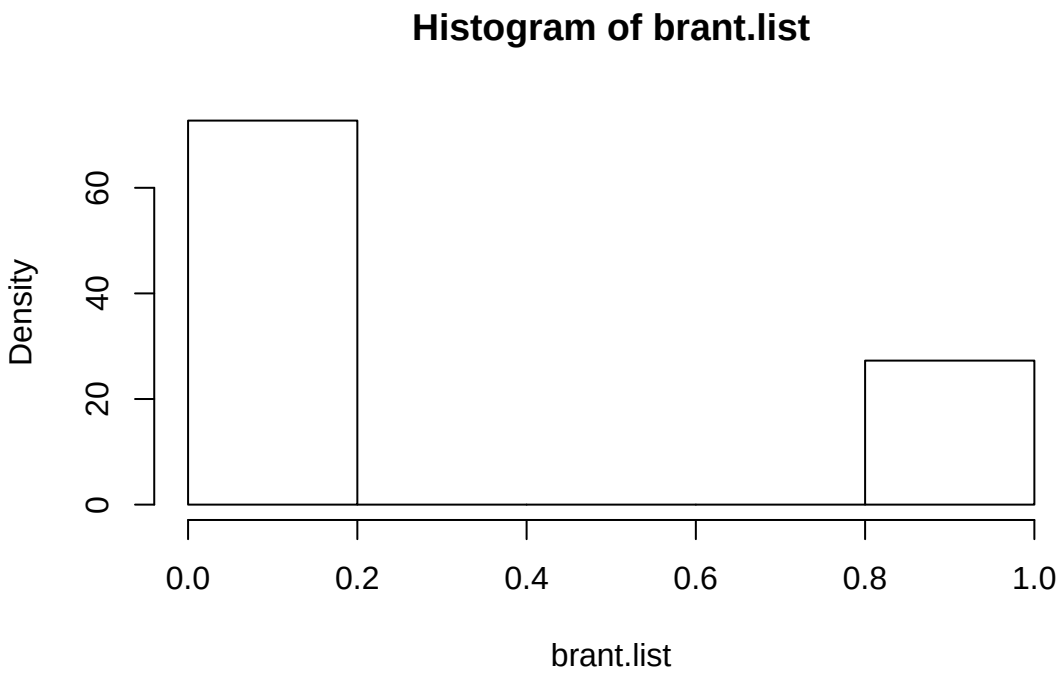
```
psppiplaA great deal            16.17   9   0.06
cptppolaa little confident      6.78    9   0.66
cptppolaQuite confident     9.09    9   0.43
cptppolaVery confident      27.01   9   0
cptppolaCompletely confident        5.58    9   0.78
generaltrust                15.68   9   0.07
generalsatisfaction         55.35   9   0
behaviorinvolvmentLow level     20.4    9   0.02
behaviorinvolvmentMedian level  8.58    9   0.48
behaviorinvolvmentHigh level        19.43   9   0.02
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041533 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

Warning in brant(submodel.brant): glm.fit: fitted probabilities numerically
0 or 1 occurred

---------------------------------------------------------------------
Test for                X2  df  probability
---------------------------------------------------------------------
Omnibus                 792.35  477 0
gndrFemale              3.86    9   0.92
agegroup20-29               6.26    9   0.71
agegroup30-39               4.57    9   0.87
agegroup40-49               3.81    9   0.92
agegroup50-59               2.62    9   0.98
agegroup60-69               6.78    9   0.66
agegroup70-79               4.46    9   0.88
agegroup80-89               9.5 9   0.39
agegroup90+             15.65   9   0.07
edulvlbPrimary              8.77    9   0.46
edulvlbLower Secondary      7.95    9   0.54
edulvlbUpper Secondary      6.02    9   0.74
edulvlbVocational           7.47    9   0.59
edulvlbAssociate            5.24    9   0.81
edulvlbBachelor         3.75    9   0.93
edulvlbMaster               4.81    9   0.85
edulvlbDoctoral         0.33    9   1
hinctnta0-10 percentile     18.35   9   0.03
hinctnta10-20 percentile        15.27   9   0.08
hinctnta20-30 percentile        13.4    9   0.15
hinctnta30-40 percentile        13.54   9   0.14
hinctnta40-50 percentile        3.98    9   0.91
hinctnta50-60 percentile        5.27    9   0.81
hinctnta60-70 percentile        14.46   9   0.11
hinctnta70-80 percentile        10.57   9   0.31
```

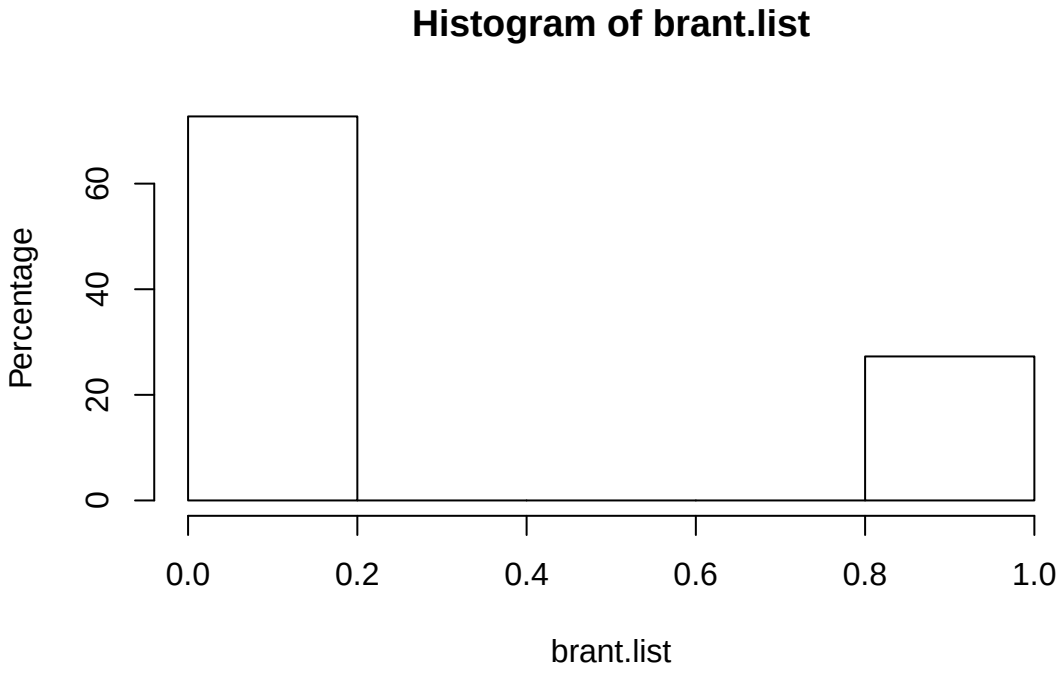
```
hinctnta80-90 percentile        25.14   9   0
hinctnta90-100 percentile       16.32   9   0.06
pdwrkYes                12.54   9   0.18
healthGood              4.68    9   0.86
healthFair              17.17   9   0.05
healthBad               20.35   9   0.02
healthVery Bad              30.18   9   0
psppsgvaVery little         18.73   9   0.03
psppsgvaSome                17.73   9   0.04
psppsgvaA lot               26.52   9   0
psppsgvaA great deal            5.52    9   0.79
actrolgaVery little able        10.11   9   0.34
actrolgaQuite able          8.18    9   0.52
actrolgaVery able           6.66    9   0.67
actrolgaCompletely able     5.03    9   0.83
psppiplaVery little         21.18   9   0.01
psppiplaSome                8.31    9   0.5
psppiplaA lot               17.32   9   0.04
psppiplaA great deal            10.59   9   0.3
cptppolaa little confident      6.35    9   0.7
cptppolaQuite confident     4.44    9   0.88
cptppolaVery confident      5.94    9   0.75
cptppolaCompletely confident        25.68   9   0
generaltrust                27.15   9   0
generalsatisfaction         43.75   9   0
behaviorinvolvmentLow level     27.07   9   0
behaviorinvolvmentMedian level  36.35   9   0
behaviorinvolvmentHigh level        21.16   9   0.01
---------------------------------------------------------------------

H0: Parallel Regression Assumption holds

Warning in brant(submodel.brant): 490041525 combinations in table(dv,ivs)
do not occur. Because of that, the test results might be invalid.
```

```
> mean(brant.list)
```

```
[1] 0.2721087
```

```
> brant.hist=hist(brant.list, plot=F)
> brant.hist$density=brant.hist$counts/sum(brant.hist$counts)*100
> plot(brant.hist, freq=FALSE)
```




```
> plot(brant.hist, freq=FALSE, ylab='Percentage')
```