new

Liancheng

2023-11-26

(1) Data cleaning

```
rm(list = ls())
gc()
```

```
##            used (Mb) gc trigger (Mb) max used (Mb)
## Ncells 470221 25.2     1013058 54.2   660860 35.3
## Vcells 882648  6.8     8388608 64.0  1800812 13.8
```

```
set.seed(123)
############## (1) Data cleaning ####################################
## select variables
library(NHANES)
library(car)
```

```
## Loading required package: carData
```

```
library(naniar)
library(ggplot2)
df0 <- NHANES
df <- NHANES[NHANES$Age >= 18 & NHANES$Age < 60,]
# colSums(is.na(df)) / nrow(df)
df <- df[, which(colSums(is.na(df)) / nrow(df) < 0.3)]
# exclude duplication
df <- df[!duplicated(df),]
names(df)
```

```
##  [1] "ID"              "SurveyYr"        "Gender"          "Age"
##  [5] "AgeDecade"       "Race1"           "Education"       "MaritalStatus"
##  [9] "HHIncome"        "HHIncomeMid"     "Poverty"         "HomeRooms"
## [13] "HomeOwn"         "Work"            "Weight"          "Height"
## [17] "BMI"             "BMI_WHO"         "Pulse"           "BPSysAve"
## [21] "BPDiaAve"        "BPSys1"          "BPDia1"          "BPSys2"
## [25] "BPDia2"          "BPSys3"          "BPDia3"          "DirectChol"
## [29] "TotChol"         "UrineVol1"       "UrineFlow1"      "Diabetes"
## [33] "HealthGen"       "DaysPhysHlthBad" "DaysMentHlthBad" "LittleInterest"
## [37] "Depressed"       "SleepHrsNight"   "SleepTrouble"    "PhysActive"
## [41] "Alcohol12PlusYr" "AlcoholYear"     "Smoke100"        "Smoke100n"
## [45] "Marijuana"       "RegularMarij"    "HardDrugs"       "SexEver"
## [49] "SexAge"          "SexNumPartnLife" "SexNumPartYear"  "SameSex"
## [53] "SexOrientation"
```
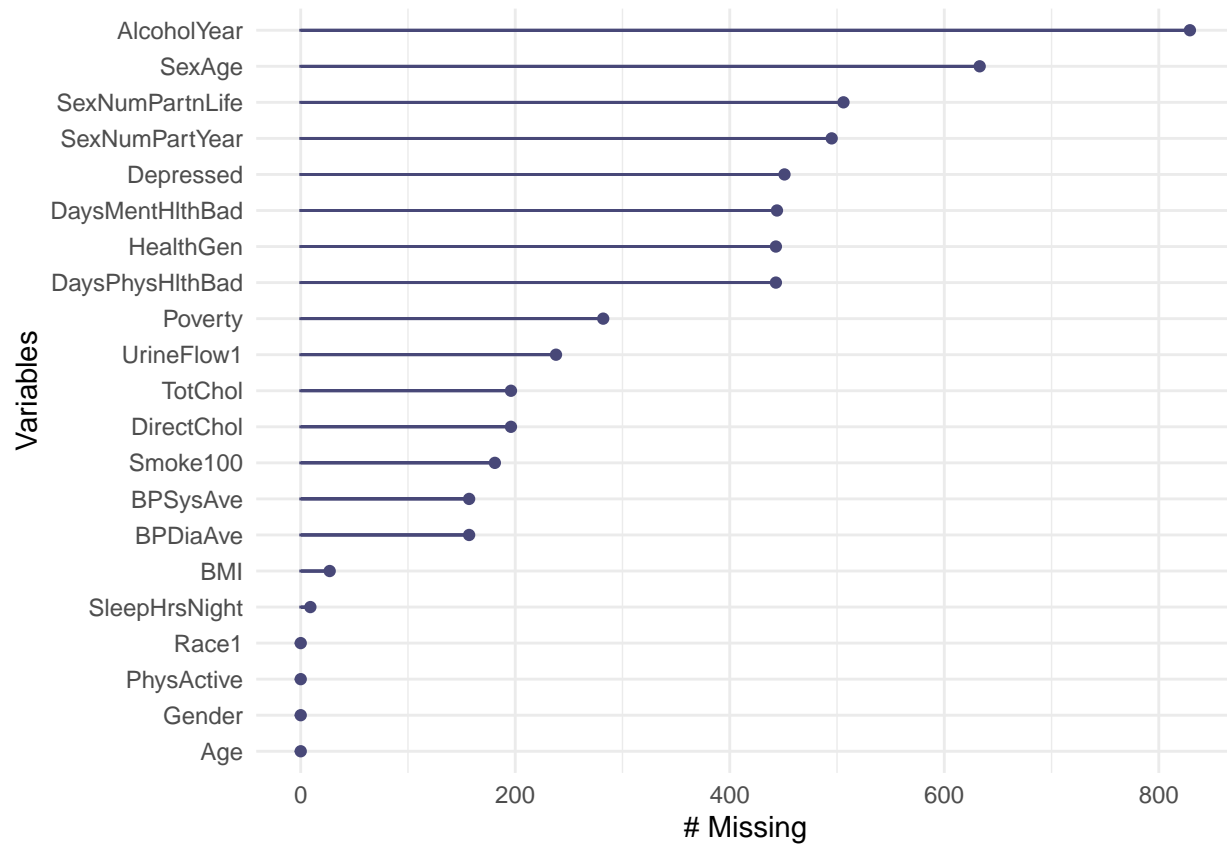
```
# df$BPSysAve
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following object is masked from 'package:car':
##
##     recode

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```
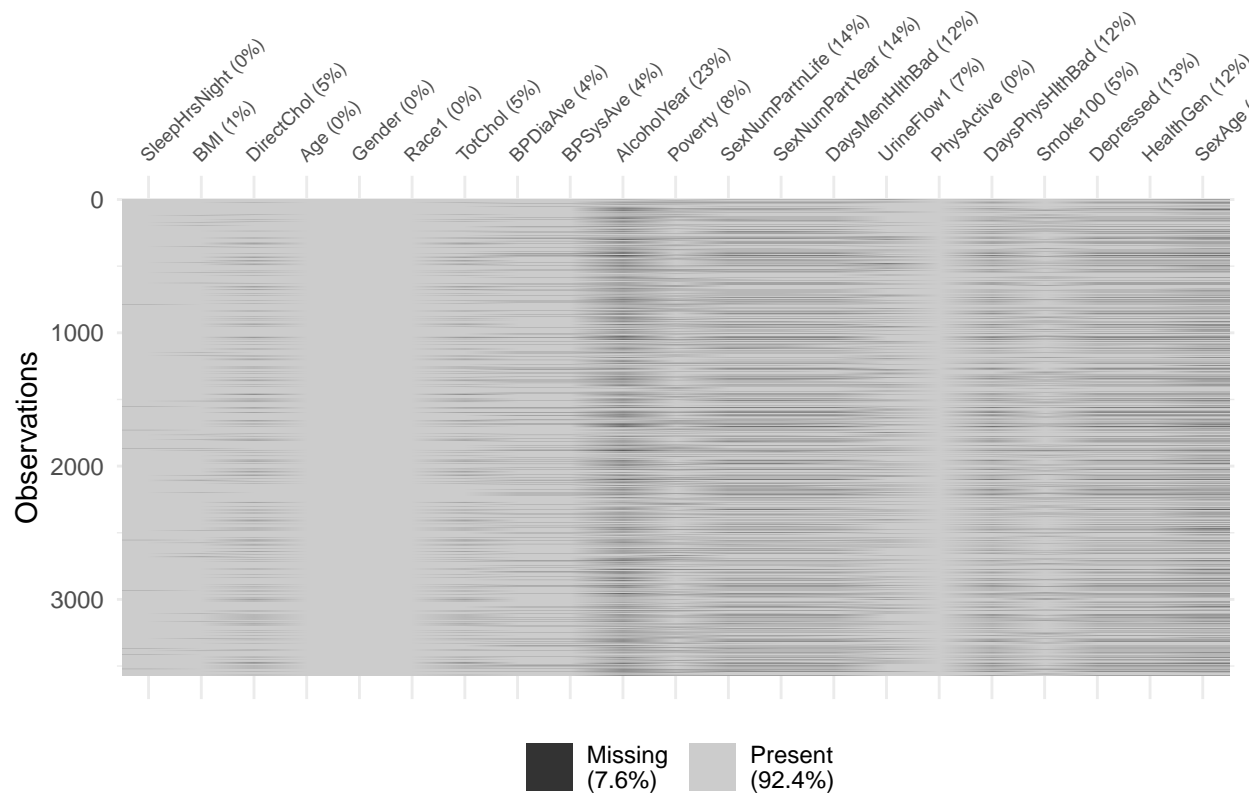
```
df2 <- df %>% select(
  SleepHrsNight,
  BMI,
  DirectChol,
  Age,
  Gender,
  Race1,
  TotChol,
  BPDiaAve,
  BPSysAve,
  AlcoholYear,
  Poverty,
  SexNumPartnLife,
  SexNumPartYear,
  DaysMentHlthBad,
  UrineFlow1,
  PhysActive,
  DaysPhysHlthBad,
  Smoke100,
  Depressed,
  HealthGen,
  SexAge
)

gg_miss_var(df2)
```

```
vis_miss(df2) + theme(axis.text.x = element_text(size = 7))
```

Column labels (left to right): SleepHrsNight (0%), BMI (1%), DirectChol (5%), Age (0%), Gender (0%), Race1 (0%), TotChol (5%), BPDiaAve (4%), BPSysAve (4%), AlcoholYear (23%), Poverty (8%), SexNumPartnLife (14%), SexNumPartYear (14%), DaysMentHlthBad (12%), UrineFlow1 (7%), PhysActive (0%), DaysPhysHlthBad (12%), Smoke100 (5%), Depressed (13%), HealthGen (12%), SexAge

Legend: Missing (7.6%), Present (92.4%)

```r
df3 <- na.omit(df2)
#df3$SleepHrsNight <- df3$SleepHrsNight * 60
#df3 <- df3[, -which(names(df3) %in% "SleepHrsNight")]
# cor(df3$BPSysAve,df3$BPDiaAve)
psych::describe(df3)
```

```
##                 vars    n   mean    sd median trimmed   mad   min     max
## SleepHrsNight      1 2152   6.78  1.31   7.00    6.85  1.48  2.00   12.00
## BMI                2 2152  28.77  6.75  27.60   28.09  5.78 15.02   69.00
## DirectChol         3 2152   1.35  0.41   1.29    1.31  0.39  0.39    3.83
## Age                4 2152  39.18 11.33  39.00   39.15 14.83 20.00   59.00
## Gender*            5 2152   1.53  0.50   2.00    1.54  0.00  1.00    2.00
## Race1*             6 2152   3.43  1.15   4.00    3.57  0.00  1.00    5.00
## TotChol            7 2152   5.07  1.05   4.99    5.01  1.04  1.53   13.65
## BPDiaAve           8 2152  71.19 11.84  71.00   71.28 10.38  0.00  116.00
## BPSysAve           9 2152 117.43 14.28 116.00  116.50 13.34 78.00  209.00
## AlcoholYear       10 2152  70.59 94.22  24.00   50.94 35.58  0.00  364.00
## Poverty           11 2152   2.84  1.69   2.78    2.89  2.49  0.00    5.00
## SexNumPartnLife   12 2152  16.73 66.13   7.00    8.91  5.93  0.00 2000.00
## SexNumPartYear    13 2152   1.38  2.59   1.00    1.04  0.00  0.00   69.00
## DaysMentHlthBad   14 2152   4.47  8.02   0.00    2.40  0.00  0.00   30.00
## UrineFlow1        15 2152   1.07  0.97   0.81    0.91  0.60  0.00   10.14
## PhysActive*       16 2152   1.58  0.49   2.00    1.60  0.00  1.00    2.00
## DaysPhysHlthBad   17 2152   3.16  7.19   0.00    1.12  0.00  0.00   30.00
## Smoke100*         18 2152   1.46  0.50   1.00    1.45  0.00  1.00    2.00
## Depressed*        19 2152   1.30  0.58   1.00    1.16  0.00  1.00    3.00
```

4

```
## HealthGen*          20 2152   2.64  0.94    3.00    2.65  1.48  1.00    5.00
## SexAge              21 2152  17.10  3.39   17.00   16.80  2.97  9.00   44.00
##                      range  skew kurtosis    se
## SleepHrsNight        10.00 -0.30     0.69 0.03
## BMI                  53.98  1.28     2.96 0.15
## DirectChol            3.44  1.09     2.27 0.01
## Age                  39.00  0.02    -1.15 0.24
## Gender*               1.00 -0.12    -1.99 0.01
## Race1*                4.00 -1.13     0.08 0.02
## TotChol              12.12  0.92     3.47 0.02
## BPDiaAve            116.00 -0.39     3.13 0.26
## BPSysAve            131.00  1.00     2.94 0.31
## AlcoholYear         364.00  1.66     1.98 2.03
## Poverty               5.00 -0.01    -1.47 0.04
## SexNumPartnLife    2000.00 18.82   456.62 1.43
## SexNumPartYear       69.00 14.07   293.16 0.06
## DaysMentHlthBad      30.00  2.16     3.76 0.17
## UrineFlow1           10.14  2.89    14.06 0.02
## PhysActive*           1.00 -0.32    -1.90 0.01
## DaysPhysHlthBad      30.00  2.80     7.06 0.15
## Smoke100*             1.00  0.15    -1.98 0.01
## Depressed*            2.00  1.83     2.21 0.01
## HealthGen*            4.00  0.11    -0.33 0.02
## SexAge               35.00  1.51     5.56 0.07
```

```
# psych::pairs.panels(df3)
hist(df3$SleepHrsNight)
```

Histogram of df3$SleepHrsNight

df3$SleepHrsNight
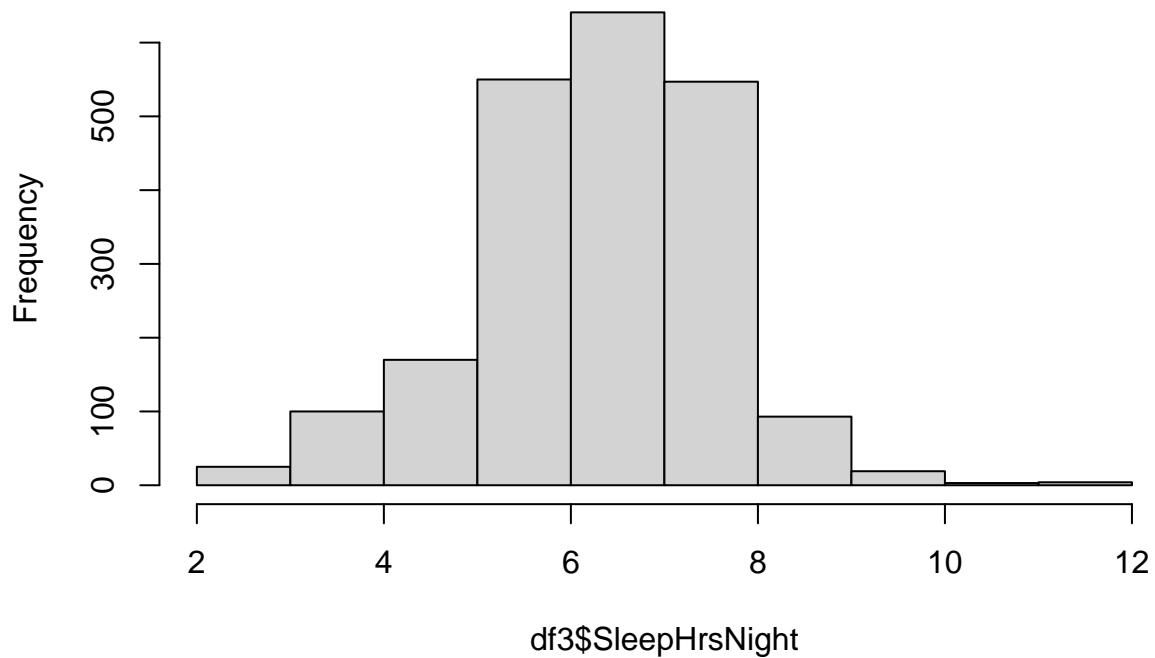
```r
# colSums(is.na(df2)) / nrow(df2)
fit0 <-
  lm(SleepHrsNight ~ .,
     data = df3)
#data type
df3$Gender <- ifelse(df3$Gender == "male", 0, 1)
df3 <- df3 %>%
  mutate(
    Race1 = case_when(
      Race1 == 'Black' ~ 1,
      Race1 == 'Hispanic' ~ 2,
      Race1 == 'Mexican' ~ 3,
      Race1 == 'White' ~ 4,
      Race1 == 'Other' ~ 5,
      TRUE ~ NA_integer_   # Default value if none of the conditions are met
    )
  )

library(psych)
```

```
##
## Attaching package: 'psych'

## The following objects are masked from 'package:ggplot2':
##
##     %+%, alpha
```

```
## The following object is masked from 'package:car':
##
##      logit
```

```r
library(ggplot2)
library(reshape2)

# psych::describe
desc_stats <- psych::describe(df3)

# Transform the data format for easy visualization
# Use the measure.vars parameter to specify the columns to melt
desc_stats_long <- melt(desc_stats, measure.vars = colnames(desc_stats), variable.name = "Statistic", va

# Corrected ggplot2 visual code
ggplot(desc_stats_long[desc_stats_long$Statistic == "mean", ], aes(x = rownames(desc_stats), y = Value))
  geom_bar(stat = "identity") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  labs(x = "Variable", y = "Mean", title = "Mean of Each Variable in selected data")
```
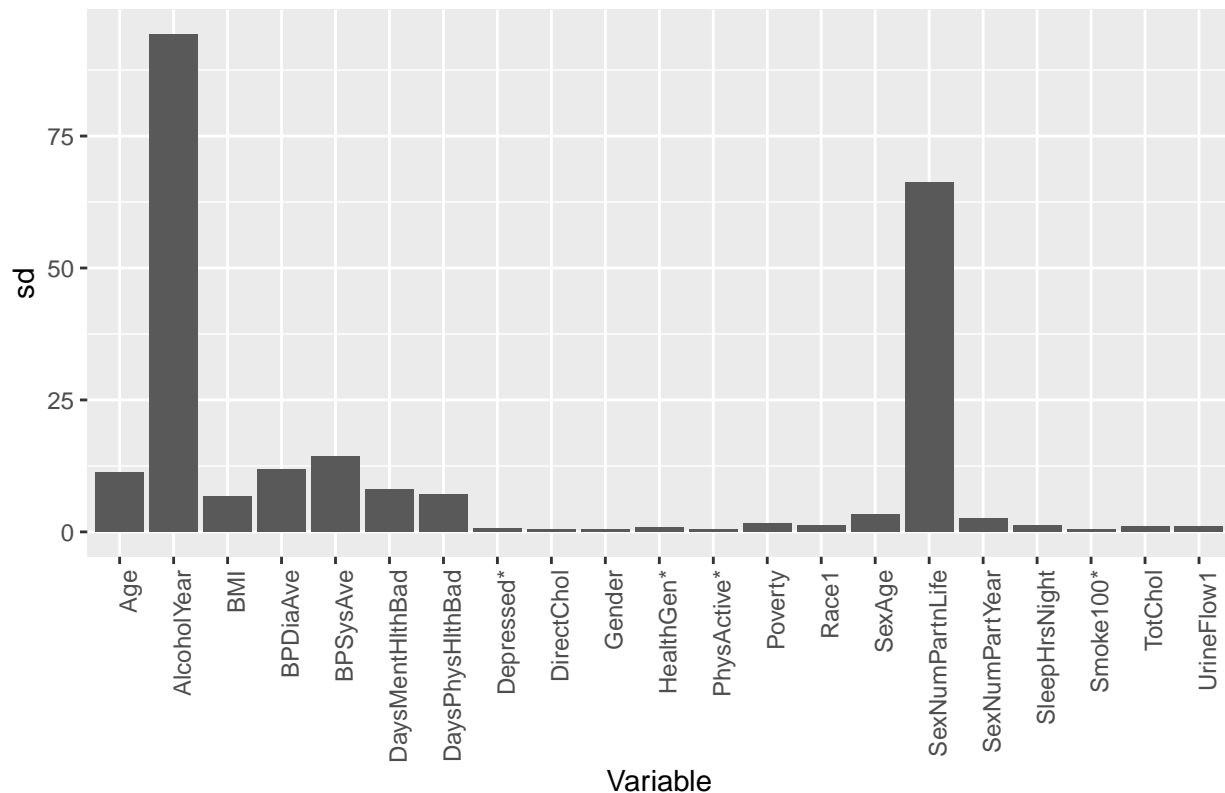

Mean of Each Variable in selected data
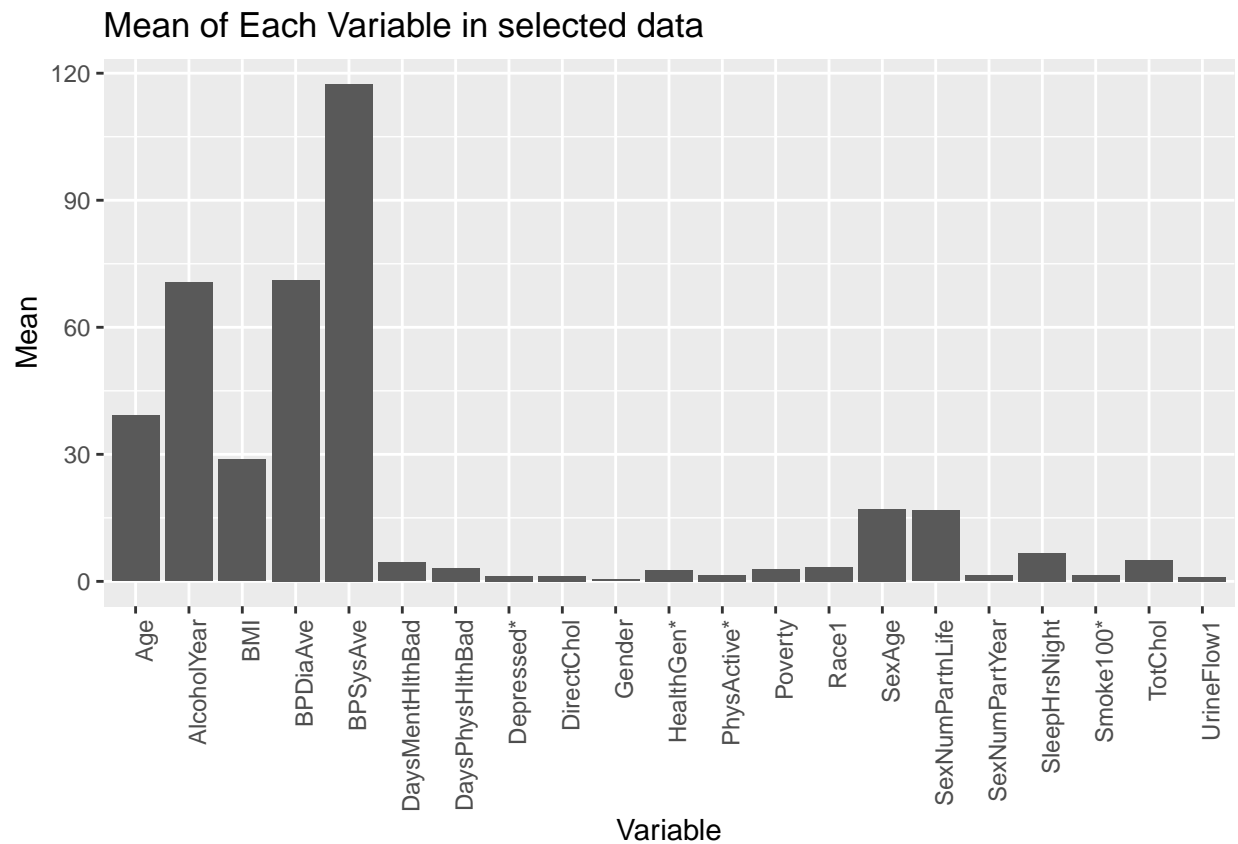
```r
ggplot(desc_stats_long[desc_stats_long$Statistic == "sd", ], aes(x = rownames(desc_stats), y = Value)) +
  geom_bar(stat = "identity") +
  theme(axis.text.x = element_text(angle = 90, hjust = 1)) +
  labs(x = "Variable", y = "sd", title = "sd of Each Variable in selected data")
```

sd of Each Variable in selected data

#Raw data normality analysis

```
# Assuming 'df3' is your dataframe from the NHANES dataset.
# Load necessary libraries
library(e1071)
library(ggplot2)
library(rlang)

# Function to perform normality analysis on a given column
perform_normality_analysis <- function(data, column_x, column_y) {
  # Check if the columns are numeric
  if(!is.numeric(data[[column_x]]) || !is.numeric(data[[column_y]])) {
    return(paste("One or both columns are not numeric. Skipping."))
  }

  # Shapiro-Wilk Test for Y column
  shapiro_test <- shapiro.test(data[[column_y]])

  # Skewness and Kurtosis for Y column
  skewness_value <- skewness(data[[column_y]])
  kurtosis_value <- kurtosis(data[[column_y]])

  # Q-Q Plot for Y column
  qqplot <- ggplot(data, aes_string(sample = column_y)) +
          stat_qq() +
          stat_qq_line() +
          ggtitle(paste("Q-Q Plot for", column_y))
```

```r
  # Histogram with Normal Distribution Fit for Y column
  hist_plot <- ggplot(data, aes_string(x = column_y)) +
              geom_histogram(aes(y = ..density..), binwidth = 1, fill = "blue", alpha = 0.5) +
              geom_density(color = "red", size = 1) +
              theme_bw() +
              xlab(paste(column_y, "(Value)")) +
              ylab("Density") +
              ggtitle(paste("Histogram with Normal Distribution Fit for", column_y))

  # Scatter Plot with Jittering and Alpha adjustment
  scatter_plot <- ggplot(df3, aes_string(x = "SleepHrsNight", y = "BMI")) +
              geom_jitter(alpha = 0.5, width = 0.2) + # Add jittering and alpha adjustment
              geom_smooth(method = "lm", color = "red") +
              theme_bw() +
              ggtitle("Scatter Plot with Regression Line for SleepHrsNight vs BMI")

  # Boxplot for Y column
  boxplot <- ggplot(data, aes_string(y = column_y)) +
            geom_boxplot() +
            theme_bw() +
            ggtitle(paste("Boxplot for", column_y))

  # Density Plot for Y column
  density_plot <- ggplot(data, aes_string(x = column_y)) +
              geom_density(fill = "blue", alpha = 0.5) +
              theme_bw() +
              ggtitle(paste("Density Plot for", column_y))

  # Output results
  list(
    Column_Y = column_y,
    Shapiro_Test = shapiro_test,
    Skewness = skewness_value,
    Kurtosis = kurtosis_value,
    QQPlot = qqplot,
    Histogram = hist_plot,
    ScatterPlot = scatter_plot,
    Boxplot = boxplot,
    DensityPlot = density_plot
  )
}

# Analyze BMI with SleepHrsNight as X-axis
bmi_sleep_analysis <- perform_normality_analysis(df3, "SleepHrsNight", "BMI")
```

```
## Warning: `aes_string()` was deprecated in ggplot2 3.0.0.
## i Please use tidy evaluation idioms with `aes()`.
## i See also `vignette("ggplot2-in-packages")` for more information.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
```

```
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
# Display the results
print(bmi_sleep_analysis$Shapiro_Test)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  data[[column_y]]
## W = 0.92639, p-value < 2.2e-16
```

```
print(paste("Skewness:", bmi_sleep_analysis$Skewness))
```
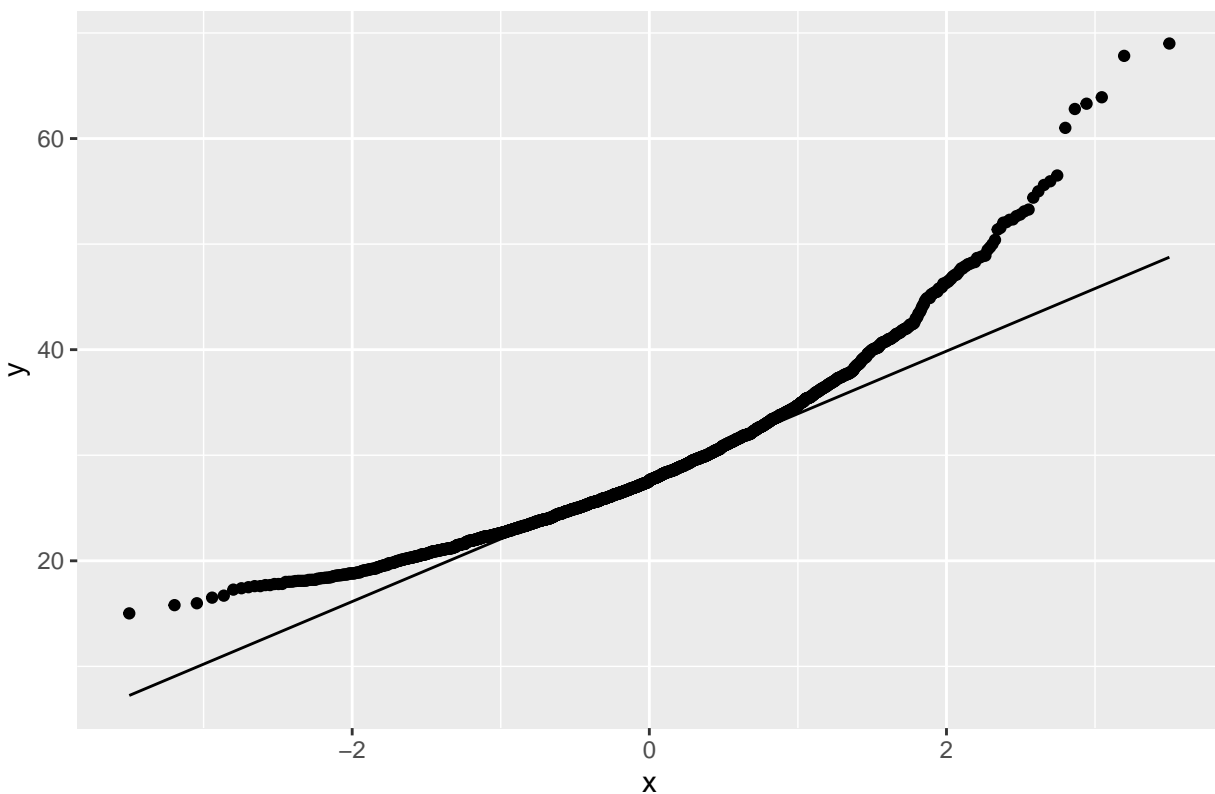
```
## [1] "Skewness: 1.282503606303"
```

```
print(paste("Kurtosis:", bmi_sleep_analysis$Kurtosis))
```

```
## [1] "Kurtosis: 2.95825812976249"
```

```
print(bmi_sleep_analysis$QQPlot)
```

Q–Q Plot for BMI


```
print(bmi_sleep_analysis$Histogram)
```

```
## Warning: The dot-dot notation (`..density..`) was deprecated in ggplot2 3.4.0.
## i Please use `after_stat(density)` instead.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
```

```
## generated.
```

Histogram with Normal Distribution Fit for BMI
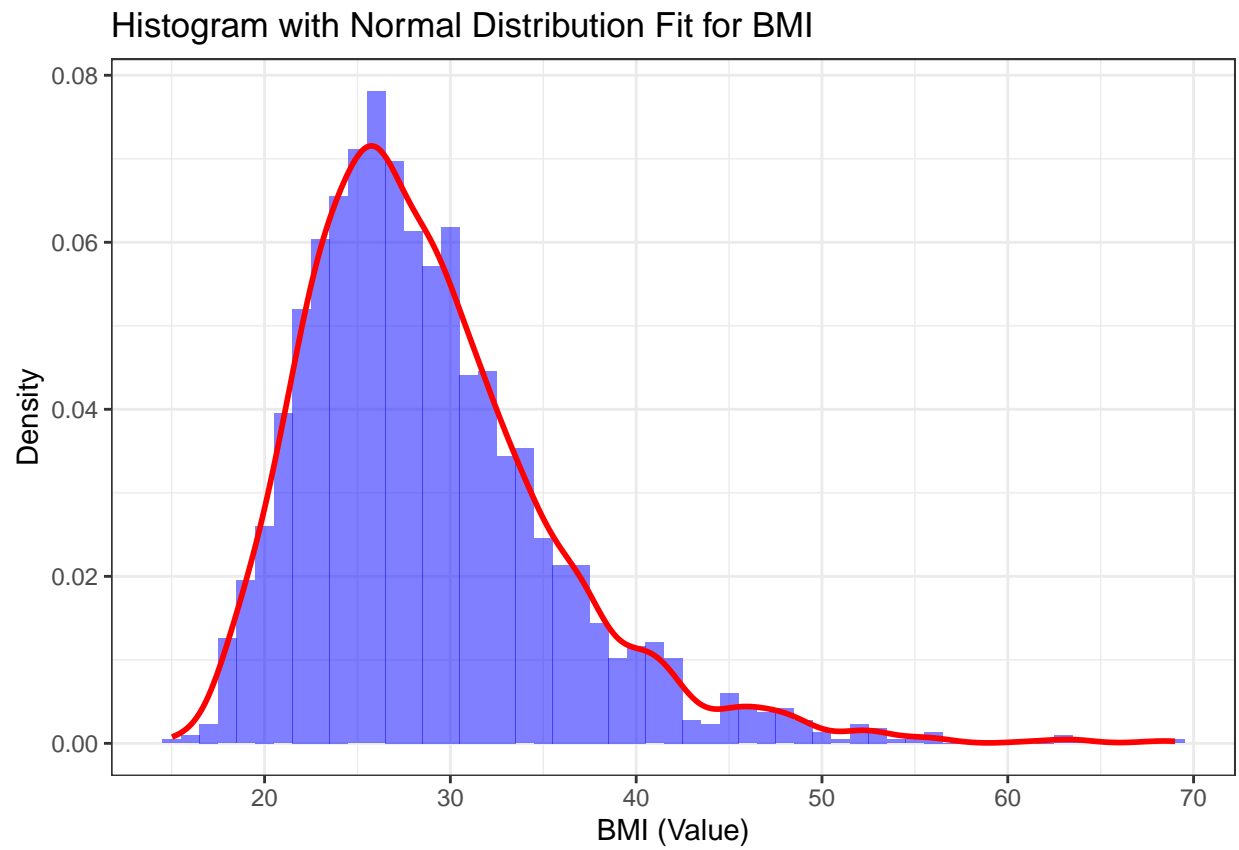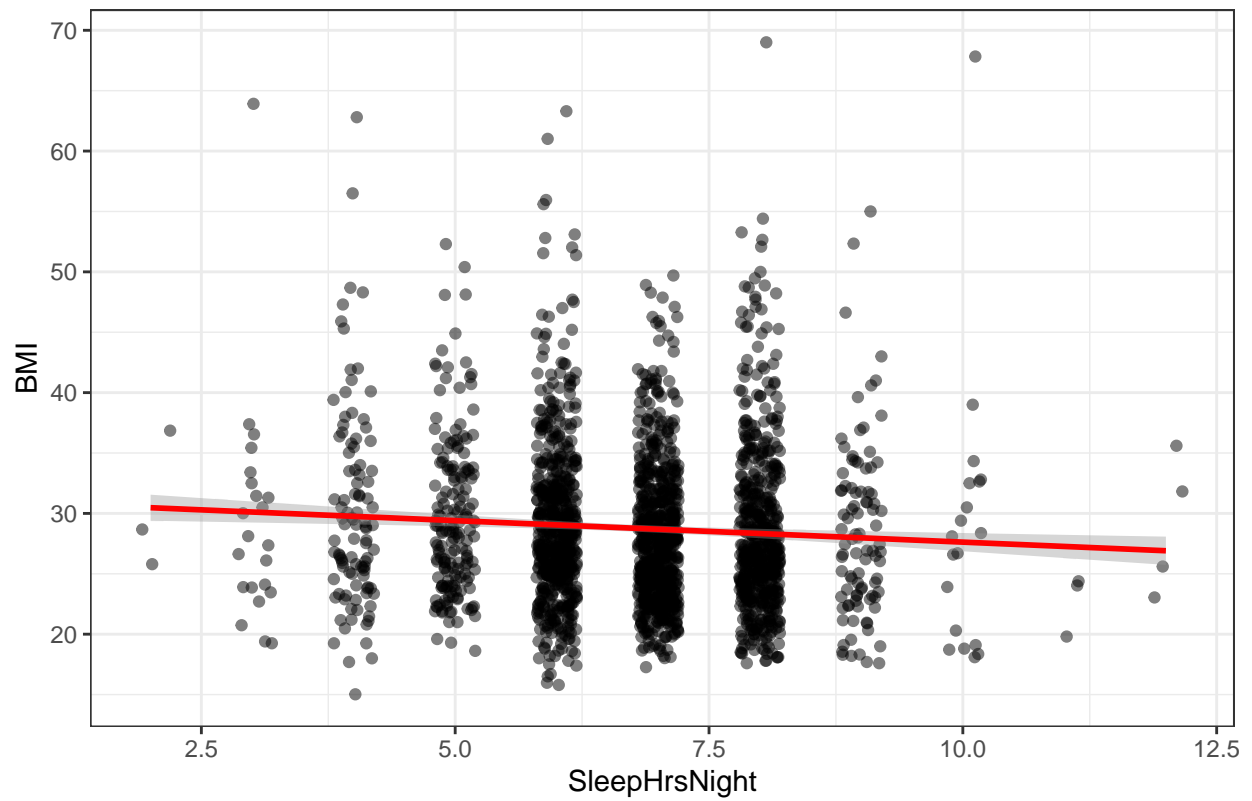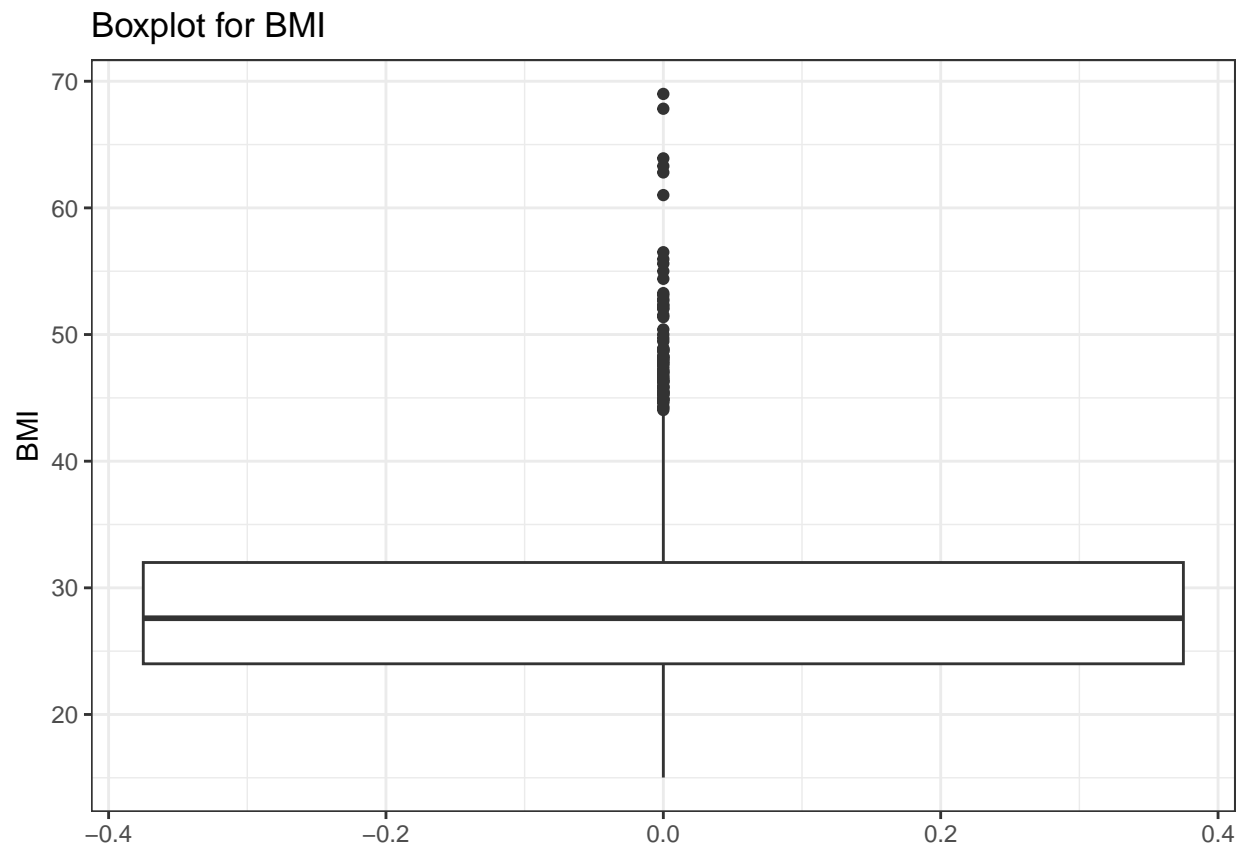


```
print(bmi_sleep_analysis$ScatterPlot)
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

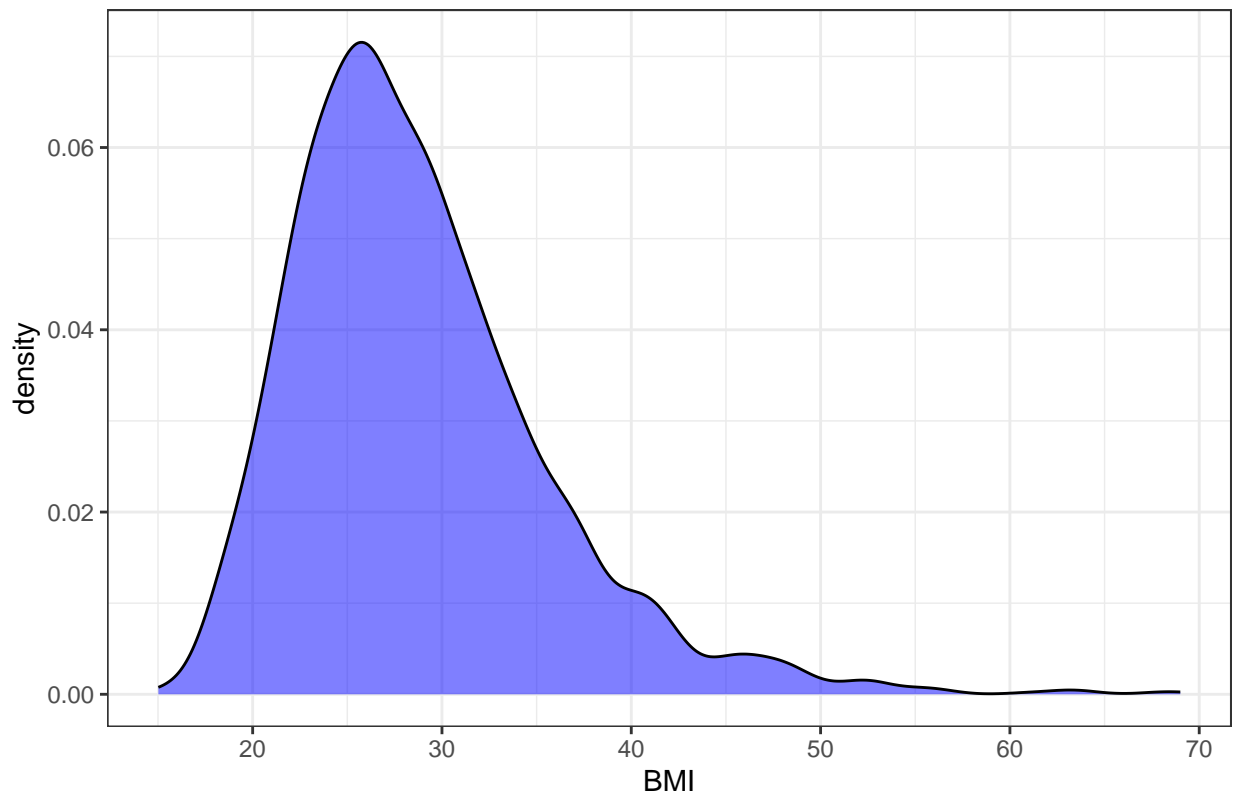## Scatter Plot with Regression Line for SleepHrsNight vs BMI


```
print(bmi_sleep_analysis$Boxplot)
```

Boxplot for BMI


```
print(bmi_sleep_analysis$DensityPlot)
```

Density Plot for BMI

#basic characteristics

```r
# Assuming 'df3' is your dataframe.

# Load necessary library
library(dplyr)

# Function to get basic characteristics of a given column
get_basic_characteristics <- function(data, column) {
  # Ensure the column is numeric
  if(!is.numeric(data[[column]])) {
    return(data.frame(Variable = column, Mean = NA, Median = NA, SD = NA, Min = NA, Max = NA, Q1 = NA, (
  }

  # Calculate basic characteristics
  characteristics <- data %>%
                  summarise(
                    Mean = mean(.data[[column]], na.rm = TRUE),
                    Median = median(.data[[column]], na.rm = TRUE),
                    SD = sd(.data[[column]], na.rm = TRUE),
                    Min = min(.data[[column]], na.rm = TRUE),
                    Max = max(.data[[column]], na.rm = TRUE),
                    Q1 = quantile(.data[[column]], 0.25, na.rm = TRUE),
                    Q3 = quantile(.data[[column]], 0.75, na.rm = TRUE)
                  ) %>%
                  mutate(Variable = column) %>%
                  select(Variable, everything())
```

```r
  # Return the results
  return(characteristics)
}

# List of columns to analyze
columns_to_analyze <- c("SleepHrsNight", "BMI", "DirectChol", "Age", "Gender", "Race1", "TotChol", "BPD

# Apply the function to each column and combine results
combined_characteristics <- lapply(columns_to_analyze, function(col) get_basic_characteristics(df3, col
                            bind_rows()

# Display the combined basic characteristics
print(combined_characteristics)
```

```
## # A tibble: 21 x 8
##    Variable         Mean Median    SD   Min   Max    Q1    Q3
##    <chr>           <dbl>  <dbl> <dbl> <dbl> <dbl> <dbl> <dbl>
##  1 SleepHrsNight    6.78   7     1.31   2    12     6     8
##  2 BMI             28.8   27.6   6.75  15.0  69    24    32
##  3 DirectChol       1.35   1.29  0.410  0.39  3.83  1.06  1.58
##  4 Age             39.2   39    11.3   20    59    30    49
##  5 Gender           0.470  0     0.499  0     1     0     1
##  6 Race1            3.43   4     1.15   1     5     3     4
##  7 TotChol          5.07   4.99  1.05   1.53 13.6   4.32  5.69
##  8 BPDiaAve        71.2   71    11.8    0   116    64    78
##  9 BPSysAve       117.   116    14.3   78   209   108   125
## 10 AlcoholYear     70.6   24    94.2    0   364     4   104
## # i 11 more rows
```

(2) Baseline characteristics

```r
Hmisc::describe(df3)
```

```
## df3
##
##  21  Variables      2152  Observations
## --------------------------------------------------------------------------------
## SleepHrsNight
##        n  missing distinct     Info    Mean     Gmd     .05     .10
##     2152        0       11     0.94    6.781   1.415       4       5
##      .25      .50      .75     .90     .95
##        6        7        8       8       9
##
## lowest :  2  3  4  5  6, highest:  8  9 10 11 12
##
## Value           2     3     4     5     6     7     8     9    10    11    12
## Frequency       3    22   100   170   550   641   547    93    19     3     4
## Proportion  0.001 0.010 0.046 0.079 0.256 0.298 0.254 0.043 0.009 0.001 0.002
## --------------------------------------------------------------------------------
## BMI
##        n  missing distinct     Info    Mean     Gmd     .05     .10
##     2152        0     1072        1    28.77   7.223   20.18   21.50
```

```
##       .25      .50      .75      .90      .95
##     24.00    27.60    32.00    37.36    41.22
##
## lowest : 15.02 15.80 15.98 16.51 16.70, highest: 62.80 63.30 63.91 67.83 69.00
## -------------------------------------------------------------------------------
## DirectChol
##         n  missing distinct     Info     Mean      Gmd      .05      .10
##      2152        0       98    0.999    1.346   0.4446     0.80     0.91
##       .25      .50      .75      .90      .95
##      1.06     1.29     1.58     1.89     2.09
##
## lowest : 0.39 0.41 0.52 0.54 0.57, highest: 3.13 3.41 3.44 3.59 3.83
## -------------------------------------------------------------------------------
## Age
##         n  missing distinct     Info     Mean      Gmd      .05      .10
##      2152        0       40    0.999    39.18    13.08       21       23
##       .25      .50      .75      .90      .95
##        30       39       49       55       57
##
## lowest : 20 21 22 23 24, highest: 55 56 57 58 59
## -------------------------------------------------------------------------------
## Gender
##         n  missing distinct     Info      Sum     Mean      Gmd
##      2152        0        2    0.747     1011   0.4698   0.4984
##
## -------------------------------------------------------------------------------
## Race1
##         n  missing distinct     Info     Mean      Gmd
##      2152        0        5    0.758    3.428    1.115
##
## lowest : 1 2 3 4 5, highest: 1 2 3 4 5
##
## Value            1      2      3      4      5
## Frequency      289    145    230   1333    155
## Proportion   0.134  0.067  0.107  0.619  0.072
## -------------------------------------------------------------------------------
## TotChol
##         n  missing distinct     Info     Mean      Gmd      .05      .10
##      2152        0      208        1    5.069    1.151     3.57     3.85
##       .25      .50      .75      .90      .95
##      4.32     4.99     5.69     6.36     6.83
##
## lowest :  1.53  2.69  2.74  2.79  2.82, highest:  9.31  9.34  9.90 12.28 13.65
## -------------------------------------------------------------------------------
## BPDiaAve
##         n  missing distinct     Info     Mean      Gmd      .05      .10
##      2152        0       84    0.999    71.19    12.83       53       57
##       .25      .50      .75      .90      .95
##        64       71       78       85       89
##
## lowest :   0  20  21  22  25, highest: 108 109 110 114 116
## -------------------------------------------------------------------------------
## BPSysAve
##         n  missing distinct     Info     Mean      Gmd      .05      .10
```

```
##        2152           0          98     0.999      117.4      15.44        97       101
##         .25         .50         .75       .90        .95
##         108         116         125       134        142
##
## lowest :  78  83  84  85  86, highest: 182 184 191 202 209
## -----------------------------------------------------------------------------------
## AlcoholYear
##           n    missing    distinct      Info       Mean        Gmd       .05        .10
##        2152           0          56     0.993      70.59       91.9         0          0
##         .25         .50         .75       .90        .95
##           4          24         104       208        260
##
## lowest :   0   1   2   3   4, highest: 260 300 312 360 364
## -----------------------------------------------------------------------------------
## Poverty
##           n    missing    distinct      Info       Mean        Gmd       .05        .10
##        2152           0         393     0.988      2.841      1.931     0.340      0.660
##         .25         .50         .75       .90        .95
##       1.277       2.780       4.817     5.000      5.000
##
## lowest : 0.00 0.02 0.03 0.04 0.05, highest: 4.95 4.96 4.97 4.99 5.00
## -----------------------------------------------------------------------------------
## SexNumPartnLife
##           n    missing    distinct      Info       Mean        Gmd       .05        .10
##        2152           0          81     0.995      16.73      22.47         1          1
##         .25         .50         .75       .90        .95
##           3           7          15        30         50
##
## lowest :    0    1    2    3    4, highest:  600  800  999 1000 2000
## -----------------------------------------------------------------------------------
## SexNumPartYear
##           n    missing    distinct      Info       Mean        Gmd       .05        .10
##        2152           0          21     0.645      1.381       1.18         0          0
##         .25         .50         .75       .90        .95
##           1           1           1         2          3
##
## lowest :  0  1  2  3  4, highest: 19 20 30 50 69
## -----------------------------------------------------------------------------------
## DaysMentHlthBad
##           n    missing    distinct      Info       Mean        Gmd       .05        .10
##        2152           0          28     0.844      4.475      6.894         0          0
##         .25         .50         .75       .90        .95
##           0           0           5        15         30
##
## lowest :  0  1  2  3  4, highest: 25 26 27 29 30
## -----------------------------------------------------------------------------------
## UrineFlow1
##           n    missing    distinct      Info       Mean        Gmd       .05        .10
##        2152           0        1337         1      1.074     0.9061    0.1960     0.2775
##         .25         .50         .75       .90        .95
##      0.4580      0.8100      1.3618    2.1929     2.7780
##
## lowest : 0.000 0.006 0.011 0.014 0.016, highest: 7.325 7.826 8.730 9.410 10.143
## -----------------------------------------------------------------------------------
```

```
## PhysActive
##         n  missing distinct
##      2152        0        2
##
## Value          No   Yes
## Frequency     906  1246
## Proportion  0.421 0.579
## -------------------------------------------------------------------------------
## DaysPhysHlthBad
##         n  missing distinct     Info     Mean      Gmd      .05      .10
##      2152        0       24    0.708    3.165    5.318     0.00     0.00
##      .25      .50      .75      .90      .95
##     0.00     0.00     2.00    10.00    24.45
##
## lowest :  0  1  2  3  4, highest: 24 25 26 28 30
## -------------------------------------------------------------------------------
## Smoke100
##         n  missing distinct
##      2152        0        2
##
## Value          No   Yes
## Frequency    1155   997
## Proportion  0.537 0.463
## -------------------------------------------------------------------------------
## Depressed
##         n  missing distinct
##      2152        0        3
##
## Value         None Several    Most
## Frequency     1657     355     140
## Proportion   0.770   0.165   0.065
## -------------------------------------------------------------------------------
## HealthGen
##         n  missing distinct
##      2152        0        5
##
## lowest : Excellent Vgood     Good      Fair      Poor
## highest: Excellent Vgood     Good      Fair      Poor
##
## Value     Excellent     Vgood      Good      Fair      Poor
## Frequency       240       697       854       313        48
## Proportion    0.112     0.324     0.397     0.145     0.022
## -------------------------------------------------------------------------------
## SexAge
##         n  missing distinct     Info     Mean      Gmd      .05      .10
##      2152        0       28    0.985     17.1    3.463    13.00    14.00
##      .25      .50      .75      .90      .95
##    15.00    17.00    18.00    21.00    23.45
##
## lowest :  9 10 11 12 13, highest: 32 34 35 37 44
## -------------------------------------------------------------------------------
```

(3) linear regression model

```
##simple linear regression##
model1 = lm(df3$SleepHrsNight ~ df3$BMI, data = df3)
summary(model1)
```

```
##
## Call:
## lm(formula = df3$SleepHrsNight ~ df3$BMI, data = df3)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -4.8209 -0.8022  0.1710  1.1494  5.3105
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  7.166900   0.123331  58.111  < 2e-16 ***
## df3$BMI     -0.013409   0.004174  -3.213  0.00133 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.307 on 2150 degrees of freedom
## Multiple R-squared:  0.004778,   Adjusted R-squared:  0.004315
## F-statistic: 10.32 on 1 and 2150 DF,  p-value: 0.001334
```

```
par(mfrow = c(2, 3)) #read more from ?plot.lm
plot(model1, which = 1)
plot(model1, which = 2)
plot(model1, which = 3)
plot(model1, which = 4)
plot(model1, which = 5)
plot(model1, which = 6)
```
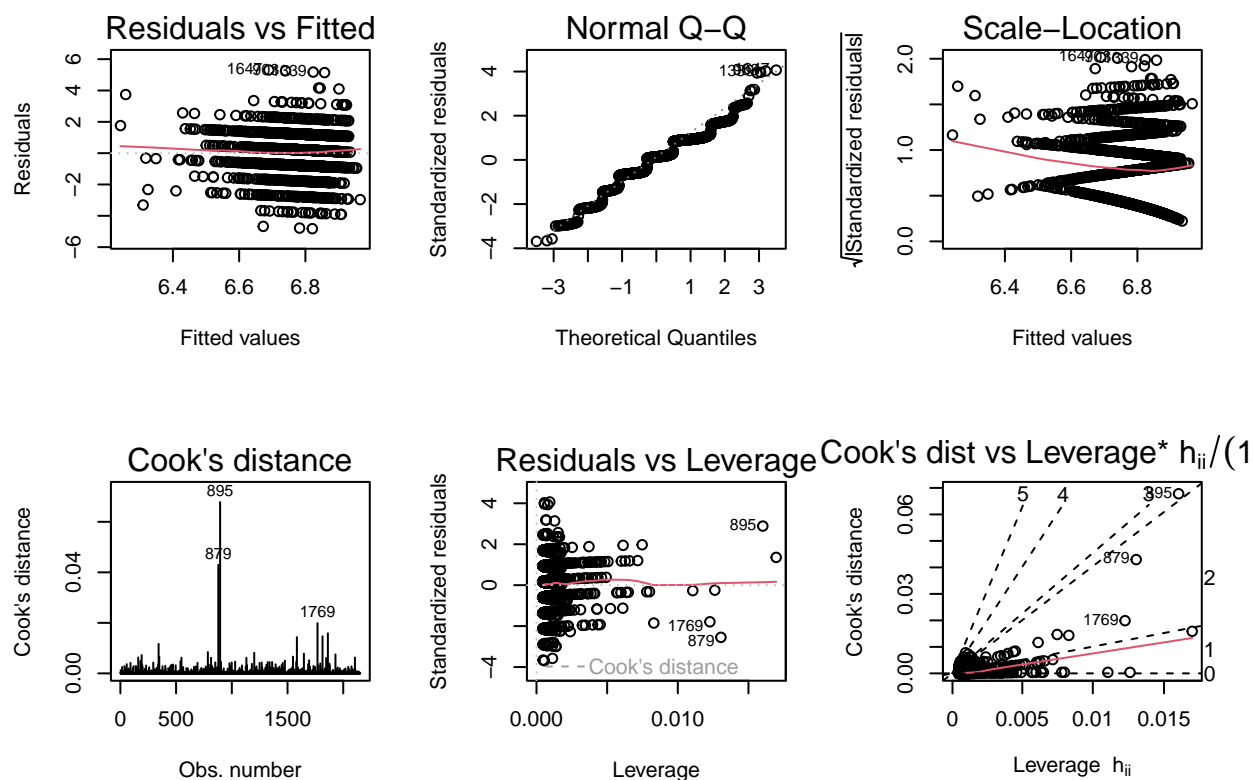
```
par(mfrow = c(1, 1)) # reset

dummy_b = 1 * (df3$Race1 == "Black")
dummy_h = 1 * (df3$Race1 == "Hispanic")
dummy_m = 1 * (df3$Race1 == "Mexican")
dummy_w = 1 * (df3$Race1 == "White")
dummy_o = 1 * (df3$Race1 == "Other")

age_quant = quantile(df3$Age)
df3$AgeC = 0
df3$AgeC[df3$Age > age_quant[2] & df3$Age <= age_quant[3]] = 1
df3$AgeC[df3$Age > age_quant[3] & df3$Age <= age_quant[4]] = 2
df3$AgeC[df3$Age > age_quant[4]] = 3

### multiple linear regression###
# model_1 add demographic
m_1 = lm(BMI ~ SleepHrsNight + Age + Gender + factor(Race1), df3)
summary(m_1)

##
## Call:
## lm(formula = BMI ~ SleepHrsNight + Age + Gender + factor(Race1),
##      data = df3)
##
## Residuals:
##      Min      1Q  Median      3Q      Max
```

```
## -14.347  -4.497  -1.201   3.190  40.277
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)    30.78080    0.97780  31.480  < 2e-16 ***
## SleepHrsNight  -0.29383    0.11031  -2.664 0.007785 **
## Age             0.05055    0.01282   3.944 8.26e-05 ***
## Gender          0.25869    0.28895   0.895 0.370740
## factor(Race1)2 -2.28054    0.67704  -3.368 0.000769 ***
## factor(Race1)3 -1.02309    0.59140  -1.730 0.083782 .
## factor(Race1)4 -2.51942    0.43385  -5.807 7.30e-09 ***
## factor(Race1)5 -4.14341    0.66274  -6.252 4.88e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.643 on 2144 degrees of freedom
## Multiple R-squared:  0.03564,    Adjusted R-squared:  0.03249
## F-statistic: 11.32 on 7 and 2144 DF,  p-value: 3.698e-14
## model_2 add known risk factors
m_2 = lm(
  BMI ~ SleepHrsNight + Age + Gender + Race1 + TotChol + BPDiaAve + BPSysAve + AlcoholYear + Smoke100 +
    DaysPhysHlthBad + PhysActive,
  df3
)
summary(m_2)

##
## Call:
## lm(formula = BMI ~ SleepHrsNight + Age + Gender + Race1 + TotChol +
##     BPDiaAve + BPSysAve + AlcoholYear + Smoke100 + DaysPhysHlthBad +
##     PhysActive, data = df3)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -14.752  -4.236  -0.849   3.055  37.857
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     21.023150   1.610401  13.055  < 2e-16 ***
## SleepHrsNight   -0.212193   0.107400  -1.976 0.048314 *
## Age              0.012839   0.013495   0.951 0.341528
## Gender           0.514621   0.291331   1.766 0.077463 .
## Race1           -0.622971   0.122615  -5.081 4.09e-07 ***
## TotChol          0.076572   0.139325   0.550 0.582658
## BPDiaAve         0.054500   0.014049   3.879 0.000108 ***
## BPSysAve         0.066004   0.012027   5.488 4.55e-08 ***
## AlcoholYear     -0.009762   0.001533  -6.368 2.34e-10 ***
## Smoke100Yes     -0.507830   0.287921  -1.764 0.077911 .
## DaysPhysHlthBad  0.066309   0.019785   3.352 0.000818 ***
## PhysActiveYes   -1.260928   0.292769  -4.307 1.73e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.413 on 2140 degrees of freedom
```

```
## Multiple R-squared:  0.1029, Adjusted R-squared:  0.09826
## F-statistic: 22.31 on 11 and 2140 DF,  p-value: < 2.2e-16
```

#LINE

#influential observations

#multicollinearity

```
vif(m_1)
```

```
##                  GVIF Df GVIF^(1/(2*Df))
## SleepHrsNight 1.017942  1        1.008931
## Age           1.028310  1        1.014056
## Gender        1.014189  1        1.007069
## factor(Race1) 1.042495  4        1.005216
```

```
vif(m_2)
```

```
##   SleepHrsNight           Age          Gender           Race1        TotChol
##        1.035419      1.223319        1.106167        1.045711       1.122357
##        BPDiaAve        BPSysAve      AlcoholYear        Smoke100 DaysPhysHlthBad
##        1.447702      1.542999        1.091195        1.078534       1.057582
##       PhysActive
##        1.093222
```

model_3 add additional risk factors

```
m_3 = lm(
  BMI ~ SleepHrsNight + Age + Gender + Race1  + Poverty + TotChol + BPDiaAve + BPSysAve + AlcoholYear +
    DaysPhysHlthBad + HealthGen + PhysActive,
  df3
)
summary(m_3)
```

```
##
## Call:
## lm(formula = BMI ~ SleepHrsNight + Age + Gender + Race1 + Poverty +
##     TotChol + BPDiaAve + BPSysAve + AlcoholYear + Smoke100 +
##     UrineFlow1 + DaysMentHlthBad + DaysPhysHlthBad + HealthGen +
##     PhysActive, data = df3)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -16.838  -4.054  -0.646   3.203  35.902
##
## Coefficients:
##               Estimate Std. Error t value Pr(>|t|)
## (Intercept)   18.471020   1.621565  11.391  < 2e-16 ***
## SleepHrsNight -0.121393   0.106352  -1.141  0.25382
## Age            0.010806   0.013725   0.787  0.43118
## Gender         0.532917   0.286537   1.860  0.06304 .
## Race1         -0.500763   0.122151  -4.100 4.29e-05 ***
## Poverty        0.073370   0.090958   0.807  0.41997
## TotChol        0.030653   0.136000   0.225  0.82170
## BPDiaAve       0.058458   0.013721   4.260 2.13e-05 ***
```

```
## BPSysAve         0.053724   0.011806    4.550 5.65e-06 ***
## AlcoholYear      -0.008337   0.001515   -5.503 4.18e-08 ***
## Smoke100Yes      -0.807332   0.287264   -2.810  0.00499 **
## UrineFlow1       -0.113369   0.142545   -0.795  0.42652
## DaysMentHlthBad  -0.030360   0.017984   -1.688  0.09153 .
## DaysPhysHlthBad   0.014779   0.020974    0.705  0.48112
## HealthGenVgood    1.922013   0.470923    4.081 4.64e-05 ***
## HealthGenGood     3.569501   0.468730    7.615 3.93e-14 ***
## HealthGenFair     5.283476   0.575334    9.183  < 2e-16 ***
## HealthGenPoor     7.546146   1.078147    6.999 3.43e-12 ***
## PhysActiveYes    -0.818408   0.294015   -2.784  0.00542 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.251 on 2133 degrees of freedom
## Multiple R-squared:  0.1504, Adjusted R-squared:  0.1432
## F-statistic: 20.97 on 18 and 2133 DF,  p-value: < 2.2e-16
```

```
vif(m_3)
```

```
##                      GVIF Df GVIF^(1/(2*Df))
## SleepHrsNight    1.068552  1        1.033708
## Age              1.331598  1        1.153949
## Gender           1.126176  1        1.061214
## Race1            1.092236  1        1.045101
## Poverty          1.302699  1        1.141358
## TotChol          1.125511  1        1.060901
## BPDiaAve         1.453387  1        1.205565
## BPSysAve         1.564805  1        1.250922
## AlcoholYear      1.121584  1        1.059049
## Smoke100         1.129923  1        1.062979
## UrineFlow1       1.044330  1        1.021925
## DaysMentHlthBad  1.145584  1        1.070320
## DaysPhysHlthBad  1.250957  1        1.118462
## HealthGen        1.435741  4        1.046248
## PhysActive       1.160363  1        1.077202
```

```
par(mfrow = c(2, 3)) #read more from ?plot.lm
plot(m_3, which = 1)
plot(m_3, which = 2)
plot(m_3, which = 3)
plot(m_3, which = 4)
plot(m_3, which = 5)
plot(m_3, which = 6)
```
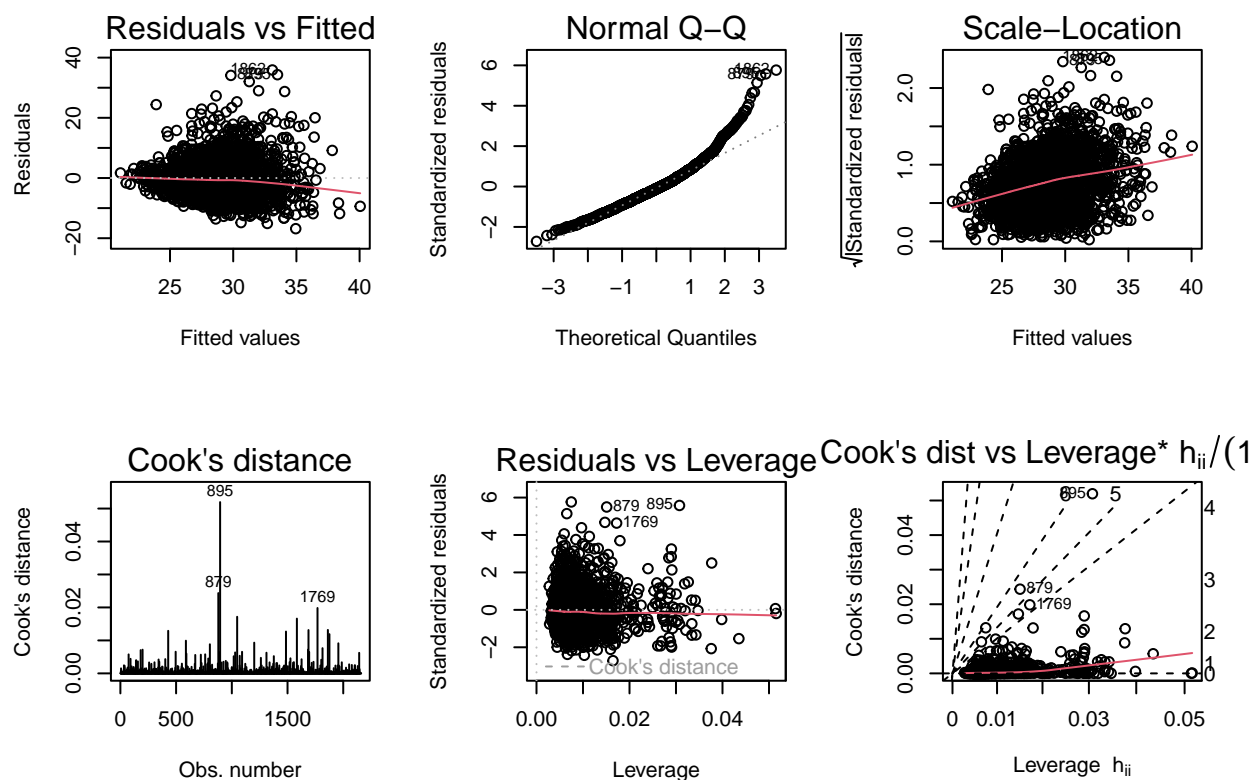
```r
par(mfrow = c(1, 1)) # reset

# model_4 add additional risk factors
m_full = lm(
  BMI ~ SleepHrsNight + Age + Gender + Race1  + Poverty + TotChol + BPDiaAve + BPSysAve + AlcoholYear +
    DaysPhysHlthBad + HealthGen + PhysActive + SleepHrsNight * Age + SleepHrsNight *
    Gender,
  df3
)
summary(m_full)
```

```
##
## Call:
## lm(formula = BMI ~ SleepHrsNight + Age + Gender + Race1 + Poverty +
##     TotChol + BPDiaAve + BPSysAve + AlcoholYear + Smoke100 +
##     UrineFlow1 + DaysMentHlthBad + DaysPhysHlthBad + HealthGen +
##     PhysActive + SleepHrsNight * Age + SleepHrsNight * Gender,
##     data = df3)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -17.019  -4.059  -0.648   3.165  36.301
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)      21.349305   2.996916   7.124 1.43e-12 ***
```

```
## SleepHrsNight        -0.542616   0.378594  -1.433  0.15194
## Age                  -0.105136   0.062783  -1.675  0.09416 .
## Gender                3.768696   1.435161   2.626  0.00870 **
## Race1                -0.503222   0.121964  -4.126 3.83e-05 ***
## Poverty               0.072729   0.090968   0.800  0.42409
## TotChol               0.014773   0.135905   0.109  0.91345
## BPDiaAve              0.058709   0.013701   4.285 1.91e-05 ***
## BPSysAve              0.054450   0.011792   4.617 4.12e-06 ***
## AlcoholYear          -0.008396   0.001513  -5.549 3.23e-08 ***
## Smoke100Yes          -0.802999   0.286852  -2.799  0.00517 **
## UrineFlow1           -0.102218   0.142435  -0.718  0.47305
## DaysMentHlthBad      -0.030250   0.017962  -1.684  0.09230 .
## DaysPhysHlthBad       0.015142   0.020943   0.723  0.46975
## HealthGenVgood        1.928283   0.470249   4.101 4.28e-05 ***
## HealthGenGood         3.559316   0.468010   7.605 4.24e-14 ***
## HealthGenFair         5.299570   0.575060   9.216  < 2e-16 ***
## HealthGenPoor         7.640142   1.077494   7.091 1.81e-12 ***
## PhysActiveYes        -0.837418   0.294615  -2.842  0.00452 **
## SleepHrsNight:Age     0.017092   0.009024   1.894  0.05837 .
## SleepHrsNight:Gender -0.477032   0.206903  -2.306  0.02123 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6.242 on 2131 degrees of freedom
## Multiple R-squared:  0.1538, Adjusted R-squared:  0.1459
## F-statistic: 19.37 on 20 and 2131 DF,  p-value: < 2.2e-16
```

```
vif(m_full)
```

```
## there are higher-order terms (interactions) in this model
## consider setting type = 'predictor'; see ?vif

##                          GVIF Df GVIF^(1/(2*Df))
## SleepHrsNight        13.583457  1        3.685574
## Age                  27.952318  1        5.286995
## Gender               28.340488  1        5.323579
## Race1                 1.092306  1        1.045135
## Poverty               1.307058  1        1.143266
## TotChol               1.127465  1        1.061822
## BPDiaAve              1.453678  1        1.205686
## BPSysAve              1.565996  1        1.251398
## AlcoholYear           1.122185  1        1.059332
## Smoke100              1.130221  1        1.063119
## UrineFlow1            1.045986  1        1.022734
## DaysMentHlthBad       1.146283  1        1.070646
## DaysPhysHlthBad       1.251072  1        1.118513
## HealthGen             1.447335  4        1.047300
## PhysActive            1.168763  1        1.081093
## SleepHrsNight:Age    37.541993  1        6.127152
## SleepHrsNight:Gender 29.940850  1        5.471823
```

```
par(mfrow = c(2, 3)) #read more from ?plot.lm
plot(m_full, which = 1)
plot(m_full, which = 2)
plot(m_full, which = 3)
plot(m_full, which = 4)
```

```
plot(m_full, which = 5)
plot(m_full, which = 6)
```
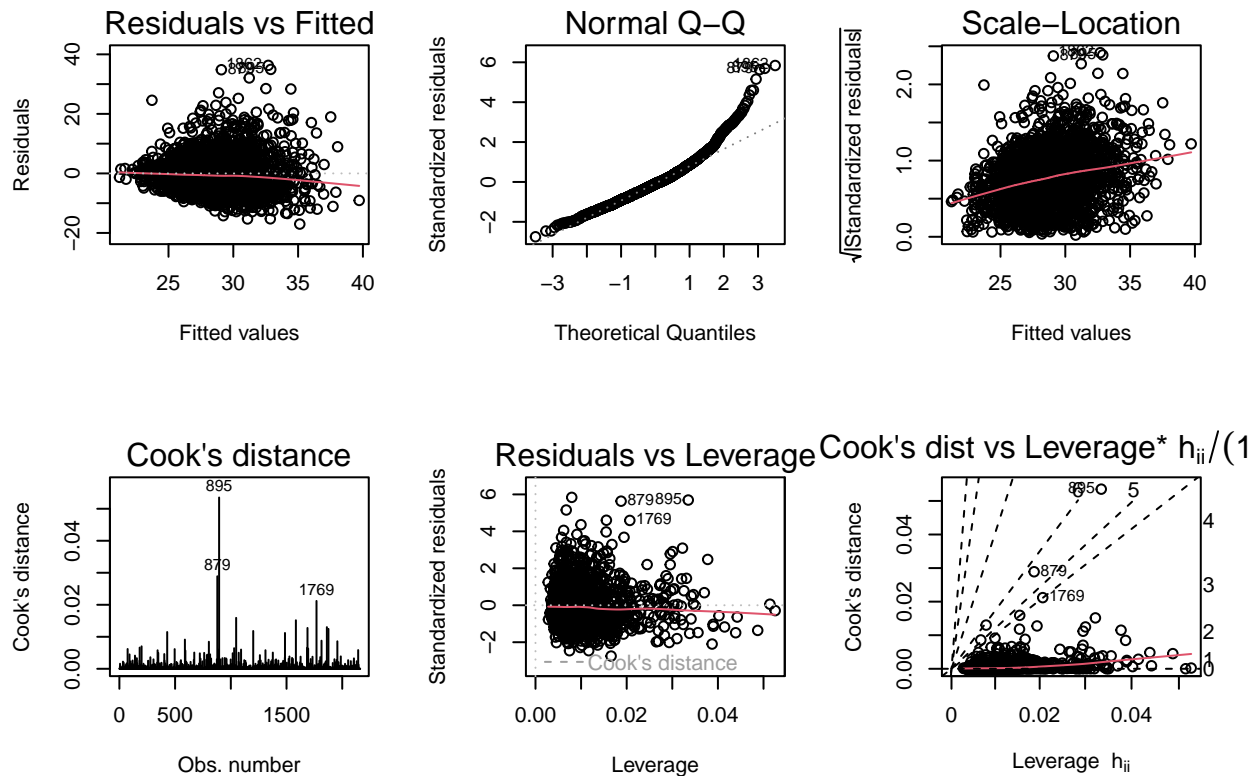


```
par(mfrow = c(1, 1)) # reset

getMode <- function(v) {
  uniqv <- unique(v)
  uniqv[which.max(tabulate(match(v, uniqv)))]
}

new_data <- expand.grid(SleepHrsNight = seq(min(df3$SleepHrsNight), max(df3$SleepHrsNight), length.out =
                        Age = quantile(df3$Age, probs = c(0.25, 0.5, 0.75)),
                        Gender = median(df3$Gender, na.rm = TRUE),
                        Race1 = median(df3$Race1, na.rm = TRUE),
                        Poverty = median(df3$Poverty, na.rm = TRUE),
                        TotChol = median(df3$TotChol, na.rm = TRUE),
                        BPDiaAve = median(df3$BPDiaAve, na.rm = TRUE),
                        BPSysAve = median(df3$BPSysAve, na.rm = TRUE),
                        AlcoholYear = median(df3$AlcoholYear, na.rm = TRUE),
                        Smoke100 = getMode(df3$Smoke100),
                        UrineFlow1 = median(df3$UrineFlow1, na.rm = TRUE),
                        DaysMentHlthBad = median(df3$DaysMentHlthBad, na.rm = TRUE),
                        DaysPhysHlthBad = median(df3$DaysPhysHlthBad, na.rm = TRUE),
                        HealthGen = getMode(df3$HealthGen),
                        PhysActive = getMode(df3$PhysActive)
)
```

26

```
# predict
new_data$predicted_BMI <- predict(m_full, newdata = new_data)
# interaction
library(ggplot2)
ggplot(new_data, aes(x = SleepHrsNight, y = predicted_BMI, group = factor(Age))) +
  geom_line(aes(color = factor(Age))) +
  labs(title = "Interaction between Sleep Hours and Age on BMI",
       x = "Sleep Hours per Night",
       y = "Predicted BMI")
```
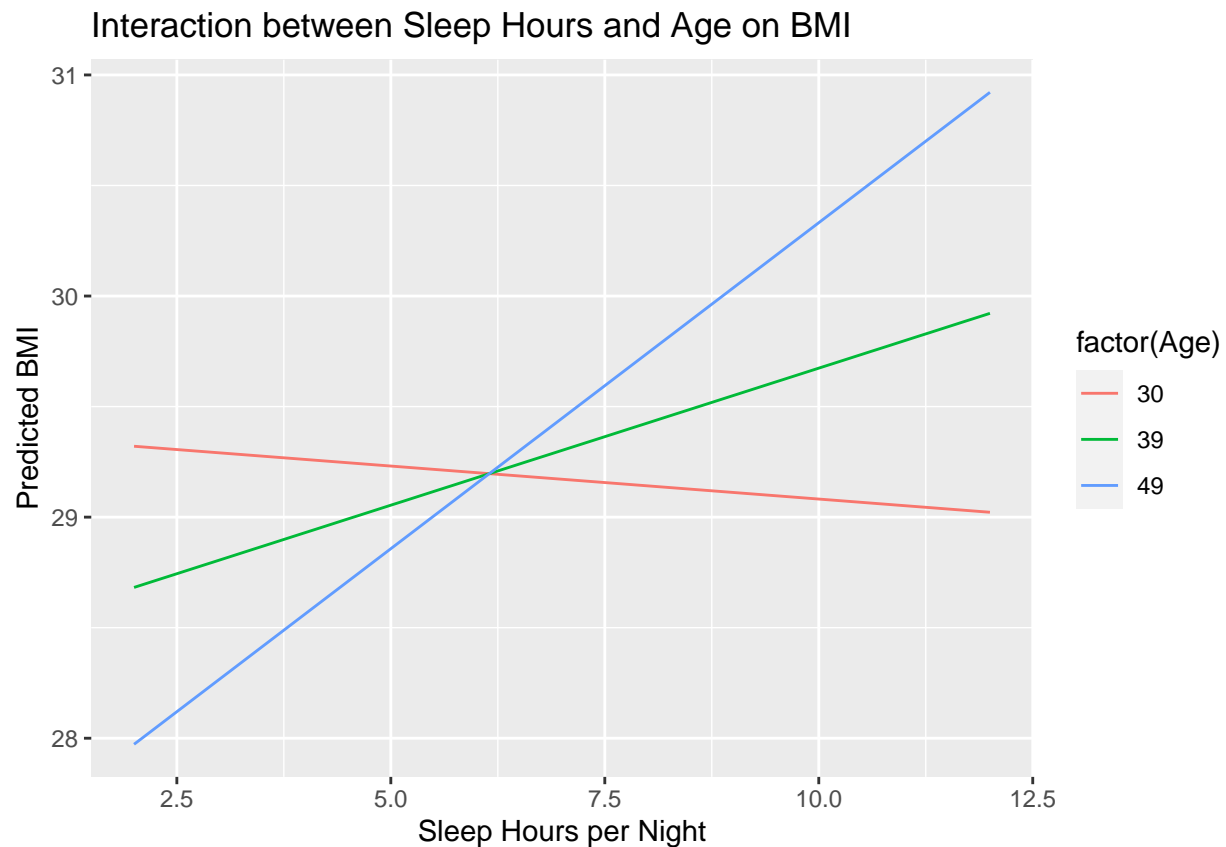

(4) Diagnosis: 10-fold CV

```
library(caret)
```

```
## Loading required package: lattice
splitIndex <-
  createDataPartition(df3$SleepHrsNight, p = 0.7, list = FALSE)
trainData <- df3[splitIndex, ]
testData <- df3[-splitIndex, ]
predictions <- predict(m_full, newdata = testData)
mse <- mean((testData$SleepHrsNight - predictions) ^ 2)
control <-
  trainControl(method = "cv", number = 10)  # 10-fold cross-validation
```

```
cv_model <-
  train(
    SleepHrsNight ~ .,
    data = df3,
    method = "lm",
    trControl = control
  )
cv_model
```

```
## Linear Regression
##
## 2152 samples
##   21 predictor
##
## No pre-processing
## Resampling: Cross-Validated (10 fold)
## Summary of sample sizes: 1937, 1938, 1936, 1937, 1937, 1937, ...
## Resampling results:
##
##   RMSE       Rsquared    MAE
##   1.280209   0.05043061  0.9931499
##
## Tuning parameter 'intercept' was held constant at a value of TRUE
```

```
(cv_results <- cv_model$results)
```

```
##   intercept       RMSE    Rsquared        MAE     RMSESD  RsquaredSD      MAESD
## 1      TRUE  1.280209  0.05043061  0.9931499  0.04543809  0.02732622  0.02794626
```

## (4) Diagnosis: Normality Assumption

```
library(ggplot2)
library(patchwork)
# Initializes an empty patchwork object
plot_list <- list()

# Draw a histogram for each numeric variable (except Race1 and Gender) and add it to the list
for (var in names(df3)) {
  if (is.numeric(df3[[var]]) && !(var %in% c("Race1", "Gender"))) {
    p <- ggplot(df3, aes(x = .data[[var]])) +
      geom_histogram(
        aes(y = after_stat(density)),
        binwidth = 1,
        fill = "blue",
        color = "black"
      ) +
      geom_density(col = "red") +
      ggtitle(paste("Histogram and Density for", var)) +
      xlab(var) +
      ylab("Density")
    plot_list[[length(plot_list) + 1]] <- p
  }
```

```
}

# Use patchwork to put all the charts together
combined_plot <- wrap_plots(plot_list, ncol = 2)
print(combined_plot)
```
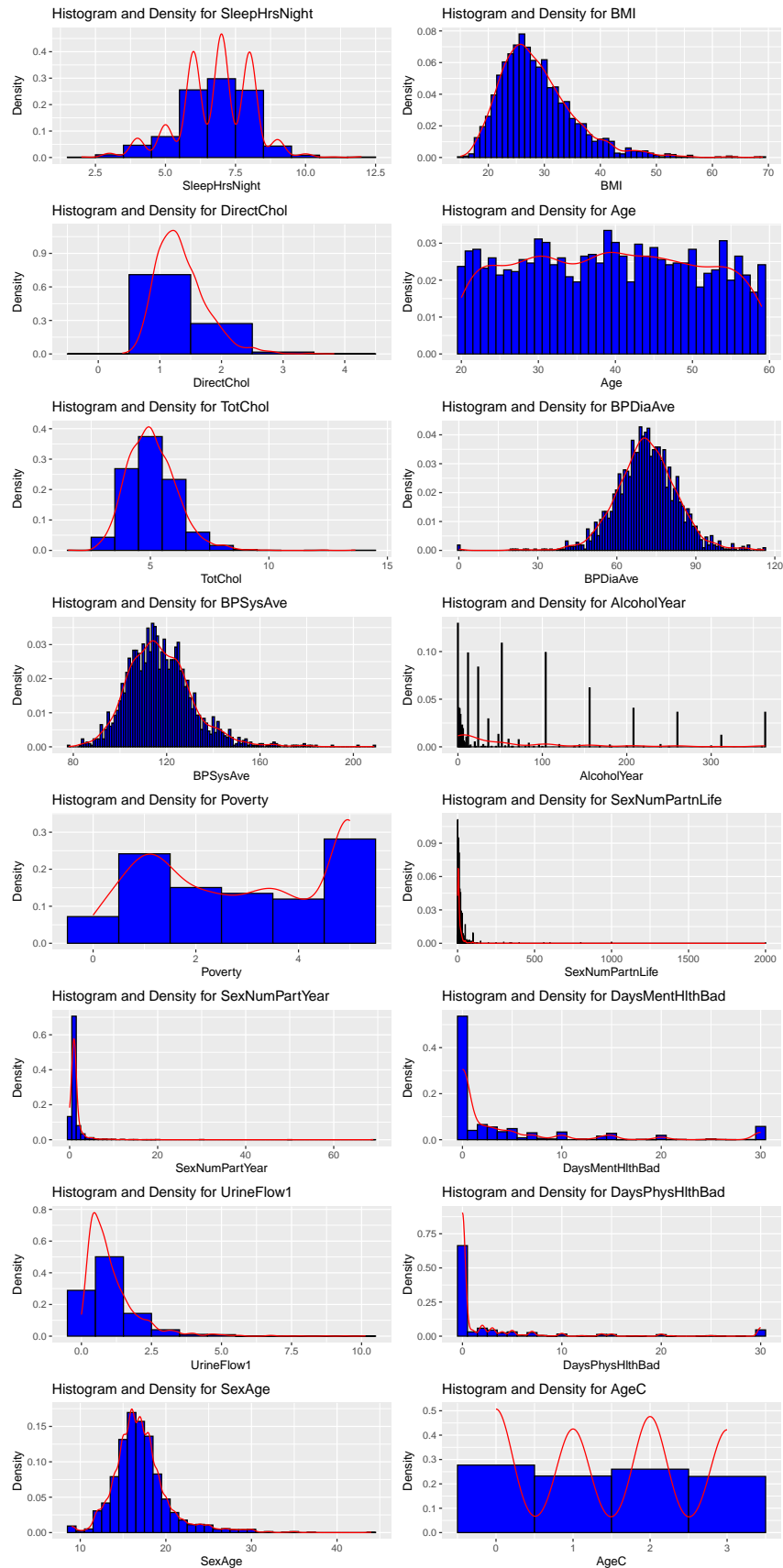
```r
df3 <- data.frame(df3)
library(dplyr)
# Shapiro-Wilk normality test is performed for each numerical variable in df3
results <- sapply(df3, function(x) {
  if (is.numeric(x)) {
    shapiro_test <- shapiro.test(x)
    return(c(shapiro_test$statistic, shapiro_test$p.value))
  } else {
    return(c(NA, NA))
  }
})
# Convert the result to a data box and name the column
results_df <- as.data.frame(t(results))
names(results_df) <- c("W", "p.value")
# Add a variable name as a new column
results_df$Variable <- rownames(results_df)
# Rearrange the order of columns
results_df <- results_df[, c("Variable", "W", "p.value")]
# Calculate the corrected P-value (for example, using Bonferroni correction)
results_df$p.adjusted <-
  p.adjust(results_df$p.value, method = "bonferroni")
print(results_df)
```

```
##                        Variable         W      p.value   p.adjusted
## SleepHrsNight     SleepHrsNight 0.9347691 1.022342e-29 1.840215e-28
## BMI                         BMI 0.9263898 2.950926e-31 5.311666e-30
## DirectChol           DirectChol 0.9439221 7.552977e-28 1.359536e-26
## Age                         Age 0.9579654 1.832383e-24 3.298290e-23
## Gender                   Gender 0.6352876 1.636740e-55 2.946133e-54
## Race1                     Race1 0.7327797 3.104346e-50 5.587823e-49
## TotChol                 TotChol 0.9642744 1.175111e-22 2.115200e-21
## BPDiaAve               BPDiaAve 0.9718079 3.709893e-20 6.677808e-19
## BPSysAve               BPSysAve 0.9554033 3.865527e-25 6.957949e-24
## AlcoholYear         AlcoholYear 0.7454040 1.944127e-49 3.499428e-48
## Poverty                 Poverty 0.8942742 4.092136e-36 7.365845e-35
## SexNumPartnLife SexNumPartnLife 0.1496531 2.951432e-71 5.312577e-70
## SexNumPartYear   SexNumPartYear 0.2562318 1.244353e-68 2.239836e-67
## DaysMentHlthBad DaysMentHlthBad 0.6112779 1.254550e-56 2.258190e-55
## UrineFlow1           UrineFlow1 0.7555438 8.969094e-49 1.614437e-47
## PhysActive           PhysActive        NA           NA           NA
## DaysPhysHlthBad DaysPhysHlthBad 0.4968273 2.926552e-61 5.267794e-60
## Smoke100               Smoke100        NA           NA           NA
## Depressed             Depressed        NA           NA           NA
## HealthGen             HealthGen        NA           NA           NA
## SexAge                   SexAge 0.8954434 5.842918e-36 1.051725e-34
## AgeC                       AgeC 0.8533480 8.034125e-41 1.446143e-39
```

Standardized residuals, Studentized residuals

```r
# Regular residuals
residual_1 <- m_full$residuals
```

```r
# Standardized residuals
residual_2 <- rstandard(m_full)

# Studentized residuals
residual_3 <- rstudent(m_full)

# Externally studentized residuals
# Note: Externally studentized residuals are the same as studentized residuals in most cases
residual_4 <- rstudent(m_full)

# Creating a data frame to summarize these residuals
residual_summary <- data.frame(
  Residuals = c("Regular", "Standardized", "Studentized", "Externally Studentized"),
  Mean = c(mean(residual_1), mean(residual_2), mean(residual_3), mean(residual_4)),
  SD = c(sd(residual_1), sd(residual_2), sd(residual_3), sd(residual_4)),
  Min = c(min(residual_1), min(residual_2), min(residual_3), min(residual_4)),
  Max = c(max(residual_1), max(residual_2), max(residual_3), max(residual_4))
)

# Display the summary
print(residual_summary)
```

```
##                   Residuals          Mean       SD        Min       Max
## 1                   Regular -1.448790e-16 6.212489 -17.019074 36.300973
## 2              Standardized -2.232345e-05 1.000939  -2.749618  5.839262
## 3               Studentized  2.310529e-04 1.002091  -2.753862  5.885164
## 4 Externally Studentized  2.310529e-04 1.002091  -2.753862  5.885164
```

```r
# Load necessary library
library(ggplot2)

# Assuming m_full is your linear model
# m_full <- lm(SleepMinNight ~ ., data = df3)

# Calculate standardized and studentized residuals
residual_2 <- rstandard(m_full)
residual_3 <- rstudent(m_full)

# Calculate leverage values
leverage_values <- hatvalues(m_full)

# Create a data frame for plotting
plot_data <- data.frame(
  Standardized_Residuals = residual_2,
  Difference = residual_3 - residual_2,
  Leverage = leverage_values
)

# Create the plot
ggplot(plot_data, aes(x = Standardized_Residuals, y = Difference)) +
  geom_point(aes(size = Leverage)) +
  ggtitle("Difference between Studentized and Standardized Residuals vs. Standardized Residuals") +
  xlab("Standardized Residuals") +
  ylab("Difference between Studentized and Standardized Residuals")
```
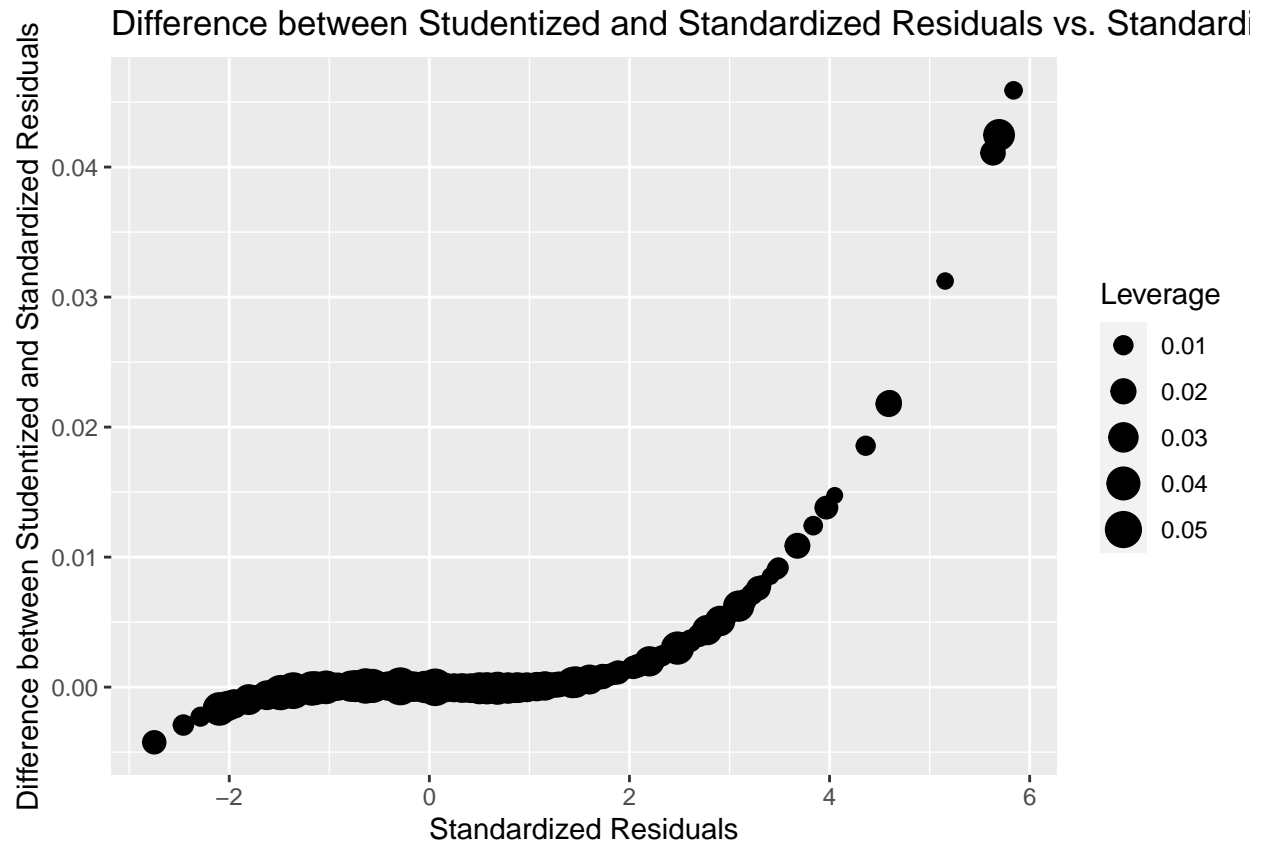
Difference between Studentized and Standardized Residuals vs. Standard[

```r
# Display the plot
print(ggplot)
```

```
## function (data = NULL, mapping = aes(), ..., environment = parent.frame())
## {
##     UseMethod("ggplot")
## }
## <bytecode: 0x54437b8>
## <environment: namespace:ggplot2>
```

```r
# Load necessary library
library(ggplot2)

# Assuming m_full is your linear model
# m_full <- lm(SleepMinNight ~ ., data = df3)

# Calculate studentized and externally studentized residuals
residual_3 <- rstudent(m_full)
residual_4 <- rstudent(m_full)  # Externally studentized residuals are typically the same as studentize

# Regular residuals
residual_1 <- m_full$residuals

# Create a data frame for plotting
plot_data <- data.frame(
  Studentized_Residuals = residual_3,
  Difference = residual_4 - residual_3,
```

```
  Residual_Squared = residual_1^2
)

# Create the plot
ggplot(plot_data, aes(x = Studentized_Residuals, y = Difference)) +
  geom_point(aes(size = Residual_Squared)) +
  ggtitle("Difference between Externally Studentized and Studentized Residuals vs. Studentized Residuals
  xlab("Studentized Residuals") +
  ylab("Difference between Externally Studentized and Studentized Residuals")
```
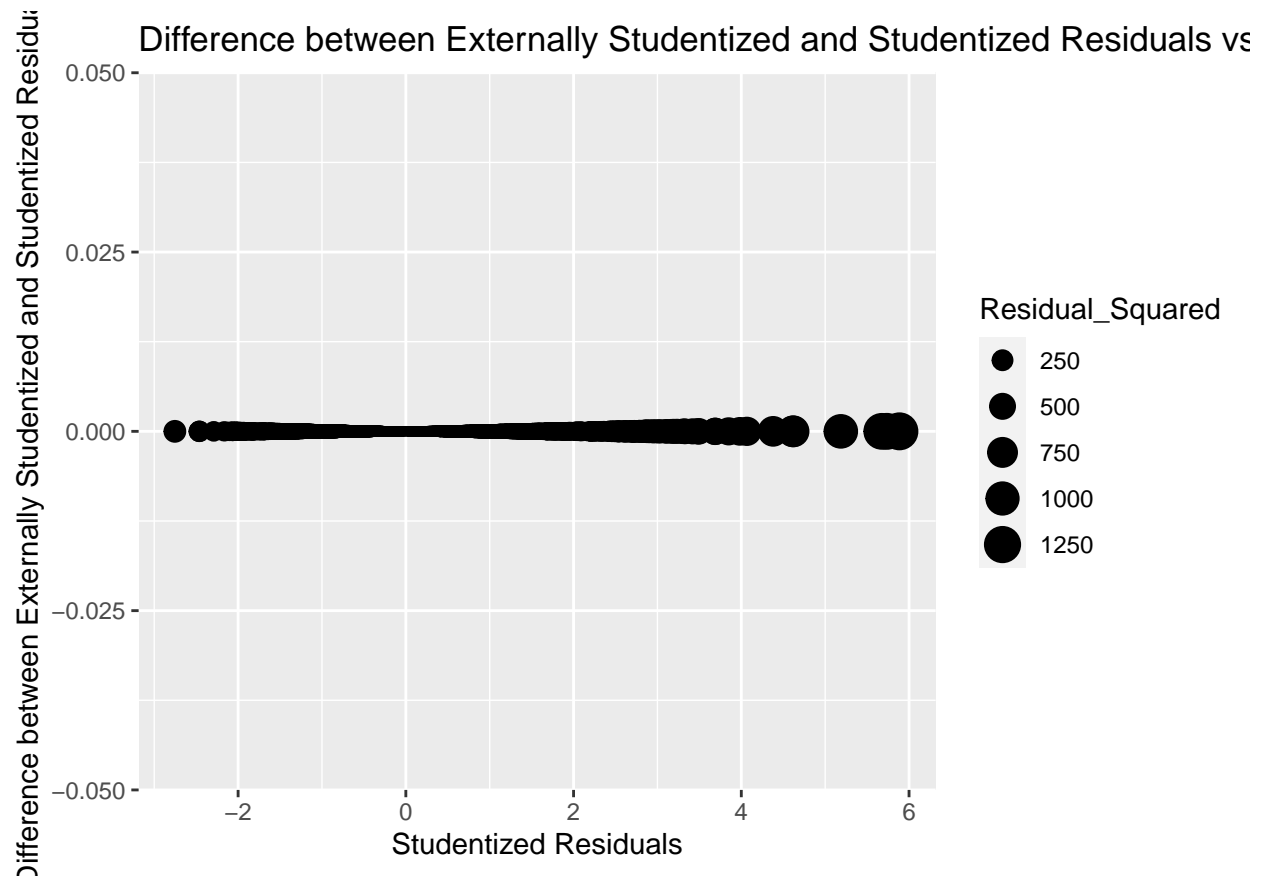


```
# Display the plot
print(ggplot)

## function (data = NULL, mapping = aes(), ..., environment = parent.frame())
## {
##     UseMethod("ggplot")
## }
## <bytecode: 0x54437b8>
## <environment: namespace:ggplot2>
```
```
# Load necessary library
library(ggplot2)

# Assuming m_full is your linear model
# m_full <- lm(SleepMinNight ~ ., data = df3)

# Calculate regular residuals
```

```
residual_1 <- m_full$residuals

# Get predicted values from the model
predicted_values <- predict(m_full)

# Create the plot
ggplot() +
  geom_point(aes(x = predicted_values, y = residual_1)) +
  ggtitle("Residuals vs. Predicted Values") +
  xlab("Predicted Values") +
  ylab("Residuals") +
  theme_minimal()
```


Residuals vs. Predicted Values

```
# Display the plot
print(ggplot)
```

```
## function (data = NULL, mapping = aes(), ..., environment = parent.frame())
## {
##     UseMethod("ggplot")
## }
## <bytecode: 0x54437b8>
## <environment: namespace:ggplot2>
```

```
# Load necessary library
library(ggplot2)

# Assuming m_full is your linear model
```

```
# m_full <- lm(SleepMinNight ~ ., data = df3)

# Calculate different types of residuals
residual_2 <- rstandard(m_full)
residual_3 <- rstudent(m_full)
residual_4 <- rstudent(m_full)   # Externally studentized residuals

# Get predicted values from the model
predicted_values <- predict(m_full)

# Plot for Standardized Residuals
ggplot() +
  geom_point(aes(x = predicted_values, y = residual_2)) +
  ggtitle("Standardized Residuals vs. Predicted Values") +
  xlab("Predicted Values") +
  ylab("Standardized Residuals") +
  theme_minimal()
```
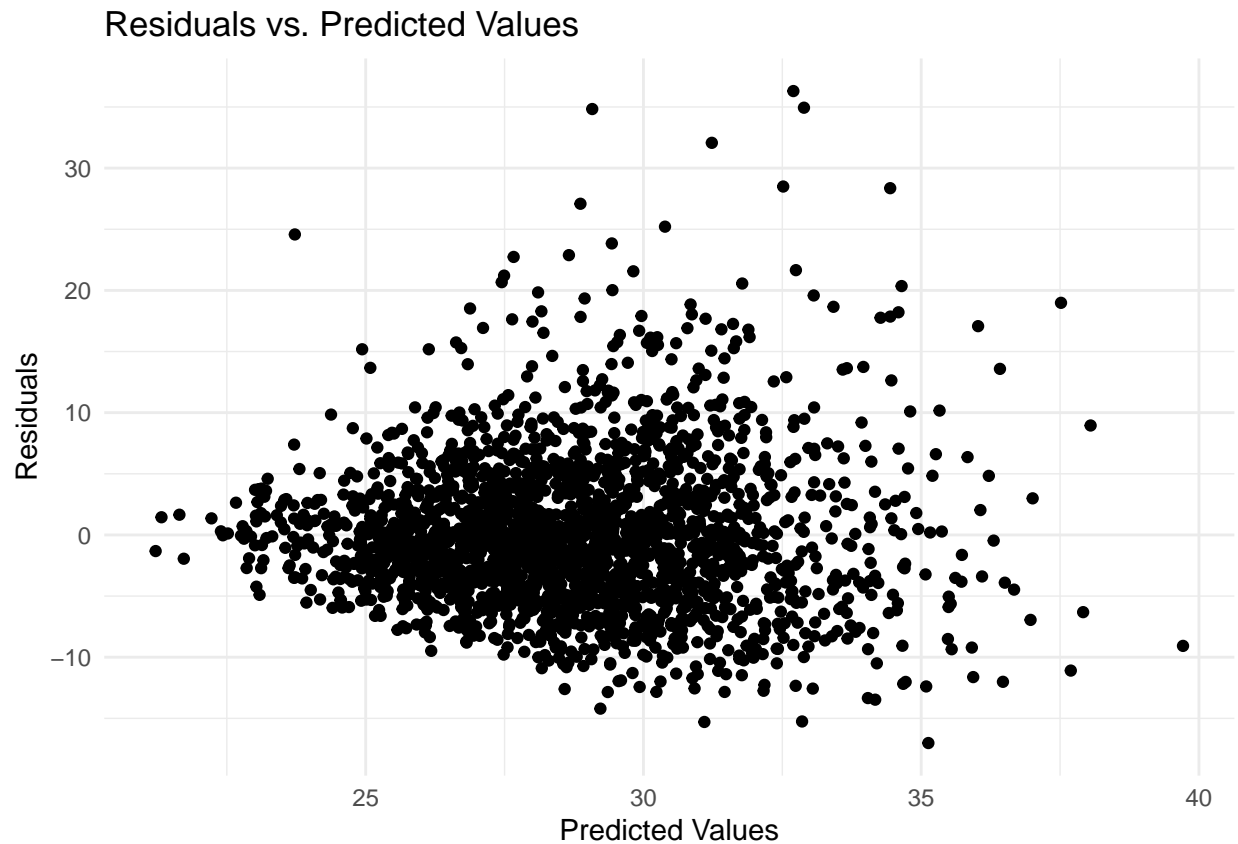

Standardized Residuals vs. Predicted Values
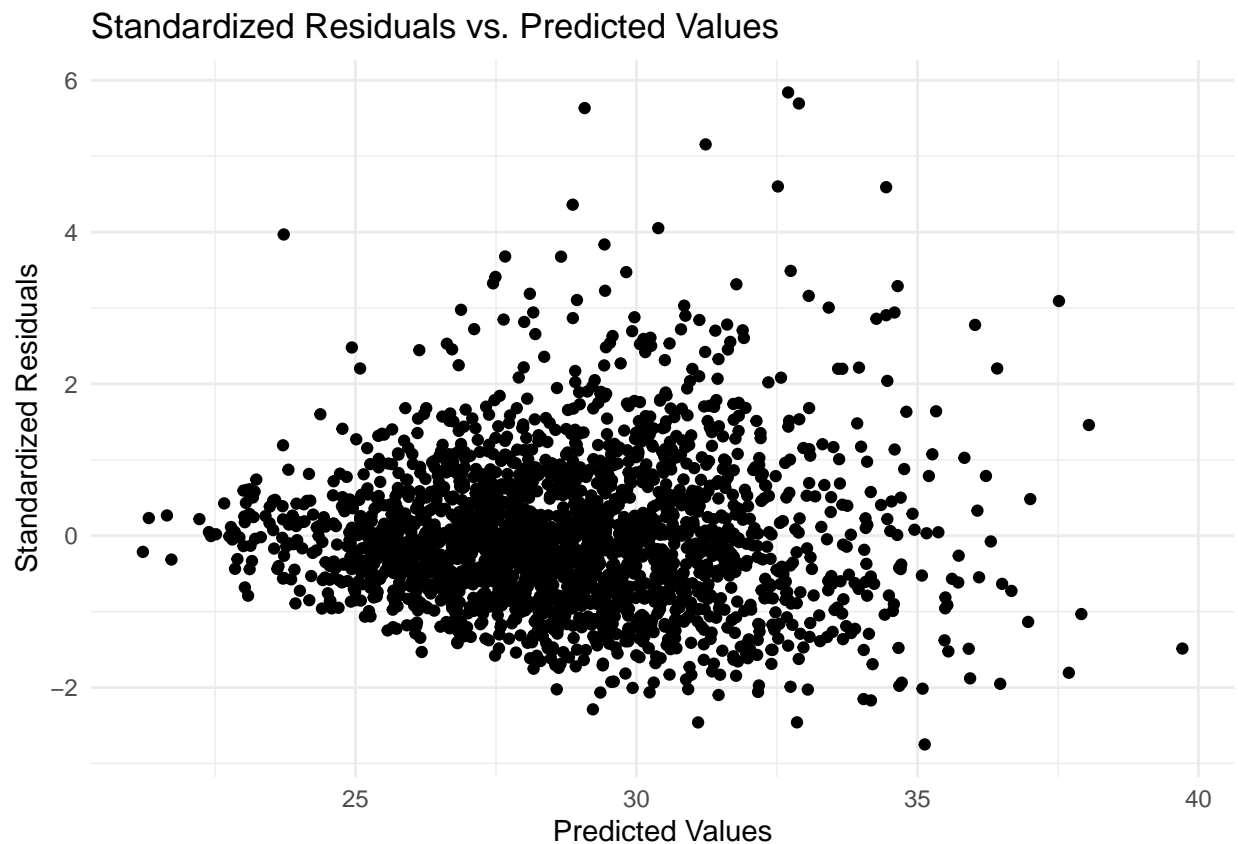
```
# Plot for Studentized Residuals
ggplot() +
  geom_point(aes(x = predicted_values, y = residual_3)) +
  ggtitle("Studentized Residuals vs. Predicted Values") +
  xlab("Predicted Values") +
  ylab("Studentized Residuals") +
  theme_minimal()
```

Studentized Residuals vs. Predicted Values
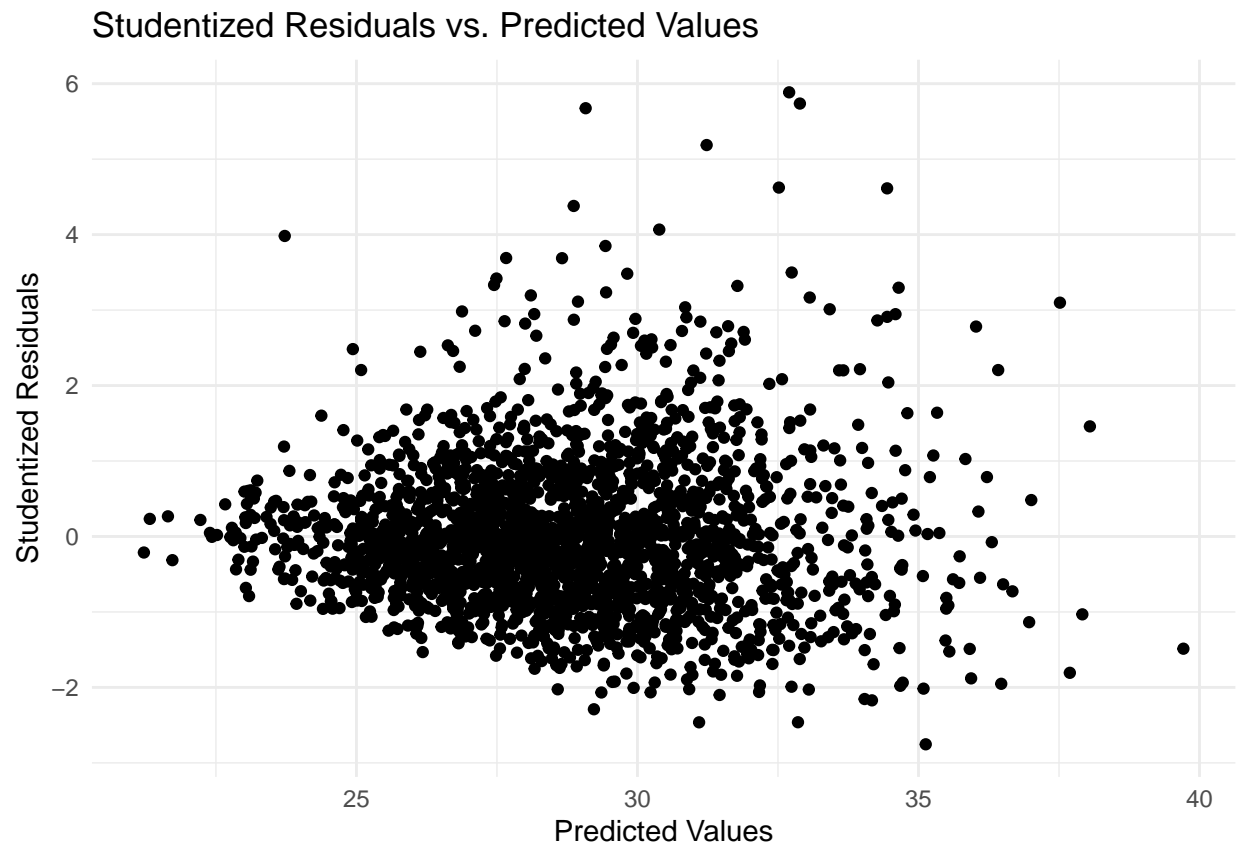

```r
# Plot for Externally Studentized Residuals
ggplot() +
  geom_point(aes(x = predicted_values, y = residual_4)) +
  ggtitle("Externally Studentized Residuals vs. Predicted Values") +
  xlab("Predicted Values") +
  ylab("Externally Studentized Residuals") +
  theme_minimal()
```

Externally Studentized Residuals vs. Predicted Values
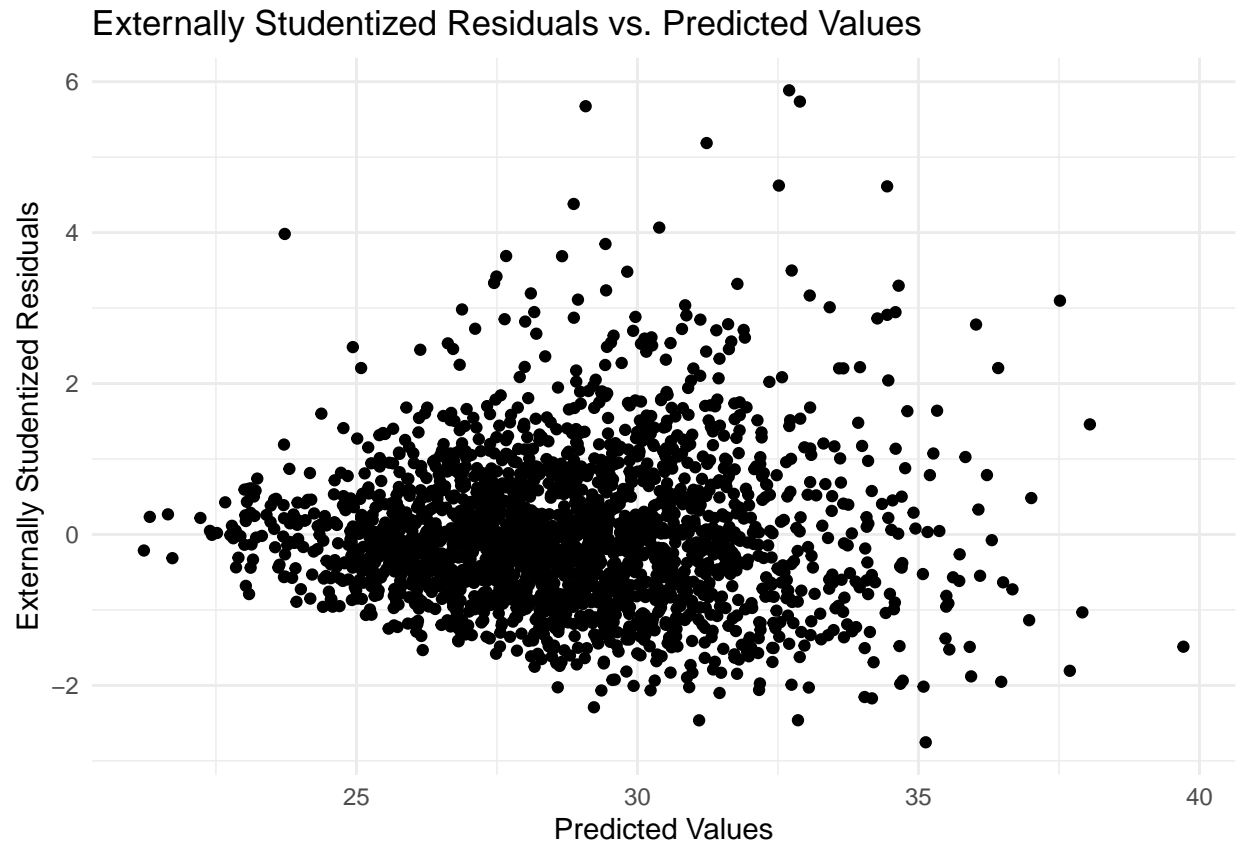
(5) Model Selection

```
step(m_full)
```

```
## Start:  AIC=7902.52
## BMI ~ SleepHrsNight + Age + Gender + Race1 + Poverty + TotChol +
##     BPDiaAve + BPSysAve + AlcoholYear + Smoke100 + UrineFlow1 +
##     DaysMentHlthBad + DaysPhysHlthBad + HealthGen + PhysActive +
##     SleepHrsNight * Age + SleepHrsNight * Gender
##
##                        Df Sum of Sq   RSS    AIC
## - TotChol               1       0.5 83018 7900.5
## - UrineFlow1            1      20.1 83038 7901.0
## - DaysPhysHlthBad       1      20.4 83038 7901.0
## - Poverty               1      24.9 83043 7901.2
## <none>                              83018 7902.5
## - DaysMentHlthBad       1     110.5 83128 7903.4
## - SleepHrsNight:Age     1     139.7 83158 7904.1
## - SleepHrsNight:Gender  1     207.1 83225 7905.9
## - Smoke100              1     305.3 83323 7908.4
## - PhysActive            1     314.7 83333 7908.7
## - Race1                 1     663.2 83681 7917.6
## - BPDiaAve              1     715.3 83733 7919.0
## - BPSysAve              1     830.6 83848 7921.9
```

```
## - AlcoholYear             1    1199.6 84217 7931.4
## - HealthGen               4    4547.8 87566 8009.3
##
## Step:  AIC=7900.53
## BMI ~ SleepHrsNight + Age + Gender + Race1 + Poverty + BPDiaAve +
##     BPSysAve + AlcoholYear + Smoke100 + UrineFlow1 + DaysMentHlthBad +
##     DaysPhysHlthBad + HealthGen + PhysActive + SleepHrsNight:Age +
##     SleepHrsNight:Gender
##
##                         Df Sum of Sq   RSS    AIC
## - UrineFlow1             1      20.0 83038 7899.1
## - DaysPhysHlthBad        1      20.3 83039 7899.1
## - Poverty                1      24.8 83043 7899.2
## <none>                              83018 7900.5
## - DaysMentHlthBad        1     110.9 83129 7901.4
## - SleepHrsNight:Age      1     140.5 83159 7902.2
## - SleepHrsNight:Gender   1     207.6 83226 7903.9
## - Smoke100               1     306.6 83325 7906.5
## - PhysActive             1     315.3 83334 7906.7
## - Race1                  1     662.9 83681 7915.6
## - BPDiaAve               1     725.3 83744 7917.3
## - BPSysAve               1     832.7 83851 7920.0
## - AlcoholYear            1    1200.1 84218 7929.4
## - HealthGen              4    4554.4 87573 8007.5
##
## Step:  AIC=7899.05
## BMI ~ SleepHrsNight + Age + Gender + Race1 + Poverty + BPDiaAve +
##     BPSysAve + AlcoholYear + Smoke100 + DaysMentHlthBad + DaysPhysHlthBad +
##     HealthGen + PhysActive + SleepHrsNight:Age + SleepHrsNight:Gender
##
##                         Df Sum of Sq   RSS    AIC
## - DaysPhysHlthBad        1      20.2 83058 7897.6
## - Poverty                1      21.7 83060 7897.6
## <none>                              83038 7899.1
## - DaysMentHlthBad        1     113.2 83152 7900.0
## - SleepHrsNight:Age      1     144.9 83183 7900.8
## - SleepHrsNight:Gender   1     207.9 83246 7902.4
## - Smoke100               1     307.7 83346 7905.0
## - PhysActive             1     325.0 83363 7905.5
## - Race1                  1     690.4 83729 7914.9
## - BPDiaAve               1     728.0 83766 7915.8
## - BPSysAve               1     828.9 83867 7918.4
## - AlcoholYear            1    1223.1 84261 7928.5
## - HealthGen              4    4580.6 87619 8006.6
##
## Step:  AIC=7897.57
## BMI ~ SleepHrsNight + Age + Gender + Race1 + Poverty + BPDiaAve +
##     BPSysAve + AlcoholYear + Smoke100 + DaysMentHlthBad + HealthGen +
##     PhysActive + SleepHrsNight:Age + SleepHrsNight:Gender
##
##                         Df Sum of Sq   RSS    AIC
## - Poverty                1      21.3 83080 7896.1
## <none>                              83058 7897.6
## - DaysMentHlthBad        1     100.0 83158 7898.2
```

```
## - SleepHrsNight:Age       1      143.8 83202 7899.3
## - SleepHrsNight:Gender    1      207.9 83266 7901.0
## - Smoke100                1      301.9 83360 7903.4
## - PhysActive              1      334.8 83393 7904.2
## - Race1                   1      688.1 83747 7913.3
## - BPDiaAve                1      719.1 83778 7914.1
## - BPSysAve                1      829.9 83888 7917.0
## - AlcoholYear             1     1235.8 84294 7927.4
## - HealthGen               4     5008.6 88067 8015.6
##
## Step:  AIC=7896.12
## BMI ~ SleepHrsNight + Age + Gender + Race1 + BPDiaAve + BPSysAve +
##     AlcoholYear + Smoke100 + DaysMentHlthBad + HealthGen + PhysActive +
##     SleepHrsNight:Age + SleepHrsNight:Gender
##
##                         Df Sum of Sq   RSS    AIC
## <none>                               83080 7896.1
## - DaysMentHlthBad        1      105.0 83185 7896.8
## - SleepHrsNight:Age      1      148.8 83229 7898.0
## - SleepHrsNight:Gender   1      203.5 83283 7899.4
## - PhysActive             1      317.7 83397 7902.3
## - Smoke100               1      338.7 83418 7902.9
## - Race1                  1      668.7 83748 7911.4
## - BPDiaAve               1      726.3 83806 7912.9
## - BPSysAve               1      818.4 83898 7915.2
## - AlcoholYear            1     1214.9 84295 7925.4
## - HealthGen              4     5098.7 88178 8016.3
##
## Call:
## lm(formula = BMI ~ SleepHrsNight + Age + Gender + Race1 + BPDiaAve +
##     BPSysAve + AlcoholYear + Smoke100 + DaysMentHlthBad + HealthGen +
##     PhysActive + SleepHrsNight:Age + SleepHrsNight:Gender, data = df3)
##
## Coefficients:
##        (Intercept)         SleepHrsNight                   Age
##          21.620969             -0.565231             -0.104961
##             Gender                 Race1              BPDiaAve
##           3.749303             -0.498750              0.058815
##           BPSysAve           AlcoholYear           Smoke100Yes
##           0.053941             -0.008364             -0.832608
##     DaysMentHlthBad         HealthGenVgood         HealthGenGood
##          -0.028955              1.913856              3.548945
##      HealthGenFair         HealthGenPoor          PhysActiveYes
##           5.292807              7.773117             -0.830109
##   SleepHrsNight:Age  SleepHrsNight:Gender
##           0.017598             -0.472517
```

```
library(olsrr)
```

```
##
## Attaching package: 'olsrr'

## The following object is masked from 'package:datasets':
##
##     rivers
```

```r
ols_step_forward_p(m_full, penter = 0.1, details = F)
```

```
##
##                              Selection Summary
## --------------------------------------------------------------------------------
##           Variable                    Adj.
## Step       Entered        R-Square    R-Square     C(p)        AIC        RMSE
## --------------------------------------------------------------------------------
##    1     HealthGen           0.0826     0.0809    162.3618   14153.5414   6.4747
##    2     BPDiaAve            0.1066     0.1045    103.8740   14098.4490   6.3908
##    3     AlcoholYear         0.1226     0.1201     65.6513   14061.6280   6.3349
##    4     Race1               0.1323     0.1295     43.2247   14039.7062   6.3013
##    5     BPSysAve            0.1401     0.1369     25.5844   14022.2771   6.2744
##    6     Smoke100            0.1430     0.1394     20.2357   14016.9620   6.2652
##    7     PhysActive          0.1463     0.1424     13.8134   14010.5477   6.2544
##    8     Gender              0.1476     0.1432     12.6813   14009.4102   6.2513
##    9     SleepHrsNight:Gender 0.1497    0.1449      9.4392   14006.1486   6.2451
##   10     DaysMentHlthBad     0.1509     0.1458      8.3036   14004.9953   6.2420
##   11     Poverty             0.1514     0.1458      9.1090   14005.7926   6.2417
##   12     DaysPhysHlthBad     0.1516     0.1457     10.4990   14007.1783   6.2423
##   13     TotChol             0.1517     0.1453     12.3665   14009.0448   6.2436
##   14     UrineFlow1          0.1519     0.1452     13.7880   14010.4620   6.2442
##   15     Age                 0.1522     0.1450     15.1916   14011.8610   6.2448
##   16     SleepHrsNight       0.1524     0.1448     16.5871   14013.2516   6.2454
##   17     SleepHrsNight:Age   0.1538     0.1459     15.0000   14011.6323   6.2416
## --------------------------------------------------------------------------------
```

```r
ols_step_forward_p(m_full, penter = 0.05, details = F)
```

```
##
##                              Selection Summary
## --------------------------------------------------------------------------------
##           Variable                    Adj.
## Step       Entered        R-Square    R-Square     C(p)        AIC        RMSE
## --------------------------------------------------------------------------------
##    1     HealthGen           0.0826     0.0809    162.3618   14153.5414   6.4747
##    2     BPDiaAve            0.1066     0.1045    103.8740   14098.4490   6.3908
##    3     AlcoholYear         0.1226     0.1201     65.6513   14061.6280   6.3349
##    4     Race1               0.1323     0.1295     43.2247   14039.7062   6.3013
##    5     BPSysAve            0.1401     0.1369     25.5844   14022.2771   6.2744
##    6     Smoke100            0.1430     0.1394     20.2357   14016.9620   6.2652
##    7     PhysActive          0.1463     0.1424     13.8134   14010.5477   6.2544
## --------------------------------------------------------------------------------
```

```r
ols_mallows_cp(model = m_3, fullmodel = m_full)  # Mallows' Cp
```

```
## [1] 19.69163
```

#general hypothesis test

```r
# Load the required libraries
library(dplyr)
library(car)
library(emmeans)

# Assuming your dataframe is df3
```

```r
# Categorizing Age
df3 <- df3 %>%
  mutate(
    Age_Category = case_when(
      Age >= 18 & Age < 30 ~ "18-29",
      Age >= 30 & Age < 40 ~ "30-39",
      Age >= 40 & Age < 50 ~ "40-49",
      Age >= 50 & Age < 60 ~ "50-59",
      TRUE ~ NA_character_  # For cases not in the 18 to 60 age range
    ),
    Gender = as.factor(Gender),  # Ensure Gender is a factor type
    Race1 = as.factor(Race1)     # Ensure Race1 is a factor type
  )


# Update the model using categorical variables
m_full_updated <- lm(SleepHrsNight ~ Age_Category + Gender + Race1, data = df3)

# Overall hypothesis test
anova_results_updated <- Anova(m_full_updated, type="III")
```

```
## Warning in printHypothesis(L, rhs, names(b)): one or more coefficients in the hypothesis include
##       arithmetic operators in their names;
##    the printed representation of the hypothesis will be omitted
```

```r
summary(anova_results_updated)
```

```
##      Sum Sq              Df            F value             Pr(>F)
## Min.   :  15.29   Min.   :   1.0   Min.   :   3.014   Min.   :0.0000000
## 1st Qu.:  20.99   1st Qu.:   1.0   1st Qu.:   4.783   1st Qu.:0.0001986
## Median :  36.33   Median :   3.0   Median :   8.894   Median :0.0003498
## Mean   :2332.98   Mean   : 430.4   Mean   :1183.827   Mean   :0.0074135
## 3rd Qu.:3622.64   3rd Qu.:   4.0   3rd Qu.:1187.938   3rd Qu.:0.0075647
## Max.   :7969.66   Max.   :2143.0   Max.   :4714.505   Max.   :0.0289545
##                                    NA's   :1          NA's   :1
```

```r
# Post-hoc comparisons using emmeans
emmeans_results_updated <- emmeans(m_full_updated, specs = pairwise ~ Age_Category + Gender + Race1)
summary(emmeans_results_updated)
```

```
## $emmeans
##  Age_Category Gender Race1 emmean     SE   df lower.CL upper.CL
##  18-29        0      1       6.51 0.0947 2143     6.32     6.69
##  30-39        0      1       6.42 0.0948 2143     6.24     6.61
##  40-49        0      1       6.30 0.0954 2143     6.11     6.48
##  50-59        0      1       6.31 0.0965 2143     6.12     6.50
##  18-29        1      1       6.70 0.0936 2143     6.52     6.89
##  30-39        1      1       6.62 0.0935 2143     6.44     6.81
##  40-49        1      1       6.49 0.0950 2143     6.31     6.68
##  50-59        1      1       6.51 0.0970 2143     6.32     6.70
##  18-29        0      2       6.69 0.1197 2143     6.46     6.93
##  30-39        0      2       6.61 0.1209 2143     6.37     6.85
##  40-49        0      2       6.48 0.1212 2143     6.25     6.72
##  50-59        0      2       6.50 0.1246 2143     6.26     6.74
##  18-29        1      2       6.89 0.1202 2143     6.66     7.13
##  30-39        1      2       6.81 0.1213 2143     6.57     7.05
```

```
## 40-49         1       2        6.68 0.1222 2143      6.44      6.92
## 50-59         1       2        6.70 0.1263 2143      6.45      6.95
## 18-29         0       3        6.93 0.0989 2143      6.73      7.12
## 30-39         0       3        6.85 0.0995 2143      6.65      7.04
## 40-49         0       3        6.72 0.0999 2143      6.52      6.91
## 50-59         0       3        6.74 0.1056 2143      6.53      6.94
## 18-29         1       3        7.13 0.1031 2143      6.93      7.33
## 30-39         1       3        7.04 0.1036 2143      6.84      7.25
## 40-49         1       3        6.92 0.1047 2143      6.71      7.12
## 50-59         1       3        6.93 0.1110 2143      6.72      7.15
## 18-29         0       4        6.87 0.0688 2143      6.73      7.00
## 30-39         0       4        6.79 0.0661 2143      6.66      6.91
## 40-49         0       4        6.66 0.0646 2143      6.53      6.78
## 50-59         0       4        6.67 0.0658 2143      6.55      6.80
## 18-29         1       4        7.07 0.0689 2143      6.93      7.20
## 30-39         1       4        6.98 0.0659 2143      6.85      7.11
## 40-49         1       4        6.86 0.0657 2143      6.73      6.99
## 50-59         1       4        6.87 0.0681 2143      6.74      7.01
## 18-29         0       5        6.80 0.1173 2143      6.57      7.03
## 30-39         0       5        6.71 0.1157 2143      6.49      6.94
## 40-49         0       5        6.59 0.1185 2143      6.35      6.82
## 50-59         0       5        6.60 0.1212 2143      6.36      6.84
## 18-29         1       5        6.99 0.1185 2143      6.76      7.23
## 30-39         1       5        6.91 0.1168 2143      6.68      7.14
## 40-49         1       5        6.78 0.1202 2143      6.55      7.02
## 50-59         1       5        6.80 0.1235 2143      6.56      7.04
##
## Confidence level used: 0.95
##
## $contrasts
##  contrast                                                 estimate     SE   df t.ratio
##  (18-29 Gender0 Race11) - (30-39 Gender0 Race11)  0.082425 0.0787 2143    1.047
##  (18-29 Gender0 Race11) - (40-49 Gender0 Race11)  0.209495 0.0791 2143    2.648
##  (18-29 Gender0 Race11) - (50-59 Gender0 Race11)  0.193261 0.0822 2143    2.352
##  (18-29 Gender0 Race11) - (18-29 Gender1 Race11) -0.198758 0.0564 2143   -3.524
##  (18-29 Gender0 Race11) - (30-39 Gender1 Race11) -0.116333 0.0967 2143   -1.203
##  (18-29 Gender0 Race11) - (40-49 Gender1 Race11)  0.010737 0.0978 2143    0.110
##  (18-29 Gender0 Race11) - (50-59 Gender1 Race11) -0.005496 0.1012 2143   -0.054
##  (18-29 Gender0 Race11) - (18-29 Gender0 Race12) -0.187693 0.1325 2143   -1.417
##  (18-29 Gender0 Race11) - (30-39 Gender0 Race12) -0.105268 0.1550 2143   -0.679
##  (18-29 Gender0 Race11) - (40-49 Gender0 Race12)  0.021802 0.1551 2143    0.141
##  (18-29 Gender0 Race11) - (50-59 Gender0 Race12)  0.005568 0.1586 2143    0.035
##  (18-29 Gender0 Race11) - (18-29 Gender1 Race12) -0.386451 0.1451 2143   -2.663
##  (18-29 Gender0 Race11) - (30-39 Gender1 Race12) -0.304026 0.1659 2143   -1.832
##  (18-29 Gender0 Race11) - (40-49 Gender1 Race12) -0.176956 0.1664 2143   -1.063
##  (18-29 Gender0 Race11) - (50-59 Gender1 Race12) -0.193190 0.1702 2143   -1.135
##  (18-29 Gender0 Race11) - (18-29 Gender0 Race13) -0.423084 0.1155 2143   -3.664
##  (18-29 Gender0 Race11) - (30-39 Gender0 Race13) -0.340659 0.1402 2143   -2.430
##  (18-29 Gender0 Race11) - (40-49 Gender0 Race13) -0.213589 0.1402 2143   -1.523
##  (18-29 Gender0 Race11) - (50-59 Gender0 Race13) -0.229823 0.1454 2143   -1.581
##  (18-29 Gender0 Race11) - (18-29 Gender1 Race13) -0.621842 0.1326 2143   -4.690
##  (18-29 Gender0 Race11) - (30-39 Gender1 Race13) -0.539417 0.1545 2143   -3.491
##  (18-29 Gender0 Race11) - (40-49 Gender1 Race13) -0.412347 0.1550 2143   -2.660
##  (18-29 Gender0 Race11) - (50-59 Gender1 Race13) -0.428580 0.1602 2143   -2.675
```

```
## (18-29 Gender0 Race11) - (18-29 Gender0 Race14) -0.362270 0.0845 2143   -4.285
## (18-29 Gender0 Race11) - (30-39 Gender0 Race14) -0.279845 0.1139 2143   -2.458
## (18-29 Gender0 Race11) - (40-49 Gender0 Race14) -0.152775 0.1128 2143   -1.354
## (18-29 Gender0 Race11) - (50-59 Gender0 Race14) -0.169008 0.1147 2143   -1.473
## (18-29 Gender0 Race11) - (18-29 Gender1 Race14) -0.561028 0.1027 2143   -5.462
## (18-29 Gender0 Race11) - (30-39 Gender1 Race14) -0.478602 0.1278 2143   -3.744
## (18-29 Gender0 Race11) - (40-49 Gender1 Race14) -0.351533 0.1275 2143   -2.757
## (18-29 Gender0 Race11) - (50-59 Gender1 Race14) -0.367766 0.1299 2143   -2.832
## (18-29 Gender0 Race11) - (18-29 Gender0 Race15) -0.290337 0.1296 2143   -2.239
## (18-29 Gender0 Race11) - (30-39 Gender0 Race15) -0.207912 0.1505 2143   -1.382
## (18-29 Gender0 Race11) - (40-49 Gender0 Race15) -0.080842 0.1524 2143   -0.530
## (18-29 Gender0 Race11) - (50-59 Gender0 Race15) -0.097076 0.1554 2143   -0.625
## (18-29 Gender0 Race11) - (18-29 Gender1 Race15) -0.489095 0.1431 2143   -3.417
## (18-29 Gender0 Race11) - (30-39 Gender1 Race15) -0.406670 0.1621 2143   -2.508
## (18-29 Gender0 Race11) - (40-49 Gender1 Race15) -0.279600 0.1644 2143   -1.701
## (18-29 Gender0 Race11) - (50-59 Gender1 Race15) -0.295834 0.1677 2143   -1.764
## (30-39 Gender0 Race11) - (40-49 Gender0 Race11)  0.127070 0.0776 2143    1.638
## (30-39 Gender0 Race11) - (50-59 Gender0 Race11)  0.110836 0.0805 2143    1.377
## (30-39 Gender0 Race11) - (18-29 Gender1 Race11) -0.281183 0.0970 2143   -2.900
## (30-39 Gender0 Race11) - (30-39 Gender1 Race11) -0.198758 0.0564 2143   -3.524
## (30-39 Gender0 Race11) - (40-49 Gender1 Race11) -0.071688 0.0967 2143   -0.741
## (30-39 Gender0 Race11) - (50-59 Gender1 Race11) -0.087921 0.0999 2143   -0.880
## (30-39 Gender0 Race11) - (18-29 Gender0 Race12) -0.270119 0.1531 2143   -1.764
## (30-39 Gender0 Race11) - (30-39 Gender0 Race12) -0.187693 0.1325 2143   -1.417
## (30-39 Gender0 Race11) - (40-49 Gender0 Race12) -0.060623 0.1533 2143   -0.395
## (30-39 Gender0 Race11) - (50-59 Gender0 Race12) -0.076857 0.1568 2143   -0.490
## (30-39 Gender0 Race11) - (18-29 Gender1 Race12) -0.468876 0.1643 2143   -2.854
## (30-39 Gender0 Race11) - (30-39 Gender1 Race12) -0.386451 0.1451 2143   -2.663
## (30-39 Gender0 Race11) - (40-49 Gender1 Race12) -0.259381 0.1649 2143   -1.573
## (30-39 Gender0 Race11) - (50-59 Gender1 Race12) -0.275615 0.1686 2143   -1.635
## (30-39 Gender0 Race11) - (18-29 Gender0 Race13) -0.505509 0.1393 2143   -3.629
## (30-39 Gender0 Race11) - (30-39 Gender0 Race13) -0.423084 0.1155 2143   -3.664
## (30-39 Gender0 Race11) - (40-49 Gender0 Race13) -0.296014 0.1389 2143   -2.131
## (30-39 Gender0 Race11) - (50-59 Gender0 Race13) -0.312248 0.1440 2143   -2.169
## (30-39 Gender0 Race11) - (18-29 Gender1 Race13) -0.704267 0.1539 2143   -4.577
## (30-39 Gender0 Race11) - (30-39 Gender1 Race13) -0.621842 0.1326 2143   -4.690
## (30-39 Gender0 Race11) - (40-49 Gender1 Race13) -0.494772 0.1539 2143   -3.214
## (30-39 Gender0 Race11) - (50-59 Gender1 Race13) -0.511006 0.1591 2143   -3.213
## (30-39 Gender0 Race11) - (18-29 Gender0 Race14) -0.444695 0.1171 2143   -3.797
## (30-39 Gender0 Race11) - (30-39 Gender0 Race14) -0.362270 0.0845 2143   -4.285
## (30-39 Gender0 Race11) - (40-49 Gender0 Race14) -0.235200 0.1134 2143   -2.074
## (30-39 Gender0 Race11) - (50-59 Gender0 Race14) -0.251434 0.1151 2143   -2.184
## (30-39 Gender0 Race11) - (18-29 Gender1 Race14) -0.643453 0.1309 2143   -4.914
## (30-39 Gender0 Race11) - (30-39 Gender1 Race14) -0.561028 0.1027 2143   -5.462
## (30-39 Gender0 Race11) - (40-49 Gender1 Race14) -0.433958 0.1281 2143   -3.387
## (30-39 Gender0 Race11) - (50-59 Gender1 Race14) -0.450191 0.1303 2143   -3.454
## (30-39 Gender0 Race11) - (18-29 Gender0 Race15) -0.372762 0.1529 2143   -2.438
## (30-39 Gender0 Race11) - (30-39 Gender0 Race15) -0.290337 0.1296 2143   -2.239
## (30-39 Gender0 Race11) - (40-49 Gender0 Race15) -0.163267 0.1528 2143   -1.068
## (30-39 Gender0 Race11) - (50-59 Gender0 Race15) -0.179501 0.1557 2143   -1.153
## (30-39 Gender0 Race11) - (18-29 Gender1 Race15) -0.571520 0.1645 2143   -3.474
## (30-39 Gender0 Race11) - (30-39 Gender1 Race15) -0.489095 0.1431 2143   -3.417
## (30-39 Gender0 Race11) - (40-49 Gender1 Race15) -0.362025 0.1649 2143   -2.196
## (30-39 Gender0 Race11) - (50-59 Gender1 Race15) -0.378259 0.1680 2143   -2.251
```

```
## (40-49 Gender0 Race11) - (50-59 Gender0 Race11) -0.016234 0.0804 2143  -0.202
## (40-49 Gender0 Race11) - (18-29 Gender1 Race11) -0.408253 0.0965 2143  -4.230
## (40-49 Gender0 Race11) - (30-39 Gender1 Race11) -0.325828 0.0951 2143  -3.426
## (40-49 Gender0 Race11) - (40-49 Gender1 Race11) -0.198758 0.0564 2143  -3.524
## (40-49 Gender0 Race11) - (50-59 Gender1 Race11) -0.214991 0.0991 2143  -2.169
## (40-49 Gender0 Race11) - (18-29 Gender0 Race12) -0.397188 0.1535 2143  -2.587
## (40-49 Gender0 Race11) - (30-39 Gender0 Race12) -0.314763 0.1537 2143  -2.048
## (40-49 Gender0 Race11) - (40-49 Gender0 Race12) -0.187693 0.1325 2143  -1.417
## (40-49 Gender0 Race11) - (50-59 Gender0 Race12) -0.203927 0.1569 2143  -1.299
## (40-49 Gender0 Race11) - (18-29 Gender1 Race12) -0.595946 0.1642 2143  -3.630
## (40-49 Gender0 Race11) - (30-39 Gender1 Race12) -0.513521 0.1643 2143  -3.126
## (40-49 Gender0 Race11) - (40-49 Gender1 Race12) -0.386451 0.1451 2143  -2.663
## (40-49 Gender0 Race11) - (50-59 Gender1 Race12) -0.402685 0.1683 2143  -2.393
## (40-49 Gender0 Race11) - (18-29 Gender0 Race13) -0.632579 0.1397 2143  -4.527
## (40-49 Gender0 Race11) - (30-39 Gender0 Race13) -0.550154 0.1393 2143  -3.949
## (40-49 Gender0 Race11) - (40-49 Gender0 Race13) -0.423084 0.1155 2143  -3.664
## (40-49 Gender0 Race11) - (50-59 Gender0 Race13) -0.439318 0.1441 2143  -3.048
## (40-49 Gender0 Race11) - (18-29 Gender1 Race13) -0.831337 0.1538 2143  -5.407
## (40-49 Gender0 Race11) - (30-39 Gender1 Race13) -0.748912 0.1533 2143  -4.886
## (40-49 Gender0 Race11) - (40-49 Gender1 Race13) -0.621842 0.1326 2143  -4.690
## (40-49 Gender0 Race11) - (50-59 Gender1 Race13) -0.638075 0.1587 2143  -4.020
## (40-49 Gender0 Race11) - (18-29 Gender0 Race14) -0.571765 0.1187 2143  -4.816
## (40-49 Gender0 Race11) - (30-39 Gender0 Race14) -0.489340 0.1161 2143  -4.215
## (40-49 Gender0 Race11) - (40-49 Gender0 Race14) -0.362270 0.0845 2143  -4.285
## (40-49 Gender0 Race11) - (50-59 Gender0 Race14) -0.378503 0.1164 2143  -3.251
## (40-49 Gender0 Race11) - (18-29 Gender1 Race14) -0.770523 0.1318 2143  -5.847
## (40-49 Gender0 Race11) - (30-39 Gender1 Race14) -0.688098 0.1293 2143  -5.321
## (40-49 Gender0 Race11) - (40-49 Gender1 Race14) -0.561028 0.1027 2143  -5.462
## (40-49 Gender0 Race11) - (50-59 Gender1 Race14) -0.577261 0.1309 2143  -4.411
## (40-49 Gender0 Race11) - (18-29 Gender0 Race15) -0.499832 0.1514 2143  -3.302
## (40-49 Gender0 Race11) - (30-39 Gender0 Race15) -0.417407 0.1493 2143  -2.795
## (40-49 Gender0 Race11) - (40-49 Gender0 Race15) -0.290337 0.1296 2143  -2.239
## (40-49 Gender0 Race11) - (50-59 Gender0 Race15) -0.306571 0.1539 2143  -1.992
## (40-49 Gender0 Race11) - (18-29 Gender1 Race15) -0.698590 0.1627 2143  -4.295
## (40-49 Gender0 Race11) - (30-39 Gender1 Race15) -0.616165 0.1607 2143  -3.834
## (40-49 Gender0 Race11) - (40-49 Gender1 Race15) -0.489095 0.1431 2143  -3.417
## (40-49 Gender0 Race11) - (50-59 Gender1 Race15) -0.505328 0.1660 2143  -3.045
## (50-59 Gender0 Race11) - (18-29 Gender1 Race11) -0.392019 0.0982 2143  -3.994
## (50-59 Gender0 Race11) - (30-39 Gender1 Race11) -0.309594 0.0966 2143  -3.205
## (50-59 Gender0 Race11) - (40-49 Gender1 Race11) -0.182524 0.0973 2143  -1.875
## (50-59 Gender0 Race11) - (50-59 Gender1 Race11) -0.198758 0.0564 2143  -3.524
## (50-59 Gender0 Race11) - (18-29 Gender0 Race12) -0.380955 0.1531 2143  -2.488
## (50-59 Gender0 Race11) - (30-39 Gender0 Race12) -0.298530 0.1532 2143  -1.949
## (50-59 Gender0 Race11) - (40-49 Gender0 Race12) -0.171460 0.1530 2143  -1.121
## (50-59 Gender0 Race11) - (50-59 Gender0 Race12) -0.187693 0.1325 2143  -1.417
## (50-59 Gender0 Race11) - (18-29 Gender1 Race12) -0.579713 0.1633 2143  -3.550
## (50-59 Gender0 Race11) - (30-39 Gender1 Race12) -0.497287 0.1632 2143  -3.046
## (50-59 Gender0 Race11) - (40-49 Gender1 Race12) -0.370218 0.1635 2143  -2.264
## (50-59 Gender0 Race11) - (50-59 Gender1 Race12) -0.386451 0.1451 2143  -2.663
## (50-59 Gender0 Race11) - (18-29 Gender0 Race13) -0.616345 0.1380 2143  -4.466
## (50-59 Gender0 Race11) - (30-39 Gender0 Race13) -0.533920 0.1375 2143  -3.884
## (50-59 Gender0 Race11) - (40-49 Gender0 Race13) -0.406850 0.1372 2143  -2.965
## (50-59 Gender0 Race11) - (50-59 Gender0 Race13) -0.423084 0.1155 2143  -3.664
## (50-59 Gender0 Race11) - (18-29 Gender1 Race13) -0.815103 0.1516 2143  -5.376
```

```
## (50-59 Gender0 Race11) - (30-39 Gender1 Race13) -0.732678 0.1510 2143  -4.851
## (50-59 Gender0 Race11) - (40-49 Gender1 Race13) -0.605608 0.1513 2143  -4.002
## (50-59 Gender0 Race11) - (50-59 Gender1 Race13) -0.621842 0.1326 2143  -4.690
## (50-59 Gender0 Race11) - (18-29 Gender0 Race14) -0.555531 0.1210 2143  -4.591
## (50-59 Gender0 Race11) - (30-39 Gender0 Race14) -0.473106 0.1183 2143  -4.000
## (50-59 Gender0 Race11) - (40-49 Gender0 Race14) -0.346036 0.1169 2143  -2.959
## (50-59 Gender0 Race11) - (50-59 Gender0 Race14) -0.362270 0.0845 2143  -4.285
## (50-59 Gender0 Race11) - (18-29 Gender1 Race14) -0.754289 0.1332 2143  -5.662
## (50-59 Gender0 Race11) - (30-39 Gender1 Race14) -0.671864 0.1306 2143  -5.143
## (50-59 Gender0 Race11) - (40-49 Gender1 Race14) -0.544794 0.1300 2143  -4.190
## (50-59 Gender0 Race11) - (50-59 Gender1 Race14) -0.561028 0.1027 2143  -5.462
## (50-59 Gender0 Race11) - (18-29 Gender0 Race15) -0.483599 0.1516 2143  -3.190
## (50-59 Gender0 Race11) - (30-39 Gender0 Race15) -0.401173 0.1495 2143  -2.684
## (50-59 Gender0 Race11) - (40-49 Gender0 Race15) -0.274103 0.1512 2143  -1.813
## (50-59 Gender0 Race11) - (50-59 Gender0 Race15) -0.290337 0.1296 2143  -2.239
## (50-59 Gender0 Race11) - (18-29 Gender1 Race15) -0.682356 0.1623 2143  -4.203
## (50-59 Gender0 Race11) - (30-39 Gender1 Race15) -0.599931 0.1603 2143  -3.743
## (50-59 Gender0 Race11) - (40-49 Gender1 Race15) -0.472861 0.1623 2143  -2.913
## (50-59 Gender0 Race11) - (50-59 Gender1 Race15) -0.489095 0.1431 2143  -3.417
## (18-29 Gender1 Race11) - (30-39 Gender1 Race11)  0.082425 0.0787 2143   1.047
## (18-29 Gender1 Race11) - (40-49 Gender1 Race11)  0.209495 0.0791 2143   2.648
## (18-29 Gender1 Race11) - (50-59 Gender1 Race11)  0.193261 0.0822 2143   2.352
## (18-29 Gender1 Race11) - (18-29 Gender0 Race12)  0.011064 0.1428 2143   0.077
## (18-29 Gender1 Race11) - (30-39 Gender0 Race12)  0.093490 0.1640 2143   0.570
## (18-29 Gender1 Race11) - (40-49 Gender0 Race12)  0.220559 0.1636 2143   1.348
## (18-29 Gender1 Race11) - (50-59 Gender0 Race12)  0.204326 0.1664 2143   1.228
## (18-29 Gender1 Race11) - (18-29 Gender1 Race12) -0.187693 0.1325 2143  -1.417
## (18-29 Gender1 Race11) - (30-39 Gender1 Race12) -0.105268 0.1550 2143  -0.679
## (18-29 Gender1 Race11) - (40-49 Gender1 Race12)  0.021802 0.1551 2143   0.141
## (18-29 Gender1 Race11) - (50-59 Gender1 Race12)  0.005568 0.1586 2143   0.035
## (18-29 Gender1 Race11) - (18-29 Gender0 Race13) -0.224326 0.1243 2143  -1.804
## (18-29 Gender1 Race11) - (30-39 Gender0 Race13) -0.141901 0.1476 2143  -0.961
## (18-29 Gender1 Race11) - (40-49 Gender0 Race13) -0.014831 0.1472 2143  -0.101
## (18-29 Gender1 Race11) - (50-59 Gender0 Race13) -0.031065 0.1515 2143  -0.205
## (18-29 Gender1 Race11) - (18-29 Gender1 Race13) -0.423084 0.1155 2143  -3.664
## (18-29 Gender1 Race11) - (30-39 Gender1 Race13) -0.340659 0.1402 2143  -2.430
## (18-29 Gender1 Race11) - (40-49 Gender1 Race13) -0.213589 0.1402 2143  -1.523
## (18-29 Gender1 Race11) - (50-59 Gender1 Race13) -0.229823 0.1454 2143  -1.581
## (18-29 Gender1 Race11) - (18-29 Gender0 Race14) -0.163512 0.1006 2143  -1.626
## (18-29 Gender1 Race11) - (30-39 Gender0 Race14) -0.081087 0.1263 2143  -0.642
## (18-29 Gender1 Race11) - (40-49 Gender0 Race14)  0.045983 0.1247 2143   0.369
## (18-29 Gender1 Race11) - (50-59 Gender0 Race14)  0.029749 0.1258 2143   0.237
## (18-29 Gender1 Race11) - (18-29 Gender1 Race14) -0.362270 0.0845 2143  -4.285
## (18-29 Gender1 Race11) - (30-39 Gender1 Race14) -0.279845 0.1139 2143  -2.458
## (18-29 Gender1 Race11) - (40-49 Gender1 Race14) -0.152775 0.1128 2143  -1.354
## (18-29 Gender1 Race11) - (50-59 Gender1 Race14) -0.169008 0.1147 2143  -1.473
## (18-29 Gender1 Race11) - (18-29 Gender0 Race15) -0.091579 0.1396 2143  -0.656
## (18-29 Gender1 Race11) - (30-39 Gender0 Race15) -0.009154 0.1592 2143  -0.057
## (18-29 Gender1 Race11) - (40-49 Gender0 Race15)  0.117916 0.1606 2143   0.734
## (18-29 Gender1 Race11) - (50-59 Gender0 Race15)  0.101682 0.1629 2143   0.624
## (18-29 Gender1 Race11) - (18-29 Gender1 Race15) -0.290337 0.1296 2143  -2.239
## (18-29 Gender1 Race11) - (30-39 Gender1 Race15) -0.207912 0.1505 2143  -1.382
## (18-29 Gender1 Race11) - (40-49 Gender1 Race15) -0.080842 0.1524 2143  -0.530
## (18-29 Gender1 Race11) - (50-59 Gender1 Race15) -0.097076 0.1554 2143  -0.625
```

```
## (30-39 Gender1 Race11) - (40-49 Gender1 Race11)   0.127070 0.0776 2143    1.638
## (30-39 Gender1 Race11) - (50-59 Gender1 Race11)   0.110836 0.0805 2143    1.377
## (30-39 Gender1 Race11) - (18-29 Gender0 Race12)  -0.071361 0.1621 2143   -0.440
## (30-39 Gender1 Race11) - (30-39 Gender0 Race12)   0.011064 0.1428 2143    0.077
## (30-39 Gender1 Race11) - (40-49 Gender0 Race12)   0.138134 0.1619 2143    0.853
## (30-39 Gender1 Race11) - (50-59 Gender0 Race12)   0.121901 0.1646 2143    0.740
## (30-39 Gender1 Race11) - (18-29 Gender1 Race12)  -0.270119 0.1531 2143   -1.764
## (30-39 Gender1 Race11) - (30-39 Gender1 Race12)  -0.187693 0.1325 2143   -1.417
## (30-39 Gender1 Race11) - (40-49 Gender1 Race12)  -0.060623 0.1533 2143   -0.395
## (30-39 Gender1 Race11) - (50-59 Gender1 Race12)  -0.076857 0.1568 2143   -0.490
## (30-39 Gender1 Race11) - (18-29 Gender0 Race13)  -0.306751 0.1466 2143   -2.092
## (30-39 Gender1 Race11) - (30-39 Gender0 Race13)  -0.224326 0.1243 2143   -1.804
## (30-39 Gender1 Race11) - (40-49 Gender0 Race13)  -0.097256 0.1458 2143   -0.667
## (30-39 Gender1 Race11) - (50-59 Gender0 Race13)  -0.113490 0.1501 2143   -0.756
## (30-39 Gender1 Race11) - (18-29 Gender1 Race13)  -0.505509 0.1393 2143   -3.629
## (30-39 Gender1 Race11) - (30-39 Gender1 Race13)  -0.423084 0.1155 2143   -3.664
## (30-39 Gender1 Race11) - (40-49 Gender1 Race13)  -0.296014 0.1389 2143   -2.131
## (30-39 Gender1 Race11) - (50-59 Gender1 Race13)  -0.312248 0.1440 2143   -2.169
## (30-39 Gender1 Race11) - (18-29 Gender0 Race14)  -0.245937 0.1291 2143   -1.906
## (30-39 Gender1 Race11) - (30-39 Gender0 Race14)  -0.163512 0.1006 2143   -1.626
## (30-39 Gender1 Race11) - (40-49 Gender0 Race14)  -0.036442 0.1252 2143   -0.291
## (30-39 Gender1 Race11) - (50-59 Gender0 Race14)  -0.052676 0.1261 2143   -0.418
## (30-39 Gender1 Race11) - (18-29 Gender1 Race14)  -0.444695 0.1171 2143   -3.797
## (30-39 Gender1 Race11) - (30-39 Gender1 Race14)  -0.362270 0.0845 2143   -4.285
## (30-39 Gender1 Race11) - (40-49 Gender1 Race14)  -0.235200 0.1134 2143   -2.074
## (30-39 Gender1 Race11) - (50-59 Gender1 Race14)  -0.251434 0.1151 2143   -2.184
## (30-39 Gender1 Race11) - (18-29 Gender0 Race15)  -0.174005 0.1613 2143   -1.079
## (30-39 Gender1 Race11) - (30-39 Gender0 Race15)  -0.091579 0.1396 2143   -0.656
## (30-39 Gender1 Race11) - (40-49 Gender0 Race15)   0.035491 0.1609 2143    0.221
## (30-39 Gender1 Race11) - (50-59 Gender0 Race15)   0.019257 0.1631 2143    0.118
## (30-39 Gender1 Race11) - (18-29 Gender1 Race15)  -0.372762 0.1529 2143   -2.438
## (30-39 Gender1 Race11) - (30-39 Gender1 Race15)  -0.290337 0.1296 2143   -2.239
## (30-39 Gender1 Race11) - (40-49 Gender1 Race15)  -0.163267 0.1528 2143   -1.068
## (30-39 Gender1 Race11) - (50-59 Gender1 Race15)  -0.179501 0.1557 2143   -1.153
## (40-49 Gender1 Race11) - (50-59 Gender1 Race11)  -0.016234 0.0804 2143   -0.202
## (40-49 Gender1 Race11) - (18-29 Gender0 Race12)  -0.198431 0.1629 2143   -1.218
## (40-49 Gender1 Race11) - (30-39 Gender0 Race12)  -0.116005 0.1631 2143   -0.711
## (40-49 Gender1 Race11) - (40-49 Gender0 Race12)   0.011064 0.1428 2143    0.077
## (40-49 Gender1 Race11) - (50-59 Gender0 Race12)  -0.005169 0.1652 2143   -0.031
## (40-49 Gender1 Race11) - (18-29 Gender1 Race12)  -0.397188 0.1535 2143   -2.587
## (40-49 Gender1 Race11) - (30-39 Gender1 Race12)  -0.314763 0.1537 2143   -2.048
## (40-49 Gender1 Race11) - (40-49 Gender1 Race12)  -0.187693 0.1325 2143   -1.417
## (40-49 Gender1 Race11) - (50-59 Gender1 Race12)  -0.203927 0.1569 2143   -1.299
## (40-49 Gender1 Race11) - (18-29 Gender0 Race13)  -0.433821 0.1476 2143   -2.940
## (40-49 Gender1 Race11) - (30-39 Gender0 Race13)  -0.351396 0.1473 2143   -2.386
## (40-49 Gender1 Race11) - (40-49 Gender0 Race13)  -0.224326 0.1243 2143   -1.804
## (40-49 Gender1 Race11) - (50-59 Gender0 Race13)  -0.240560 0.1507 2143   -1.596
## (40-49 Gender1 Race11) - (18-29 Gender1 Race13)  -0.632579 0.1397 2143   -4.527
## (40-49 Gender1 Race11) - (30-39 Gender1 Race13)  -0.550154 0.1393 2143   -3.949
## (40-49 Gender1 Race11) - (40-49 Gender1 Race13)  -0.423084 0.1155 2143   -3.664
## (40-49 Gender1 Race11) - (50-59 Gender1 Race13)  -0.439318 0.1441 2143   -3.048
## (40-49 Gender1 Race11) - (18-29 Gender0 Race14)  -0.373007 0.1311 2143   -2.846
## (40-49 Gender1 Race11) - (30-39 Gender0 Race14)  -0.290582 0.1288 2143   -2.256
## (40-49 Gender1 Race11) - (40-49 Gender0 Race14)  -0.163512 0.1006 2143   -1.626
```

```
## (40-49 Gender1 Race11) - (50-59 Gender0 Race14) -0.179746 0.1278 2143  -1.406
## (40-49 Gender1 Race11) - (18-29 Gender1 Race14) -0.571765 0.1187 2143  -4.816
## (40-49 Gender1 Race11) - (30-39 Gender1 Race14) -0.489340 0.1161 2143  -4.215
## (40-49 Gender1 Race11) - (40-49 Gender1 Race14) -0.362270 0.0845 2143  -4.285
## (40-49 Gender1 Race11) - (50-59 Gender1 Race14) -0.378503 0.1164 2143  -3.251
## (40-49 Gender1 Race11) - (18-29 Gender0 Race15) -0.301074 0.1604 2143  -1.877
## (40-49 Gender1 Race11) - (30-39 Gender0 Race15) -0.218649 0.1586 2143  -1.379
## (40-49 Gender1 Race11) - (40-49 Gender0 Race15) -0.091579 0.1396 2143  -0.656
## (40-49 Gender1 Race11) - (50-59 Gender0 Race15) -0.107813 0.1619 2143  -0.666
## (40-49 Gender1 Race11) - (18-29 Gender1 Race15) -0.499832 0.1514 2143  -3.302
## (40-49 Gender1 Race11) - (30-39 Gender1 Race15) -0.417407 0.1493 2143  -2.795
## (40-49 Gender1 Race11) - (40-49 Gender1 Race15) -0.290337 0.1296 2143  -2.239
## (40-49 Gender1 Race11) - (50-59 Gender1 Race15) -0.306571 0.1539 2143  -1.992
## (50-59 Gender1 Race11) - (18-29 Gender0 Race12) -0.182197 0.1630 2143  -1.117
## (50-59 Gender1 Race11) - (30-39 Gender0 Race12) -0.099772 0.1632 2143  -0.611
## (50-59 Gender1 Race11) - (40-49 Gender0 Race12)  0.027298 0.1625 2143   0.168
## (50-59 Gender1 Race11) - (50-59 Gender0 Race12)  0.011064 0.1428 2143   0.077
## (50-59 Gender1 Race11) - (18-29 Gender1 Race12) -0.380955 0.1531 2143  -2.488
## (50-59 Gender1 Race11) - (30-39 Gender1 Race12) -0.298530 0.1532 2143  -1.949
## (50-59 Gender1 Race11) - (40-49 Gender1 Race12) -0.171460 0.1530 2143  -1.121
## (50-59 Gender1 Race11) - (50-59 Gender1 Race12) -0.187693 0.1325 2143  -1.417
## (50-59 Gender1 Race11) - (18-29 Gender0 Race13) -0.417588 0.1465 2143  -2.850
## (50-59 Gender1 Race11) - (30-39 Gender0 Race13) -0.335162 0.1461 2143  -2.294
## (50-59 Gender1 Race11) - (40-49 Gender0 Race13) -0.208093 0.1453 2143  -1.432
## (50-59 Gender1 Race11) - (50-59 Gender0 Race13) -0.224326 0.1243 2143  -1.804
## (50-59 Gender1 Race11) - (18-29 Gender1 Race13) -0.616345 0.1380 2143  -4.466
## (50-59 Gender1 Race11) - (30-39 Gender1 Race13) -0.533920 0.1375 2143  -3.884
## (50-59 Gender1 Race11) - (40-49 Gender1 Race13) -0.406850 0.1372 2143  -2.965
## (50-59 Gender1 Race11) - (50-59 Gender1 Race13) -0.423084 0.1155 2143  -3.664
## (50-59 Gender1 Race11) - (18-29 Gender0 Race14) -0.356774 0.1338 2143  -2.666
## (50-59 Gender1 Race11) - (30-39 Gender0 Race14) -0.274348 0.1315 2143  -2.087
## (50-59 Gender1 Race11) - (40-49 Gender0 Race14) -0.147279 0.1296 2143  -1.136
## (50-59 Gender1 Race11) - (50-59 Gender0 Race14) -0.163512 0.1006 2143  -1.626
## (50-59 Gender1 Race11) - (18-29 Gender1 Race14) -0.555531 0.1210 2143  -4.591
## (50-59 Gender1 Race11) - (30-39 Gender1 Race14) -0.473106 0.1183 2143  -4.000
## (50-59 Gender1 Race11) - (40-49 Gender1 Race14) -0.346036 0.1169 2143  -2.959
## (50-59 Gender1 Race11) - (50-59 Gender1 Race14) -0.362270 0.0845 2143  -4.285
## (50-59 Gender1 Race11) - (18-29 Gender0 Race15) -0.284841 0.1611 2143  -1.768
## (50-59 Gender1 Race11) - (30-39 Gender0 Race15) -0.202416 0.1592 2143  -1.271
## (50-59 Gender1 Race11) - (40-49 Gender0 Race15) -0.075346 0.1603 2143  -0.470
## (50-59 Gender1 Race11) - (50-59 Gender0 Race15) -0.091579 0.1396 2143  -0.656
## (50-59 Gender1 Race11) - (18-29 Gender1 Race15) -0.483599 0.1516 2143  -3.190
## (50-59 Gender1 Race11) - (30-39 Gender1 Race15) -0.401173 0.1495 2143  -2.684
## (50-59 Gender1 Race11) - (40-49 Gender1 Race15) -0.274103 0.1512 2143  -1.813
## (50-59 Gender1 Race11) - (50-59 Gender1 Race15) -0.290337 0.1296 2143  -2.239
## (18-29 Gender0 Race12) - (30-39 Gender0 Race12)  0.082425 0.0787 2143   1.047
## (18-29 Gender0 Race12) - (40-49 Gender0 Race12)  0.209495 0.0791 2143   2.648
## (18-29 Gender0 Race12) - (50-59 Gender0 Race12)  0.193261 0.0822 2143   2.352
## (18-29 Gender0 Race12) - (18-29 Gender1 Race12) -0.198758 0.0564 2143  -3.524
## (18-29 Gender0 Race12) - (30-39 Gender1 Race12) -0.116333 0.0967 2143  -1.203
## (18-29 Gender0 Race12) - (40-49 Gender1 Race12)  0.010737 0.0978 2143   0.110
## (18-29 Gender0 Race12) - (50-59 Gender1 Race12) -0.005496 0.1012 2143  -0.054
## (18-29 Gender0 Race12) - (18-29 Gender0 Race13) -0.235391 0.1380 2143  -1.705
## (18-29 Gender0 Race12) - (30-39 Gender0 Race13) -0.152965 0.1584 2143  -0.966
```

48

```
## (18-29 Gender0 Race12) - (40-49 Gender0 Race13) -0.025895 0.1586 2143   -0.163
## (18-29 Gender0 Race12) - (50-59 Gender0 Race13) -0.042129 0.1612 2143   -0.261
## (18-29 Gender0 Race12) - (18-29 Gender1 Race13) -0.434148 0.1515 2143   -2.865
## (18-29 Gender0 Race12) - (30-39 Gender1 Race13) -0.351723 0.1702 2143   -2.067
## (18-29 Gender0 Race12) - (40-49 Gender1 Race13) -0.224653 0.1708 2143   -1.315
## (18-29 Gender0 Race12) - (50-59 Gender1 Race13) -0.240887 0.1738 2143   -1.386
## (18-29 Gender0 Race12) - (18-29 Gender0 Race14) -0.174576 0.1141 2143   -1.530
## (18-29 Gender0 Race12) - (30-39 Gender0 Race14) -0.092151 0.1362 2143   -0.677
## (18-29 Gender0 Race12) - (40-49 Gender0 Race14)  0.034919 0.1355 2143    0.258
## (18-29 Gender0 Race12) - (50-59 Gender0 Race14)  0.018685 0.1348 2143    0.139
## (18-29 Gender0 Race12) - (18-29 Gender1 Race14) -0.373334 0.1268 2143   -2.943
## (18-29 Gender0 Race12) - (30-39 Gender1 Race14) -0.290909 0.1469 2143   -1.980
## (18-29 Gender0 Race12) - (40-49 Gender1 Race14) -0.163839 0.1468 2143   -1.116
## (18-29 Gender0 Race12) - (50-59 Gender1 Race14) -0.180073 0.1468 2143   -1.227
## (18-29 Gender0 Race12) - (18-29 Gender0 Race15) -0.102644 0.1503 2143   -0.683
## (18-29 Gender0 Race12) - (30-39 Gender0 Race15) -0.020219 0.1677 2143   -0.121
## (18-29 Gender0 Race12) - (40-49 Gender0 Race15)  0.106851 0.1696 2143    0.630
## (18-29 Gender0 Race12) - (50-59 Gender0 Race15)  0.090618 0.1705 2143    0.532
## (18-29 Gender0 Race12) - (18-29 Gender1 Race15) -0.301401 0.1610 2143   -1.872
## (18-29 Gender0 Race12) - (30-39 Gender1 Race15) -0.218976 0.1773 2143   -1.235
## (18-29 Gender0 Race12) - (40-49 Gender1 Race15) -0.091907 0.1795 2143   -0.512
## (18-29 Gender0 Race12) - (50-59 Gender1 Race15) -0.108140 0.1808 2143   -0.598
## (30-39 Gender0 Race12) - (40-49 Gender0 Race12)  0.127070 0.0776 2143    1.638
## (30-39 Gender0 Race12) - (50-59 Gender0 Race12)  0.110836 0.0805 2143    1.377
## (30-39 Gender0 Race12) - (18-29 Gender1 Race12) -0.281183 0.0970 2143   -2.900
## (30-39 Gender0 Race12) - (30-39 Gender1 Race12) -0.198758 0.0564 2143   -3.524
## (30-39 Gender0 Race12) - (40-49 Gender1 Race12) -0.071688 0.0967 2143   -0.741
## (30-39 Gender0 Race12) - (50-59 Gender1 Race12) -0.087921 0.0999 2143   -0.880
## (30-39 Gender0 Race12) - (18-29 Gender0 Race13) -0.317816 0.1594 2143   -1.993
## (30-39 Gender0 Race12) - (30-39 Gender0 Race13) -0.235391 0.1380 2143   -1.705
## (30-39 Gender0 Race12) - (40-49 Gender0 Race13) -0.108321 0.1583 2143   -0.684
## (30-39 Gender0 Race12) - (50-59 Gender0 Race13) -0.124554 0.1609 2143   -0.774
## (30-39 Gender0 Race12) - (18-29 Gender1 Race13) -0.516574 0.1713 2143   -3.015
## (30-39 Gender0 Race12) - (30-39 Gender1 Race13) -0.434148 0.1515 2143   -2.865
## (30-39 Gender0 Race12) - (40-49 Gender1 Race13) -0.307078 0.1707 2143   -1.799
## (30-39 Gender0 Race12) - (50-59 Gender1 Race13) -0.323312 0.1735 2143   -1.863
## (30-39 Gender0 Race12) - (18-29 Gender0 Race14) -0.257002 0.1410 2143   -1.822
## (30-39 Gender0 Race12) - (30-39 Gender0 Race14) -0.174576 0.1141 2143   -1.530
## (30-39 Gender0 Race12) - (40-49 Gender0 Race14) -0.047507 0.1371 2143   -0.347
## (30-39 Gender0 Race12) - (50-59 Gender0 Race14) -0.063740 0.1363 2143   -0.468
## (30-39 Gender0 Race12) - (18-29 Gender1 Race14) -0.455759 0.1516 2143   -3.007
## (30-39 Gender0 Race12) - (30-39 Gender1 Race14) -0.373334 0.1268 2143   -2.943
## (30-39 Gender0 Race12) - (40-49 Gender1 Race14) -0.246264 0.1483 2143   -1.660
## (30-39 Gender0 Race12) - (50-59 Gender1 Race14) -0.262498 0.1482 2143   -1.771
## (30-39 Gender0 Race12) - (18-29 Gender0 Race15) -0.185069 0.1716 2143   -1.079
## (30-39 Gender0 Race12) - (30-39 Gender0 Race15) -0.102644 0.1503 2143   -0.683
## (30-39 Gender0 Race12) - (40-49 Gender0 Race15)  0.024426 0.1708 2143    0.143
## (30-39 Gender0 Race12) - (50-59 Gender0 Race15)  0.008193 0.1716 2143    0.048
## (30-39 Gender0 Race12) - (18-29 Gender1 Race15) -0.383827 0.1811 2143   -2.119
## (30-39 Gender0 Race12) - (30-39 Gender1 Race15) -0.301401 0.1610 2143   -1.872
## (30-39 Gender0 Race12) - (40-49 Gender1 Race15) -0.174332 0.1808 2143   -0.964
## (30-39 Gender0 Race12) - (50-59 Gender1 Race15) -0.190565 0.1820 2143   -1.047
## (40-49 Gender0 Race12) - (50-59 Gender0 Race12) -0.016234 0.0804 2143   -0.202
## (40-49 Gender0 Race12) - (18-29 Gender1 Race12) -0.408253 0.0965 2143   -4.230
```

```
## (40-49 Gender0 Race12) - (30-39 Gender1 Race12) -0.325828 0.0951 2143   -3.426
## (40-49 Gender0 Race12) - (40-49 Gender1 Race12) -0.198758 0.0564 2143   -3.524
## (40-49 Gender0 Race12) - (50-59 Gender1 Race12) -0.214991 0.0991 2143   -2.169
## (40-49 Gender0 Race12) - (18-29 Gender0 Race13) -0.444886 0.1596 2143   -2.787
## (40-49 Gender0 Race12) - (30-39 Gender0 Race13) -0.362461 0.1584 2143   -2.289
## (40-49 Gender0 Race12) - (40-49 Gender0 Race13) -0.235391 0.1380 2143   -1.705
## (40-49 Gender0 Race12) - (50-59 Gender0 Race13) -0.251624 0.1609 2143   -1.564
## (40-49 Gender0 Race12) - (18-29 Gender1 Race13) -0.643644 0.1711 2143   -3.763
## (40-49 Gender0 Race12) - (30-39 Gender1 Race13) -0.561218 0.1698 2143   -3.305
## (40-49 Gender0 Race12) - (40-49 Gender1 Race13) -0.434148 0.1515 2143   -2.865
## (40-49 Gender0 Race12) - (50-59 Gender1 Race13) -0.450382 0.1731 2143   -2.602
## (40-49 Gender0 Race12) - (18-29 Gender0 Race14) -0.384072 0.1422 2143   -2.702
## (40-49 Gender0 Race12) - (30-39 Gender0 Race14) -0.301646 0.1389 2143   -2.171
## (40-49 Gender0 Race12) - (40-49 Gender0 Race14) -0.174576 0.1141 2143   -1.530
## (40-49 Gender0 Race12) - (50-59 Gender0 Race14) -0.190810 0.1372 2143   -1.391
## (40-49 Gender0 Race12) - (18-29 Gender1 Race14) -0.582829 0.1521 2143   -3.831
## (40-49 Gender0 Race12) - (30-39 Gender1 Race14) -0.500404 0.1490 2143   -3.358
## (40-49 Gender0 Race12) - (40-49 Gender1 Race14) -0.373334 0.1268 2143   -2.943
## (40-49 Gender0 Race12) - (50-59 Gender1 Race14) -0.389568 0.1485 2143   -2.623
## (40-49 Gender0 Race12) - (18-29 Gender0 Race15) -0.312139 0.1701 2143   -1.835
## (40-49 Gender0 Race12) - (30-39 Gender0 Race15) -0.229714 0.1674 2143   -1.372
## (40-49 Gender0 Race12) - (40-49 Gender0 Race15) -0.102644 0.1503 2143   -0.683
## (40-49 Gender0 Race12) - (50-59 Gender0 Race15) -0.118877 0.1699 2143   -0.700
## (40-49 Gender0 Race12) - (18-29 Gender1 Race15) -0.510897 0.1793 2143   -2.850
## (40-49 Gender0 Race12) - (30-39 Gender1 Race15) -0.428471 0.1767 2143   -2.425
## (40-49 Gender0 Race12) - (40-49 Gender1 Race15) -0.301401 0.1610 2143   -1.872
## (40-49 Gender0 Race12) - (50-59 Gender1 Race15) -0.317635 0.1799 2143   -1.765
## (50-59 Gender0 Race12) - (18-29 Gender1 Race12) -0.392019 0.0982 2143   -3.994
## (50-59 Gender0 Race12) - (30-39 Gender1 Race12) -0.309594 0.0966 2143   -3.205
## (50-59 Gender0 Race12) - (40-49 Gender1 Race12) -0.182524 0.0973 2143   -1.875
## (50-59 Gender0 Race12) - (50-59 Gender1 Race12) -0.198758 0.0564 2143   -3.524
## (50-59 Gender0 Race12) - (18-29 Gender0 Race13) -0.428652 0.1601 2143   -2.678
## (50-59 Gender0 Race12) - (30-39 Gender0 Race13) -0.346227 0.1587 2143   -2.182
## (50-59 Gender0 Race12) - (40-49 Gender0 Race13) -0.219157 0.1586 2143   -1.381
## (50-59 Gender0 Race12) - (50-59 Gender0 Race13) -0.235391 0.1380 2143   -1.705
## (50-59 Gender0 Race12) - (18-29 Gender1 Race13) -0.627410 0.1710 2143   -3.670
## (50-59 Gender0 Race12) - (30-39 Gender1 Race13) -0.544985 0.1696 2143   -3.214
## (50-59 Gender0 Race12) - (40-49 Gender1 Race13) -0.417915 0.1700 2143   -2.458
## (50-59 Gender0 Race12) - (50-59 Gender1 Race13) -0.434148 0.1515 2143   -2.865
## (50-59 Gender0 Race12) - (18-29 Gender0 Race14) -0.367838 0.1462 2143   -2.516
## (50-59 Gender0 Race12) - (30-39 Gender0 Race14) -0.285413 0.1429 2143   -1.997
## (50-59 Gender0 Race12) - (40-49 Gender0 Race14) -0.158343 0.1420 2143   -1.115
## (50-59 Gender0 Race12) - (50-59 Gender0 Race14) -0.174576 0.1141 2143   -1.530
## (50-59 Gender0 Race12) - (18-29 Gender1 Race14) -0.566596 0.1554 2143   -3.647
## (50-59 Gender0 Race12) - (30-39 Gender1 Race14) -0.484171 0.1522 2143   -3.181
## (50-59 Gender0 Race12) - (40-49 Gender1 Race14) -0.357101 0.1518 2143   -2.352
## (50-59 Gender0 Race12) - (50-59 Gender1 Race14) -0.373334 0.1268 2143   -2.943
## (50-59 Gender0 Race12) - (18-29 Gender0 Race15) -0.295905 0.1721 2143   -1.719
## (50-59 Gender0 Race12) - (30-39 Gender0 Race15) -0.213480 0.1694 2143   -1.261
## (50-59 Gender0 Race12) - (40-49 Gender0 Race15) -0.086410 0.1710 2143   -0.505
## (50-59 Gender0 Race12) - (50-59 Gender0 Race15) -0.102644 0.1503 2143   -0.683
## (50-59 Gender0 Race12) - (18-29 Gender1 Race15) -0.494663 0.1807 2143   -2.737
## (50-59 Gender0 Race12) - (30-39 Gender1 Race15) -0.412238 0.1780 2143   -2.316
## (50-59 Gender0 Race12) - (40-49 Gender1 Race15) -0.285168 0.1800 2143   -1.584
```

```
## (50-59 Gender0 Race12) - (50-59 Gender1 Race15) -0.301401 0.1610 2143  -1.872
## (18-29 Gender1 Race12) - (30-39 Gender1 Race12)  0.082425 0.0787 2143   1.047
## (18-29 Gender1 Race12) - (40-49 Gender1 Race12)  0.209495 0.0791 2143   2.648
## (18-29 Gender1 Race12) - (50-59 Gender1 Race12)  0.193261 0.0822 2143   2.352
## (18-29 Gender1 Race12) - (18-29 Gender0 Race13) -0.036633 0.1467 2143  -0.250
## (18-29 Gender1 Race12) - (30-39 Gender0 Race13)  0.045792 0.1660 2143   0.276
## (18-29 Gender1 Race12) - (40-49 Gender0 Race13)  0.172862 0.1658 2143   1.043
## (18-29 Gender1 Race12) - (50-59 Gender0 Race13)  0.156629 0.1678 2143   0.934
## (18-29 Gender1 Race12) - (18-29 Gender1 Race13) -0.235391 0.1380 2143  -1.705
## (18-29 Gender1 Race12) - (30-39 Gender1 Race13) -0.152965 0.1584 2143  -0.966
## (18-29 Gender1 Race12) - (40-49 Gender1 Race13) -0.025895 0.1586 2143  -0.163
## (18-29 Gender1 Race12) - (50-59 Gender1 Race13) -0.042129 0.1612 2143  -0.261
## (18-29 Gender1 Race12) - (18-29 Gender0 Race14)  0.024181 0.1278 2143   0.189
## (18-29 Gender1 Race12) - (30-39 Gender0 Race14)  0.106607 0.1479 2143   0.721
## (18-29 Gender1 Race12) - (40-49 Gender0 Race14)  0.233676 0.1467 2143   1.592
## (18-29 Gender1 Race12) - (50-59 Gender0 Race14)  0.217443 0.1455 2143   1.494
## (18-29 Gender1 Race12) - (18-29 Gender1 Race14) -0.174576 0.1141 2143  -1.530
## (18-29 Gender1 Race12) - (30-39 Gender1 Race14) -0.092151 0.1362 2143  -0.677
## (18-29 Gender1 Race12) - (40-49 Gender1 Race14)  0.034919 0.1355 2143   0.258
## (18-29 Gender1 Race12) - (50-59 Gender1 Race14)  0.018685 0.1348 2143   0.139
## (18-29 Gender1 Race12) - (18-29 Gender0 Race15)  0.096114 0.1600 2143   0.601
## (18-29 Gender1 Race12) - (30-39 Gender0 Race15)  0.178539 0.1766 2143   1.011
## (18-29 Gender1 Race12) - (40-49 Gender0 Race15)  0.305609 0.1779 2143   1.717
## (18-29 Gender1 Race12) - (50-59 Gender0 Race15)  0.289376 0.1783 2143   1.623
## (18-29 Gender1 Race12) - (18-29 Gender1 Race15) -0.102644 0.1503 2143  -0.683
## (18-29 Gender1 Race12) - (30-39 Gender1 Race15) -0.020219 0.1677 2143  -0.121
## (18-29 Gender1 Race12) - (40-49 Gender1 Race15)  0.106851 0.1696 2143   0.630
## (18-29 Gender1 Race12) - (50-59 Gender1 Race15)  0.090618 0.1705 2143   0.532
## (30-39 Gender1 Race12) - (40-49 Gender1 Race12)  0.127070 0.0776 2143   1.638
## (30-39 Gender1 Race12) - (50-59 Gender1 Race12)  0.110836 0.0805 2143   1.377
## (30-39 Gender1 Race12) - (18-29 Gender0 Race13) -0.119058 0.1669 2143  -0.713
## (30-39 Gender1 Race12) - (30-39 Gender0 Race13) -0.036633 0.1467 2143  -0.250
## (30-39 Gender1 Race12) - (40-49 Gender0 Race13)  0.090437 0.1655 2143   0.547
## (30-39 Gender1 Race12) - (50-59 Gender0 Race13)  0.074204 0.1674 2143   0.443
## (30-39 Gender1 Race12) - (18-29 Gender1 Race13) -0.317816 0.1594 2143  -1.993
## (30-39 Gender0 Race12) - (30-39 Gender1 Race13) -0.235391 0.1380 2143  -1.705
## (30-39 Gender1 Race12) - (40-49 Gender1 Race13) -0.108321 0.1583 2143  -0.684
## (30-39 Gender1 Race12) - (50-59 Gender1 Race13) -0.124554 0.1609 2143  -0.774
## (30-39 Gender1 Race12) - (18-29 Gender0 Race14) -0.058244 0.1522 2143  -0.383
## (30-39 Gender1 Race12) - (30-39 Gender0 Race14)  0.024181 0.1278 2143   0.189
## (30-39 Gender1 Race12) - (40-49 Gender0 Race14)  0.151251 0.1481 2143   1.021
## (30-39 Gender1 Race12) - (50-59 Gender0 Race14)  0.135018 0.1468 2143   0.920
## (30-39 Gender1 Race12) - (18-29 Gender1 Race14) -0.257002 0.1410 2143  -1.822
## (30-39 Gender1 Race12) - (30-39 Gender1 Race14) -0.174576 0.1141 2143  -1.530
## (30-39 Gender1 Race12) - (40-49 Gender1 Race14) -0.047507 0.1371 2143  -0.347
## (30-39 Gender1 Race12) - (50-59 Gender1 Race14) -0.063740 0.1363 2143  -0.468
## (30-39 Gender1 Race12) - (18-29 Gender0 Race15)  0.013689 0.1801 2143   0.076
## (30-39 Gender1 Race12) - (30-39 Gender0 Race15)  0.096114 0.1600 2143   0.601
## (30-39 Gender1 Race12) - (40-49 Gender0 Race15)  0.223184 0.1790 2143   1.247
## (30-39 Gender1 Race12) - (50-59 Gender0 Race15)  0.206950 0.1793 2143   1.154
## (30-39 Gender1 Race12) - (18-29 Gender1 Race15) -0.185069 0.1716 2143  -1.079
## (30-39 Gender1 Race12) - (30-39 Gender1 Race15) -0.102644 0.1503 2143  -0.683
## (30-39 Gender1 Race12) - (40-49 Gender1 Race15)  0.024426 0.1708 2143   0.143
## (30-39 Gender1 Race12) - (50-59 Gender1 Race15)  0.008193 0.1716 2143   0.048
```

```
## (40-49 Gender1 Race12) - (50-59 Gender1 Race12) -0.016234 0.0804 2143   -0.202
## (40-49 Gender1 Race12) - (18-29 Gender0 Race13) -0.246128 0.1676 2143   -1.469
## (40-49 Gender1 Race12) - (30-39 Gender0 Race13) -0.163703 0.1664 2143   -0.984
## (40-49 Gender1 Race12) - (40-49 Gender0 Race13) -0.036633 0.1467 2143   -0.250
## (40-49 Gender1 Race12) - (50-59 Gender0 Race13) -0.052866 0.1678 2143   -0.315
## (40-49 Gender1 Race12) - (18-29 Gender1 Race13) -0.444886 0.1596 2143   -2.787
## (40-49 Gender1 Race12) - (30-39 Gender1 Race13) -0.362461 0.1584 2143   -2.289
## (40-49 Gender1 Race12) - (40-49 Gender1 Race13) -0.235391 0.1380 2143   -1.705
## (40-49 Gender1 Race12) - (50-59 Gender1 Race13) -0.251624 0.1609 2143   -1.564
## (40-49 Gender1 Race12) - (18-29 Gender0 Race14) -0.185314 0.1537 2143   -1.205
## (40-49 Gender1 Race12) - (30-39 Gender0 Race14) -0.102889 0.1508 2143   -0.682
## (40-49 Gender1 Race12) - (40-49 Gender0 Race14)  0.024181 0.1278 2143    0.189
## (40-49 Gender1 Race12) - (50-59 Gender0 Race14)  0.007948 0.1481 2143    0.054
## (40-49 Gender1 Race12) - (18-29 Gender1 Race14) -0.384072 0.1422 2143   -2.702
## (40-49 Gender1 Race12) - (30-39 Gender1 Race14) -0.301646 0.1389 2143   -2.171
## (40-49 Gender1 Race12) - (40-49 Gender1 Race14) -0.174576 0.1141 2143   -1.530
## (40-49 Gender1 Race12) - (50-59 Gender1 Race14) -0.190810 0.1372 2143   -1.391
## (40-49 Gender1 Race12) - (18-29 Gender0 Race15) -0.113381 0.1791 2143   -0.633
## (40-49 Gender1 Race12) - (30-39 Gender0 Race15) -0.030956 0.1767 2143   -0.175
## (40-49 Gender1 Race12) - (40-49 Gender0 Race15)  0.096114 0.1600 2143    0.601
## (40-49 Gender1 Race12) - (50-59 Gender0 Race15)  0.079880 0.1781 2143    0.449
## (40-49 Gender1 Race12) - (18-29 Gender1 Race15) -0.312139 0.1701 2143   -1.835
## (40-49 Gender1 Race12) - (30-39 Gender1 Race15) -0.229714 0.1674 2143   -1.372
## (40-49 Gender1 Race12) - (40-49 Gender1 Race15) -0.102644 0.1503 2143   -0.683
## (40-49 Gender1 Race12) - (50-59 Gender1 Race15) -0.118877 0.1699 2143   -0.700
## (50-59 Gender1 Race12) - (18-29 Gender0 Race13) -0.229894 0.1685 2143   -1.365
## (50-59 Gender1 Race12) - (30-39 Gender0 Race13) -0.147469 0.1672 2143   -0.882
## (50-59 Gender1 Race12) - (40-49 Gender0 Race13) -0.020399 0.1667 2143   -0.122
## (50-59 Gender1 Race12) - (50-59 Gender0 Race13) -0.036633 0.1467 2143   -0.250
## (50-59 Gender1 Race12) - (18-29 Gender1 Race13) -0.428652 0.1601 2143   -2.678
## (50-59 Gender1 Race12) - (30-39 Gender1 Race13) -0.346227 0.1587 2143   -2.182
## (50-59 Gender1 Race12) - (40-49 Gender1 Race13) -0.219157 0.1586 2143   -1.381
## (50-59 Gender1 Race12) - (50-59 Gender1 Race13) -0.235391 0.1380 2143   -1.705
## (50-59 Gender1 Race12) - (18-29 Gender0 Race14) -0.169080 0.1580 2143   -1.070
## (50-59 Gender1 Race12) - (30-39 Gender0 Race14) -0.086655 0.1551 2143   -0.559
## (50-59 Gender1 Race12) - (40-49 Gender0 Race14)  0.040415 0.1537 2143    0.263
## (50-59 Gender1 Race12) - (50-59 Gender0 Race14)  0.024181 0.1278 2143    0.189
## (50-59 Gender1 Race12) - (18-29 Gender1 Race14) -0.367838 0.1462 2143   -2.516
## (50-59 Gender1 Race12) - (30-39 Gender1 Race14) -0.285413 0.1429 2143   -1.997
## (50-59 Gender1 Race12) - (40-49 Gender1 Race14) -0.158343 0.1420 2143   -1.115
## (50-59 Gender1 Race12) - (50-59 Gender1 Race14) -0.174576 0.1141 2143   -1.530
## (50-59 Gender1 Race12) - (18-29 Gender0 Race15) -0.097147 0.1815 2143   -0.535
## (50-59 Gender1 Race12) - (30-39 Gender0 Race15) -0.014722 0.1790 2143   -0.082
## (50-59 Gender1 Race12) - (40-49 Gender0 Race15)  0.112348 0.1801 2143    0.624
## (50-59 Gender1 Race12) - (50-59 Gender0 Race15)  0.096114 0.1600 2143    0.601
## (50-59 Gender1 Race12) - (18-29 Gender1 Race15) -0.295905 0.1721 2143   -1.719
## (50-59 Gender1 Race12) - (30-39 Gender1 Race15) -0.213480 0.1694 2143   -1.261
## (50-59 Gender1 Race12) - (40-49 Gender1 Race15) -0.086410 0.1710 2143   -0.505
## (50-59 Gender1 Race12) - (50-59 Gender1 Race15) -0.102644 0.1503 2143   -0.683
## (18-29 Gender0 Race13) - (30-39 Gender0 Race13)  0.082425 0.0787 2143    1.047
## (18-29 Gender0 Race13) - (40-49 Gender0 Race13)  0.209495 0.0791 2143    2.648
## (18-29 Gender0 Race13) - (50-59 Gender0 Race13)  0.193261 0.0822 2143    2.352
## (18-29 Gender0 Race13) - (18-29 Gender1 Race13) -0.198758 0.0564 2143   -3.524
## (18-29 Gender0 Race13) - (30-39 Gender1 Race13) -0.116333 0.0967 2143   -1.203
```

```
## (18-29 Gender0 Race13) - (40-49 Gender1 Race13)  0.010737 0.0978 2143   0.110
## (18-29 Gender0 Race13) - (50-59 Gender1 Race13) -0.005496 0.1012 2143  -0.054
## (18-29 Gender0 Race13) - (18-29 Gender0 Race14)  0.060814 0.0938 2143   0.649
## (18-29 Gender0 Race13) - (30-39 Gender0 Race14)  0.143239 0.1204 2143   1.190
## (18-29 Gender0 Race13) - (40-49 Gender0 Race14)  0.270309 0.1196 2143   2.261
## (18-29 Gender0 Race13) - (50-59 Gender0 Race14)  0.254076 0.1173 2143   2.166
## (18-29 Gender0 Race13) - (18-29 Gender1 Race14) -0.137944 0.1055 2143  -1.307
## (18-29 Gender0 Race13) - (30-39 Gender1 Race14) -0.055518 0.1296 2143  -0.428
## (18-29 Gender0 Race13) - (40-49 Gender1 Race14)  0.071551 0.1295 2143   0.553
## (18-29 Gender0 Race13) - (50-59 Gender1 Race14)  0.055318 0.1281 2143   0.432
## (18-29 Gender0 Race13) - (18-29 Gender0 Race15)  0.132747 0.1353 2143   0.981
## (18-29 Gender0 Race13) - (30-39 Gender0 Race15)  0.215172 0.1549 2143   1.389
## (18-29 Gender0 Race13) - (40-49 Gender0 Race15)  0.342242 0.1570 2143   2.180
## (18-29 Gender0 Race13) - (50-59 Gender0 Race15)  0.326008 0.1568 2143   2.079
## (18-29 Gender0 Race13) - (18-29 Gender1 Race15) -0.066011 0.1446 2143  -0.456
## (18-29 Gender0 Race13) - (30-39 Gender1 Race15)  0.016414 0.1631 2143   0.101
## (18-29 Gender0 Race13) - (40-49 Gender1 Race15)  0.143484 0.1655 2143   0.867
## (18-29 Gender0 Race13) - (50-59 Gender1 Race15)  0.127250 0.1659 2143   0.767
## (30-39 Gender0 Race13) - (40-49 Gender0 Race13)  0.127070 0.0776 2143   1.638
## (30-39 Gender0 Race13) - (50-59 Gender0 Race13)  0.110836 0.0805 2143   1.377
## (30-39 Gender0 Race13) - (18-29 Gender1 Race13) -0.281183 0.0970 2143  -2.900
## (30-39 Gender0 Race13) - (30-39 Gender1 Race13) -0.198758 0.0564 2143  -3.524
## (30-39 Gender0 Race13) - (40-49 Gender1 Race13) -0.071688 0.0967 2143  -0.741
## (30-39 Gender0 Race13) - (50-59 Gender1 Race13) -0.087921 0.0999 2143  -0.880
## (30-39 Gender0 Race13) - (18-29 Gender0 Race14) -0.021611 0.1244 2143  -0.174
## (30-39 Gender0 Race13) - (30-39 Gender0 Race14)  0.060814 0.0938 2143   0.649
## (30-39 Gender0 Race13) - (40-49 Gender0 Race14)  0.187884 0.1206 2143   1.557
## (30-39 Gender0 Race13) - (50-59 Gender0 Race14)  0.171650 0.1183 2143   1.452
## (30-39 Gender0 Race13) - (18-29 Gender1 Race14) -0.220369 0.1336 2143  -1.649
## (30-39 Gender0 Race13) - (30-39 Gender1 Race14) -0.137944 0.1055 2143  -1.307
## (30-39 Gender0 Race13) - (40-49 Gender1 Race14) -0.010874 0.1306 2143  -0.083
## (30-39 Gender0 Race13) - (50-59 Gender1 Race14) -0.027107 0.1290 2143  -0.210
## (30-39 Gender0 Race13) - (18-29 Gender0 Race15)  0.050322 0.1581 2143   0.318
## (30-39 Gender0 Race13) - (30-39 Gender0 Race15)  0.132747 0.1353 2143   0.981
## (30-39 Gender0 Race13) - (40-49 Gender0 Race15)  0.259817 0.1578 2143   1.647
## (30-39 Gender0 Race13) - (50-59 Gender0 Race15)  0.243583 0.1575 2143   1.546
## (30-39 Gender0 Race13) - (18-29 Gender1 Race15) -0.148436 0.1662 2143  -0.893
## (30-39 Gender0 Race13) - (30-39 Gender1 Race15) -0.066011 0.1446 2143  -0.456
## (30-39 Gender0 Race13) - (40-49 Gender1 Race15)  0.061059 0.1663 2143   0.367
## (30-39 Gender0 Race13) - (50-59 Gender1 Race15)  0.044825 0.1666 2143   0.269
## (40-49 Gender0 Race13) - (50-59 Gender0 Race13) -0.016234 0.0804 2143  -0.202
## (40-49 Gender0 Race13) - (18-29 Gender1 Race13) -0.408253 0.0965 2143  -4.230
## (40-49 Gender0 Race13) - (30-39 Gender1 Race13) -0.325828 0.0951 2143  -3.426
## (40-49 Gender0 Race13) - (40-49 Gender1 Race13) -0.198758 0.0564 2143  -3.524
## (40-49 Gender0 Race13) - (50-59 Gender1 Race13) -0.214991 0.0991 2143  -2.169
## (40-49 Gender0 Race13) - (18-29 Gender0 Race14) -0.148681 0.1257 2143  -1.183
## (40-49 Gender0 Race13) - (30-39 Gender0 Race14) -0.066256 0.1227 2143  -0.540
## (40-49 Gender0 Race13) - (40-49 Gender0 Race14)  0.060814 0.0938 2143   0.649
## (40-49 Gender0 Race13) - (50-59 Gender0 Race14)  0.044581 0.1193 2143   0.374
## (40-49 Gender0 Race13) - (18-29 Gender1 Race14) -0.347439 0.1342 2143  -2.588
## (40-49 Gender0 Race13) - (30-39 Gender1 Race14) -0.265014 0.1313 2143  -2.018
## (40-49 Gender0 Race13) - (40-49 Gender1 Race14) -0.137944 0.1055 2143  -1.307
## (40-49 Gender0 Race13) - (50-59 Gender1 Race14) -0.154177 0.1294 2143  -1.192
## (40-49 Gender0 Race13) - (18-29 Gender0 Race15) -0.076748 0.1564 2143  -0.491
```

```
## (40-49 Gender0 Race13) - (30-39 Gender0 Race15)  0.005677 0.1541 2143   0.037
## (40-49 Gender0 Race13) - (40-49 Gender0 Race15)  0.132747 0.1353 2143   0.981
## (40-49 Gender0 Race13) - (50-59 Gender0 Race15)  0.116513 0.1556 2143   0.749
## (40-49 Gender0 Race13) - (18-29 Gender1 Race15) -0.275506 0.1642 2143  -1.678
## (40-49 Gender0 Race13) - (30-39 Gender1 Race15) -0.193081 0.1619 2143  -1.193
## (40-49 Gender0 Race13) - (40-49 Gender1 Race15) -0.066011 0.1446 2143  -0.456
## (40-49 Gender0 Race13) - (50-59 Gender1 Race15) -0.082244 0.1643 2143  -0.500
## (50-59 Gender0 Race13) - (18-29 Gender1 Race13) -0.392019 0.0982 2143  -3.994
## (50-59 Gender0 Race13) - (30-39 Gender1 Race13) -0.309594 0.0966 2143  -3.205
## (50-59 Gender0 Race13) - (40-49 Gender1 Race13) -0.182524 0.0973 2143  -1.875
## (50-59 Gender0 Race13) - (50-59 Gender1 Race13) -0.198758 0.0564 2143  -3.524
## (50-59 Gender0 Race13) - (18-29 Gender0 Race14) -0.132447 0.1316 2143  -1.006
## (50-59 Gender0 Race13) - (30-39 Gender0 Race14) -0.050022 0.1287 2143  -0.389
## (50-59 Gender0 Race13) - (40-49 Gender0 Race14)  0.077048 0.1276 2143   0.604
## (50-59 Gender0 Race13) - (50-59 Gender0 Race14)  0.060814 0.0938 2143   0.649
## (50-59 Gender0 Race13) - (18-29 Gender1 Race14) -0.331205 0.1392 2143  -2.380
## (50-59 Gender0 Race13) - (30-39 Gender1 Race14) -0.248780 0.1363 2143  -1.826
## (50-59 Gender0 Race13) - (40-49 Gender1 Race14) -0.121710 0.1358 2143  -0.896
## (50-59 Gender0 Race13) - (50-59 Gender1 Race14) -0.137944 0.1055 2143  -1.307
## (50-59 Gender0 Race13) - (18-29 Gender0 Race15) -0.060515 0.1597 2143  -0.379
## (50-59 Gender0 Race13) - (30-39 Gender0 Race15)  0.021911 0.1573 2143   0.139
## (50-59 Gender0 Race13) - (40-49 Gender0 Race15)  0.148980 0.1591 2143   0.936
## (50-59 Gender0 Race13) - (50-59 Gender0 Race15)  0.132747 0.1353 2143   0.981
## (50-59 Gender0 Race13) - (18-29 Gender1 Race15) -0.259272 0.1668 2143  -1.554
## (50-59 Gender0 Race13) - (30-39 Gender1 Race15) -0.176847 0.1644 2143  -1.076
## (50-59 Gender0 Race13) - (40-49 Gender1 Race15) -0.049777 0.1666 2143  -0.299
## (50-59 Gender0 Race13) - (50-59 Gender1 Race15) -0.066011 0.1446 2143  -0.456
## (18-29 Gender1 Race13) - (30-39 Gender1 Race13)  0.082425 0.0787 2143   1.047
## (18-29 Gender1 Race13) - (40-49 Gender1 Race13)  0.209495 0.0791 2143   2.648
## (18-29 Gender1 Race13) - (50-59 Gender1 Race13)  0.193261 0.0822 2143   2.352
## (18-29 Gender1 Race13) - (18-29 Gender0 Race14)  0.259572 0.1132 2143   2.293
## (18-29 Gender1 Race13) - (30-39 Gender0 Race14)  0.341997 0.1361 2143   2.512
## (18-29 Gender1 Race13) - (40-49 Gender0 Race14)  0.469067 0.1349 2143   3.478
## (18-29 Gender1 Race13) - (50-59 Gender0 Race14)  0.452833 0.1322 2143   3.425
## (18-29 Gender1 Race13) - (18-29 Gender1 Race14)  0.060814 0.0938 2143   0.649
## (18-29 Gender1 Race13) - (30-39 Gender1 Race14)  0.143239 0.1204 2143   1.190
## (18-29 Gender1 Race13) - (40-49 Gender1 Race14)  0.270309 0.1196 2143   2.261
## (18-29 Gender1 Race13) - (50-59 Gender1 Race14)  0.254076 0.1173 2143   2.166
## (18-29 Gender1 Race13) - (18-29 Gender0 Race15)  0.331505 0.1485 2143   2.232
## (18-29 Gender1 Race13) - (30-39 Gender0 Race15)  0.413930 0.1667 2143   2.483
## (18-29 Gender1 Race13) - (40-49 Gender0 Race15)  0.541000 0.1681 2143   3.218
## (18-29 Gender1 Race13) - (50-59 Gender0 Race15)  0.524766 0.1675 2143   3.134
## (18-29 Gender1 Race13) - (18-29 Gender1 Race15)  0.132747 0.1353 2143   0.981
## (18-29 Gender1 Race13) - (30-39 Gender1 Race15)  0.215172 0.1549 2143   1.389
## (18-29 Gender1 Race13) - (40-49 Gender1 Race15)  0.342242 0.1570 2143   2.180
## (18-29 Gender1 Race13) - (50-59 Gender1 Race15)  0.326008 0.1568 2143   2.079
## (30-39 Gender1 Race13) - (40-49 Gender1 Race13)  0.127070 0.0776 2143   1.638
## (30-39 Gender1 Race13) - (50-59 Gender1 Race13)  0.110836 0.0805 2143   1.377
## (30-39 Gender1 Race13) - (18-29 Gender0 Race14)  0.177147 0.1396 2143   1.269
## (30-39 Gender1 Race13) - (30-39 Gender0 Race14)  0.259572 0.1132 2143   2.293
## (30-39 Gender1 Race13) - (40-49 Gender0 Race14)  0.386642 0.1357 2143   2.848
## (30-39 Gender1 Race13) - (50-59 Gender0 Race14)  0.370408 0.1330 2143   2.786
## (30-39 Gender1 Race13) - (18-29 Gender1 Race14) -0.021611 0.1244 2143  -0.174
## (30-39 Gender1 Race13) - (30-39 Gender1 Race14)  0.060814 0.0938 2143   0.649
```

```
## (30-39 Gender1 Race13) - (40-49 Gender1 Race14)    0.187884 0.1206 2143    1.557
## (30-39 Gender1 Race13) - (50-59 Gender1 Race14)    0.171650 0.1183 2143    1.452
## (30-39 Gender1 Race13) - (18-29 Gender0 Race15)    0.249080 0.1694 2143    1.470
## (30-39 Gender1 Race13) - (30-39 Gender0 Race15)    0.331505 0.1485 2143    2.232
## (30-39 Gender1 Race13) - (40-49 Gender0 Race15)    0.458575 0.1688 2143    2.717
## (30-39 Gender1 Race13) - (50-59 Gender0 Race15)    0.442341 0.1680 2143    2.633
## (30-39 Gender1 Race13) - (18-29 Gender1 Race15)    0.050322 0.1581 2143    0.318
## (30-39 Gender1 Race13) - (30-39 Gender1 Race15)    0.132747 0.1353 2143    0.981
## (30-39 Gender1 Race13) - (40-49 Gender1 Race15)    0.259817 0.1578 2143    1.647
## (30-39 Gender1 Race13) - (50-59 Gender1 Race15)    0.243583 0.1575 2143    1.546
## (40-49 Gender1 Race13) - (50-59 Gender1 Race13)   -0.016234 0.0804 2143   -0.202
## (40-49 Gender1 Race13) - (18-29 Gender0 Race14)    0.050077 0.1413 2143    0.354
## (40-49 Gender1 Race13) - (30-39 Gender0 Race14)    0.132502 0.1387 2143    0.955
## (40-49 Gender1 Race13) - (40-49 Gender0 Race14)    0.259572 0.1132 2143    2.293
## (40-49 Gender1 Race13) - (50-59 Gender0 Race14)    0.243338 0.1345 2143    1.810
## (40-49 Gender1 Race13) - (18-29 Gender1 Race14)   -0.148681 0.1257 2143   -1.183
## (40-49 Gender1 Race13) - (30-39 Gender1 Race14)   -0.066256 0.1227 2143   -0.540
## (40-49 Gender1 Race13) - (40-49 Gender1 Race14)    0.060814 0.0938 2143    0.649
## (40-49 Gender1 Race13) - (50-59 Gender1 Race14)    0.044581 0.1193 2143    0.374
## (40-49 Gender1 Race13) - (18-29 Gender0 Race15)    0.122010 0.1684 2143    0.725
## (40-49 Gender1 Race13) - (30-39 Gender0 Race15)    0.204435 0.1663 2143    1.230
## (40-49 Gender1 Race13) - (40-49 Gender0 Race15)    0.331505 0.1485 2143    2.232
## (40-49 Gender1 Race13) - (50-59 Gender0 Race15)    0.315271 0.1667 2143    1.891
## (40-49 Gender1 Race13) - (18-29 Gender1 Race15)   -0.076748 0.1564 2143   -0.491
## (40-49 Gender1 Race13) - (30-39 Gender1 Race15)    0.005677 0.1541 2143    0.037
## (40-49 Gender1 Race13) - (40-49 Gender1 Race15)    0.132747 0.1353 2143    0.981
## (40-49 Gender1 Race13) - (50-59 Gender1 Race15)    0.116513 0.1556 2143    0.749
## (50-59 Gender1 Race13) - (18-29 Gender0 Race14)    0.066310 0.1471 2143    0.451
## (50-59 Gender1 Race13) - (30-39 Gender0 Race14)    0.148736 0.1446 2143    1.029
## (50-59 Gender1 Race13) - (40-49 Gender0 Race14)    0.275805 0.1431 2143    1.927
## (50-59 Gender1 Race13) - (50-59 Gender0 Race14)    0.259572 0.1132 2143    2.293
## (50-59 Gender1 Race13) - (18-29 Gender1 Race14)   -0.132447 0.1316 2143   -1.006
## (50-59 Gender1 Race13) - (30-39 Gender1 Race14)   -0.050022 0.1287 2143   -0.389
## (50-59 Gender1 Race13) - (40-49 Gender1 Race14)    0.077048 0.1276 2143    0.604
## (50-59 Gender1 Race13) - (50-59 Gender1 Race14)    0.060814 0.0938 2143    0.649
## (50-59 Gender1 Race13) - (18-29 Gender0 Race15)    0.138243 0.1719 2143    0.804
## (50-59 Gender1 Race13) - (30-39 Gender0 Race15)    0.220668 0.1698 2143    1.300
## (50-59 Gender1 Race13) - (40-49 Gender0 Race15)    0.347738 0.1710 2143    2.034
## (50-59 Gender1 Race13) - (50-59 Gender0 Race15)    0.331505 0.1485 2143    2.232
## (50-59 Gender1 Race13) - (18-29 Gender1 Race15)   -0.060515 0.1597 2143   -0.379
## (50-59 Gender1 Race13) - (30-39 Gender1 Race15)    0.021911 0.1573 2143    0.139
## (50-59 Gender1 Race13) - (40-49 Gender1 Race15)    0.148980 0.1591 2143    0.936
## (50-59 Gender1 Race13) - (50-59 Gender1 Race15)    0.132747 0.1353 2143    0.981
## (18-29 Gender0 Race14) - (30-39 Gender0 Race14)    0.082425 0.0787 2143    1.047
## (18-29 Gender0 Race14) - (40-49 Gender0 Race14)    0.209495 0.0791 2143    2.648
## (18-29 Gender0 Race14) - (50-59 Gender0 Race14)    0.193261 0.0822 2143    2.352
## (18-29 Gender0 Race14) - (18-29 Gender1 Race14)   -0.198758 0.0564 2143   -3.524
## (18-29 Gender0 Race14) - (30-39 Gender1 Race14)   -0.116333 0.0967 2143   -1.203
## (18-29 Gender0 Race14) - (40-49 Gender1 Race14)    0.010737 0.0978 2143    0.110
## (18-29 Gender0 Race14) - (50-59 Gender1 Race14)   -0.005496 0.1012 2143   -0.054
## (18-29 Gender0 Race14) - (18-29 Gender0 Race15)    0.071933 0.1108 2143    0.649
## (18-29 Gender0 Race14) - (30-39 Gender0 Race15)    0.154358 0.1359 2143    1.136
## (18-29 Gender0 Race14) - (40-49 Gender0 Race15)    0.281428 0.1392 2143    2.022
## (18-29 Gender0 Race14) - (50-59 Gender0 Race15)    0.265194 0.1427 2143    1.859
```

```
## (18-29 Gender0 Race14) - (18-29 Gender1 Race15) -0.126825 0.1254 2143   -1.011
## (18-29 Gender0 Race14) - (30-39 Gender1 Race15) -0.044400 0.1480 2143   -0.300
## (18-29 Gender0 Race14) - (40-49 Gender1 Race15)  0.082670 0.1515 2143    0.546
## (18-29 Gender0 Race14) - (50-59 Gender1 Race15)  0.066436 0.1553 2143    0.428
## (30-39 Gender0 Race14) - (40-49 Gender0 Race14)  0.127070 0.0776 2143    1.638
## (30-39 Gender0 Race14) - (50-59 Gender0 Race14)  0.110836 0.0805 2143    1.377
## (30-39 Gender0 Race14) - (18-29 Gender1 Race14) -0.281183 0.0970 2143   -2.900
## (30-39 Gender0 Race14) - (30-39 Gender1 Race14) -0.198758 0.0564 2143   -3.524
## (30-39 Gender0 Race14) - (40-49 Gender1 Race14) -0.071688 0.0967 2143   -0.741
## (30-39 Gender0 Race14) - (50-59 Gender1 Race14) -0.087921 0.0999 2143   -0.880
## (30-39 Gender0 Race14) - (18-29 Gender0 Race15) -0.010492 0.1359 2143   -0.077
## (30-39 Gender0 Race14) - (30-39 Gender0 Race15)  0.071933 0.1108 2143    0.649
## (30-39 Gender0 Race14) - (40-49 Gender0 Race15)  0.199003 0.1383 2143    1.439
## (30-39 Gender0 Race14) - (50-59 Gender0 Race15)  0.182769 0.1417 2143    1.290
## (30-39 Gender0 Race14) - (18-29 Gender1 Race15) -0.209250 0.1481 2143   -1.413
## (30-39 Gender0 Race14) - (30-39 Gender1 Race15) -0.126825 0.1254 2143   -1.011
## (30-39 Gender0 Race14) - (40-49 Gender1 Race15)  0.000245 0.1508 2143    0.002
## (30-39 Gender0 Race14) - (50-59 Gender1 Race15) -0.015989 0.1544 2143   -0.104
## (40-49 Gender0 Race14) - (50-59 Gender0 Race14) -0.016234 0.0804 2143   -0.202
## (40-49 Gender0 Race14) - (18-29 Gender1 Race14) -0.408253 0.0965 2143   -4.230
## (40-49 Gender0 Race14) - (30-39 Gender1 Race14) -0.325828 0.0951 2143   -3.426
## (40-49 Gender0 Race14) - (40-49 Gender1 Race14) -0.198758 0.0564 2143   -3.524
## (40-49 Gender0 Race14) - (50-59 Gender1 Race14) -0.214991 0.0991 2143   -2.169
## (40-49 Gender0 Race14) - (18-29 Gender0 Race15) -0.137562 0.1330 2143   -1.034
## (40-49 Gender0 Race14) - (30-39 Gender0 Race15) -0.055137 0.1321 2143   -0.417
## (40-49 Gender0 Race14) - (40-49 Gender0 Race15)  0.071933 0.1108 2143    0.649
## (40-49 Gender0 Race14) - (50-59 Gender0 Race15)  0.055699 0.1386 2143    0.402
## (40-49 Gender0 Race14) - (18-29 Gender1 Race15) -0.336320 0.1450 2143   -2.320
## (40-49 Gender0 Race14) - (30-39 Gender1 Race15) -0.253895 0.1441 2143   -1.762
## (40-49 Gender0 Race14) - (40-49 Gender1 Race15) -0.126825 0.1254 2143   -1.011
## (40-49 Gender0 Race14) - (50-59 Gender1 Race15) -0.143059 0.1512 2143   -0.946
## (50-59 Gender0 Race14) - (18-29 Gender1 Race14) -0.392019 0.0982 2143   -3.994
## (50-59 Gender0 Race14) - (30-39 Gender1 Race14) -0.309594 0.0966 2143   -3.205
## (50-59 Gender0 Race14) - (40-49 Gender1 Race14) -0.182524 0.0973 2143   -1.875
## (50-59 Gender0 Race14) - (50-59 Gender1 Race14) -0.198758 0.0564 2143   -3.524
## (50-59 Gender0 Race14) - (18-29 Gender0 Race15) -0.121329 0.1331 2143   -0.912
## (50-59 Gender0 Race14) - (30-39 Gender0 Race15) -0.038904 0.1320 2143   -0.295
## (50-59 Gender0 Race14) - (40-49 Gender0 Race15)  0.088166 0.1351 2143    0.652
## (50-59 Gender0 Race14) - (50-59 Gender0 Race15)  0.071933 0.1108 2143    0.649
## (50-59 Gender0 Race14) - (18-29 Gender1 Race15) -0.320086 0.1444 2143   -2.216
## (50-59 Gender0 Race14) - (30-39 Gender1 Race15) -0.237661 0.1434 2143   -1.657
## (50-59 Gender0 Race14) - (40-49 Gender1 Race15) -0.110591 0.1468 2143   -0.753
## (50-59 Gender0 Race14) - (50-59 Gender1 Race15) -0.126825 0.1254 2143   -1.011
## (18-29 Gender1 Race14) - (30-39 Gender1 Race14)  0.082425 0.0787 2143    1.047
## (18-29 Gender1 Race14) - (40-49 Gender1 Race14)  0.209495 0.0791 2143    2.648
## (18-29 Gender1 Race14) - (50-59 Gender1 Race14)  0.193261 0.0822 2143    2.352
## (18-29 Gender1 Race14) - (18-29 Gender0 Race15)  0.270691 0.1232 2143    2.197
## (18-29 Gender1 Race14) - (30-39 Gender0 Race15)  0.353116 0.1463 2143    2.413
## (18-29 Gender1 Race14) - (40-49 Gender0 Race15)  0.480186 0.1489 2143    3.226
## (18-29 Gender1 Race14) - (50-59 Gender0 Race15)  0.463952 0.1515 2143    3.062
## (18-29 Gender1 Race14) - (18-29 Gender1 Race15)  0.071933 0.1108 2143    0.649
## (18-29 Gender1 Race14) - (30-39 Gender1 Race15)  0.154358 0.1359 2143    1.136
## (18-29 Gender1 Race14) - (40-49 Gender1 Race15)  0.281428 0.1392 2143    2.022
## (18-29 Gender1 Race14) - (50-59 Gender1 Race15)  0.265194 0.1427 2143    1.859
```

56

```
## (30-39 Gender1 Race14) - (40-49 Gender1 Race14)   0.127070 0.0776 2143    1.638
## (30-39 Gender1 Race14) - (50-59 Gender1 Race14)   0.110836 0.0805 2143    1.377
## (30-39 Gender1 Race14) - (18-29 Gender0 Race15)   0.188265 0.1461 2143    1.289
## (30-39 Gender1 Race14) - (30-39 Gender0 Race15)   0.270691 0.1232 2143    2.197
## (30-39 Gender1 Race14) - (40-49 Gender0 Race15)   0.397761 0.1479 2143    2.689
## (30-39 Gender1 Race14) - (50-59 Gender0 Race15)   0.381527 0.1505 2143    2.535
## (30-39 Gender1 Race14) - (18-29 Gender1 Race15)  -0.010492 0.1359 2143   -0.077
## (30-39 Gender1 Race14) - (30-39 Gender1 Race15)   0.071933 0.1108 2143    0.649
## (30-39 Gender1 Race14) - (40-49 Gender1 Race15)   0.199003 0.1383 2143    1.439
## (30-39 Gender1 Race14) - (50-59 Gender1 Race15)   0.182769 0.1417 2143    1.290
## (40-49 Gender1 Race14) - (50-59 Gender1 Race14)  -0.016234 0.0804 2143   -0.202
## (40-49 Gender1 Race14) - (18-29 Gender0 Race15)   0.061195 0.1440 2143    0.425
## (40-49 Gender1 Race14) - (30-39 Gender0 Race15)   0.143621 0.1433 2143    1.003
## (40-49 Gender1 Race14) - (40-49 Gender0 Race15)   0.270691 0.1232 2143    2.197
## (40-49 Gender1 Race14) - (50-59 Gender0 Race15)   0.254457 0.1482 2143    1.717
## (40-49 Gender1 Race14) - (18-29 Gender1 Race15)  -0.137562 0.1330 2143   -1.034
## (40-49 Gender1 Race14) - (30-39 Gender1 Race15)  -0.055137 0.1321 2143   -0.417
## (40-49 Gender1 Race14) - (40-49 Gender1 Race15)   0.071933 0.1108 2143    0.649
## (40-49 Gender1 Race14) - (50-59 Gender1 Race15)   0.055699 0.1386 2143    0.402
## (50-59 Gender1 Race14) - (18-29 Gender0 Race15)   0.077429 0.1446 2143    0.535
## (50-59 Gender1 Race14) - (30-39 Gender0 Race15)   0.159854 0.1438 2143    1.112
## (50-59 Gender1 Race14) - (40-49 Gender0 Race15)   0.286924 0.1461 2143    1.964
## (50-59 Gender1 Race14) - (50-59 Gender0 Race15)   0.270691 0.1232 2143    2.197
## (50-59 Gender1 Race14) - (18-29 Gender1 Race15)  -0.121329 0.1331 2143   -0.912
## (50-59 Gender1 Race14) - (30-39 Gender1 Race15)  -0.038904 0.1320 2143   -0.295
## (50-59 Gender1 Race14) - (40-49 Gender1 Race15)   0.088166 0.1351 2143    0.652
## (50-59 Gender1 Race14) - (50-59 Gender1 Race15)   0.071933 0.1108 2143    0.649
## (18-29 Gender0 Race15) - (30-39 Gender0 Race15)   0.082425 0.0787 2143    1.047
## (18-29 Gender0 Race15) - (40-49 Gender0 Race15)   0.209495 0.0791 2143    2.648
## (18-29 Gender0 Race15) - (50-59 Gender0 Race15)   0.193261 0.0822 2143    2.352
## (18-29 Gender0 Race15) - (18-29 Gender1 Race15)  -0.198758 0.0564 2143   -3.524
## (18-29 Gender0 Race15) - (30-39 Gender1 Race15)  -0.116333 0.0967 2143   -1.203
## (18-29 Gender0 Race15) - (40-49 Gender1 Race15)   0.010737 0.0978 2143    0.110
## (18-29 Gender0 Race15) - (50-59 Gender1 Race15)  -0.005496 0.1012 2143   -0.054
## (30-39 Gender0 Race15) - (40-49 Gender0 Race15)   0.127070 0.0776 2143    1.638
## (30-39 Gender0 Race15) - (50-59 Gender0 Race15)   0.110836 0.0805 2143    1.377
## (30-39 Gender0 Race15) - (18-29 Gender1 Race15)  -0.281183 0.0970 2143   -2.900
## (30-39 Gender0 Race15) - (30-39 Gender1 Race15)  -0.198758 0.0564 2143   -3.524
## (30-39 Gender0 Race15) - (40-49 Gender1 Race15)  -0.071688 0.0967 2143   -0.741
## (30-39 Gender0 Race15) - (50-59 Gender1 Race15)  -0.087921 0.0999 2143   -0.880
## (40-49 Gender0 Race15) - (50-59 Gender0 Race15)  -0.016234 0.0804 2143   -0.202
## (40-49 Gender0 Race15) - (18-29 Gender1 Race15)  -0.408253 0.0965 2143   -4.230
## (40-49 Gender0 Race15) - (30-39 Gender1 Race15)  -0.325828 0.0951 2143   -3.426
## (40-49 Gender0 Race15) - (40-49 Gender1 Race15)  -0.198758 0.0564 2143   -3.524
## (40-49 Gender0 Race15) - (50-59 Gender1 Race15)  -0.214991 0.0991 2143   -2.169
## (50-59 Gender0 Race15) - (18-29 Gender1 Race15)  -0.392019 0.0982 2143   -3.994
## (50-59 Gender0 Race15) - (30-39 Gender1 Race15)  -0.309594 0.0966 2143   -3.205
## (50-59 Gender0 Race15) - (40-49 Gender1 Race15)  -0.182524 0.0973 2143   -1.875
## (50-59 Gender0 Race15) - (50-59 Gender1 Race15)  -0.198758 0.0564 2143   -3.524
## (18-29 Gender1 Race15) - (30-39 Gender1 Race15)   0.082425 0.0787 2143    1.047
## (18-29 Gender1 Race15) - (40-49 Gender1 Race15)   0.209495 0.0791 2143    2.648
## (18-29 Gender1 Race15) - (50-59 Gender1 Race15)   0.193261 0.0822 2143    2.352
## (30-39 Gender1 Race15) - (40-49 Gender1 Race15)   0.127070 0.0776 2143    1.638
## (30-39 Gender1 Race15) - (50-59 Gender1 Race15)   0.110836 0.0805 2143    1.377
```

```
##  (40-49 Gender1 Race15) - (50-59 Gender1 Race15) -0.016234 0.0804 2143  -0.202
##   p.value
##   1.0000
##   0.8028
##   0.9458
##   0.1603
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   0.7927
##   0.9992
##   1.0000
##   1.0000
##   0.1062
##   0.9191
##   1.0000
##   1.0000
##   0.0020
##   0.1753
##   0.7947
##   0.7842
##   0.0114
##   0.9078
##   1.0000
##   1.0000
##   <.0001
##   0.0825
##   0.7230
##   0.6625
##   0.9722
##   1.0000
##   1.0000
##   1.0000
##   0.2135
##   0.8844
##   0.9998
##   0.9996
##   0.9999
##   1.0000
##   0.6054
##   0.1603
##   1.0000
##   1.0000
##   0.9996
##   1.0000
##   1.0000
##   1.0000
##   0.6444
##   0.7927
##   1.0000
```

```
##    0.9999
##    0.1181
##    0.1062
##    0.9869
##    0.9827
##    0.0033
##    0.0020
##    0.3457
##    0.3467
##    0.0694
##    0.0114
##    0.9916
##    0.9808
##    0.0007
##    <.0001
##    0.2306
##    0.1937
##    0.9157
##    0.9722
##    1.0000
##    1.0000
##    0.1839
##    0.2135
##    0.9792
##    0.9700
##    1.0000
##    0.0142
##    0.2089
##    0.1603
##    0.9827
##    0.8411
##    0.9932
##    1.0000
##    1.0000
##    0.1177
##    0.4138
##    0.7927
##    0.9327
##    0.0041
##    0.0411
##    0.1062
##    0.4784
##    0.0001
##    0.0008
##    0.0020
##    0.0317
##    0.0011
##    0.0150
##    0.0114
##    0.3189
##    <.0001
##    0.0001
##    <.0001
##    0.0067
```

```
##    0.2836
##    0.6930
##    0.9722
##    0.9959
##    0.0109
##    0.0612
##    0.2135
##    0.4813
##    0.0350
##    0.3524
##    0.9987
##    0.1603
##    0.8940
##    0.9972
##    1.0000
##    1.0000
##    0.1486
##    0.4800
##    0.9675
##    0.7927
##    0.0053
##    0.0516
##    0.5496
##    0.1062
##    0.0001
##    0.0009
##    0.0340
##    0.0020
##    0.0031
##    0.0342
##    0.5544
##    0.0114
##    <.0001
##    0.0002
##    0.0166
##    <.0001
##    0.3637
##    0.7775
##    0.9993
##    0.9722
##    0.0158
##    0.0827
##    0.5944
##    0.2135
##    1.0000
##    0.8028
##    0.9458
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
```

```
##    1.0000
##    0.9994
##    1.0000
##    1.0000
##    1.0000
##    0.1062
##    0.9191
##    1.0000
##    1.0000
##    0.9999
##    1.0000
##    1.0000
##    1.0000
##    0.0114
##    0.9078
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9722
##    1.0000
##    1.0000
##    1.0000
##    0.9999
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9996
##    1.0000
##    1.0000
##    1.0000
##    0.9903
##    0.9994
##    1.0000
##    1.0000
##    0.1181
##    0.1062
##    0.9869
##    0.9827
##    0.9982
##    0.9999
##    1.0000
##    1.0000
##    0.0694
##    0.0114
##    0.9916
##    0.9808
##    1.0000
##    1.0000
##    1.0000
```

```
##   1.0000
##   0.9157
##   0.9722
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   0.8411
##   0.9932
##   1.0000
##   1.0000
##   0.5711
##   0.9349
##   0.9994
##   1.0000
##   0.0041
##   0.0411
##   0.1062
##   0.4784
##   0.6514
##   0.9691
##   0.9999
##   1.0000
##   0.0011
##   0.0150
##   0.0114
##   0.3189
##   0.9987
##   1.0000
##   1.0000
##   1.0000
##   0.2836
##   0.6930
##   0.9722
##   0.9959
##   1.0000
##   1.0000
##   1.0000
##   1.0000
##   0.8940
##   0.9972
##   1.0000
##   1.0000
##   0.6478
##   0.9610
##   1.0000
##   0.9994
##   0.0053
##   0.0516
##   0.5496
##   0.1062
```

```
##    0.7903
##    0.9907
##    1.0000
##    0.9999
##    0.0031
##    0.0342
##    0.5544
##    0.0114
##    0.9996
##    1.0000
##    1.0000
##    1.0000
##    0.3637
##    0.7775
##    0.9993
##    0.9722
##    1.0000
##    0.8028
##    0.9458
##    0.1603
##    1.0000
##    1.0000
##    1.0000
##    0.9998
##    1.0000
##    1.0000
##    1.0000
##    0.6349
##    0.9921
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.5680
##    0.9963
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9987
##    1.0000
##    1.0000
##    1.0000
##    0.9999
##    1.0000
##    0.6054
##    0.1603
##    1.0000
##    1.0000
##    0.9958
```

```
##    0.9998
##    1.0000
##    1.0000
##    0.5062
##    0.6349
##    0.9994
##    0.9988
##    0.9993
##    1.0000
##    1.0000
##    1.0000
##    0.5135
##    0.5680
##    0.9999
##    0.9996
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9880
##    0.9987
##    1.0000
##    1.0000
##    1.0000
##    0.0142
##    0.2089
##    0.1603
##    0.9827
##    0.6997
##    0.9622
##    0.9998
##    1.0000
##    0.0776
##    0.2814
##    0.6349
##    0.8321
##    0.7650
##    0.9824
##    1.0000
##    1.0000
##    0.0619
##    0.2482
##    0.5680
##    0.8188
##    0.9991
##    1.0000
##    1.0000
##    1.0000
##    0.6479
##    0.9209
##    0.9987
##    0.9996
##    0.0350
##    0.3524
```

```
##    0.9987
##    0.1603
##    0.7821
##    0.9811
##    1.0000
##    0.9998
##    0.1042
##    0.3459
##    0.9074
##    0.6349
##    0.8806
##    0.9957
##    1.0000
##    1.0000
##    0.1118
##    0.3708
##    0.9458
##    0.5680
##    0.9998
##    1.0000
##    1.0000
##    1.0000
##    0.7383
##    0.9558
##    1.0000
##    0.9987
##    1.0000
##    0.8028
##    0.9458
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9998
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9998
##    0.9999
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9999
```

```
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9958
##    0.9998
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9993
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.6997
##    0.9622
##    0.9998
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.7650
##    0.9824
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9991
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
```

```
##    0.7821
##    0.9811
##    1.0000
##    0.9998
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.8806
##    0.9957
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9998
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.8028
##    0.9458
##    0.1603
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9682
##    0.9831
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9814
##    0.9913
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9999
##    1.0000
##    0.6054
##    0.1603
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9999
```

```
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9999
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.0142
##    0.2089
##    0.1603
##    0.9827
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.8406
##    0.9948
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9999
##    1.0000
##    1.0000
##    1.0000
##    0.0350
##    0.3524
##    0.9987
##    0.1603
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9371
##    0.9992
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.8028
```

```
##    0.9458
##    0.9613
##    0.8825
##    0.1820
##    0.2095
##    1.0000
##    1.0000
##    0.9682
##    0.9831
##    0.9734
##    0.8963
##    0.3432
##    0.4079
##    1.0000
##    1.0000
##    0.9814
##    0.9913
##    0.9999
##    1.0000
##    1.0000
##    0.9613
##    0.6490
##    0.7005
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9734
##    0.7540
##    0.8128
##    1.0000
##    1.0000
##    0.9999
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9613
##    0.9994
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9734
##    0.9984
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
```

```
##    0.9978
##    0.9613
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9940
##    0.9734
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.8028
##    0.9458
##    0.1603
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9946
##    0.9989
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9999
##    1.0000
##    0.6054
##    0.1603
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.0142
##    0.2089
##    0.1603
##    0.9827
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9547
##    0.9996
```

```
##    1.0000
##    1.0000
##    0.0350
##    0.3524
##    0.9987
##    0.1603
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9761
##    0.9999
##    1.0000
##    1.0000
##    1.0000
##    0.8028
##    0.9458
##    0.9790
##    0.9254
##    0.3370
##    0.4668
##    1.0000
##    1.0000
##    0.9946
##    0.9989
##    0.9999
##    1.0000
##    1.0000
##    0.9790
##    0.7741
##    0.8705
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9790
##    0.9998
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.9968
##    0.9790
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    1.0000
##    0.8028
```

```
##   0.9458
##   0.1603
##   1.0000
##   1.0000
##   1.0000
##   0.9999
##   1.0000
##   0.6054
##   0.1603
##   1.0000
##   1.0000
##   1.0000
##   0.0142
##   0.2089
##   0.1603
##   0.9827
##   0.0350
##   0.3524
##   0.9987
##   0.1603
##   1.0000
##   0.8028
##   0.9458
##   0.9999
##   1.0000
##   1.0000
##
## P value adjustment: tukey method for comparing a family of 40 estimates
```