```r
setwd("~/Documents/Classes/Stat423")
df <- read.csv("sleep_cycle_productivity.csv")

df$Gender <- as.factor(df$Gender)

rating_vars <- c("Sleep.Quality", "Productivity.Score", "Mood.Score", "Stress.Level")
for (var in rating_vars) {
  new_var <- paste0(var, "Cat")
  df[[new_var]] <- cut(df[[var]], breaks = c(0, 3, 7, 10),
                       labels = c("Low", "Medium", "High"), right = TRUE)
  df[[new_var]] <- as.factor(df[[new_var]])
}

summary(df)
```

```
##      Date              Person_ID         Age           Gender
##  Length:5000        Min.   :1000   Min.   :18.00   Female:1675
##  Class :character   1st Qu.:3258   1st Qu.:28.00   Male  :1718
##  Mode  :character   Median :5603   Median :39.00   Other :1607
##                     Mean   :5527   Mean   :38.59
##                     3rd Qu.:7750   3rd Qu.:49.00
##                     Max.   :9998   Max.   :59.00
##  Sleep.Start.Time Sleep.End.Time Total.Sleep.Hours Sleep.Quality
##  Min.   :20.00    Min.   :0.56   Min.   :4.500     Min.   : 1.000
##  1st Qu.:21.02    1st Qu.:3.66   1st Qu.:5.690     1st Qu.: 3.000
##  Median :22.02    Median :4.97   Median :6.960     Median : 5.000
##  Mean   :22.01    Mean   :4.98   Mean   :6.975     Mean   : 5.521
##  3rd Qu.:23.00    3rd Qu.:6.31   3rd Qu.:8.210     3rd Qu.: 8.000
##  Max.   :23.98    Max.   :9.42   Max.   :9.500     Max.   :10.000
##  Exercise..mins.day. Caffeine.Intake..mg. Screen.Time.Before.Bed..mins.
##  Min.   : 0.00       Min.   :  0.0        Min.   :  0.00
##  1st Qu.:22.00       1st Qu.: 73.0        1st Qu.: 46.00
##  Median :44.00       Median :144.0        Median : 92.00
##  Mean   :43.96       Mean   :146.7        Mean   : 91.42
##  3rd Qu.:66.00       3rd Qu.:220.0        3rd Qu.:136.00
##  Max.   :89.00       Max.   :299.0        Max.   :179.00
##  Work.Hours..hrs.day. Productivity.Score   Mood.Score      Stress.Level
##  Min.   : 4.000       Min.   : 1.000     Min.   : 1.000   Min.   : 1.000
##  1st Qu.: 6.033       1st Qu.: 3.000     1st Qu.: 3.000   1st Qu.: 3.000
##  Median : 7.998       Median : 6.000     Median : 5.000   Median : 6.000
##  Mean   : 7.988       Mean   : 5.644     Mean   : 5.371   Mean   : 5.548
##  3rd Qu.: 9.905       3rd Qu.: 8.000     3rd Qu.: 8.000   3rd Qu.: 8.000
##  Max.   :11.999       Max.   :10.000     Max.   :10.000   Max.   :10.000
##  Sleep.QualityCat Productivity.ScoreCat Mood.ScoreCat Stress.LevelCat
##  Low   :1473      Low   :1428           Low   :1561   Low   :1489
##  Medium:2035      Medium:1964           Medium:2047   Medium:1966
##  High  :1492      High  :1608           High  :1392   High  :1545
##
##
##
```

```r
head(df)
```

```
##         Date Person_ID Age Gender Sleep.Start.Time Sleep.End.Time
```

```
## 1 2024-04-12      1860  32  Other            23.33           4.61
## 2 2024-11-04      1769  41 Female            21.02           2.43
## 3 2024-08-31      2528  20   Male            22.10           3.45
## 4 2024-02-22      8041  37  Other            23.10           6.65
## 5 2024-02-23      4843  46  Other            21.42           4.17
## 6 2024-07-08      7439  38   Male            21.77           6.41
##   Total.Sleep.Hours Sleep.Quality Exercise..mins.day. Caffeine.Intake..mg.
## 1              5.28             3                  86                   87
## 2              5.41             5                  32                   21
## 3              5.35             7                  17                   88
## 4              7.55             8                  46                   34
## 5              6.75            10                  61                  269
## 6              8.64            10                  88                  251
##   Screen.Time.Before.Bed..mins. Work.Hours..hrs.day. Productivity.Score
## 1                           116            8.808920                   8
## 2                            88            6.329833                  10
## 3                            59            8.506306                  10
## 4                            80            6.070240                   8
## 5                            94           11.374994                   8
## 6                           123            6.207993                   1
##   Mood.Score Stress.Level Sleep.QualityCat Productivity.ScoreCat Mood.ScoreCat
## 1          3            6              Low                  High           Low
## 2          3            7           Medium                  High           Low
## 3          9           10           Medium                  High          High
## 4          4            2             High                  High        Medium
## 5          7            9             High                  High        Medium
## 6          9            7             High                   Low          High
##   Stress.LevelCat
## 1          Medium
## 2          Medium
## 3            High
## 4             Low
## 5            High
## 6          Medium
```

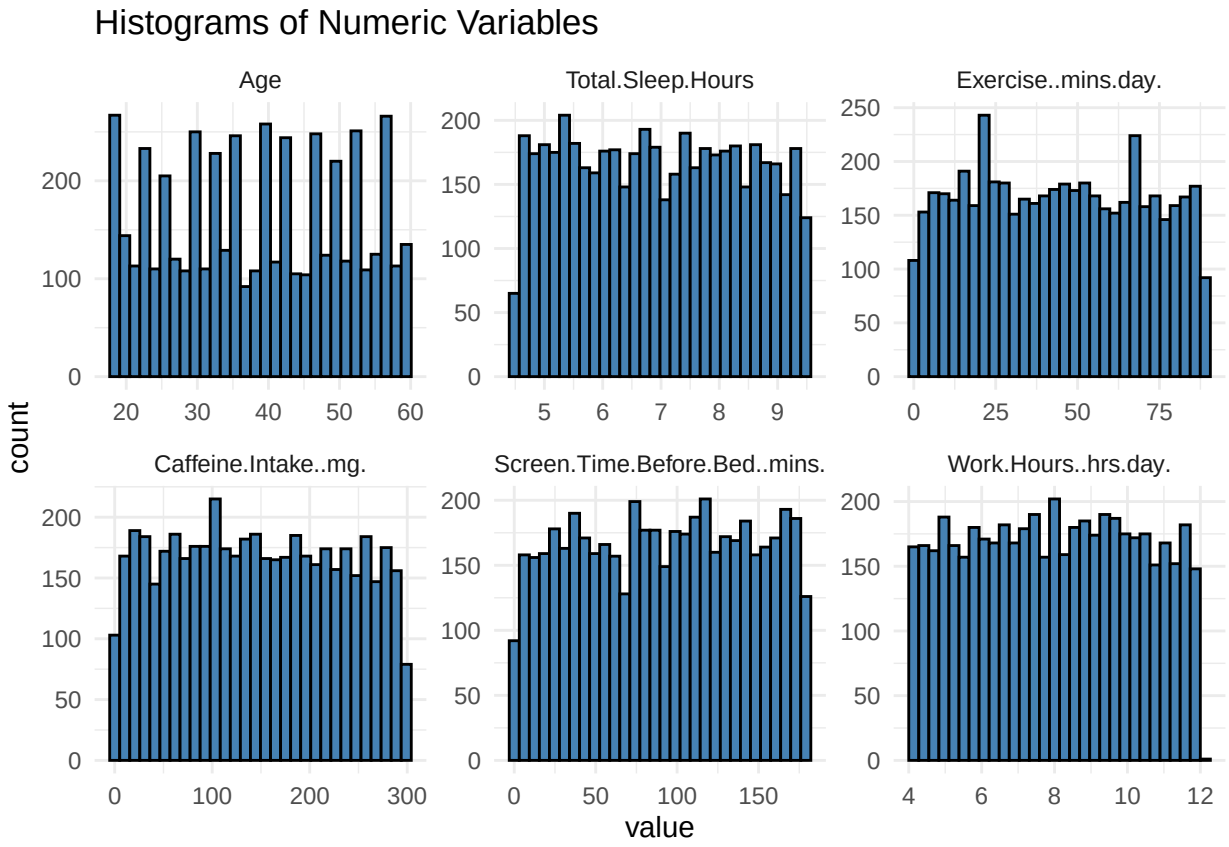
```r
numeric_vars <- c("Age", "Total.Sleep.Hours", "Exercise..mins.day.",
                  "Caffeine.Intake..mg.", "Screen.Time.Before.Bed..mins.", "Work.Hours..hrs.day.")

df_numeric <- df[, numeric_vars]
summary(df_numeric)
```

```
##       Age        Total.Sleep.Hours Exercise..mins.day. Caffeine.Intake..mg.
##  Min.   :18.00   Min.   :4.500     Min.   : 0.00       Min.   :  0.0
##  1st Qu.:28.00   1st Qu.:5.690     1st Qu.:22.00       1st Qu.: 73.0
##  Median :39.00   Median :6.960     Median :44.00       Median :144.0
##  Mean   :38.59   Mean   :6.975     Mean   :43.96       Mean   :146.7
##  3rd Qu.:49.00   3rd Qu.:8.210     3rd Qu.:66.00       3rd Qu.:220.0
##  Max.   :59.00   Max.   :9.500     Max.   :89.00       Max.   :299.0
##  Screen.Time.Before.Bed..mins. Work.Hours..hrs.day.
##  Min.   :  0.00                Min.   : 4.000
##  1st Qu.: 46.00                1st Qu.: 6.033
##  Median : 92.00                Median : 7.998
##  Mean   : 91.42                Mean   : 7.988
##  3rd Qu.:136.00                3rd Qu.: 9.905
##  Max.   :179.00                Max.   :11.999
```

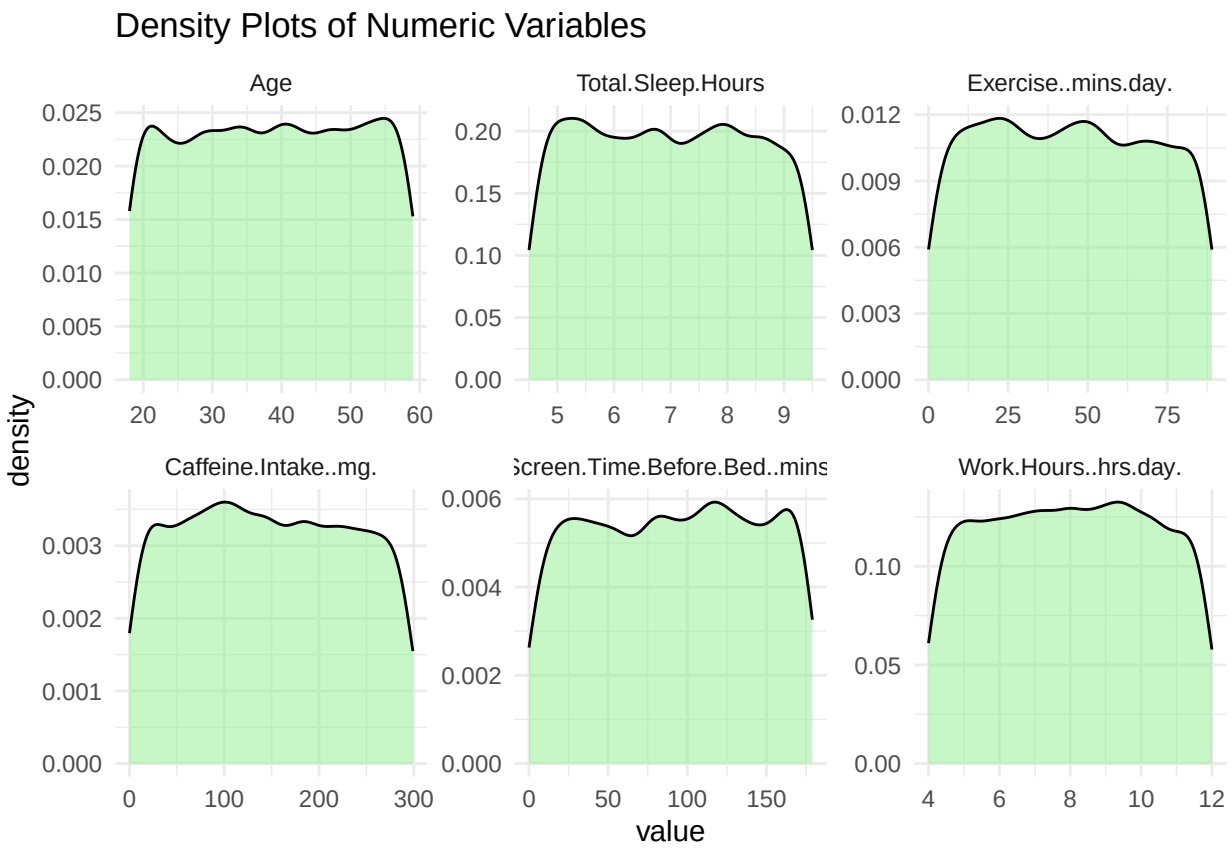
```
library(ggplot2)
library(reshape2)
df_numeric_long <- melt(df_numeric)
```

```
## No id variables; using all as measure variables
```

```
ggplot(df_numeric_long, aes(x = value)) +
  geom_histogram(bins = 30, fill = "steelblue", color = "black") +
  facet_wrap(~ variable, scales = "free") +
  theme_minimal() +
  ggtitle("Histograms of Numeric Variables")
```

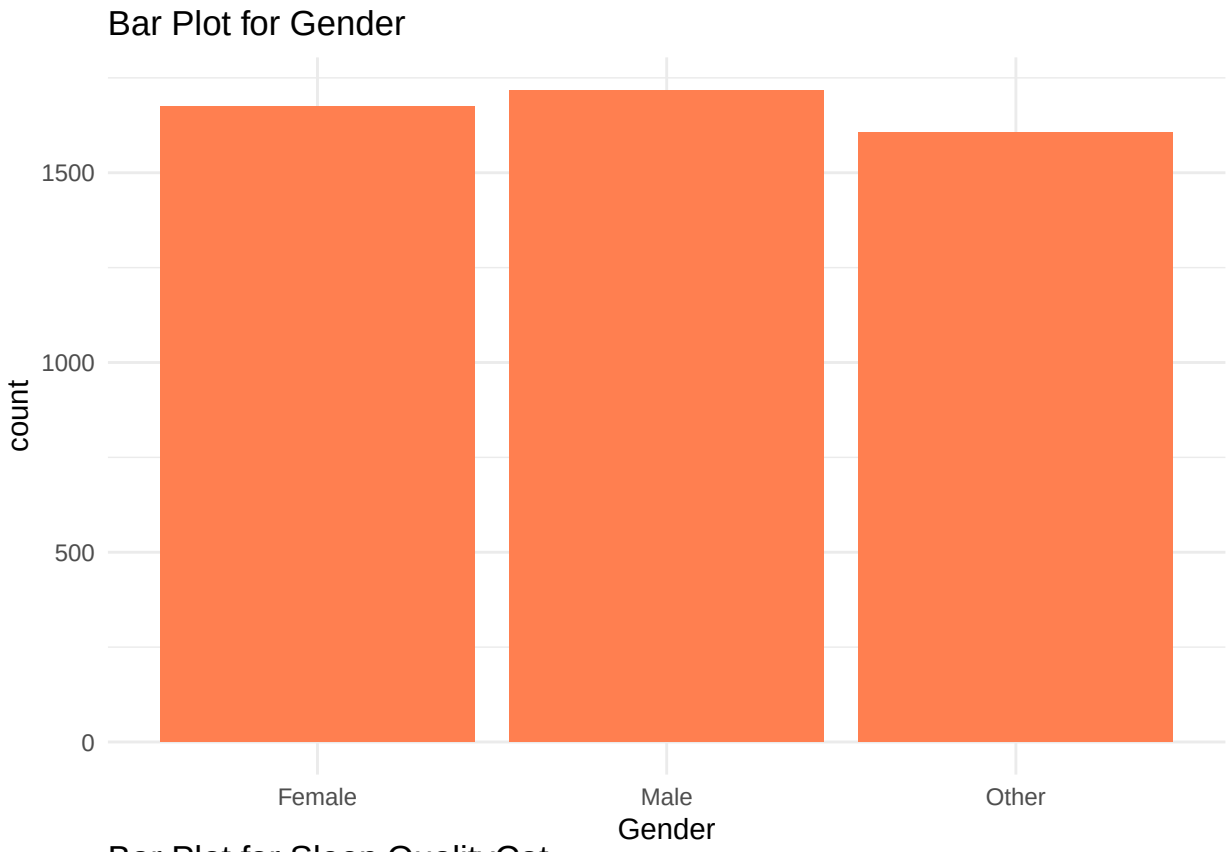


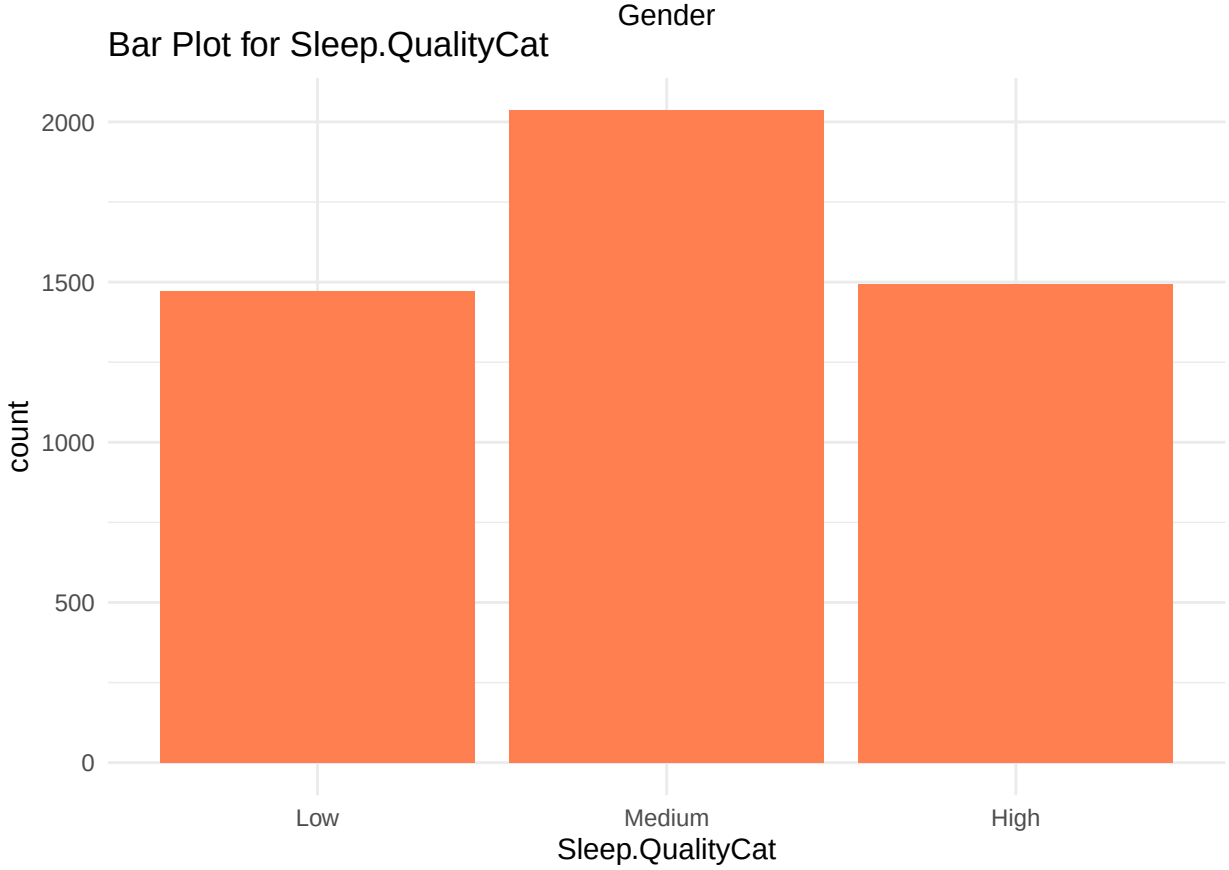

```
ggplot(df_numeric_long, aes(x = value)) +
  geom_density(fill = "lightgreen", alpha = 0.5) +
  facet_wrap(~ variable, scales = "free") +
  theme_minimal() +
  ggtitle("Density Plots of Numeric Variables")
```

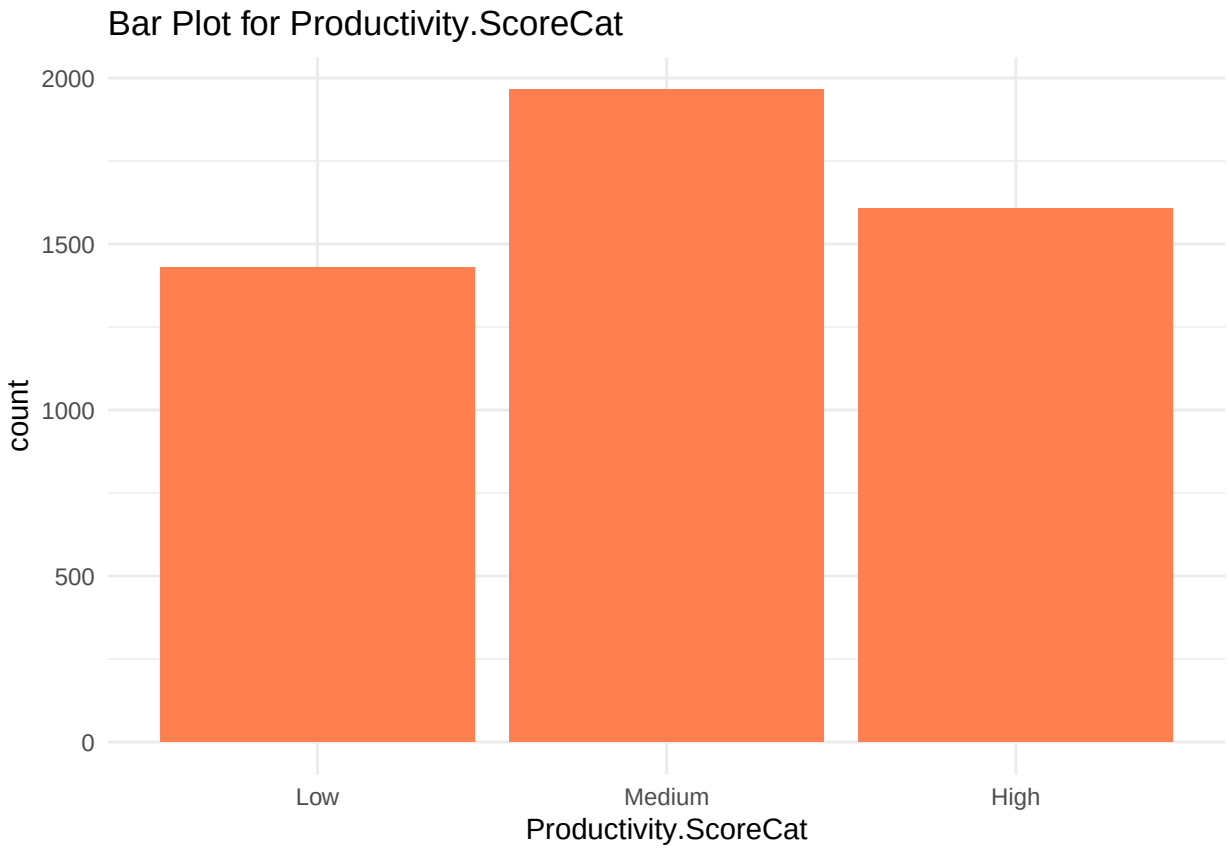


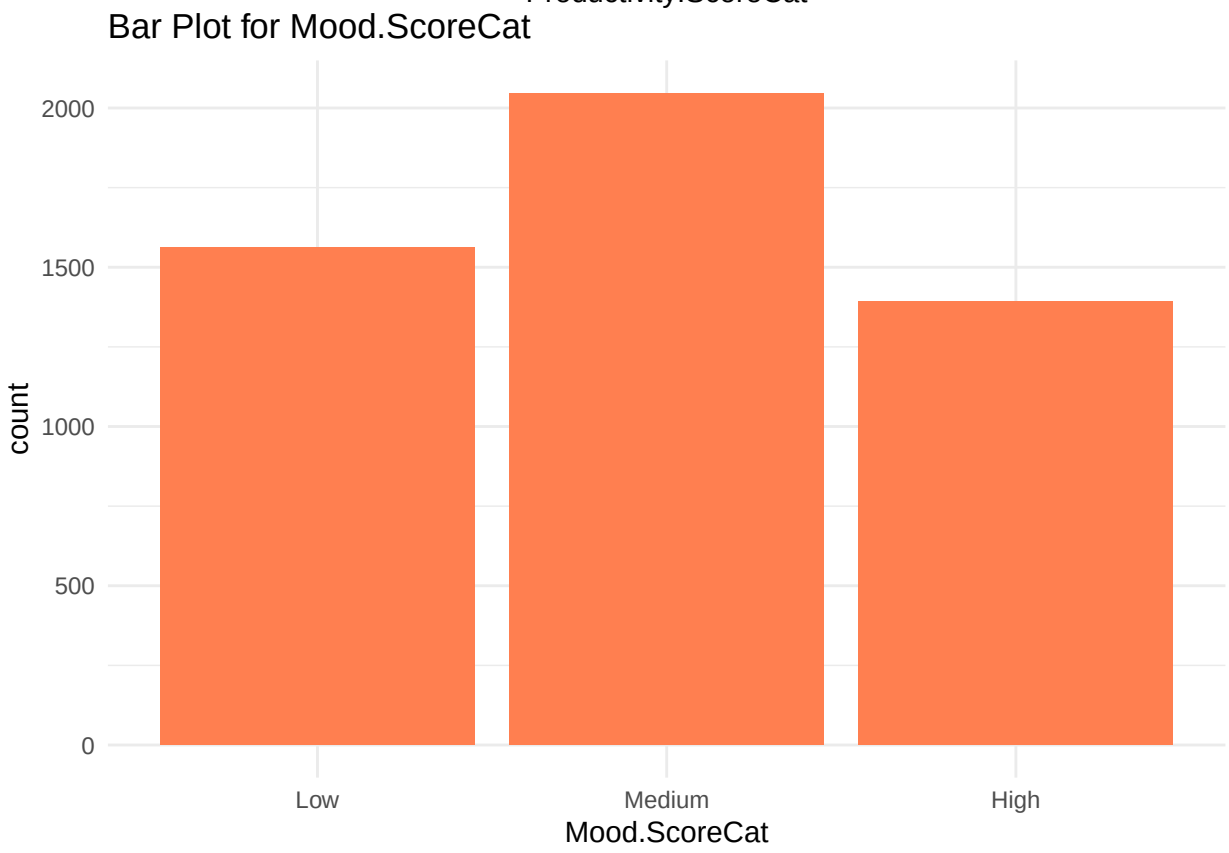

```
categorical_vars <- c("Gender", "Sleep.QualityCat", "Productivity.ScoreCat", "Mood.ScoreCat", "Stress.L

par(mfrow = c(3,2))

for (var in categorical_vars) {
  print(ggplot(df, aes_string(x = var)) +
  geom_bar(fill = "coral") +
  theme_minimal() +
  ggtitle(paste("Bar Plot for", var)))
}
```

```
## 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.
```


Bar Plot for Gender
1500
1000
500
0
count
Female
Male
Other
Gender


Bar Plot for Sleep.QualityCat
2000
1500
1000
500
0
count
Low
Medium
High
Sleep.QualityCat

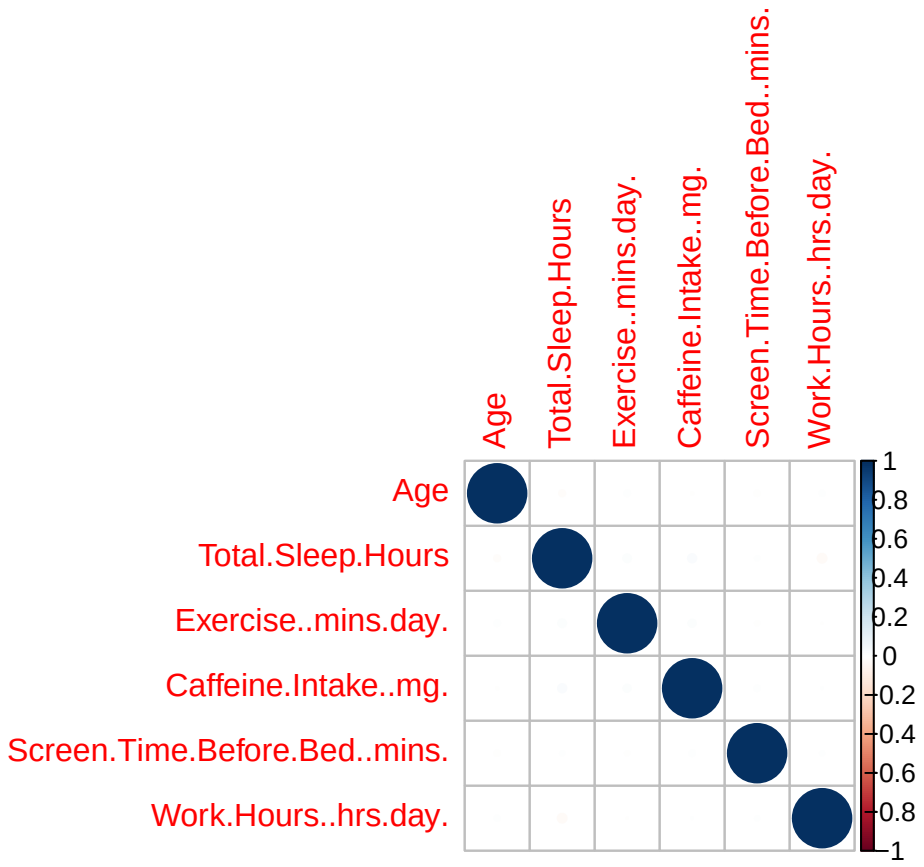

Bar Plot for Productivity.ScoreCat
2000
1500
1000
500
0
count
Low
Medium
High
Productivity.ScoreCat


Bar Plot for Mood.ScoreCat
2000
1500
1000
500
0
count
Low
Medium
High
Mood.ScoreCat


```
library(corrplot)
```

```
## corrplot 0.95 loaded
```

```
numeric_vars <- c("Age", "Total.Sleep.Hours", "Exercise..mins.day.",
                  "Caffeine.Intake..mg.", "Screen.Time.Before.Bed..mins.", "Work.Hours..hrs.day.")

df_numeric <- df[, numeric_vars]

cor_matrix <- cor(df_numeric, use = "complete.obs")
corrplot(cor_matrix,  method = "circle")
```



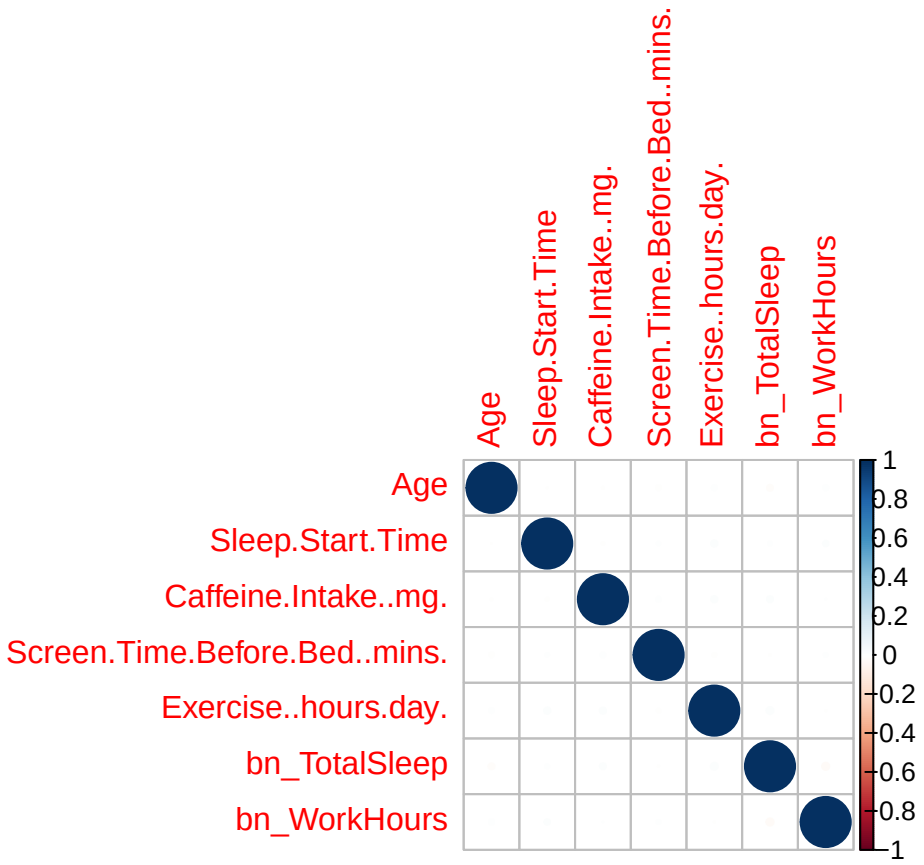

```
setwd("~/Documents/Classes/Stat423")
df <- read.csv("sleep_cycle_productivity.csv")
df$Gender <- as.factor(df$Gender)

rating_vars <- c("Sleep.Quality", "Productivity.Score", "Mood.Score", "Stress.Level")
for (var in rating_vars) {
  new_var <- paste0(var, "Cat")
  df[[new_var]] <- cut(df[[var]],
                       breaks = c(0, 3, 7, 10),
                       labels = c("Low", "Medium", "High"),
                       right = TRUE)
  df[[new_var]] <- as.factor(df[[new_var]])
}

df_model <- df[, !(names(df) %in% c("Date", "Person_ID", "Sleep.End.Time",
                                    "Sleep.Quality", "Productivity.Score", "Mood.Score", "Stress.Level"
df_model$Exercise..hours.day. <- df_model$Exercise..mins.day./60

library(bestNormalize)

bn_sleep <- bestNormalize(df_model$Total.Sleep.Hours)
```

```
## Warning: `progress_estimated()` was deprecated in dplyr 1.0.0.
## i The deprecated feature was likely used in the bestNormalize package.
##   Please report the issue to the authors.
## This warning is displayed once every 8 hours.
```

```
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```

```
#print(bn_sleep$chosen_transform)
#paste("Transformation used: ", bn_sleep$chosen_transform)
df_model$bn_TotalSleep <- predict(bn_sleep)

bn_work <- bestNormalize(df_model$Work.Hours..hrs.day.)
```

```
#paste("Transformation used: ", bn_work$chosen_transform)
df_model$bn_WorkHours <- predict(bn_work)

df_model_corr_plot <- df_model[, !(names(df_model) %in% c("Total.Sleep.Hours", "Work.Hours..hrs.day.",

cor_matrix <- cor(df_model_corr_plot[, sapply(df_model_corr_plot, is.numeric)], use = "complete.obs")
corrplot(cor_matrix, method = "circle")
```




```
model_sleep_bn <- lm(bn_TotalSleep ~ (Age + Gender + Exercise..hours.day. + Sleep.Start.Time +
                                      Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. +
                                      Work.Hours..hrs.day. + Sleep.QualityCat + Productivity.ScoreCat +
                                      Mood.ScoreCat + Stress.LevelCat)^2, data = df_model)

model_sleep_reduced <- step(model_sleep_bn, direction = "backward", trace = 0)
summary(model_sleep_reduced)
```

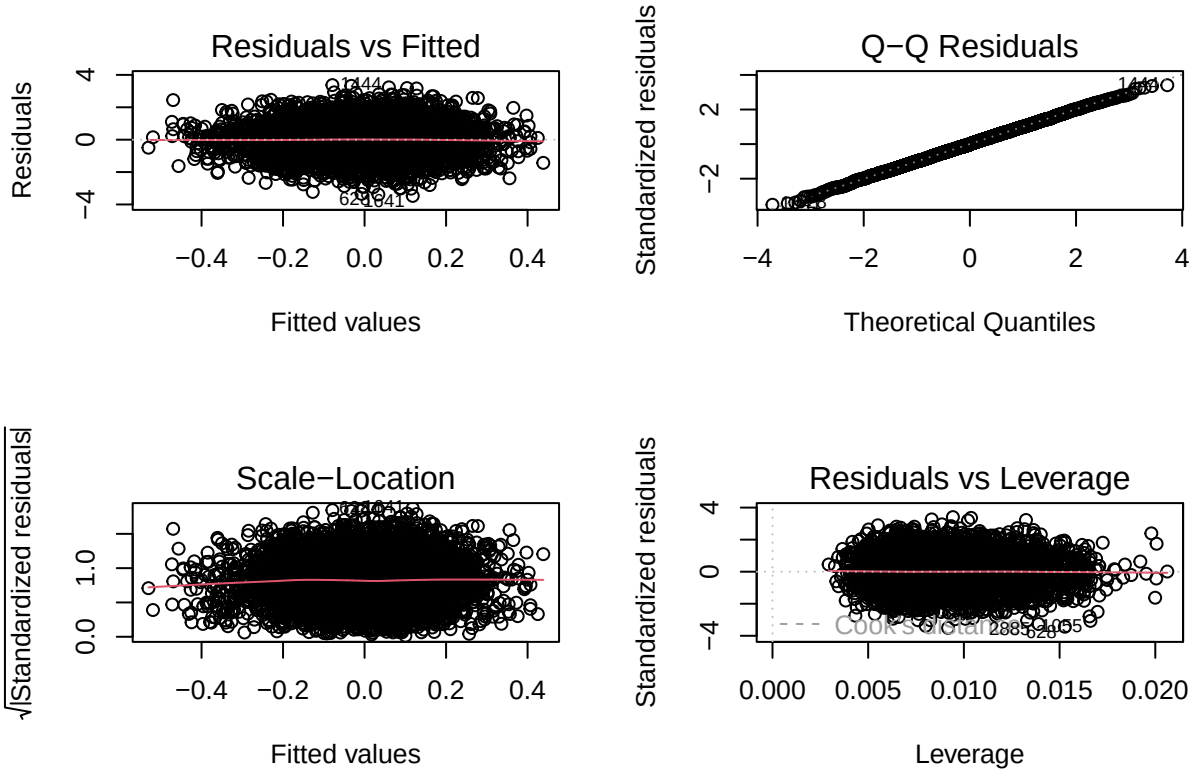
```
##
## Call:
## lm(formula = bn_TotalSleep ~ Age + Gender + Exercise..hours.day. +
```

```
##     Sleep.Start.Time + Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. +
##     Work.Hours..hrs.day. + Sleep.QualityCat + Productivity.ScoreCat +
##     Mood.ScoreCat + Stress.LevelCat + Age:Sleep.QualityCat +
##     Gender:Caffeine.Intake..mg. + Exercise..hours.day.:Sleep.Start.Time +
##     Exercise..hours.day.:Caffeine.Intake..mg. + Sleep.Start.Time:Work.Hours..hrs.day. +
##     Sleep.Start.Time:Productivity.ScoreCat + Sleep.Start.Time:Mood.ScoreCat +
##     Caffeine.Intake..mg.:Sleep.QualityCat + Caffeine.Intake..mg.:Mood.ScoreCat +
##     Caffeine.Intake..mg.:Stress.LevelCat + Screen.Time.Before.Bed..mins.:Sleep.QualityCat +
##     Work.Hours..hrs.day.:Mood.ScoreCat + Sleep.QualityCat:Mood.ScoreCat +
##     Productivity.ScoreCat:Mood.ScoreCat, data = df_model)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.4710 -0.6678 -0.0094  0.6750  3.3694
##
## Coefficients:
##                                                    Estimate Std. Error
## (Intercept)                                       3.767e-01  1.237e+00
## Age                                              -5.288e-04  2.102e-03
## GenderMale                                       -1.003e-01  6.823e-02
## GenderOther                                      -1.384e-01  6.886e-02
## Exercise..hours.day.                              1.358e+00  6.253e-01
## Sleep.Start.Time                                  3.441e-03  5.583e-02
## Caffeine.Intake..mg.                             -1.783e-03  5.948e-04
## Screen.Time.Before.Bed..mins.                    -2.519e-04  4.960e-04
## Work.Hours..hrs.day.                             -2.345e-01  1.185e-01
## Sleep.QualityCatMedium                           -1.559e-01  1.470e-01
## Sleep.QualityCatHigh                              1.109e-01  1.576e-01
## Productivity.ScoreCatMedium                      -7.118e-01  6.615e-01
## Productivity.ScoreCatHigh                         8.758e-01  6.929e-01
## Mood.ScoreCatMedium                               1.012e+00  6.533e-01
## Mood.ScoreCatHigh                                -4.108e-02  7.104e-01
## Stress.LevelCatMedium                            -1.323e-01  6.787e-02
## Stress.LevelCatHigh                               1.967e-02  7.265e-02
## Age:Sleep.QualityCatMedium                        1.926e-03  2.780e-03
## Age:Sleep.QualityCatHigh                         -4.467e-03  2.963e-03
## GenderMale:Caffeine.Intake..mg.                   6.804e-04  3.985e-04
## GenderOther:Caffeine.Intake..mg.                  8.196e-04  4.048e-04
## Exercise..hours.day.:Sleep.Start.Time            -6.462e-02  2.828e-02
## Exercise..hours.day.:Caffeine.Intake..mg.         7.129e-04  3.881e-04
## Sleep.Start.Time:Work.Hours..hrs.day.             9.401e-03  5.360e-03
## Sleep.Start.Time:Productivity.ScoreCatMedium      3.060e-02  2.990e-02
## Sleep.Start.Time:Productivity.ScoreCatHigh       -3.372e-02  3.137e-02
## Sleep.Start.Time:Mood.ScoreCatMedium             -5.568e-02  2.894e-02
## Sleep.Start.Time:Mood.ScoreCatHigh               -7.342e-03  3.170e-02
## Caffeine.Intake..mg.:Sleep.QualityCatMedium       1.352e-05  3.980e-04
## Caffeine.Intake..mg.:Sleep.QualityCatHigh         8.769e-04  4.253e-04
## Caffeine.Intake..mg.:Mood.ScoreCatMedium          7.914e-04  3.948e-04
## Caffeine.Intake..mg.:Mood.ScoreCatHigh            1.901e-04  4.274e-04
## Caffeine.Intake..mg.:Stress.LevelCatMedium        7.478e-04  4.001e-04
## Caffeine.Intake..mg.:Stress.LevelCatHigh         -1.051e-04  4.263e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium  9.024e-04  6.527e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh   -4.432e-04  7.053e-04
## Work.Hours..hrs.day.:Mood.ScoreCatMedium          2.968e-02  1.474e-02
```

```
## Work.Hours..hrs.day.:Mood.ScoreCatHigh                1.960e-02  1.614e-02
## Sleep.QualityCatMedium:Mood.ScoreCatMedium           -8.769e-02  8.108e-02
## Sleep.QualityCatHigh:Mood.ScoreCatMedium             -6.845e-02  8.736e-02
## Sleep.QualityCatMedium:Mood.ScoreCatHigh              2.153e-01  8.876e-02
## Sleep.QualityCatHigh:Mood.ScoreCatHigh                3.858e-02  9.527e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium       5.110e-02  8.260e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium        -1.348e-01  8.634e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh        -7.018e-02  9.132e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh          -2.157e-01  9.489e-02
##                                                     t value Pr(>|t|)
## (Intercept)                                           0.304  0.76077
## Age                                                  -0.252  0.80134
## GenderMale                                           -1.470  0.14164
## GenderOther                                          -2.010  0.04452 *
## Exercise..hours.day.                                  2.171  0.02998 *
## Sleep.Start.Time                                      0.062  0.95085
## Caffeine.Intake..mg.                                 -2.997  0.00274 **
## Screen.Time.Before.Bed..mins.                        -0.508  0.61154
## Work.Hours..hrs.day.                                 -1.979  0.04787 *
## Sleep.QualityCatMedium                               -1.060  0.28904
## Sleep.QualityCatHigh                                  0.704  0.48161
## Productivity.ScoreCatMedium                          -1.076  0.28194
## Productivity.ScoreCatHigh                             1.264  0.20633
## Mood.ScoreCatMedium                                   1.550  0.12125
## Mood.ScoreCatHigh                                    -0.058  0.95390
## Stress.LevelCatMedium                                -1.950  0.05126 .
## Stress.LevelCatHigh                                   0.271  0.78662
## Age:Sleep.QualityCatMedium                            0.693  0.48852
## Age:Sleep.QualityCatHigh                             -1.507  0.13175
## GenderMale:Caffeine.Intake..mg.                       1.707  0.08781 .
## GenderOther:Caffeine.Intake..mg.                      2.025  0.04295 *
## Exercise..hours.day.:Sleep.Start.Time                -2.285  0.02236 *
## Exercise..hours.day.:Caffeine.Intake..mg.             1.837  0.06627 .
## Sleep.Start.Time:Work.Hours..hrs.day.                 1.754  0.07949 .
## Sleep.Start.Time:Productivity.ScoreCatMedium          1.023  0.30614
## Sleep.Start.Time:Productivity.ScoreCatHigh           -1.075  0.28237
## Sleep.Start.Time:Mood.ScoreCatMedium                 -1.924  0.05442 .
## Sleep.Start.Time:Mood.ScoreCatHigh                   -0.232  0.81685
## Caffeine.Intake..mg.:Sleep.QualityCatMedium           0.034  0.97289
## Caffeine.Intake..mg.:Sleep.QualityCatHigh             2.062  0.03927 *
## Caffeine.Intake..mg.:Mood.ScoreCatMedium              2.005  0.04506 *
## Caffeine.Intake..mg.:Mood.ScoreCatHigh                0.445  0.65654
## Caffeine.Intake..mg.:Stress.LevelCatMedium            1.869  0.06166 .
## Caffeine.Intake..mg.:Stress.LevelCatHigh             -0.246  0.80531
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium  1.383  0.16687
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh   -0.628  0.52977
## Work.Hours..hrs.day.:Mood.ScoreCatMedium              2.013  0.04415 *
## Work.Hours..hrs.day.:Mood.ScoreCatHigh                1.214  0.22463
## Sleep.QualityCatMedium:Mood.ScoreCatMedium           -1.082  0.27947
## Sleep.QualityCatHigh:Mood.ScoreCatMedium             -0.784  0.43334
## Sleep.QualityCatMedium:Mood.ScoreCatHigh              2.426  0.01532 *
## Sleep.QualityCatHigh:Mood.ScoreCatHigh                0.405  0.68557
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium       0.619  0.53618
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium        -1.561  0.11848
```

```
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh         -0.769  0.44218
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh           -2.273  0.02307 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9941 on 4954 degrees of freedom
## Multiple R-squared:  0.01911,    Adjusted R-squared:  0.0102
## F-statistic: 2.145 on 45 and 4954 DF,  p-value: 1.469e-05
```

```
par(mfrow = c(2,2))
plot(model_sleep_reduced)
```

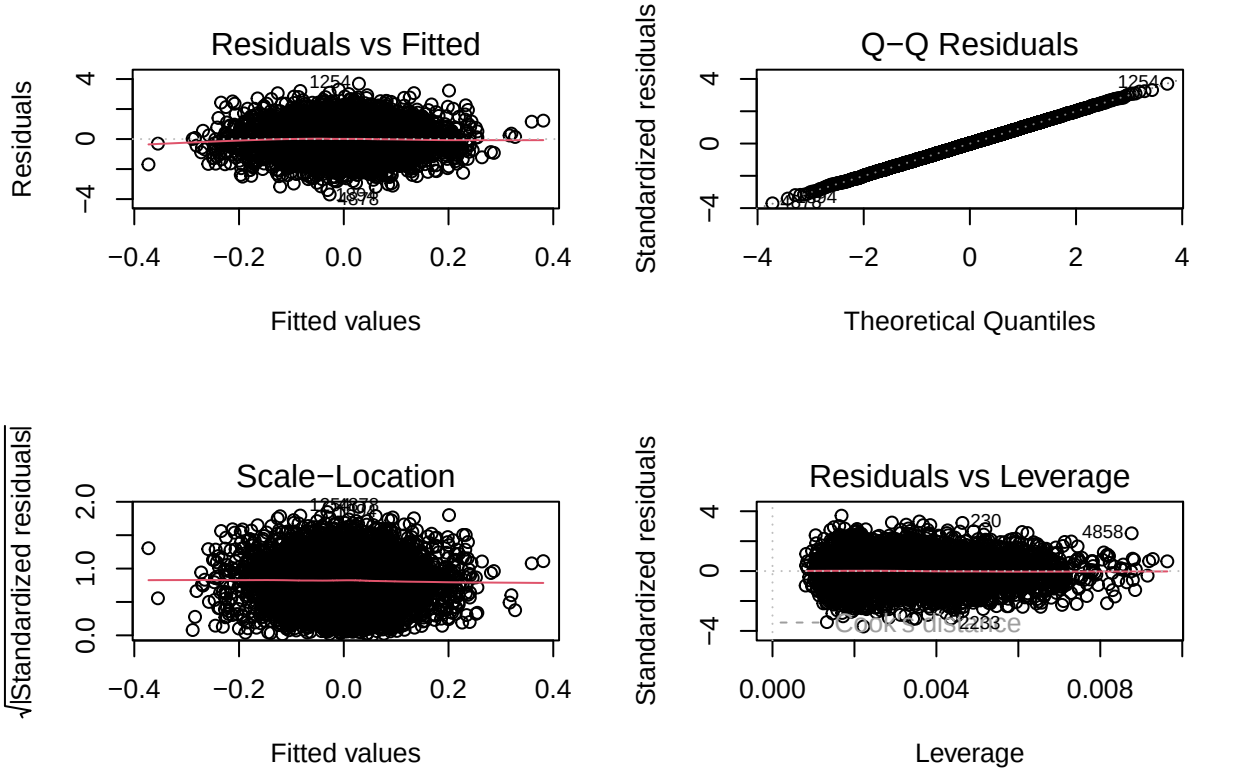



```
model_work_bn <- lm(bn_WorkHours ~ (Age + Gender + Exercise..hours.day. + Sleep.Start.Time +
                                    Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. +
                                    Total.Sleep.Hours + Sleep.QualityCat + Productivity.ScoreCat +
                                    Mood.ScoreCat + Stress.LevelCat)^2,
                    data = df_model)

model_work_reduced <- step(model_work_bn, direction = "backward", trace = 0)
summary(model_work_reduced)
```

```
##
## Call:
## lm(formula = bn_WorkHours ~ Age + Exercise..hours.day. + Sleep.Start.Time +
##     Total.Sleep.Hours + Sleep.QualityCat + Mood.ScoreCat + Age:Exercise..hours.day. +
##     Age:Sleep.QualityCat + Age:Mood.ScoreCat + Sleep.Start.Time:Total.Sleep.Hours +
##     Sleep.Start.Time:Mood.ScoreCat, data = df_model)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
```

```
## -3.6920 -0.6788 -0.0006  0.6669  3.6901
##
## Coefficients:
##                                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)                              1.434681   1.386584   1.035  0.30086
## Age                                      0.010990   0.003368   3.263  0.00111 **
## Exercise..hours.day.                     0.309049   0.108895   2.838  0.00456 **
## Sleep.Start.Time                        -0.079081   0.062677  -1.262  0.20711
## Total.Sleep.Hours                       -0.400419   0.185634  -2.157  0.03105 *
## Sleep.QualityCatMedium                   0.207793   0.112783   1.842  0.06547 .
## Sleep.QualityCatHigh                     0.168340   0.120012   1.403  0.16077
## Mood.ScoreCatMedium                      1.417800   0.648012   2.188  0.02872 *
## Mood.ScoreCatHigh                        0.743275   0.709638   1.047  0.29497
## Age:Exercise..hours.day.                -0.007912   0.002690  -2.942  0.00328 **
## Age:Sleep.QualityCatMedium              -0.006142   0.002779  -2.210  0.02714 *
## Age:Sleep.QualityCatHigh                -0.005234   0.002964  -1.766  0.07746 .
## Age:Mood.ScoreCatMedium                  0.002460   0.002729   0.902  0.36736
## Age:Mood.ScoreCatHigh                   -0.004548   0.002979  -1.527  0.12692
## Sleep.Start.Time:Total.Sleep.Hours       0.017409   0.008421   2.067  0.03875 *
## Sleep.Start.Time:Mood.ScoreCatMedium    -0.067599   0.028971  -2.333  0.01967 *
## Sleep.Start.Time:Mood.ScoreCatHigh      -0.023934   0.031732  -0.754  0.45074
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9979 on 4983 degrees of freedom
## Multiple R-squared:  0.00728,    Adjusted R-squared:  0.004093
## F-statistic: 2.284 on 16 and 4983 DF,  p-value: 0.002495
```

```r
par(mfrow = c(2,2))
plot(model_work_reduced)
```



```r
library(car)
```

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

```r
shapiro.test(df_model$bn_TotalSleep)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  df_model$bn_TotalSleep
## W = 0.99975, p-value = 0.8515
```

```r
ncvTest(model_sleep_reduced)
```

```
## Non-constant Variance Score Test
## Variance formula: ~ fitted.values
## Chisquare = 1.866765, Df = 1, p = 0.17185
```

```r
shapiro.test(df_model$bn_WorkHours)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  df_model$bn_WorkHours
## W = 0.99999, p-value = 1
```

```r
ncvTest(model_work_reduced)
```

```
## Non-constant Variance Score Test
## Variance formula: ~ fitted.values
## Chisquare = 1.970322, Df = 1, p = 0.16041
```

```r
model_work_reduced_2 <- lm(formula = bn_WorkHours ~ Age + Exercise..hours.day. + Total.Sleep.Hours +
    Sleep.QualityCat, data = df_model)

anova(model_work_reduced_2, model_work_reduced)
```

```
## Analysis of Variance Table
##
## Model 1: bn_WorkHours ~ Age + Exercise..hours.day. + Total.Sleep.Hours +
##     Sleep.QualityCat
## Model 2: bn_WorkHours ~ Age + Exercise..hours.day. + Sleep.Start.Time +
##     Total.Sleep.Hours + Sleep.QualityCat + Mood.ScoreCat + Age:Exercise..hours.day. +
##     Age:Sleep.QualityCat + Age:Mood.ScoreCat + Sleep.Start.Time:Total.Sleep.Hours +
##     Sleep.Start.Time:Mood.ScoreCat
##   Res.Df    RSS Df Sum of Sq     F    Pr(>F)
## 1   4994 4994.2
## 2   4983 4962.3 11    31.887 2.911 0.0007778 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```r
summary(model_work_reduced_2)
```

```
##
## Call:
## lm(formula = bn_WorkHours ~ Age + Exercise..hours.day. + Total.Sleep.Hours +
##     Sleep.QualityCat, data = df_model)
##
```

```
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3.7314 -0.6759  0.0011  0.6743  3.6849
##
## Coefficients:
##                           Estimate Std. Error t value Pr(>|t|)
## (Intercept)              0.1097992  0.0883212   1.243    0.214
## Age                      0.0007572  0.0011498   0.659    0.510
## Exercise..hours.day.    -0.0004163  0.0329029  -0.013    0.990
## Total.Sleep.Hours       -0.0166537  0.0097300  -1.712    0.087 .
## Sleep.QualityCatMedium -0.0308205  0.0342132  -0.901    0.368
## Sleep.QualityCatHigh    -0.0335543  0.0367339  -0.913    0.361
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1 on 4994 degrees of freedom
## Multiple R-squared:  0.0009012,  Adjusted R-squared:  -9.907e-05
## F-statistic: 0.901 on 5 and 4994 DF,  p-value: 0.4793
```

```
model_sleep_reduced_2 <- lm(formula = bn_TotalSleep ~ Age + Gender + Exercise..hours.day. +
    Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. +
    Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
    Stress.LevelCat + Age:Sleep.QualityCat + Gender:Caffeine.Intake..mg. +
    Exercise..hours.day.:Caffeine.Intake..mg. + Caffeine.Intake..mg.:Sleep.QualityCat +
    Caffeine.Intake..mg.:Mood.ScoreCat + Caffeine.Intake..mg.:Stress.LevelCat +
    Screen.Time.Before.Bed..mins.:Sleep.QualityCat + Work.Hours..hrs.day.:Mood.ScoreCat +
    Sleep.QualityCat:Mood.ScoreCat + Productivity.ScoreCat:Mood.ScoreCat,
    data = df_model)

anova(model_sleep_reduced, model_sleep_reduced_2)
```

```
## Analysis of Variance Table
##
## Model 1: bn_TotalSleep ~ Age + Gender + Exercise..hours.day. + Sleep.Start.Time +
##     Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. +
##     Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
##     Stress.LevelCat + Age:Sleep.QualityCat + Gender:Caffeine.Intake..mg. +
##     Exercise..hours.day.:Sleep.Start.Time + Exercise..hours.day.:Caffeine.Intake..mg. +
##     Sleep.Start.Time:Work.Hours..hrs.day. + Sleep.Start.Time:Productivity.ScoreCat +
##     Sleep.Start.Time:Mood.ScoreCat + Caffeine.Intake..mg.:Sleep.QualityCat +
##     Caffeine.Intake..mg.:Mood.ScoreCat + Caffeine.Intake..mg.:Stress.LevelCat +
##     Screen.Time.Before.Bed..mins.:Sleep.QualityCat + Work.Hours..hrs.day.:Mood.ScoreCat +
##     Sleep.QualityCat:Mood.ScoreCat + Productivity.ScoreCat:Mood.ScoreCat
## Model 2: bn_TotalSleep ~ Age + Gender + Exercise..hours.day. + Caffeine.Intake..mg. +
##     Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. + Sleep.QualityCat +
##     Productivity.ScoreCat + Mood.ScoreCat + Stress.LevelCat +
##     Age:Sleep.QualityCat + Gender:Caffeine.Intake..mg. + Exercise..hours.day.:Caffeine.Intake..mg. +
##     Caffeine.Intake..mg.:Sleep.QualityCat + Caffeine.Intake..mg.:Mood.ScoreCat +
##     Caffeine.Intake..mg.:Stress.LevelCat + Screen.Time.Before.Bed..mins.:Sleep.QualityCat +
##     Work.Hours..hrs.day.:Mood.ScoreCat + Sleep.QualityCat:Mood.ScoreCat +
##     Productivity.ScoreCat:Mood.ScoreCat
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   4954 4895.5
## 2   4961 4913.4 -7   -17.848 2.5801 0.0118 *
## ---
```

```
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```