

# Project 423 - Kreslyn

2025-02-26

**Research Question 2:** What sleep-related variables mostly explain the variation in total work hours?

**Research Question 3:** Are there any significant interactions between the sleep-related variables?

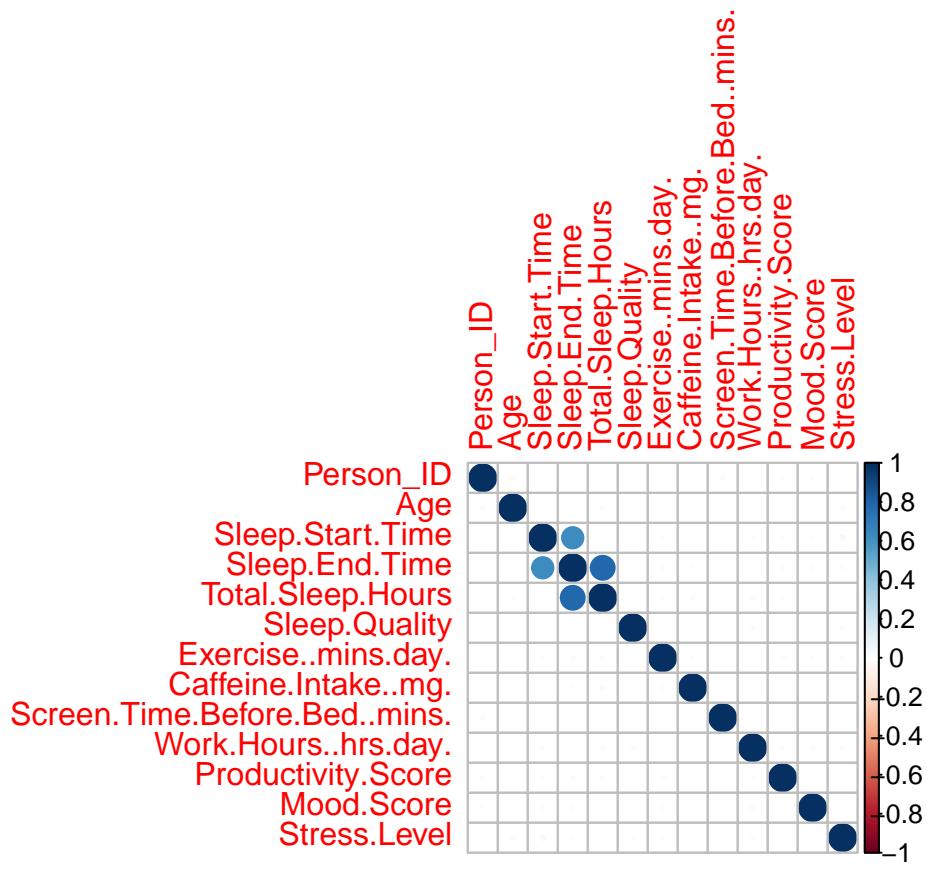
```
library(corrplot)

## Warning: package 'corrplot' was built under R version 4.3.3
## corrplot 0.95 loaded
library(tidyverse)

## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr     1.1.4      v readr     2.1.5
## vforcats   1.0.0      v stringr   1.5.1
## v ggplot2   3.4.4      v tibble    3.2.1
## v lubridate 1.9.3      v tidyrr    1.3.1
## v purrr    1.0.2

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()   masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
df <- read.csv("sleep_cycle_productivity.csv")

# Basic Correlation Between Variables:
# pairs(data_filtered, main = "Pairwise Scatter plots of Selected Variables")
cor_matrix <- cor(df[, sapply(df, is.numeric)])
corrplot(cor_matrix, method = "circle")
```

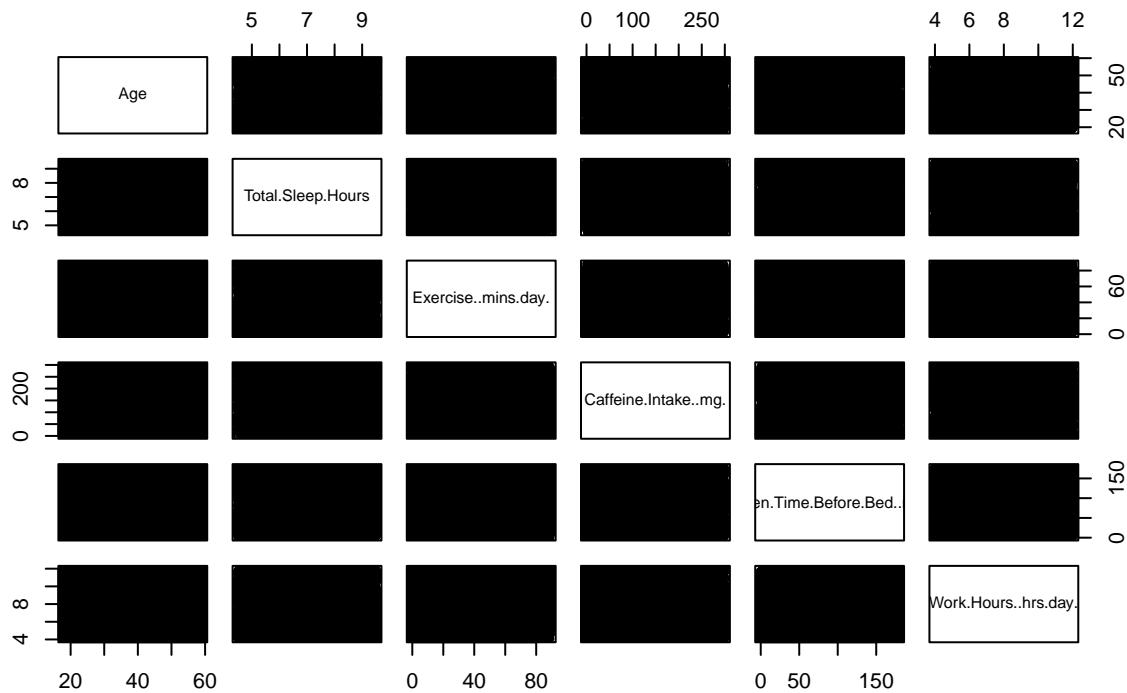


```
# Numeric variable scatter plot

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]
pairs(df_numeric, main = "Pairwise Scatter plots of Selected Variables")
```

## Pairwise Scatter plots of Selected Variables



### Findings:

Little to no correlation between variables, except start/end time and total hours no outliers.

```
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]])
}

# Getting rid of unneeded columns
df_filtered <- df %>%
  select(-Date) %>%
  select(-Person_ID) %>%
  # These rows have been transformed into factors
  select(-Stress.Level) %>%
  select(-Productivity.Score) %>%
  select(-Mood.Score) %>%
  select(-Sleep.Quality) %>%
# Will have co linearity for start, end and total hours for sleep (end-start = total)
# Choosing to omit start time (see chunk for why we chose it...)
  select(-Sleep.Start.Time)

# Omit based on predictive power (P-value in isolation)
lm_start = lm(df$Work.Hours..hrs.day. ~ df$Sleep.Start.Time)
lm_end = lm(df$Work.Hours..hrs.day. ~ df$Sleep.End.Time)
lm_inter = lm(df$Work.Hours..hrs.day. ~ df$Sleep.Start.Time*df$Sleep.End.Time)
```

```

summary(lm_start)

##
## Call:
## lm(formula = df$Work.Hours..hrs.day. ~ df$Sleep.Start.Time)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -4.0299 -1.9539  0.0101  1.9231  4.0611
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)      7.41866   0.61272 12.11 <2e-16 ***
## df$Sleep.Start.Time 0.02587   0.02781  0.93  0.352
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.276 on 4998 degrees of freedom
## Multiple R-squared:  0.0001731, Adjusted R-squared:  -2.692e-05
## F-statistic: 0.8654 on 1 and 4998 DF,  p-value: 0.3523

summary(lm_end)

##
## Call:
## lm(formula = df$Work.Hours..hrs.day. ~ df$Sleep.End.Time)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -4.0202 -1.9649  0.0116  1.9194  4.0557
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)      8.04724   0.09189 87.57 <2e-16 ***
## df$Sleep.End.Time -0.01192   0.01728 -0.69    0.49
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.276 on 4998 degrees of freedom
## Multiple R-squared:  9.517e-05, Adjusted R-squared:  -0.0001049
## F-statistic: 0.4757 on 1 and 4998 DF,  p-value: 0.4904

summary(lm_inter)

##
## Call:
## lm(formula = df$Work.Hours..hrs.day. ~ df$Sleep.Start.Time *
##      df$Sleep.End.Time)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -4.0759 -1.9470  0.0161  1.9391  4.1013
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)

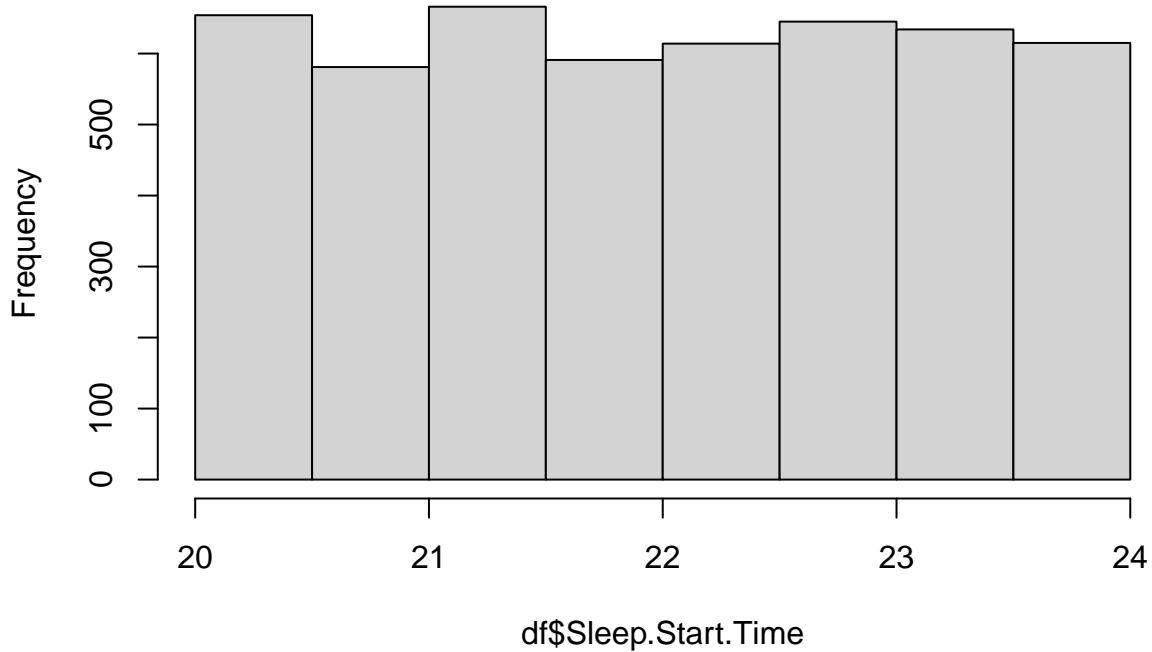
```

```

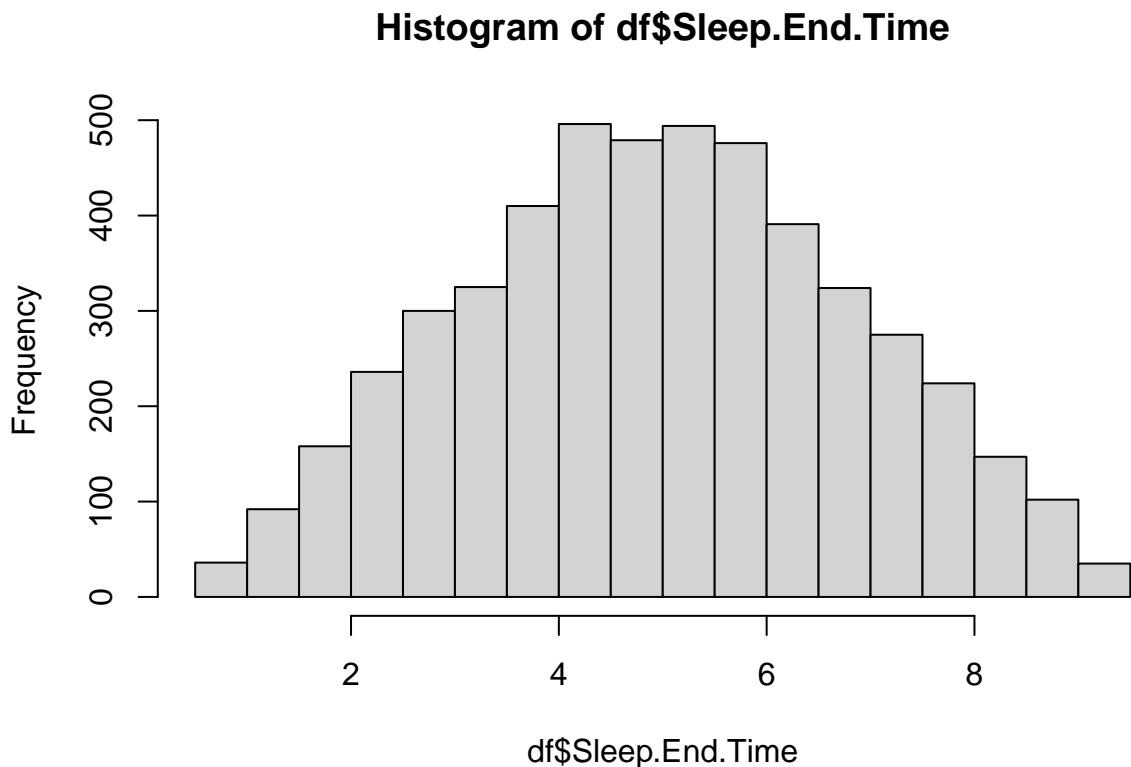
## (Intercept)           8.52697   1.83432   4.649 3.43e-06 ***
## df$Sleep.Start.Time -0.01723   0.08531  -0.202   0.840
## df$Sleep.End.Time    -0.38799   0.34456  -1.126   0.260
## df$Sleep.Start.Time:df$Sleep.End.Time  0.01598   0.01561   1.024   0.306
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.275 on 4996 degrees of freedom
## Multiple R-squared:  0.0009131, Adjusted R-squared:  0.0003131
## F-statistic: 1.522 on 3 and 4996 DF,  p-value: 0.2066
# Omit based on variation
hist(df$Sleep.Start.Time)

```

**Histogram of df\$Sleep.Start.Time**



```
hist(df$Sleep.End.Time)
```



## Chose to omit start time

The distribution of end time is better, the prediction power is about the same

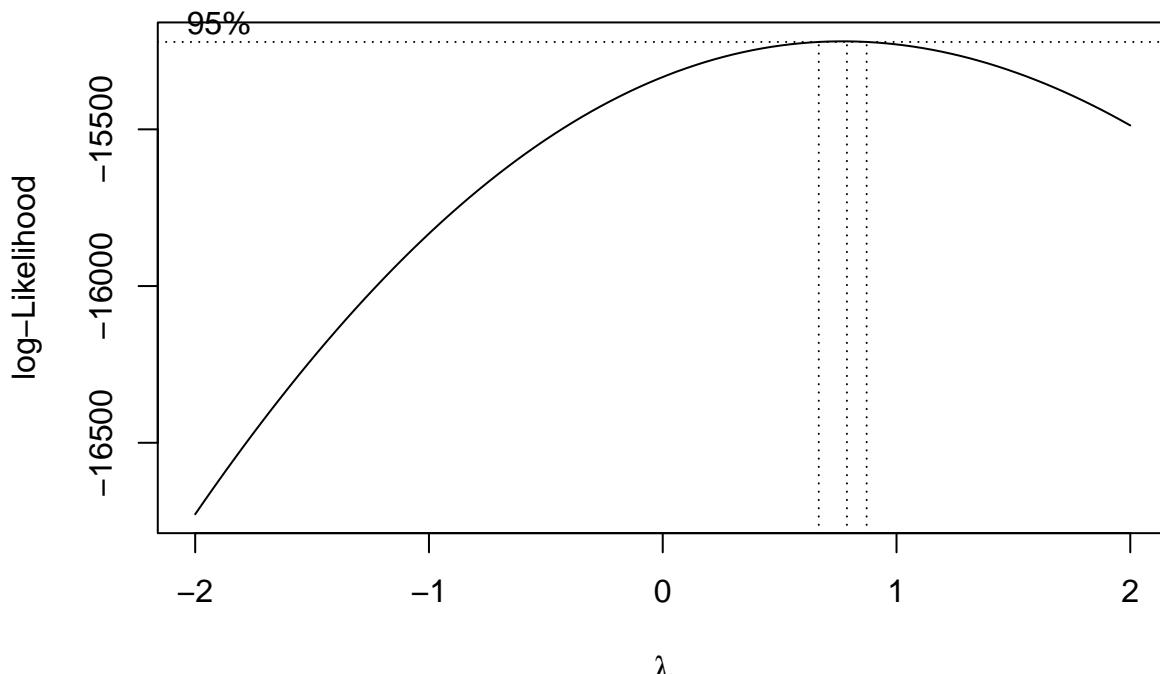
```
library(MASS)

##
## Attaching package: 'MASS'

## The following object is masked from 'package:dplyr':
##   select
library(car)

## Loading required package: carData
##
## Attaching package: 'car'

## The following object is masked from 'package:dplyr':
##   recode
## The following object is masked from 'package:purrr':
##   some
# response is strictly positive (box cox is appropriate - see notes on yeo-johnson in lecture)
additive_model <- lm(Work.Hours..hrs.day. ~ ., data = df_filtered)
bc <- boxcox(additive_model)
```



```

summary(bc)

##   Length Class  Mode
## x 100    -none- numeric
## y 100    -none- numeric
lambda.hat <- bc$x[which.max(bc$y)]


## for transforming the data once you obtain lambda
df_bc <- df_filtered %>%
  mutate(Work.Hours..hrs.day. = (Work.Hours..hrs.day.^lambda.hat - 1) / lambda.hat)

additive_bc <- lm(Work.Hours..hrs.day. ~ ., data = df_bc)
summary(additive_bc)

## 
## Call:
## lm(formula = Work.Hours..hrs.day. ~ ., data = df_bc)
## 
## Residuals:
##       Min     1Q     Median      3Q     Max 
## -2.80557 -1.24079  0.04865  1.25303  2.64576 
## 
## Coefficients:
## (Intercept)      Estimate Std. Error t value Pr(>|t|)    
## (Intercept) 5.347e+00 1.580e-01 33.838 <2e-16 ***
## Age         9.213e-04 1.698e-03  0.542  0.5875    
## GenderMale   -1.677e-02 5.074e-02 -0.330  0.7411    
## GenderOther  -5.957e-02 5.165e-02 -1.153  0.2488    
## Sleep.End.Time 1.675e-02 1.806e-02  0.928  0.3537    
## Total.Sleep.Hours -3.937e-02 2.313e-02 -1.702  0.0888 .  
## Exercise..mins.day. -9.722e-06 8.105e-04 -0.012  0.9904  
## 
## Signif. codes:  '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

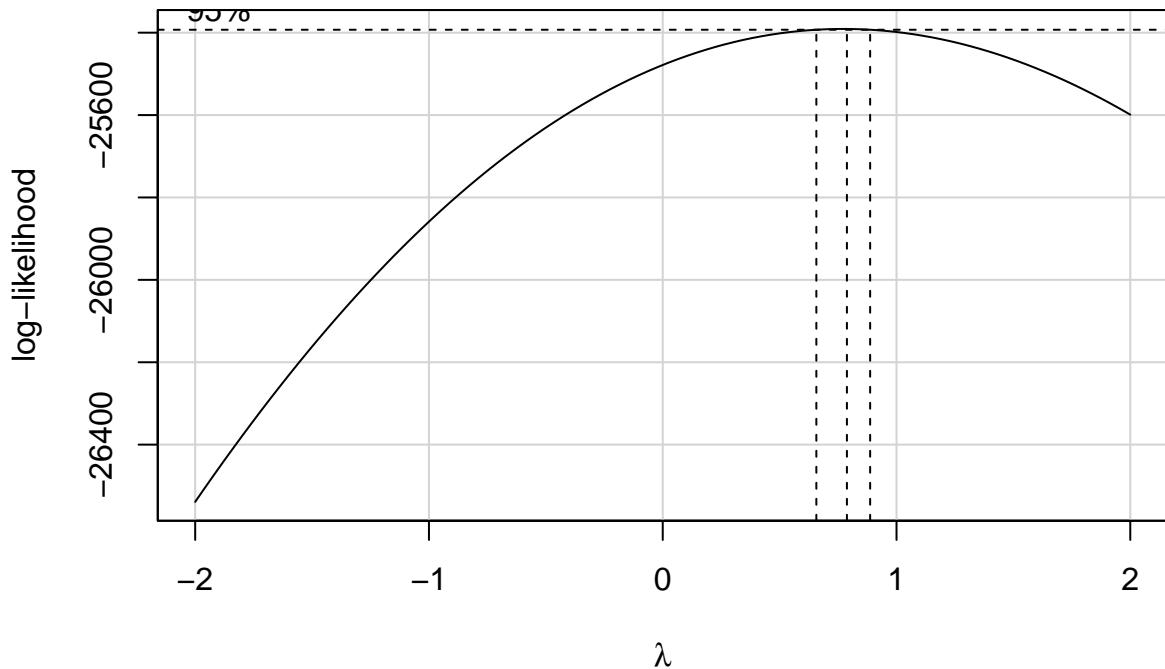
```

```

## Caffeine.Intake..mg.          2.087e-05  2.435e-04  0.086  0.9317
## Screen.Time.Before.Bed..mins. 1.567e-04  4.013e-04  0.390  0.6963
## Sleep.QualityCatMedium      -3.164e-02  5.054e-02 -0.626  0.5313
## Sleep.QualityCatHigh        -5.768e-02  5.424e-02 -1.063  0.2877
## Productivity.ScoreCatMedium 4.164e-02  5.140e-02  0.810  0.4179
## Productivity.ScoreCatHigh   -2.469e-02  5.375e-02 -0.459  0.6460
## Mood.ScoreCatMedium         2.518e-02  4.966e-02  0.507  0.6121
## Mood.ScoreCatHigh           6.638e-02  5.445e-02  1.219  0.2228
## Stress.LevelCatMedium       2.571e-03  5.081e-02  0.051  0.9596
## Stress.LevelCatHigh         5.694e-02  5.368e-02  1.061  0.2888
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.476 on 4983 degrees of freedom
## Multiple R-squared:  0.002283, Adjusted R-squared:  -0.0009203
## F-statistic: 0.7127 on 16 and 4983 DF,  p-value: 0.7837
boxCox(additive_model,family="yjPower")

```

## Profile Log-likelihood

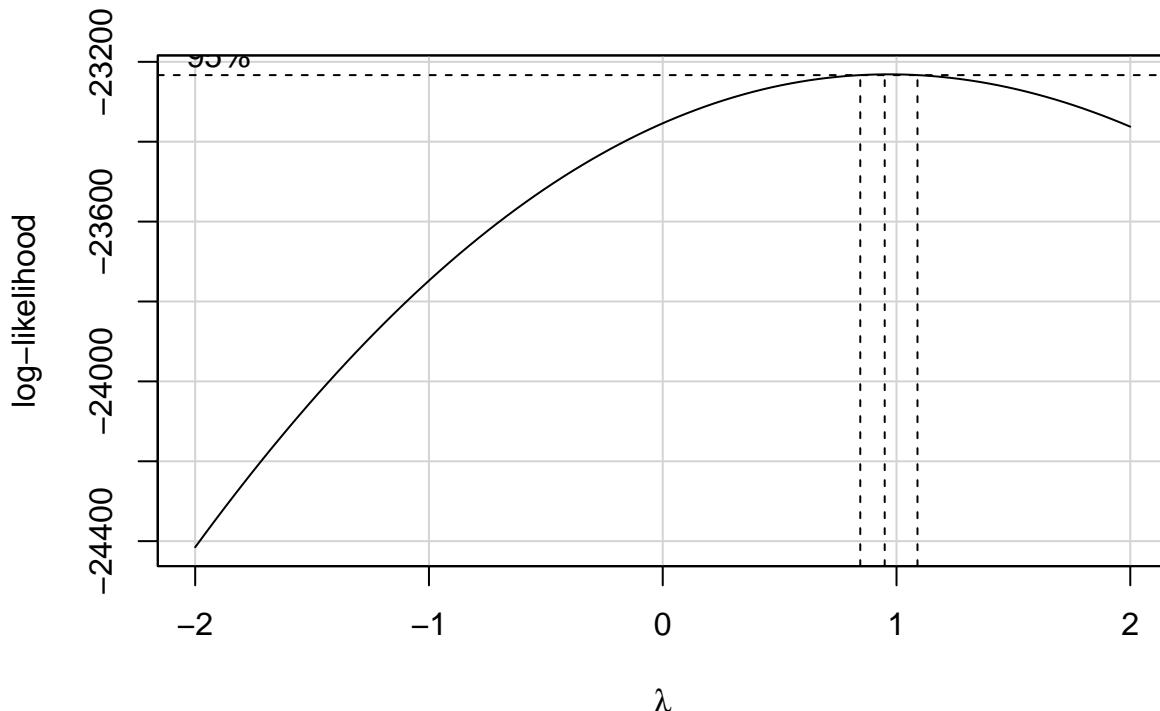


```

# To check if the log transformation worked (lambda should now be 0)
boxCox(additive_bc,family="yjPower")

```

## Profile Log-likelihood



```
# Check for colinearity issues
vif(additive_bc)

##                                     GVIF Df GVIF^(1/(2*Df))
## Age                           1.001600 1     1.000799
## Gender                        1.005458 2     1.001362
## Sleep.End.Time                2.595692 1     1.611115
## Total.Sleep.Hours             2.595831 1     1.611158
## Exercise..mins.day.           1.003032 1     1.001515
## Caffeine.Intake..mg.          1.002563 1     1.001281
## Screen.Time.Before.Bed..mins. 1.002060 1     1.001030
## Sleep.QualityCat              1.003119 2     1.000779
## Productivity.ScoreCat         1.006021 2     1.001502
## Mood.ScoreCat                 1.004532 2     1.001131
## Stress.LevelCat               1.006499 2     1.001621

# Basic full model
summary(additive_bc)

##
## Call:
## lm(formula = Work.Hours..hrs.day. ~ ., data = df_bc)
##
## Residuals:
##      Min        1Q    Median        3Q       Max
## -2.80557 -1.24079  0.04865  1.25303  2.64576
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  5.347e+00  1.580e-01  33.838 <2e-16 ***
## Age                         9.213e-04  1.698e-03   0.542   0.5875
```

```

## GenderMale           -1.677e-02 5.074e-02 -0.330  0.7411
## GenderOther          -5.957e-02 5.165e-02 -1.153  0.2488
## Sleep.End.Time       1.675e-02 1.806e-02  0.928  0.3537
## Total.Sleep.Hours   -3.937e-02 2.313e-02 -1.702  0.0888 .
## Exercise..mins.day. -9.722e-06 8.105e-04 -0.012  0.9904
## Caffeine.Intake..mg. 2.087e-05 2.435e-04  0.086  0.9317
## Screen.Time.Before.Bed..mins. 1.567e-04 4.013e-04  0.390  0.6963
## Sleep.QualityCatMedium -3.164e-02 5.054e-02 -0.626  0.5313
## Sleep.QualityCatHigh -5.768e-02 5.424e-02 -1.063  0.2877
## Productivity.ScoreCatMedium 4.164e-02 5.140e-02  0.810  0.4179
## Productivity.ScoreCatHigh -2.469e-02 5.375e-02 -0.459  0.6460
## Mood.ScoreCatMedium   2.518e-02 4.966e-02  0.507  0.6121
## Mood.ScoreCatHigh     6.638e-02 5.445e-02  1.219  0.2228
## Stress.LevelCatMedium 2.571e-03 5.081e-02  0.051  0.9596
## Stress.LevelCatHigh   5.694e-02 5.368e-02  1.061  0.2888
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.476 on 4983 degrees of freedom
## Multiple R-squared:  0.002283, Adjusted R-squared: -0.0009203
## F-statistic: 0.7127 on 16 and 4983 DF, p-value: 0.7837
full_bc <- lm(Work.Hours..hrs.day. ~ .)^2, data = df_bc)
summary(full_bc)
```

```

##
## Call:
## lm(formula = Work.Hours..hrs.day. ~ .)^2, data = df_bc)
##
## Residuals:
##      Min       1Q       Median      3Q      Max
## -3.04538 -1.21011  0.06007  1.19166  2.92022
##
## Coefficients:
##                               Estimate Std. Error
## (Intercept)                4.262e+00 8.029e-01
## Age                     2.453e-02 1.180e-02
## GenderMale              -1.485e-01 3.816e-01
## GenderOther               1.289e-01 3.907e-01
## Sleep.End.Time            -3.251e-02 1.180e-01
## Total.Sleep.Hours         6.228e-02 1.364e-01
## Exercise..mins.day.        1.409e-02 6.089e-03
## Caffeine.Intake..mg.       -2.010e-04 1.847e-03
## Screen.Time.Before.Bed..mins. -2.736e-03 2.961e-03
## Sleep.QualityCatMedium    7.498e-01 3.773e-01
## Sleep.QualityCatHigh      5.923e-01 4.067e-01
## Productivity.ScoreCatMedium 3.421e-01 3.840e-01
## Productivity.ScoreCatHigh  1.393e-01 4.031e-01
## Mood.ScoreCatMedium        -8.557e-01 3.741e-01
## Mood.ScoreCatHigh          -1.460e-01 4.110e-01
## Stress.LevelCatMedium      6.074e-01 3.760e-01
## Stress.LevelCatHigh        7.982e-04 4.003e-01
## Age:GenderMale              1.060e-03 4.183e-03
## Age:GenderOther              5.459e-03 4.252e-03
## Age:Sleep.End.Time          1.163e-03 1.468e-03
```

## Age:Total.Sleep.Hours	-2.383e-03	1.886e-03
## Age:Exercise..mins.day.	-2.061e-04	6.720e-05
## Age:Caffeine.Intake..mg.	1.907e-05	2.010e-05
## Age:Screen.Time.Before.Bed..mins.	1.304e-05	3.292e-05
## Age:Sleep.QualityCatMedium	-9.684e-03	4.151e-03
## Age:Sleep.QualityCatHigh	-8.218e-03	4.431e-03
## Age:Productivity.ScoreCatMedium	-4.895e-03	4.245e-03
## Age:Productivity.ScoreCatHigh	-8.523e-04	4.413e-03
## Age:Mood.ScoreCatMedium	2.008e-03	4.084e-03
## Age:Mood.ScoreCatHigh	-8.293e-03	4.459e-03
## Age:Stress.LevelCatMedium	-1.757e-03	4.197e-03
## Age:Stress.LevelCatHigh	2.877e-03	4.387e-03
## GenderMale:Sleep.End.Time	2.876e-04	4.454e-02
## GenderOther:Sleep.End.Time	2.643e-02	4.505e-02
## GenderMale:Total.Sleep.Hours	6.188e-03	5.728e-02
## GenderOther:Total.Sleep.Hours	-7.468e-02	5.779e-02
## GenderMale:Exercise..mins.day.	-1.444e-03	1.989e-03
## GenderOther:Exercise..mins.day.	-1.445e-03	2.014e-03
## GenderMale:Caffeine.Intake..mg.	4.243e-04	5.974e-04
## GenderOther:Caffeine.Intake..mg.	2.486e-04	6.054e-04
## GenderMale:Screen.Time.Before.Bed..mins.	-9.715e-04	9.782e-04
## GenderOther:Screen.Time.Before.Bed..mins.	6.899e-05	1.005e-03
## GenderMale:Sleep.QualityCatMedium	2.413e-01	1.241e-01
## GenderOther:Sleep.QualityCatMedium	1.087e-01	1.261e-01
## GenderMale:Sleep.QualityCatHigh	1.610e-01	1.331e-01
## GenderOther:Sleep.QualityCatHigh	1.060e-01	1.360e-01
## GenderMale:Productivity.ScoreCatMedium	2.537e-01	1.263e-01
## GenderOther:Productivity.ScoreCatMedium	1.591e-01	1.289e-01
## GenderMale:Productivity.ScoreCatHigh	6.074e-02	1.319e-01
## GenderOther:Productivity.ScoreCatHigh	2.025e-01	1.338e-01
## GenderMale:Mood.ScoreCatMedium	-1.358e-01	1.212e-01
## GenderOther:Mood.ScoreCatMedium	-1.305e-01	1.240e-01
## GenderMale:Mood.ScoreCatHigh	-9.315e-02	1.341e-01
## GenderOther:Mood.ScoreCatHigh	-2.001e-01	1.360e-01
## GenderMale:Stress.LevelCatMedium	-1.625e-01	1.248e-01
## GenderOther:Stress.LevelCatMedium	-2.259e-01	1.260e-01
## GenderMale:Stress.LevelCatHigh	6.064e-02	1.303e-01
## GenderOther:Stress.LevelCatHigh	6.202e-02	1.340e-01
## Sleep.End.Time:Total.Sleep.Hours	2.485e-03	8.313e-03
## Sleep.End.Time:Exercise..mins.day.	-2.309e-04	7.058e-04
## Sleep.End.Time:Caffeine.Intake..mg.	3.180e-04	2.150e-04
## Sleep.End.Time:Screen.Time.Before.Bed..mins.	-1.279e-04	3.512e-04
## Sleep.End.Time:Sleep.QualityCatMedium	4.231e-02	4.401e-02
## Sleep.End.Time:Sleep.QualityCatHigh	6.311e-02	4.714e-02
## Sleep.End.Time:Productivity.ScoreCatMedium	1.767e-02	4.473e-02
## Sleep.End.Time:Productivity.ScoreCatHigh	-2.888e-03	4.693e-02
## Sleep.End.Time:Mood.ScoreCatMedium	-1.076e-01	4.324e-02
## Sleep.End.Time:Mood.ScoreCatHigh	-4.060e-02	4.739e-02
## Sleep.End.Time:Stress.LevelCatMedium	-3.992e-02	4.442e-02
## Sleep.End.Time:Stress.LevelCatHigh	-5.343e-02	4.664e-02
## Total.Sleep.Hours:Exercise..mins.day.	-4.315e-04	9.072e-04
## Total.Sleep.Hours:Caffeine.Intake..mg.	-3.858e-04	2.743e-04
## Total.Sleep.Hours:Screen.Time.Before.Bed..mins.	4.263e-04	4.491e-04
## Total.Sleep.Hours:Sleep.QualityCatMedium	-8.212e-02	5.677e-02

## Total.Sleep.Hours:Sleep.QualityCatHigh	-1.063e-01	6.038e-02
## Total.Sleep.Hours:Productivity.ScoreCatMedium	-4.037e-02	5.763e-02
## Total.Sleep.Hours:Productivity.ScoreCatHigh	-1.584e-02	5.982e-02
## Total.Sleep.Hours:Mood.ScoreCatMedium	1.740e-01	5.547e-02
## Total.Sleep.Hours:Mood.ScoreCatHigh	8.874e-02	6.169e-02
## Total.Sleep.Hours:Stress.LevelCatMedium	1.334e-02	5.649e-02
## Total.Sleep.Hours:Stress.LevelCatHigh	5.550e-02	5.993e-02
## Exercise..mins.day.:Caffeine.Intake..mg.	1.461e-06	9.702e-06
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-3.407e-06	1.578e-05
## Exercise..mins.day.:Sleep.QualityCatMedium	-2.781e-03	1.967e-03
## Exercise..mins.day.:Sleep.QualityCatHigh	9.216e-04	2.127e-03
## Exercise..mins.day.:Productivity.ScoreCatMedium	3.542e-04	2.005e-03
## Exercise..mins.day.:Productivity.ScoreCatHigh	-1.951e-04	2.105e-03
## Exercise..mins.day.:Mood.ScoreCatMedium	5.604e-04	1.940e-03
## Exercise..mins.day.:Mood.ScoreCatHigh	1.460e-03	2.117e-03
## Exercise..mins.day.:Stress.LevelCatMedium	-2.764e-03	2.000e-03
## Exercise..mins.day.:Stress.LevelCatHigh	1.043e-03	2.106e-03
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-3.103e-06	4.716e-06
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	8.010e-04	5.956e-04
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	5.095e-04	6.376e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	1.745e-04	6.056e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	4.735e-04	6.331e-04
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	7.653e-05	5.914e-04
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	8.137e-04	6.387e-04
## Caffeine.Intake..mg.:Stress.LevelCatMedium	-1.358e-04	5.996e-04
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-1.029e-03	6.371e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	9.498e-05	9.773e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-6.407e-04	1.054e-03
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-5.229e-04	9.897e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	9.119e-04	1.035e-03
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	1.552e-03	9.641e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	8.703e-04	1.057e-03
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	2.207e-04	9.906e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-1.426e-04	1.048e-03
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-1.775e-01	1.259e-01
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-4.194e-02	1.349e-01
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	-2.636e-01	1.324e-01
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	-1.682e-01	1.407e-01
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	1.456e-01	1.211e-01
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	2.629e-02	1.306e-01
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	2.759e-01	1.325e-01
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	1.106e-01	1.423e-01
## Sleep.QualityCatMedium:Stress.LevelCatMedium	-2.735e-01	1.242e-01
## Sleep.QualityCatHigh:Stress.LevelCatMedium	-7.528e-02	1.341e-01
## Sleep.QualityCatMedium:Stress.LevelCatHigh	-1.258e-01	1.307e-01
## Sleep.QualityCatHigh:Stress.LevelCatHigh	1.323e-02	1.406e-01
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium	1.251e-01	1.237e-01
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium	-2.129e-01	1.296e-01
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh	-3.482e-02	1.367e-01
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh	-1.103e-01	1.419e-01
## Productivity.ScoreCatMedium:Stress.LevelCatMedium	-3.554e-02	1.262e-01
## Productivity.ScoreCatHigh:Stress.LevelCatMedium	-1.123e-02	1.323e-01
## Productivity.ScoreCatMedium:Stress.LevelCatHigh	5.691e-04	1.338e-01
## Productivity.ScoreCatHigh:Stress.LevelCatHigh	1.380e-01	1.384e-01

## Mood.ScoreCatMedium:Stress.LevelCatMedium	-1.001e-02	1.219e-01
## Mood.ScoreCatHigh:Stress.LevelCatMedium	-1.077e-01	1.331e-01
## Mood.ScoreCatMedium:Stress.LevelCatHigh	-1.807e-02	1.286e-01
## Mood.ScoreCatHigh:Stress.LevelCatHigh	-3.098e-01	1.417e-01
##	t value	Pr(> t )
## (Intercept)	5.309	1.15e-07 ***
## Age	2.079	0.03765 *
## GenderMale	-0.389	0.69721
## GenderOther	0.330	0.74139
## Sleep.End.Time	-0.275	0.78298
## Total.Sleep.Hours	0.457	0.64787
## Exercise..mins.day.	2.314	0.02070 *
## Caffeine.Intake..mg.	-0.109	0.91331
## Screen.Time.Before.Bed..mins.	-0.924	0.35552
## Sleep.QualityCatMedium	1.987	0.04693 *
## Sleep.QualityCatHigh	1.456	0.14534
## Productivity.ScoreCatMedium	0.891	0.37294
## Productivity.ScoreCatHigh	0.346	0.72960
## Mood.ScoreCatMedium	-2.287	0.02223 *
## Mood.ScoreCatHigh	-0.355	0.72236
## Stress.LevelCatMedium	1.615	0.10627
## Stress.LevelCatHigh	0.002	0.99841
## Age:GenderMale	0.253	0.79997
## Age:GenderOther	1.284	0.19932
## Age:Sleep.End.Time	0.792	0.42833
## Age:Total.Sleep.Hours	-1.264	0.20643
## Age:Exercise..mins.day.	-3.068	0.00217 **
## Age:Caffeine.Intake..mg.	0.949	0.34282
## Age:Screen.Time.Before.Bed..mins.	0.396	0.69204
## Age:Sleep.QualityCatMedium	-2.333	0.01969 *
## Age:Sleep.QualityCatHigh	-1.855	0.06369 .
## Age:Productivity.ScoreCatMedium	-1.153	0.24888
## Age:Productivity.ScoreCatHigh	-0.193	0.84687
## Age:Mood.ScoreCatMedium	0.492	0.62302
## Age:Mood.ScoreCatHigh	-1.860	0.06298 .
## Age:Stress.LevelCatMedium	-0.419	0.67555
## Age:Stress.LevelCatHigh	0.656	0.51202
## GenderMale:Sleep.End.Time	0.006	0.99485
## GenderOther:Sleep.End.Time	0.587	0.55734
## GenderMale:Total.Sleep.Hours	0.108	0.91398
## GenderOther:Total.Sleep.Hours	-1.292	0.19635
## GenderMale:Exercise..mins.day.	-0.726	0.46784
## GenderOther:Exercise..mins.day.	-0.718	0.47308
## GenderMale:Caffeine.Intake..mg.	0.710	0.47755
## GenderOther:Caffeine.Intake..mg.	0.411	0.68129
## GenderMale:Screen.Time.Before.Bed..mins.	-0.993	0.32067
## GenderOther:Screen.Time.Before.Bed..mins.	0.069	0.94527
## GenderMale:Sleep.QualityCatMedium	1.944	0.05197 .
## GenderOther:Sleep.QualityCatMedium	0.862	0.38875
## GenderMale:Sleep.QualityCatHigh	1.210	0.22634
## GenderOther:Sleep.QualityCatHigh	0.780	0.43568
## GenderMale:Productivity.ScoreCatMedium	2.010	0.04451 *
## GenderOther:Productivity.ScoreCatMedium	1.234	0.21711
## GenderMale:Productivity.ScoreCatHigh	0.460	0.64529

## GenderOther:Productivity.ScoreCatHigh	1.513	0.13033
## GenderMale:Mood.ScoreCatMedium	-1.121	0.26253
## GenderOther:Mood.ScoreCatMedium	-1.053	0.29255
## GenderMale:Mood.ScoreCatHigh	-0.694	0.48740
## GenderOther:Mood.ScoreCatHigh	-1.471	0.14136
## GenderMale:Stress.LevelCatMedium	-1.302	0.19298
## GenderOther:Stress.LevelCatMedium	-1.793	0.07309 .
## GenderMale:Stress.LevelCatHigh	0.465	0.64176
## GenderOther:Stress.LevelCatHigh	0.463	0.64340
## Sleep.End.Time:Total.Sleep.Hours	0.299	0.76502
## Sleep.End.Time:Exercise..mins.day.	-0.327	0.74361
## Sleep.End.Time:Caffeine.Intake..mg.	1.479	0.13912
## Sleep.End.Time:Screen.Time.Before.Bed..mins.	-0.364	0.71582
## Sleep.End.Time:Sleep.QualityCatMedium	0.961	0.33643
## Sleep.End.Time:Sleep.QualityCatHigh	1.339	0.18065
## Sleep.End.Time:Productivity.ScoreCatMedium	0.395	0.69282
## Sleep.End.Time:Productivity.ScoreCatHigh	-0.062	0.95094
## Sleep.End.Time:Mood.ScoreCatMedium	-2.488	0.01288 *
## Sleep.End.Time:Mood.ScoreCatHigh	-0.857	0.39163
## Sleep.End.Time:Stress.LevelCatMedium	-0.899	0.36890
## Sleep.End.Time:Stress.LevelCatHigh	-1.146	0.25201
## Total.Sleep.Hours:Exercise..mins.day.	-0.476	0.63436
## Total.Sleep.Hours:Caffeine.Intake..mg.	-1.407	0.15955
## Total.Sleep.Hours:Screen.Time.Before.Bed..mins.	0.949	0.34260
## Total.Sleep.Hours:Sleep.QualityCatMedium	-1.447	0.14806
## Total.Sleep.Hours:Sleep.QualityCatHigh	-1.760	0.07842 .
## Total.Sleep.Hours:Productivity.ScoreCatMedium	-0.700	0.48373
## Total.Sleep.Hours:Productivity.ScoreCatHigh	-0.265	0.79120
## Total.Sleep.Hours:Mood.ScoreCatMedium	3.136	0.00172 **
## Total.Sleep.Hours:Mood.ScoreCatHigh	1.438	0.15036
## Total.Sleep.Hours:Stress.LevelCatMedium	0.236	0.81327
## Total.Sleep.Hours:Stress.LevelCatHigh	0.926	0.35445
## Exercise..mins.day.:Caffeine.Intake..mg.	0.151	0.88032
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-0.216	0.82905
## Exercise..mins.day.:Sleep.QualityCatMedium	-1.414	0.15757
## Exercise..mins.day.:Sleep.QualityCatHigh	0.433	0.66484
## Exercise..mins.day.:Productivity.ScoreCatMedium	0.177	0.85979
## Exercise..mins.day.:Productivity.ScoreCatHigh	-0.093	0.92615
## Exercise..mins.day.:Mood.ScoreCatMedium	0.289	0.77265
## Exercise..mins.day.:Mood.ScoreCatHigh	0.690	0.49041
## Exercise..mins.day.:Stress.LevelCatMedium	-1.382	0.16701
## Exercise..mins.day.:Stress.LevelCatHigh	0.495	0.62064
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-0.658	0.51057
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	1.345	0.17875
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	0.799	0.42434
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	0.288	0.77320
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	0.748	0.45457
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	0.129	0.89705
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	1.274	0.20276
## Caffeine.Intake..mg.:Stress.LevelCatMedium	-0.227	0.82081
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-1.615	0.10636
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	0.097	0.92258
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-0.608	0.54330
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-0.528	0.59729

```

## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh      0.881  0.37842
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium           1.610  0.10745
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh              0.824  0.41022
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium          0.223  0.82370
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh             -0.136 0.89180
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium          -1.410  0.15857
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium             -0.311  0.75595
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh              -1.991  0.04656 *
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh                -1.196  0.23169
## Sleep.QualityCatMedium:Mood.ScoreCatMedium                   1.203  0.22912
## Sleep.QualityCatHigh:Mood.ScoreCatMedium                      0.201  0.84050
## Sleep.QualityCatMedium:Mood.ScoreCatHigh                      2.083  0.03731 *
## Sleep.QualityCatHigh:Mood.ScoreCatHigh                        0.778  0.43674
## Sleep.QualityCatMedium:Stress.LevelCatMedium                 -2.201  0.02775 *
## Sleep.QualityCatHigh:Stress.LevelCatMedium                   -0.561  0.57458
## Sleep.QualityCatMedium:Stress.LevelCatHigh                   -0.962  0.33607
## Sleep.QualityCatHigh:Stress.LevelCatHigh                     0.094  0.92502
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium              1.011  0.31195
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium                -1.643  0.10043
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh                -0.255  0.79895
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh                  -0.777  0.43708
## Productivity.ScoreCatMedium:Stress.LevelCatMedium            -0.282  0.77817
## Productivity.ScoreCatHigh:Stress.LevelCatMedium              -0.085  0.93233
## Productivity.ScoreCatMedium:Stress.LevelCatHigh              0.004  0.99661
## Productivity.ScoreCatHigh:Stress.LevelCatHigh                0.997  0.31900
## Mood.ScoreCatMedium:Stress.LevelCatMedium                   -0.082  0.93453
## Mood.ScoreCatHigh:Stress.LevelCatMedium                      -0.809  0.41828
## Mood.ScoreCatMedium:Stress.LevelCatHigh                      -0.141  0.88827
## Mood.ScoreCatHigh:Stress.LevelCatHigh                         -2.187  0.02881 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.474 on 4868 degrees of freedom
## Multiple R-squared:  0.02807,   Adjusted R-squared:  0.001914
## F-statistic: 1.073 on 131 and 4868 DF,  p-value: 0.271
coefs <- summary(full_bc)$coefficients
vars <- rownames(coefs)[which(coefs[, 4] < 0.1)]
print("Significant Interactions:")

## [1] "Significant Interactions:"
vars

## [1] "(Intercept)"
## [2] "Age"
## [3] "Exercise..mins.day."
## [4] "Sleep.QualityCatMedium"
## [5] "Mood.ScoreCatMedium"
## [6] "Age:Exercise..mins.day."
## [7] "Age:Sleep.QualityCatMedium"
## [8] "Age:Sleep.QualityCatHigh"
## [9] "Age:Mood.ScoreCatHigh"
## [10] "GenderMale:Sleep.QualityCatMedium"
## [11] "GenderMale:Productivity.ScoreCatMedium"
## [12] "GenderOther:Stress.LevelCatMedium"

```

```

## [13] "Sleep.End.Time:Mood.ScoreCatMedium"
## [14] "Total.Sleep.Hours:Sleep.QualityCatHigh"
## [15] "Total.Sleep.Hours:Mood.ScoreCatMedium"
## [16] "Sleep.QualityCatMedium:Productivity.ScoreCatHigh"
## [17] "Sleep.QualityCatMedium:Mood.ScoreCatHigh"
## [18] "Sleep.QualityCatMedium:Stress.LevelCatMedium"
## [19] "Mood.ScoreCatHigh:Stress.LevelCatHigh"

anova(full_bc, additive_bc)

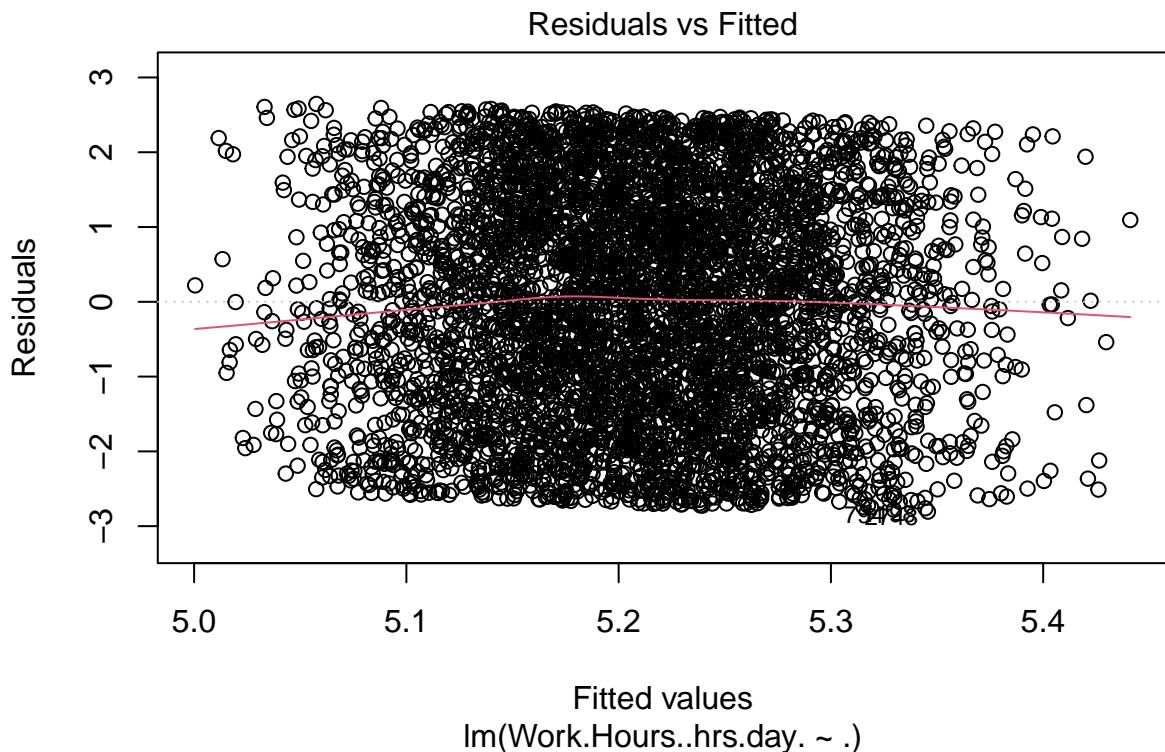
## Analysis of Variance Table
##
## Model 1: Work.Hours..hrs.day. ~ (Age + Gender + Sleep.End.Time + Total.Sleep.Hours +
##     Exercise..mins.day. + Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. +
##     Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
##     Stress.LevelCat)^2
## Model 2: Work.Hours..hrs.day. ~ Age + Gender + Sleep.End.Time + Total.Sleep.Hours +
##     Exercise..mins.day. + Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. +
##     Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
##     Stress.LevelCat
##   Res.Df   RSS   Df Sum of Sq    F Pr(>F)
## 1   4868 10577
## 2   4983 10857 -115    -280.6 1.1231 0.1767

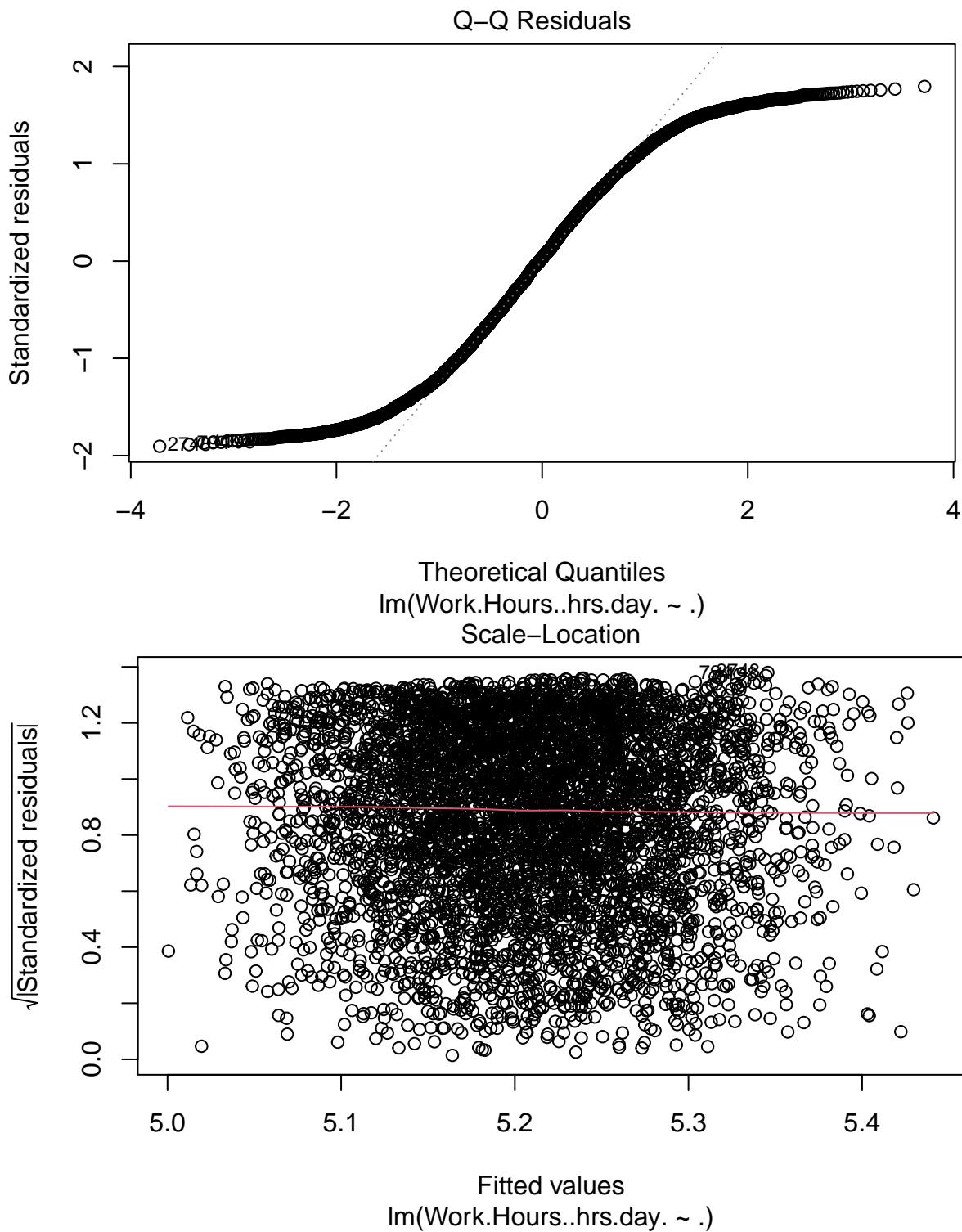
```

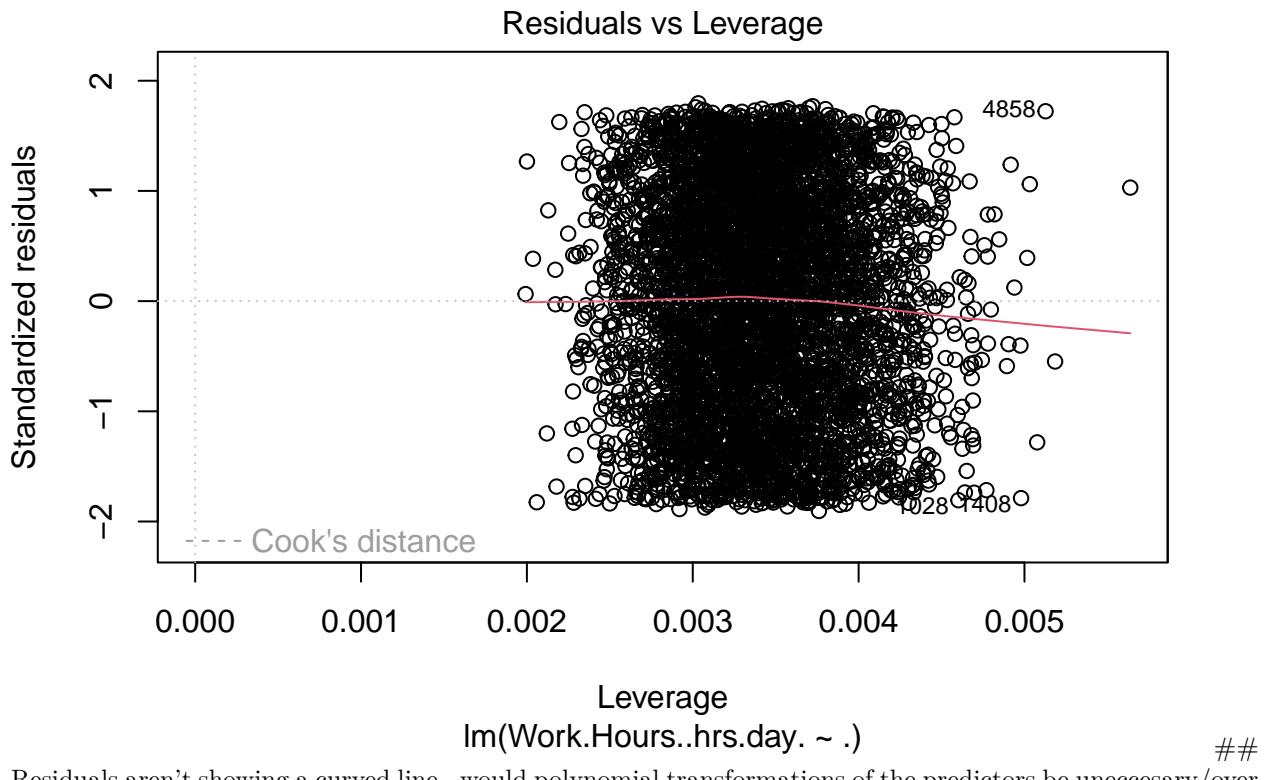
### Findings:

Using a significance level of 0.05 there are some significant interactions Using an anova test the p-value is high....

```
plot(additive_bc)
```







## Final Thoughts

No predictors are significant even after transformations, possible explanations include:

The predictors truly have no effect on work hours A different model might be better. More data may be needed for stronger statistical power.