

# STAT463 Project: Sleep Health and Lifestyle

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```
# Import libraries
library(dplyr)
library(ggplot2)
library(stringr)
library(gridExtra)
```

## Data Exploration and Preprocessing

```
# Read in dataset
dataset <- read.table("Sleep_health_and_lifestyle_dataset.csv",
                      header = TRUE, sep = ',', na.strings = "na")
```

```
# Print the first few rows of data frame
head(dataset)
```

```
##   Person.ID Gender Age      Occupation Sleep.Duration Quality.of.Sleep
## 1         1   Male  27   Software Engineer          6.1             6
## 2         2   Male  28             Doctor          6.2             6
## 3         3   Male  28             Doctor          6.2             6
## 4         4   Male  28 Sales Representative          5.9             4
## 5         5   Male  28 Sales Representative          5.9             4
## 6         6   Male  28   Software Engineer          5.9             4
##   Physical.Activity.Level Stress.Level BMI.Category Blood.Pressure Heart.Rate
## 1                      42           6   Overweight      126/83         77
## 2                      60           8     Normal      125/80         75
## 3                      60           8     Normal      125/80         75
## 4                      30           8       Obese      140/90         85
## 5                      30           8       Obese      140/90         85
## 6                      30           8       Obese      140/90         85
##   Daily.Steps Sleep.Disorder
## 1         4200           None
## 2        10000           None
## 3        10000           None
## 4         3000   Sleep Apnea
## 5         3000   Sleep Apnea
## 6         3000     Insomnia
```

```
# Explore the structure of the dataset
str(dataset)
```

```
## 'data.frame':   374 obs. of  13 variables:
```

```
## $ Person.ID           : int  1 2 3 4 5 6 7 8 9 10 ...
## $ Gender              : chr   "Male" "Male" "Male" "Male" ...
## $ Age                 : int  27 28 28 28 28 28 29 29 29 29 ...
## $ Occupation          : chr   "Software Engineer" "Doctor" "Doctor" "Sales Representative" ...
## $ Sleep.Duration      : num   6.1 6.2 6.2 5.9 5.9 5.9 6.3 7.8 7.8 7.8 ...
## $ Quality.of.Sleep    : int   6 6 6 4 4 4 6 7 7 7 ...
## $ Physical.Activity.Level: int  42 60 60 30 30 30 40 75 75 75 ...
## $ Stress.Level        : int   6 8 8 8 8 8 7 6 6 6 ...
## $ BMI.Category        : chr   "Overweight" "Normal" "Normal" "Obese" ...
## $ Blood.Pressure      : chr   "126/83" "125/80" "125/80" "140/90" ...
## $ Heart.Rate          : int   77 75 75 85 85 85 82 70 70 70 ...
## $ Daily.Steps         : int  4200 10000 10000 3000 3000 3000 3500 8000 8000 8000 ...
## $ Sleep.Disorder      : chr   "None" "None" "None" "Sleep Apnea" ...
```

```
# Get a descriptive statistics
summary(dataset)
```

```
##      Person.ID      Gender      Age      Occupation
## Min.   : 1.00   Length:374   Min.   :27.00   Length:374
## 1st Qu.: 94.25   Class :character   1st Qu.:35.25   Class :character
## Median :187.50   Mode  :character   Median :43.00   Mode  :character
## Mean   :187.50
## 3rd Qu.:280.75
## Max.   :374.00
## Max.   :59.00
## Sleep.Duration  Quality.of.Sleep  Physical.Activity.Level  Stress.Level
## Min.   :5.800   Min.   :4.000   Min.   :30.00           Min.   :3.000
## 1st Qu.:6.400   1st Qu.:6.000   1st Qu.:45.00           1st Qu.:4.000
## Median :7.200   Median :7.000   Median :60.00           Median :5.000
## Mean   :7.132   Mean   :7.313   Mean   :59.17           Mean   :5.385
## 3rd Qu.:7.800   3rd Qu.:8.000   3rd Qu.:75.00           3rd Qu.:7.000
## Max.   :8.500   Max.   :9.000   Max.   :90.00           Max.   :8.000
## BMI.Category    Blood.Pressure    Heart.Rate    Daily.Steps
## Length:374      Length:374      Min.   :65.00   Min.   : 3000
## Class :character Class :character 1st Qu.:68.00   1st Qu.: 5600
## Mode  :character Mode  :character Median :70.00   Median : 7000
##                               Mean   :70.17   Mean   : 6817
##                               3rd Qu.:72.00   3rd Qu.: 8000
##                               Max.   :86.00   Max.   :10000
## Sleep.Disorder
## Length:374
## Class :character
## Mode  :character
##
##
##
```

```
# Data preprocessing
# Split Blood Pressure column into systolic and diastolic pressure as numeric data
dataset[c('Systolic.Pressure', 'Diastolic.Pressure')] <- as.numeric(str_split_fixed(dataset$Blood.Pressure, 1, 2))

# Combine "Normal" and "Normal Weight" values in BMI.Category
dataset$BMI.Category[dataset$BMI.Category == "Normal Weight"] <- "Normal"
# Change "Obese" into "Overweight"
```

```
dataset$BMI.Category[dataset$BMI.Category == "Obese"] <- "Overweight"
```

```
# Remove Occupations that has count under 10 (namely, Software Engineer, Scientist, Sales Representative)
dataset <- dataset[!(dataset$Occupation == "Software Engineer" | dataset$Occupation == "Scientist" |
  dataset$Occupation == "Sales Representative" |
  dataset$Occupation == "Manager"),]
```

```
# Get the numeric data
```

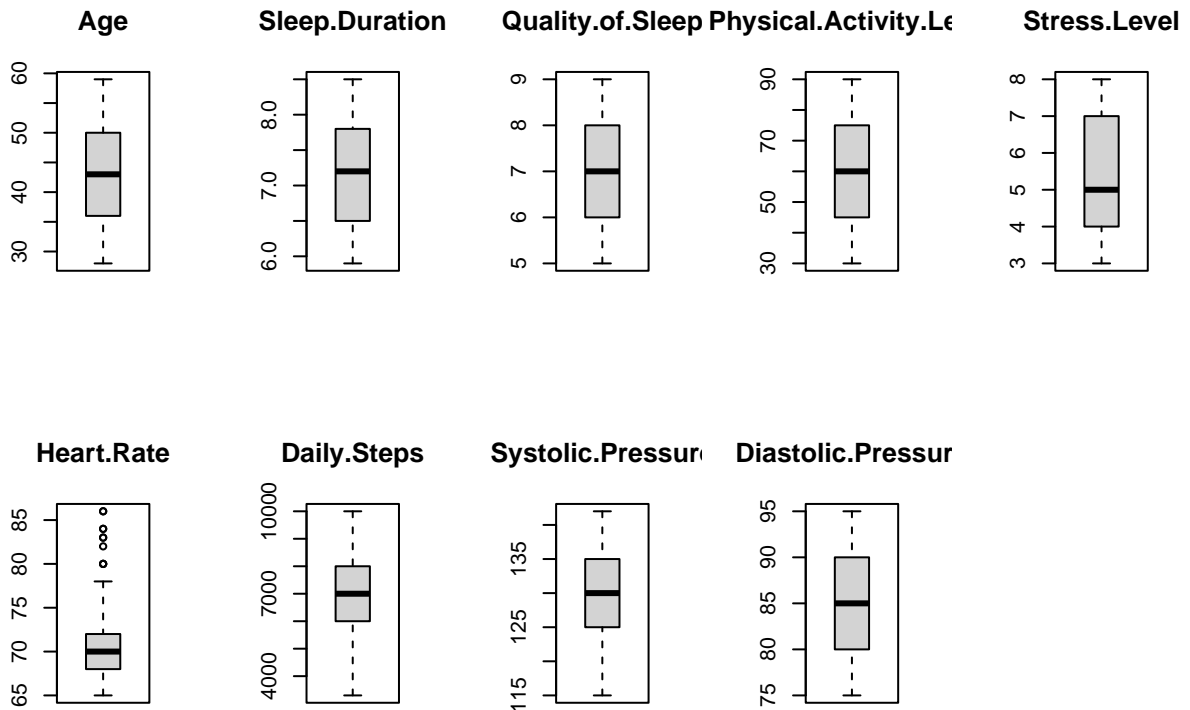
```
numeric.data <- dataset[,c(3,5,6,7,8,11,12,14,15)]
```

```
# Plot the data -- Boxplot for numeric data and Histogram for categorical data
```

```
# Boxplots
```

```
par(mfrow=c(2,5))
```

```
for (i in 1:length(numeric.data)) {
  boxplot(numeric.data[,i], main=names(numeric.data[i]), type="l")
}
```



```
# Frequency charts of the categorical data
```

```
gender <- ggplot(data = dataset, aes(x = Gender)) +
  geom_bar() +
  labs(y = "Frequency", x = "Gender")
```

```
occupation <- ggplot(data = dataset, aes(y = Occupation)) +
  geom_bar() +
```

```

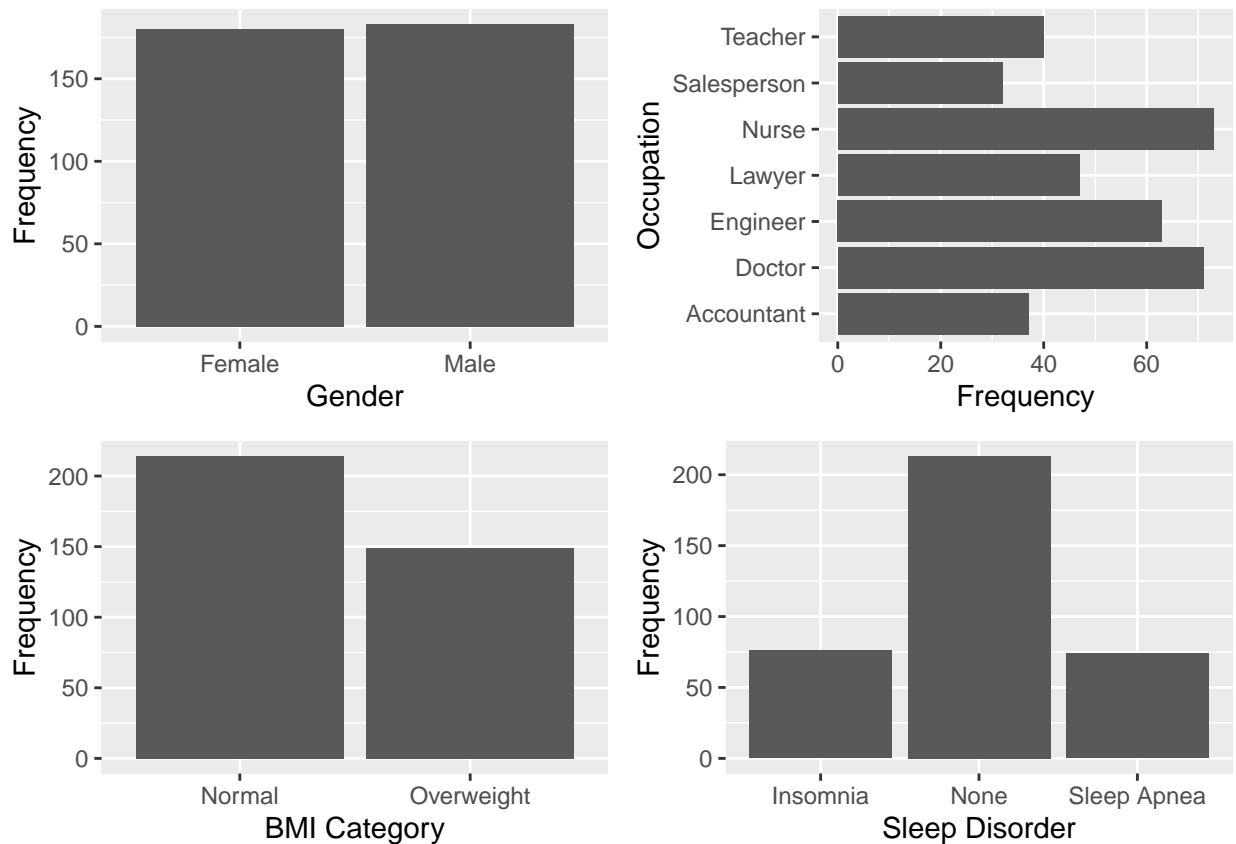
labs(y = "Occupation", x = "Frequency")

bmi <- ggplot(data = dataset, aes(x = BMI.Category)) +
  geom_bar() +
  labs(y = "Frequency", x = "BMI Category")

sleep_disorder <- ggplot(data = dataset, aes(x = Sleep.Disorder)) +
  geom_bar() +
  labs(y = "Frequency", x = "Sleep Disorder")

grid.arrange(gender, occupation, bmi, sleep_disorder, ncol = 2, nrow = 2)

```

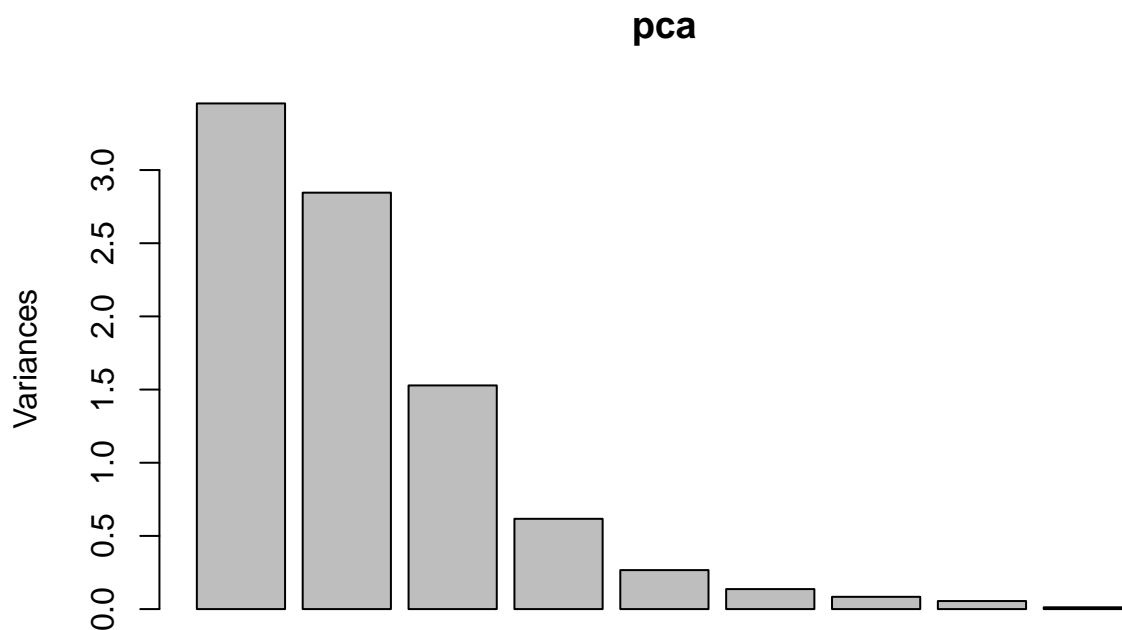


## Explore the factors affecting quality of sleep

```

# Use PCA analysis
pca <- prcomp(scale(numeric.data))
screeplot(pca)

```



```
summary(pca)
```

```
## Importance of components:
```

```
##              PC1    PC2    PC3    PC4    PC5    PC6    PC7
## Standard deviation  1.8588 1.6869 1.2362 0.78539 0.5161 0.36972 0.28959
## Proportion of Variance 0.3839 0.3162 0.1698 0.06854 0.0296 0.01519 0.00932
## Cumulative Proportion 0.3839 0.7001 0.8699 0.93843 0.9680 0.98322 0.99254
##              PC8    PC9
## Standard deviation  0.23447 0.11029
## Proportion of Variance 0.00611 0.00135
## Cumulative Proportion 0.99865 1.00000
```

```
pca$rotation
```

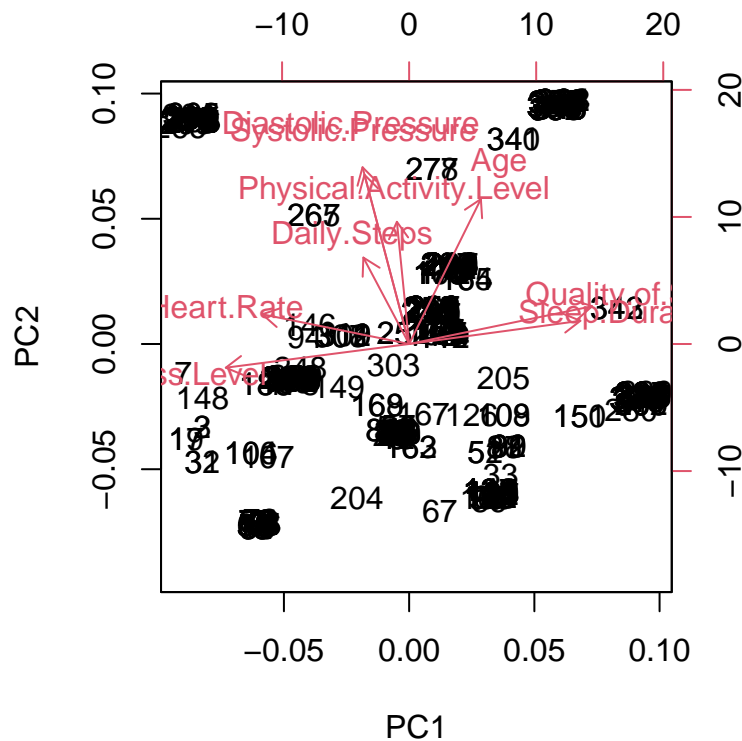
```
##              PC1          PC2          PC3          PC4
## Age           0.19928711  0.44360323 -0.298540468  0.08771766
## Sleep.Duration 0.47580701  0.07097410  0.147664001 -0.39223004
## Quality.of.Sleep 0.50839857  0.11555311  0.088271016 -0.12864909
## Physical.Activity.Level -0.03396907  0.37410114  0.583481169 -0.22866523
## Stress.Level    -0.50935587 -0.07257793  0.044612374  0.05249403
## Heart.Rate      -0.40800403  0.09097020 -0.006752184 -0.77875457
## Daily.Steps     -0.12716351  0.26462392  0.634042308  0.39106322
## Systolic.Pressure -0.12416495  0.51817687 -0.307746206  0.03352334
## Diastolic.Pressure -0.12950346  0.54110853 -0.205118630  0.07971363
```

	PC5	PC6	PC7	PC8
## Age	-0.759419284	0.12742274	0.25945473	-0.08005358
## Sleep.Duration	-0.002161696	-0.72099302	0.08530658	-0.25294162
## Quality.of.Sleep	-0.061329680	0.14508373	-0.50037733	0.62508863
## Physical.Activity.Level	0.162440451	0.23941747	0.56829562	0.24389998
## Stress.Level	-0.308697422	-0.55162110	0.08243336	0.53688313
## Heart.Rate	-0.207320541	0.18357928	-0.33597242	-0.16950227
## Daily.Steps	-0.223331870	-0.08818022	-0.45430985	-0.27923957
## Systolic.Pressure	0.299336157	-0.16856011	-0.12913019	0.22599882
## Diastolic.Pressure	0.339667903	-0.10671010	-0.09656019	-0.18265880

	PC9
## Age	0.0006974879
## Sleep.Duration	0.0427669874
## Quality.of.Sleep	-0.1947103477
## Physical.Activity.Level	-0.0012798921
## Stress.Level	-0.1895374969
## Heart.Rate	0.0214759011
## Daily.Steps	0.1297631409
## Systolic.Pressure	0.6591506141
## Diastolic.Pressure	-0.6874249478

```
biplot(pca)
```



```
# Use linear regression model
sleep <- dataset[, -c(1, 10)]
```

```
# Get the full multiple linear regression model
lr_full <- lm(scale(Quality.of.Sleep) ~ ., data = sleep)
summary(lr_full)
```

```
##
## Call:
## lm(formula = scale(Quality.of.Sleep) ~ ., data = sleep)
##
## Residuals:
```

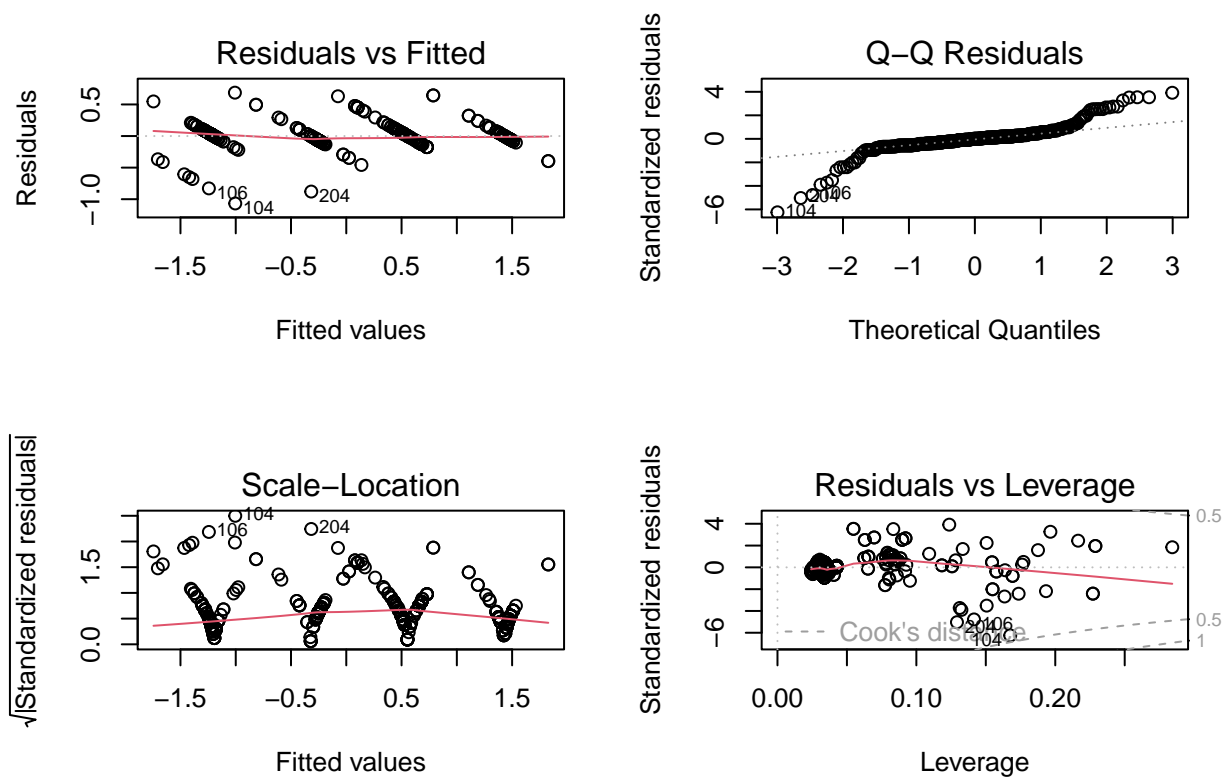
	Min	1Q	Median	3Q	Max
	-1.06742	-0.07037	0.00070	0.05154	0.68666

```
##
## Coefficients:
```

	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	-1.213e+00	7.323e-01	-1.657	0.098483 .
GenderMale	4.762e-01	5.966e-02	7.982	2.17e-14 ***
Age	4.641e-02	4.369e-03	10.623	< 2e-16 ***
OccupationDoctor	-4.817e-01	6.860e-02	-7.022	1.18e-11 ***
OccupationEngineer	-6.325e-01	6.796e-02	-9.306	< 2e-16 ***
OccupationLawyer	-4.096e-01	8.024e-02	-5.104	5.51e-07 ***
OccupationNurse	-3.673e-01	7.923e-02	-4.635	5.07e-06 ***
OccupationSalesperson	-8.257e-01	7.728e-02	-10.685	< 2e-16 ***
OccupationTeacher	-5.082e-01	6.371e-02	-7.977	2.25e-14 ***
Sleep.Duration	2.465e-01	4.006e-02	6.154	2.10e-09 ***
Physical.Activity.Level	-1.858e-03	1.262e-03	-1.473	0.141747
Stress.Level	-3.464e-01	1.787e-02	-19.388	< 2e-16 ***
BMI.CategoryOverweight	-3.620e-01	7.524e-02	-4.811	2.25e-06 ***
Heart.Rate	-1.012e-02	5.632e-03	-1.797	0.073205 .
Daily.Steps	4.500e-05	1.741e-05	2.585	0.010149 *
Sleep.DisorderNone	1.732e-01	4.507e-02	3.843	0.000145 ***
Sleep.DisorderSleep Apnea	2.384e-01	4.977e-02	4.791	2.47e-06 ***
Systolic.Pressure	2.227e-02	1.298e-02	1.716	0.087141 .
Diastolic.Pressure	-3.313e-02	1.754e-02	-1.889	0.059678 .

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.1873 on 344 degrees of freedom
## Multiple R-squared:  0.9667, Adjusted R-squared:  0.9649
## F-statistic: 554.4 on 18 and 344 DF, p-value: < 2.2e-16
```

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



```
cor(numeric.data, numeric.data$Quality.of.Sleep)
```

```
##           [,1]
## Age      0.44999752
## Sleep.Duration 0.88356596
## Quality.of.Sleep 1.00000000
## Physical.Activity.Level 0.14682864
## Stress.Level -0.90722043
## Heart.Rate -0.61066265
## Daily.Steps -0.07080688
## Systolic.Pressure -0.08851489
## Diastolic.Pressure -0.09182610
```

```
library(lme4)
```

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

```
# Mixed Linear Model, but the results were still not ideal
```

```
model <- lmer(Quality.of.Sleep ~ Sleep.Duration + (1|Occupation) , data = sleep)
summary(model)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: Quality.of.Sleep ~ Sleep.Duration + (1 | Occupation)
## Data: sleep
```

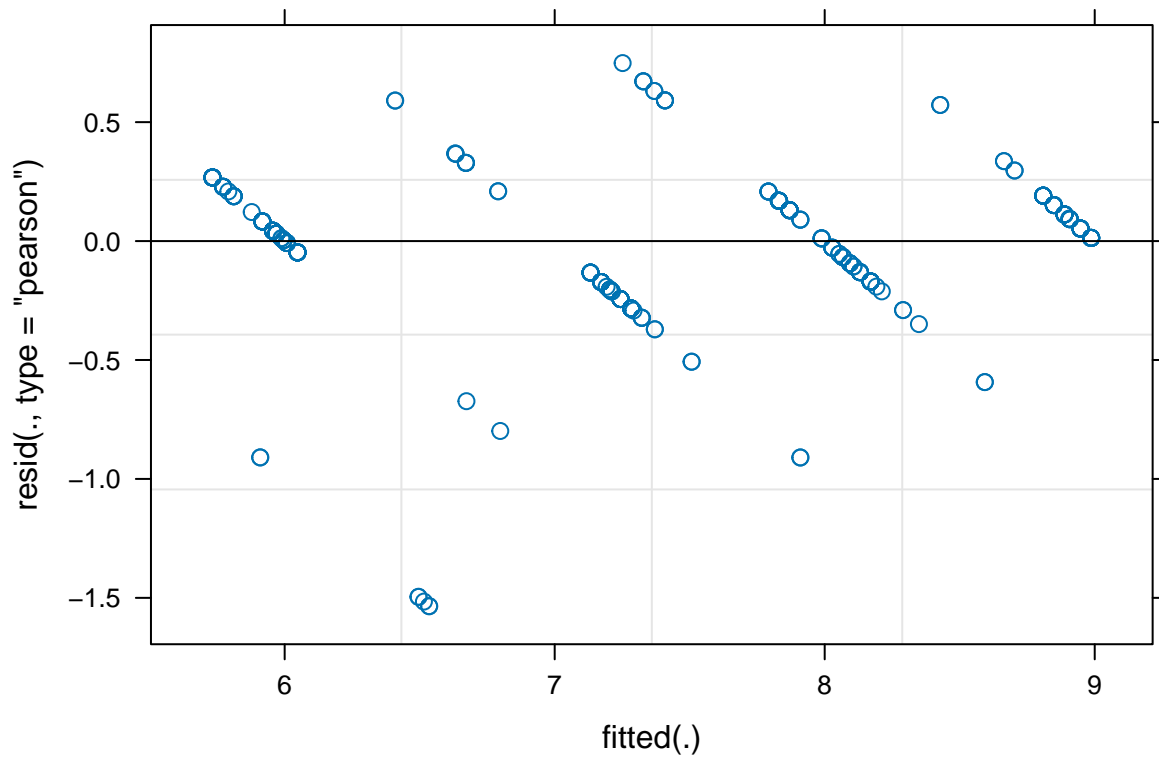


```
##
## REML criterion at convergence: 438.4
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -4.3894 -0.4401  0.0525  0.6185  2.3162
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
## Occupation (Intercept) 0.1418  0.3766
## Residual              0.1800  0.4242
## Number of obs: 363, groups: Occupation, 7
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)   -1.22745    0.28487  -4.309
## Sleep.Duration  1.20434    0.03463  34.776
##
## Correlation of Fixed Effects:
##              (Intr)
## Sleep.Durtn -0.862
```

```
model1 <- lmer(Quality.of.Sleep ~ Sleep.Duration + Stress.Level + (1|Occupation), data = sleep)
summary(model1)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: Quality.of.Sleep ~ Sleep.Duration + Stress.Level + (1 | Occupation)
##   Data: sleep
##
## REML criterion at convergence: 199.4
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -5.0854 -0.4395  0.1433  0.5595  2.4792
##
## Random effects:
##   Groups      Name      Variance Std.Dev.
## Occupation (Intercept) 0.10052  0.3170
## Residual              0.09112  0.3019
## Number of obs: 363, groups: Occupation, 7
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept)    6.76664    0.47721  14.179
## Sleep.Duration  0.39383    0.04984   7.903
## Stress.Level   -0.42085    0.02251 -18.699
##
## Correlation of Fixed Effects:
##              (Intr) Slp.Dr
## Sleep.Durtn -0.959
## Stress.Levl -0.895  0.869
```

```
plot(model1)
```



```
# Ordered Logistic Regression
```

```
olr <- MASS::polr(as.factor(Quality.of.Sleep) ~ Stress.Level + Sleep.Duration,  
                  data = dataset, Hess = TRUE)
```

```
summary(olr)
```

```
## Call:
```

```
## MASS::polr(formula = as.factor(Quality.of.Sleep) ~ Stress.Level +
```

```
##     Sleep.Duration, data = dataset, Hess = TRUE)
```

```
##
```

```
## Coefficients:
```

```
##           Value Std. Error t value
```

```
## Stress.Level  -2.582    0.2613  -9.882
```

```
## Sleep.Duration  4.538    0.4784   9.486
```

```
##
```

```
## Intercepts:
```

```
##      Value  Std. Error t value
```

```
## 5|6  4.6911  2.4584    1.9082
```

```
## 6|7 13.0445  2.6067    5.0041
```

```
## 7|8 20.0621  2.9583    6.7816
```

```
## 8|9 26.2274  3.3326    7.8699
```

```
##
```

```
## Residual Deviance: 302.4369
```

```
## AIC: 314.4369
```