

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? -> looked at work hour-related avaiables (i.e the predictors where total work hours are the response)

Basic Correlation plot, can also just use Oliver's instead

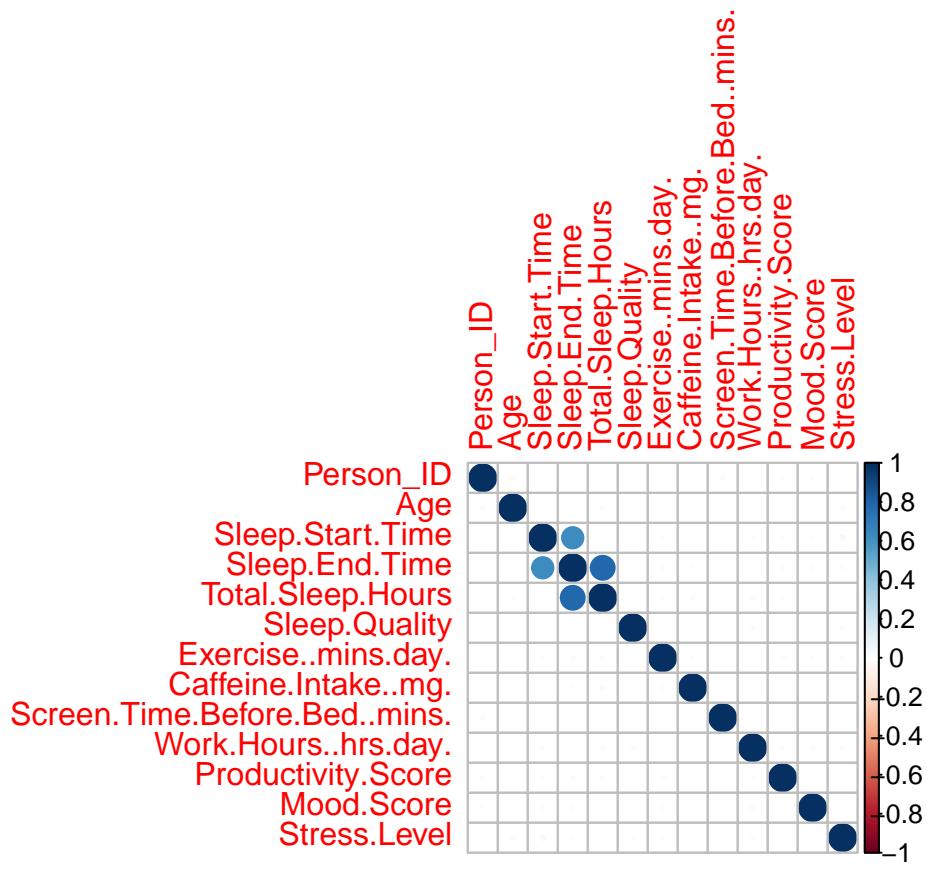
```
library(corrplot)

## 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 tidyr    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")
```



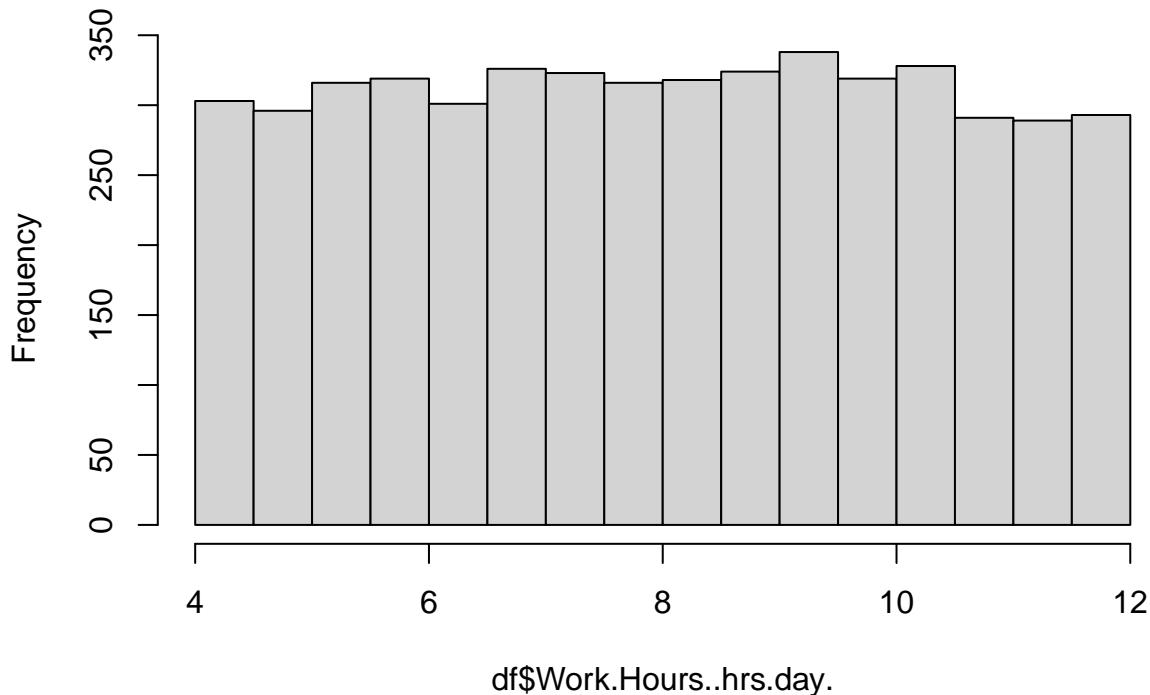
```
# Numeric variable scatter plot
```

```
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]

# No outliers in the response
hist(df$Work.Hours..hrs.day.)
```

Histogram of df\$Work.Hours..hrs.day.



Findings (Expand in report):

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)
```

How to choose end time or start time since we can't keep both

```
# 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)
```

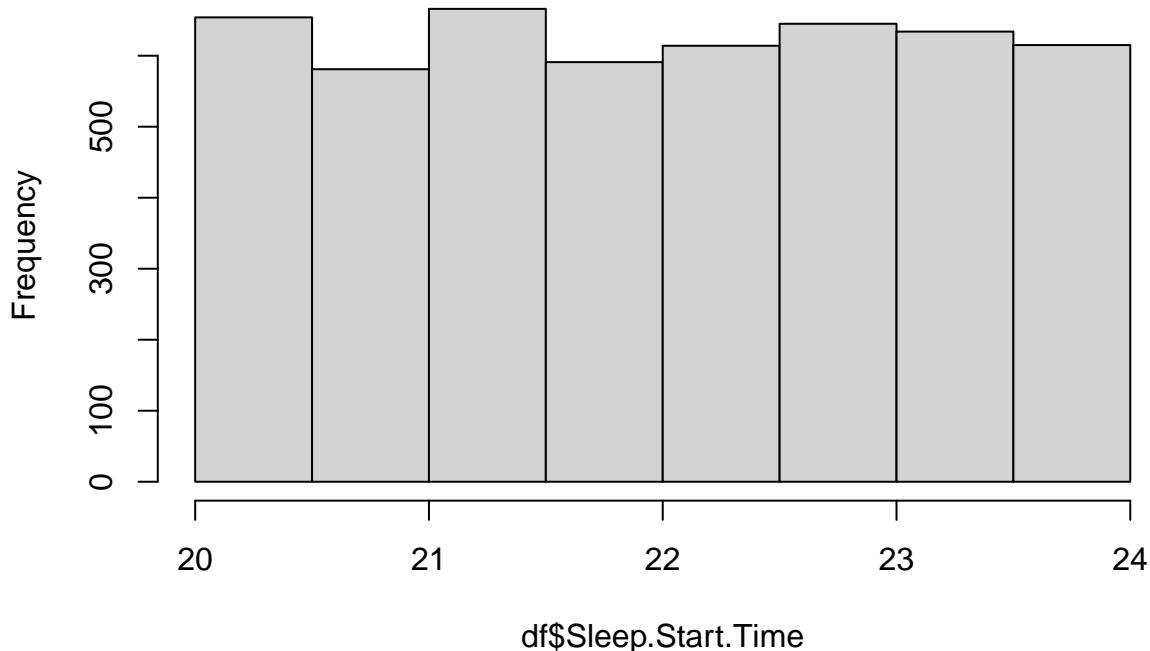
```

## 
## 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 

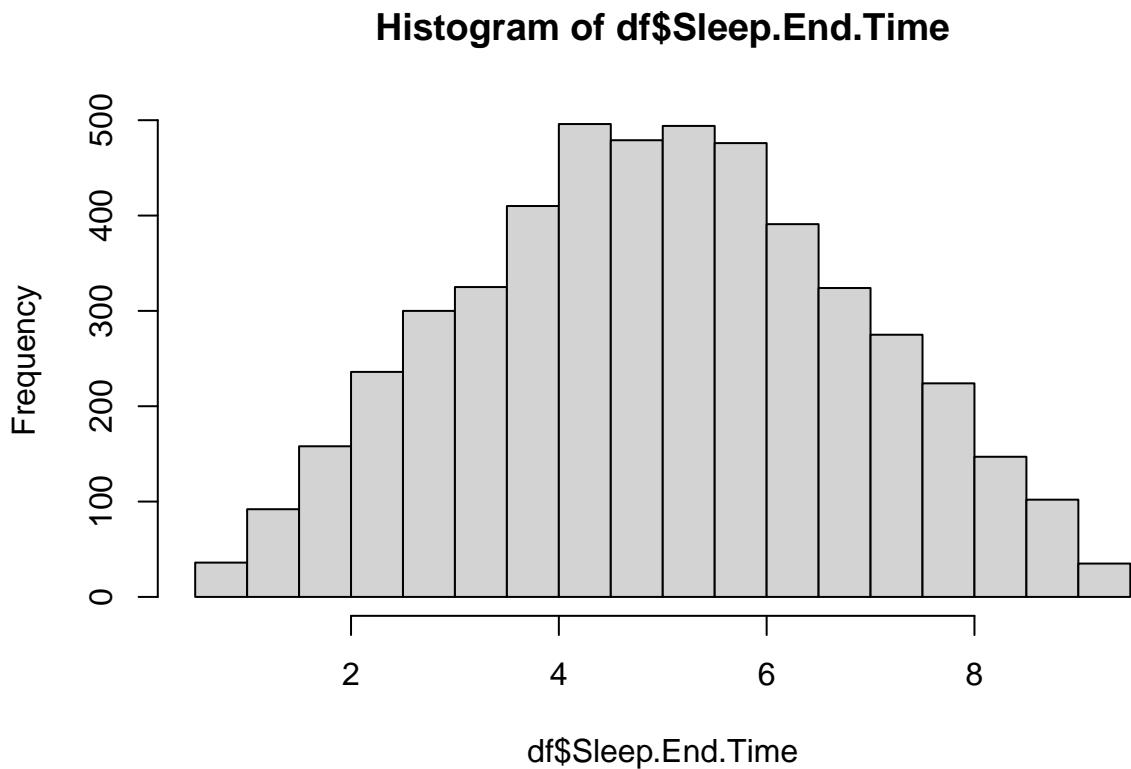
# Omit based on variation
hist(df$Sleep.Start.Time)

```

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

Beginning of Total Work Hours Model

```

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

```

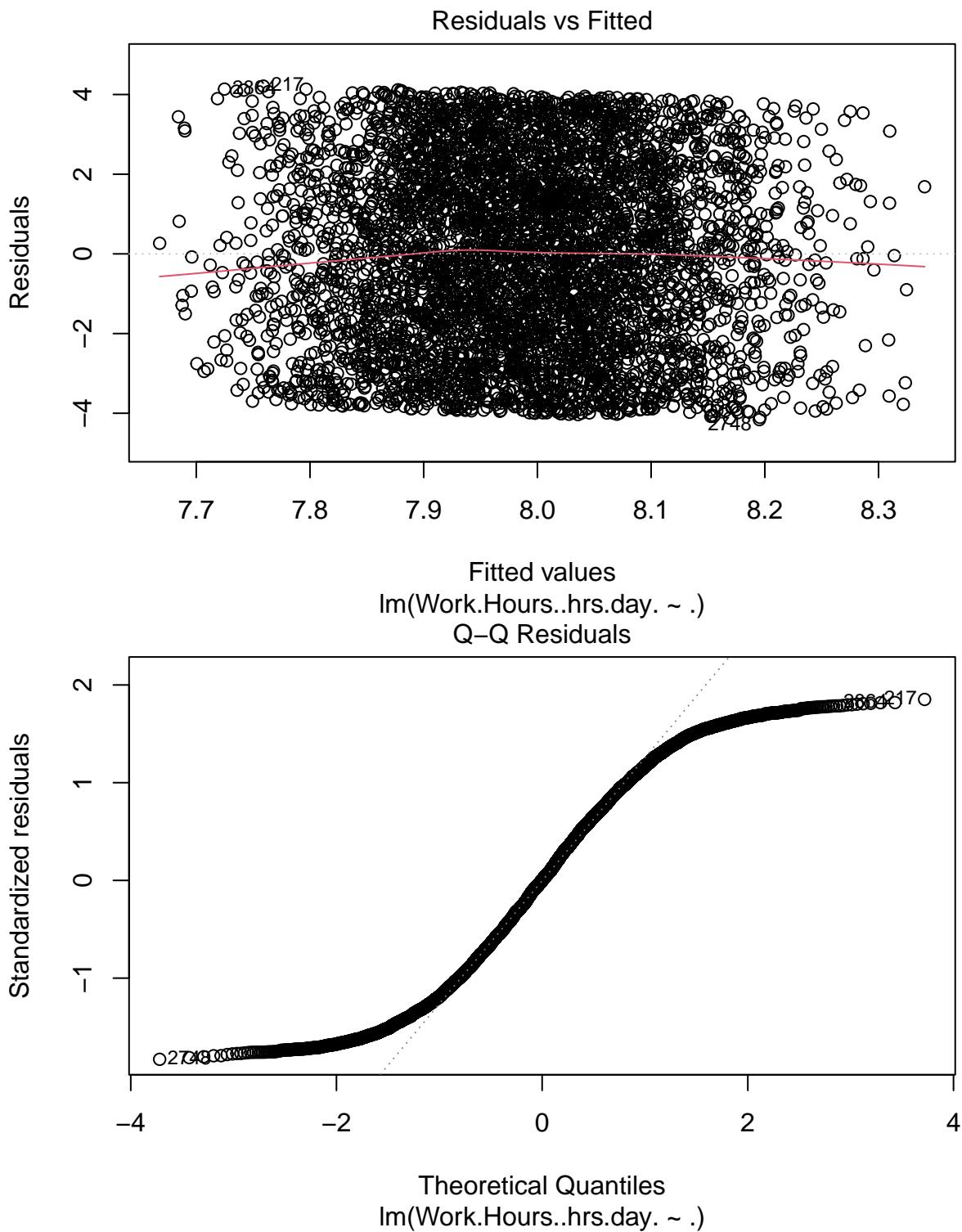
```

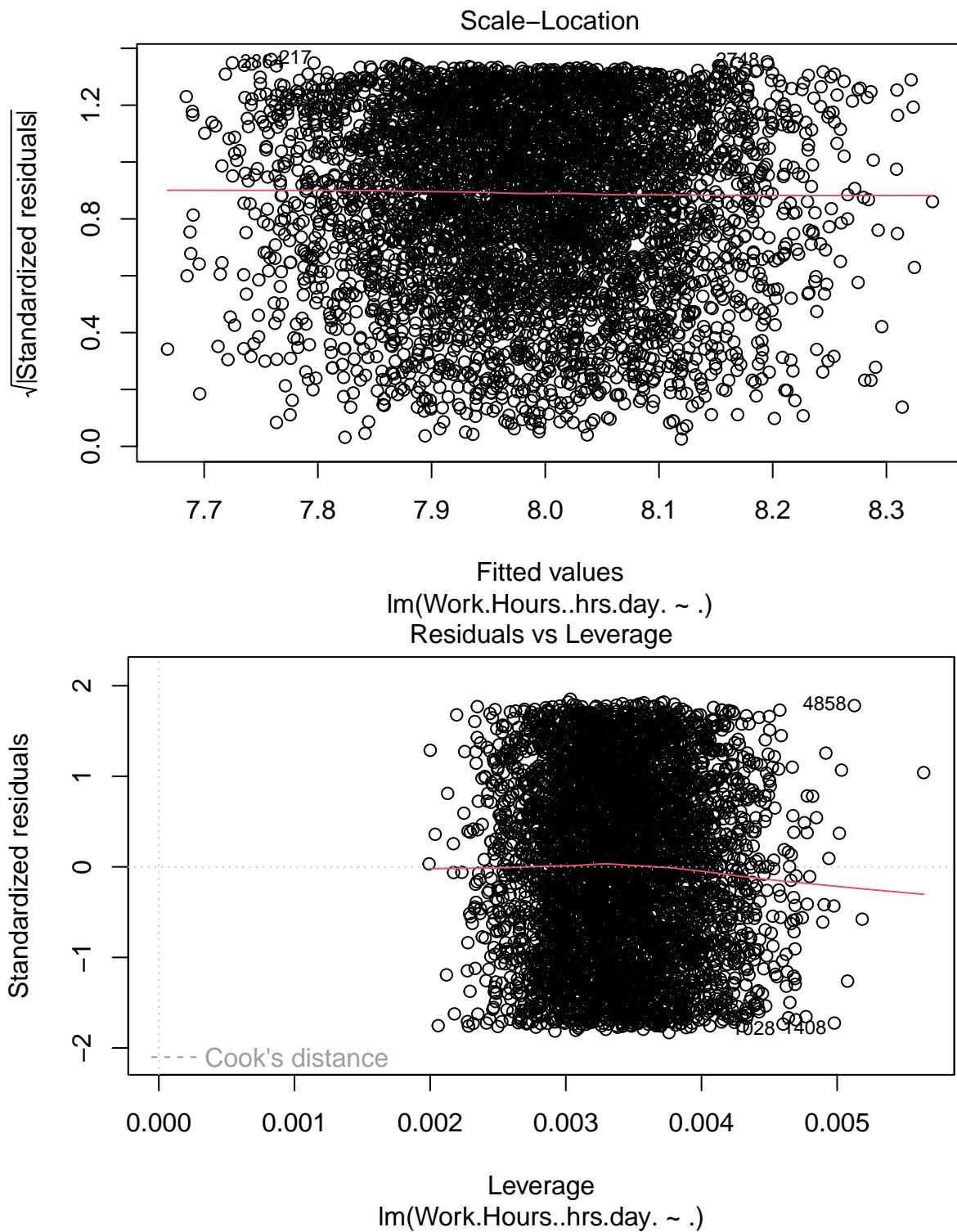
additive_model <- lm(Work.Hours..hrs.day. ~ ., data = df_filtered)
# basic variable only model
summary(additive_model)

## 
## Call:
## lm(formula = Work.Hours..hrs.day. ~ ., data = df_filtered)
## 
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -4.1605 -1.9384  0.0047  1.9224  4.2100 
## 
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)    
## (Intercept)               8.200e+00  2.437e-01 33.640 <2e-16 ***
## Age                     1.388e-03  2.620e-03  0.530  0.5963    
## GenderMale              -2.174e-02  7.826e-02 -0.278  0.7812    
## GenderOther              -9.012e-02  7.967e-02 -1.131  0.2580    
## Sleep.End.Time          2.547e-02  2.786e-02  0.914  0.3605    
## Total.Sleep.Hours       -6.075e-02 3.568e-02 -1.702  0.0887 .  
## Exercise..mins.day.     -3.288e-05 1.250e-03 -0.026  0.9790    
## Caffeine.Intake..mg.    3.299e-05  3.757e-04  0.088  0.9300    
## Screen.Time.Before.Bed..mins. 2.340e-04  6.190e-04  0.378  0.7054    
## Sleep.QualityCatMedium -4.426e-02  7.795e-02 -0.568  0.5702    
## Sleep.QualityCatHigh   -8.729e-02  8.367e-02 -1.043  0.2969    
## Productivity.ScoreCatMedium 6.745e-02  7.928e-02  0.851  0.3949    
## Productivity.ScoreCatHigh -3.319e-02  8.290e-02 -0.400  0.6889    
## Mood.ScoreCatMedium     3.748e-02  7.660e-02  0.489  0.6247    
## Mood.ScoreCatHigh       1.017e-01  8.398e-02  1.211  0.2258    
## Stress.LevelCatMedium   2.692e-03  7.836e-02  0.034  0.9726    
## Stress.LevelCatHigh     8.630e-02  8.280e-02  1.042  0.2973    
## --- 
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1 
## 
## Residual standard error: 2.277 on 4983 degrees of freedom
## Multiple R-squared:  0.002257,  Adjusted R-squared:  -0.0009468 
## F-statistic: 0.7045 on 16 and 4983 DF,  p-value: 0.7922 

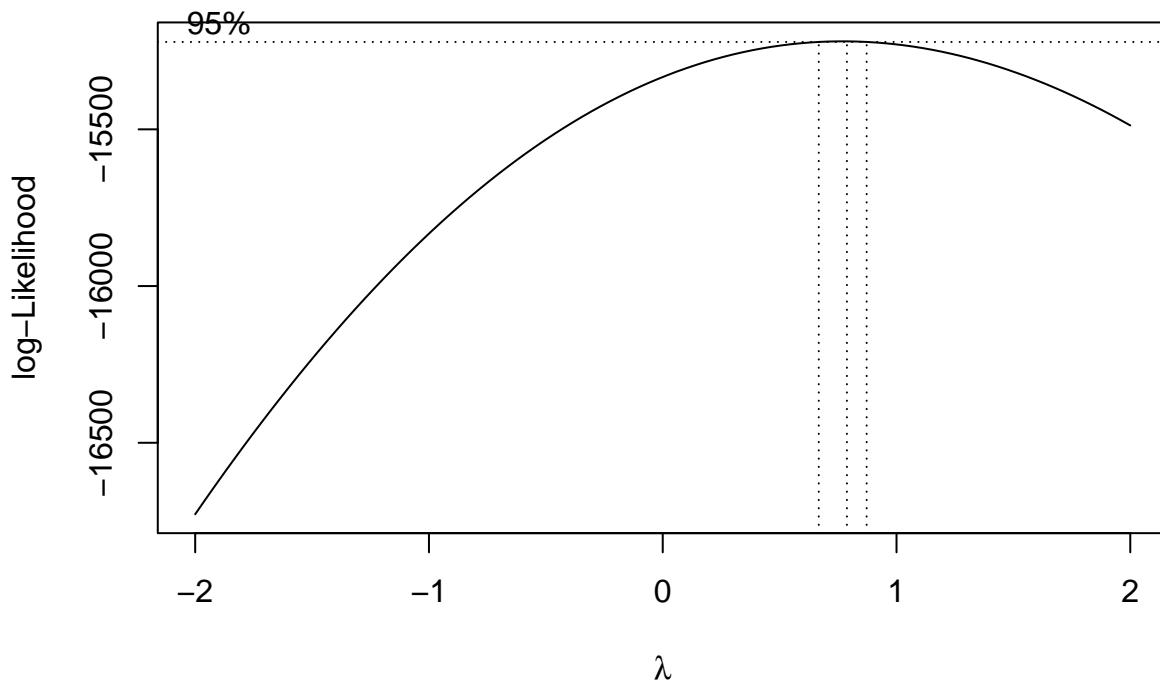
# residual plot
plot(additive_model)

```





```
# Transform the response for better results:  
# response is strictly positive (box cox is appropriate - see notes on yeo-johnson in lecture)  
# Box cox is theoretically used when we don't know what transformation is the most appropriate  
bc <- boxcox(additive_model)
```



```

summary(bc)

##   Length Class  Mode
## x 100    -none- numeric
## y 100    -none- numeric
# Find lambda
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)

# Basic model after box cox transformation
additive_bc <- lm(Work.Hours..hrs.day. ~ ., data = df_bc)
summary(additive_bc)

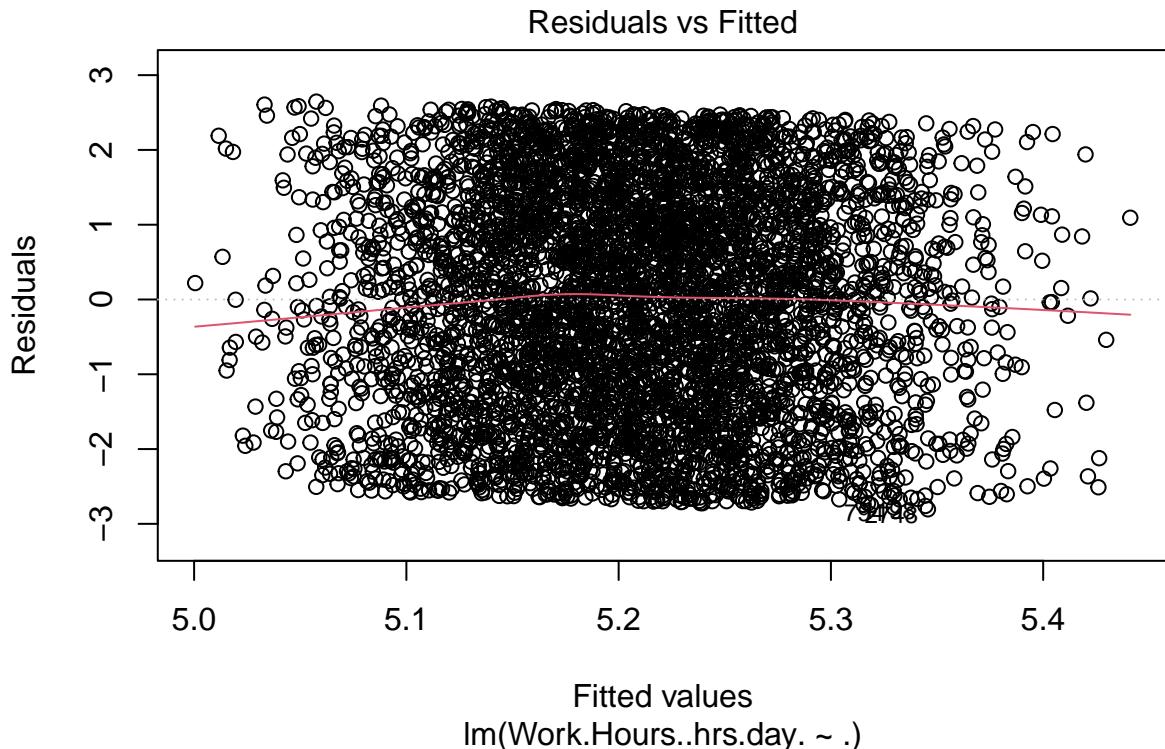
##
## Call:
## lm(formula = Work.Hours..hrs.day. ~ ., data = df_bc)
##
## Residuals:
##      Min       1Q     Median       3Q      Max 
## -2.80557 -1.24079  0.04865  1.25303  2.64576 
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)    
## (Intercept) 5.347e+00  1.580e-01 33.838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

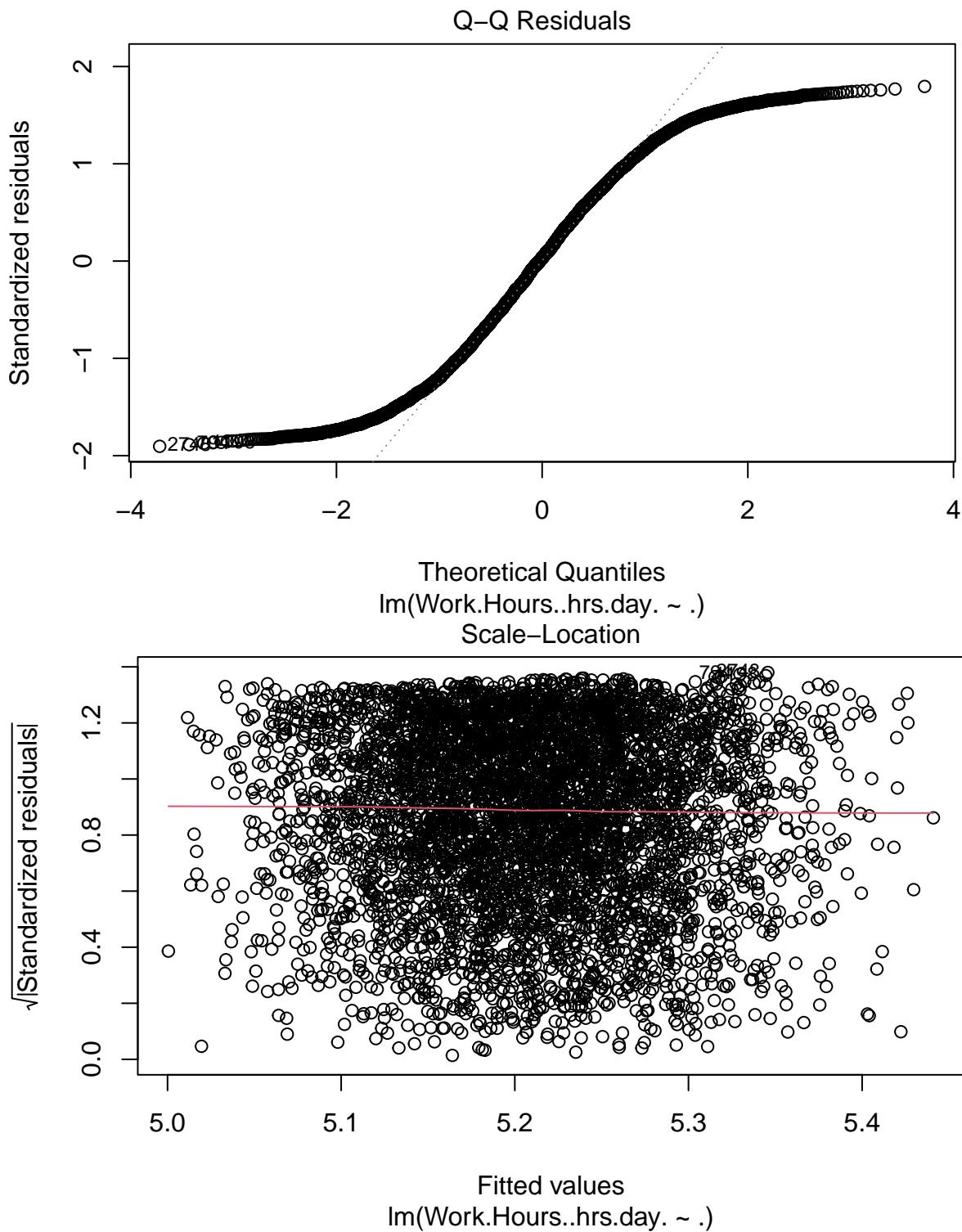
```

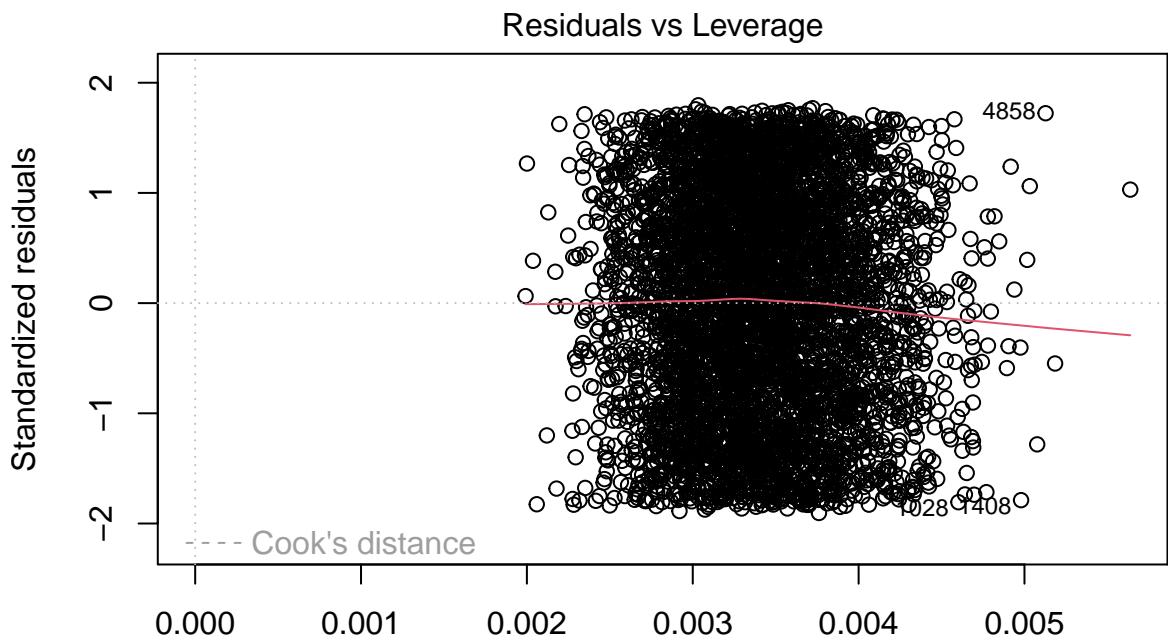
```

## 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
plot(additive_bc)

```

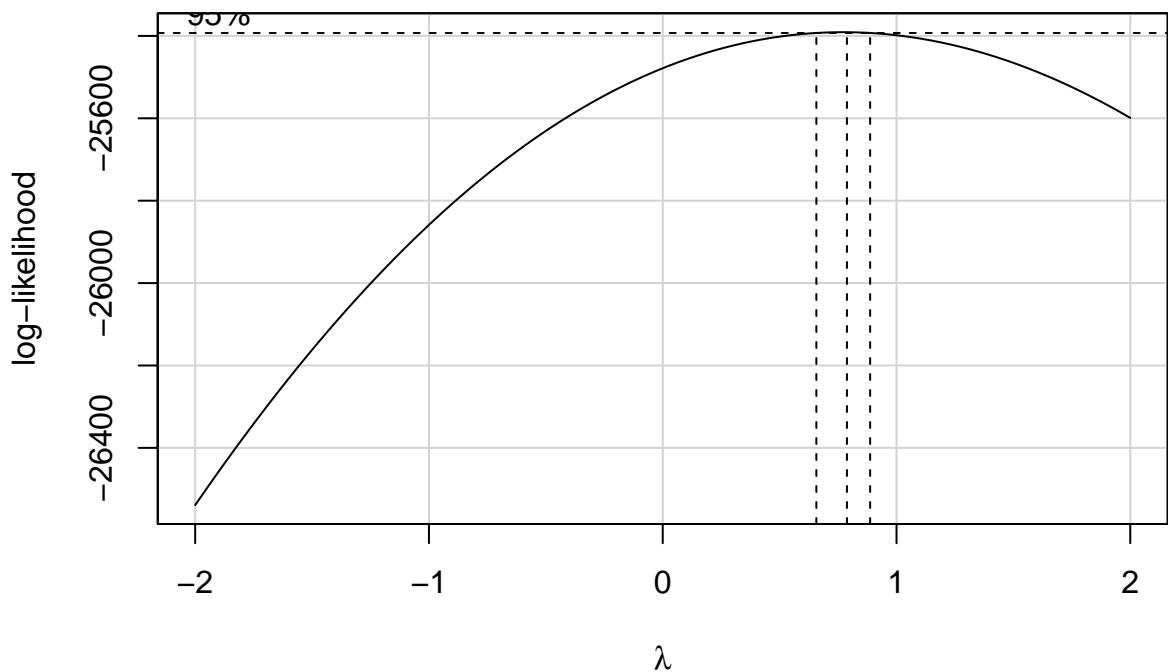






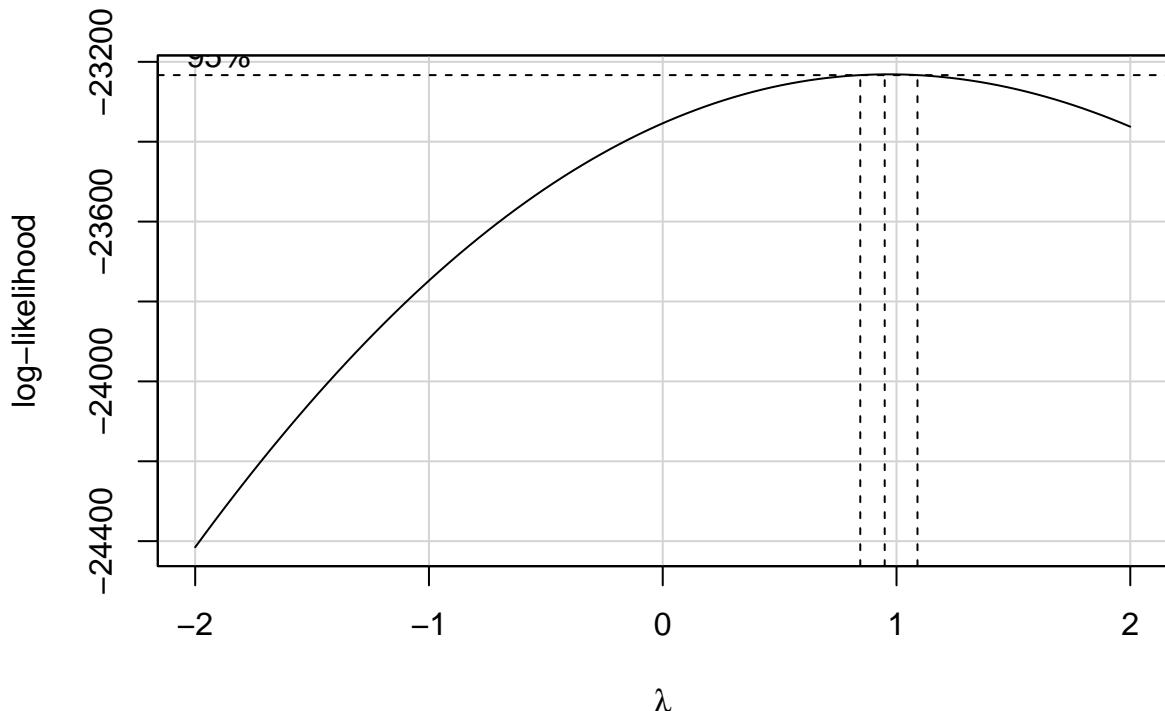
```
# Checking to see if lambda is now closer to 0
boxCox(additive_model,family="yjPower")
```

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

Findings: The R^2 actually got worse, do not move forward with the box cox transformed response

Check for interactions in the model

```
# Basic full model
summary(additive_model)

##
## Call:
## lm(formula = Work.Hours..hrs.day. ~ ., data = df_filtered)
##
## Residuals:
##      Min       1Q   Median       3Q      Max 
## -10.0000  -2.0000   0.0000  10.0000  15.0000
```

```

## -4.1605 -1.9384  0.0047  1.9224  4.2100
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)               8.200e+00  2.437e-01 33.640 <2e-16 ***
## Age                      1.388e-03  2.620e-03  0.530  0.5963
## GenderMale                -2.174e-02 7.826e-02 -0.278  0.7812
## GenderOther                -9.012e-02 7.967e-02 -1.131  0.2580
## Sleep.End.Time             2.547e-02 2.786e-02  0.914  0.3605
## Total.Sleep.Hours          -6.075e-02 3.568e-02 -1.702  0.0887 .
## Exercise..mins.day.        -3.288e-05 1.250e-03 -0.026  0.9790
## Caffeine.Intake..mg.       3.299e-05 3.757e-04  0.088  0.9300
## Screen.Time.Before.Bed..mins. 2.340e-04 6.190e-04  0.378  0.7054
## Sleep.QualityCatMedium    -4.426e-02 7.795e-02 -0.568  0.5702
## Sleep.QualityCatHigh      -8.729e-02 8.367e-02 -1.043  0.2969
## Productivity.ScoreCatMedium 6.745e-02 7.928e-02  0.851  0.3949
## Productivity.ScoreCatHigh  -3.319e-02 8.290e-02 -0.400  0.6889
## Mood.ScoreCatMedium       3.748e-02 7.660e-02  0.489  0.6247
## Mood.ScoreCatHigh         1.017e-01 8.398e-02  1.211  0.2258
## Stress.LevelCatMedium     2.692e-03 7.836e-02  0.034  0.9726
## Stress.LevelCatHigh       8.630e-02 8.280e-02  1.042  0.2973
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.277 on 4983 degrees of freedom
## Multiple R-squared:  0.002257, Adjusted R-squared:  -0.0009468
## F-statistic: 0.7045 on 16 and 4983 DF,  p-value: 0.7922
full_model <- lm(Work.Hours..hrs.day. ~ .()^2, data = df_filtered)
summary(full_model)

##
## Call:
## lm(formula = Work.Hours..hrs.day. ~ .()^2, data = df_filtered)
##
## Residuals:
##      Min       1Q       Median      3Q      Max 
## -4.5916 -1.8845  0.0243  1.8236  4.6020 
##
## Coefficients:
##                               Estimate Std. Error
## (Intercept)               6.556e+00  1.238e+00
## Age                      3.700e-02  1.820e-02
## GenderMale                -2.474e-01 5.886e-01
## GenderOther                1.894e-01 6.026e-01
## Sleep.End.Time             -5.212e-02 1.821e-01
## Total.Sleep.Hours          9.892e-02 2.103e-01
## Exercise..mins.day.        2.146e-02 9.393e-03
## Caffeine.Intake..mg.       -4.121e-04 2.849e-03
## Screen.Time.Before.Bed..mins. -4.223e-03 4.567e-03
## Sleep.QualityCatMedium    1.152e+00 5.819e-01
## Sleep.QualityCatHigh      8.976e-01 6.273e-01
## Productivity.ScoreCatMedium 5.206e-01 5.923e-01
## Productivity.ScoreCatHigh  2.038e-01 6.217e-01
## Mood.ScoreCatMedium       -1.305e+00 5.771e-01

```

## Mood.ScoreCatHigh	-2.059e-01	6.340e-01
## Stress.LevelCatMedium	9.441e-01	5.800e-01
## Stress.LevelCatHigh	2.733e-03	6.174e-01
## Age:GenderMale	1.924e-03	6.452e-03
## Age:GenderOther	8.523e-03	6.559e-03
## Age:Sleep.End.Time	1.727e-03	2.265e-03
## Age:Total.Sleep.Hours	-3.621e-03	2.909e-03
## Age:Exercise..mins.day.	-3.151e-04	1.037e-04
## Age:Caffeine.Intake..mg.	2.872e-05	3.101e-05
## Age:Screen.Time.Before.Bed..mins.	2.047e-05	5.078e-05
## Age:Sleep.QualityCatMedium	-1.442e-02	6.403e-03
## Age:Sleep.QualityCatHigh	-1.215e-02	6.834e-03
## Age:Productivity.ScoreCatMedium	-7.570e-03	6.548e-03
## Age:Productivity.ScoreCatHigh	-1.338e-03	6.807e-03
## Age:Mood.ScoreCatMedium	3.280e-03	6.300e-03
## Age:Mood.ScoreCatHigh	-1.263e-02	6.878e-03
## Age:Stress.LevelCatMedium	-2.685e-03	6.473e-03
## Age:Stress.LevelCatHigh	4.744e-03	6.768e-03
## GenderMale:Sleep.End.Time	3.496e-04	6.870e-02
## GenderOther:Sleep.End.Time	4.004e-02	6.949e-02
## GenderMale:Total.Sleep.Hours	1.031e-02	8.836e-02
## GenderOther:Total.Sleep.Hours	-1.118e-01	8.915e-02
## GenderMale:Exercise..mins.day.	-2.267e-03	3.068e-03
## GenderOther:Exercise..mins.day.	-2.398e-03	3.106e-03
## GenderMale:Caffeine.Intake..mg.	6.678e-04	9.215e-04
## GenderOther:Caffeine.Intake..mg.	3.584e-04	9.338e-04
## GenderMale:Screen.Time.Before.Bed..mins.	-1.489e-03	1.509e-03
## GenderOther:Screen.Time.Before.Bed..mins.	1.262e-04	1.550e-03
## GenderMale:Sleep.QualityCatMedium	3.745e-01	1.915e-01
## GenderOther:Sleep.QualityCatMedium	1.644e-01	1.944e-01
## GenderMale:Sleep.QualityCatHigh	2.469e-01	2.052e-01
## GenderOther:Sleep.QualityCatHigh	1.631e-01	2.097e-01
## GenderMale:Productivity.ScoreCatMedium	3.889e-01	1.948e-01
## GenderOther:Productivity.ScoreCatMedium	2.432e-01	1.988e-01
## GenderMale:Productivity.ScoreCatHigh	9.892e-02	2.035e-01
## GenderOther:Productivity.ScoreCatHigh	3.143e-01	2.064e-01
## GenderMale:Mood.ScoreCatMedium	-2.064e-01	1.869e-01
## GenderOther:Mood.ScoreCatMedium	-2.023e-01	1.912e-01
## GenderMale:Mood.ScoreCatHigh	-1.429e-01	2.069e-01
## GenderOther:Mood.ScoreCatHigh	-3.138e-01	2.098e-01
## GenderMale:Stress.LevelCatMedium	-2.526e-01	1.926e-01
## GenderOther:Stress.LevelCatMedium	-3.486e-01	1.943e-01
## GenderMale:Stress.LevelCatHigh	1.034e-01	2.010e-01
## GenderOther:Stress.LevelCatHigh	9.570e-02	2.066e-01
## Sleep.End.Time:Total.Sleep.Hours	3.911e-03	1.282e-02
## Sleep.End.Time:Exercise..mins.day.	-3.712e-04	1.089e-03
## Sleep.End.Time:Caffeine.Intake..mg.	5.010e-04	3.316e-04
## Sleep.End.Time:Screen.Time.Before.Bed..mins.	-1.848e-04	5.417e-04
## Sleep.End.Time:Sleep.QualityCatMedium	6.717e-02	6.788e-02
## Sleep.End.Time:Sleep.QualityCatHigh	9.933e-02	7.271e-02
## Sleep.End.Time:Productivity.ScoreCatMedium	2.348e-02	6.899e-02
## Sleep.End.Time:Productivity.ScoreCatHigh	-5.158e-03	7.239e-02
## Sleep.End.Time:Mood.ScoreCatMedium	-1.666e-01	6.670e-02
## Sleep.End.Time:Mood.ScoreCatHigh	-5.951e-02	7.310e-02

## Sleep.End.Time:Stress.LevelCatMedium	-5.982e-02	6.852e-02
## Sleep.End.Time:Stress.LevelCatHigh	-7.940e-02	7.194e-02
## Total.Sleep.Hours:Exercise..mins.day.	-6.578e-04	1.399e-03
## Total.Sleep.Hours:Caffeine.Intake..mg.	-5.960e-04	4.231e-04
## Total.Sleep.Hours:Screen.Time.Before.Bed..mins.	6.452e-04	6.928e-04
## Total.Sleep.Hours:Sleep.QualityCatMedium	-1.306e-01	8.757e-02
## Total.Sleep.Hours:Sleep.QualityCatHigh	-1.686e-01	9.313e-02
## Total.Sleep.Hours:Productivity.ScoreCatMedium	-6.038e-02	8.890e-02
## Total.Sleep.Hours:Productivity.ScoreCatHigh	-2.419e-02	9.227e-02
## Total.Sleep.Hours:Mood.ScoreCatMedium	2.670e-01	8.556e-02
## Total.Sleep.Hours:Mood.ScoreCatHigh	1.317e-01	9.516e-02
## Total.Sleep.Hours:Stress.LevelCatMedium	1.862e-02	8.714e-02
## Total.Sleep.Hours:Stress.LevelCatHigh	8.212e-02	9.244e-02
## Exercise..mins.day.:Caffeine.Intake..mg.	3.402e-06	1.496e-05
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-5.353e-06	2.434e-05
## Exercise..mins.day.:Sleep.QualityCatMedium	-4.325e-03	3.035e-03
## Exercise..mins.day.:Sleep.QualityCatHigh	1.481e-03	3.281e-03
## Exercise..mins.day.:Productivity.ScoreCatMedium	6.667e-04	3.093e-03
## Exercise..mins.day.:Productivity.ScoreCatHigh	-1.761e-04	3.247e-03
## Exercise..mins.day.:Mood.ScoreCatMedium	8.591e-04	2.992e-03
## Exercise..mins.day.:Mood.ScoreCatHigh	2.166e-03	3.265e-03
## Exercise..mins.day.:Stress.LevelCatMedium	-4.285e-03	3.085e-03
## Exercise..mins.day.:Stress.LevelCatHigh	1.652e-03	3.249e-03
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-4.627e-06	7.275e-06
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	1.228e-03	9.188e-04
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	8.203e-04	9.836e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	3.245e-04	9.341e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	7.880e-04	9.766e-04
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	1.123e-04	9.123e-04
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	1.254e-03	9.853e-04
## Caffeine.Intake..mg.:Stress.LevelCatMedium	-2.262e-04	9.248e-04
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-1.625e-03	9.828e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	1.697e-04	1.507e-03
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-9.777e-04	1.626e-03
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-7.558e-04	1.527e-03
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	1.370e-03	1.597e-03
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	2.317e-03	1.487e-03
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	1.367e-03	1.630e-03
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	3.231e-04	1.528e-03
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-2.706e-04	1.617e-03
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-2.754e-01	1.942e-01
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-6.495e-02	2.082e-01
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	-3.971e-01	2.042e-01
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	-2.522e-01	2.170e-01
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	2.215e-01	1.868e-01
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	4.540e-02	2.015e-01
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	4.269e-01	2.044e-01
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	1.779e-01	2.194e-01
## Sleep.QualityCatMedium:Stress.LevelCatMedium	-4.120e-01	1.917e-01
## Sleep.QualityCatHigh:Stress.LevelCatMedium	-1.079e-01	2.069e-01
## Sleep.QualityCatMedium:Stress.LevelCatHigh	-1.846e-01	2.016e-01
## Sleep.QualityCatHigh:Stress.LevelCatHigh	2.732e-02	2.169e-01
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium	1.945e-01	1.908e-01
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium	-3.288e-01	1.999e-01

```

## Productivity.ScoreCatMedium:Mood.ScoreCatHigh -4.952e-02 2.109e-01
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh -1.688e-01 2.190e-01
## Productivity.ScoreCatMedium:Stress.LevelCatMedium -5.247e-02 1.946e-01
## Productivity.ScoreCatHigh:Stress.LevelCatMedium -1.789e-02 2.041e-01
## Productivity.ScoreCatMedium:Stress.LevelCatHigh -5.005e-03 2.064e-01
## Productivity.ScoreCatHigh:Stress.LevelCatHigh 2.118e-01 2.136e-01
## Mood.ScoreCatMedium:Stress.LevelCatMedium -2.232e-02 1.881e-01
## Mood.ScoreCatHigh:Stress.LevelCatMedium -1.786e-01 2.053e-01
## Mood.ScoreCatMedium:Stress.LevelCatHigh -3.329e-02 1.984e-01
## Mood.ScoreCatHigh:Stress.LevelCatHigh -4.859e-01 2.185e-01
##
t value Pr(>|t|)
## (Intercept) 5.294 1.25e-07 ***
## Age 2.033 0.04207 *
## GenderMale -0.420 0.67424
## GenderOther 0.314 0.75328
## Sleep.End.Time -0.286 0.77467
## Total.Sleep.Hours 0.470 0.63819
## Exercise..mins.day. 2.285 0.02235 *
## Caffeine.Intake..mg. -0.145 0.88497
## Screen.Time.Before.Bed..mins. -0.925 0.35521
## Sleep.QualityCatMedium 1.979 0.04782 *
## Sleep.QualityCatHigh 1.431 0.15254
## Productivity.ScoreCatMedium 0.879 0.37949
## Productivity.ScoreCatHigh 0.328 0.74307
## Mood.ScoreCatMedium -2.262 0.02375 *
## Mood.ScoreCatHigh -0.325 0.74531
## Stress.LevelCatMedium 1.628 0.10363
## Stress.LevelCatHigh 0.004 0.99647
## Age:GenderMale 0.298 0.76552
## Age:GenderOther 1.299 0.19387
## Age:Sleep.End.Time 0.762 0.44582
## Age:Total.Sleep.Hours -1.245 0.21330
## Age:Exercise..mins.day. -3.040 0.00238 **
## Age:Caffeine.Intake..mg. 0.926 0.35446
## Age:Screen.Time.Before.Bed..mins. 0.403 0.68685
## Age:Sleep.QualityCatMedium -2.253 0.02431 *
## Age:Sleep.QualityCatHigh -1.778 0.07549 .
## Age:Productivity.ScoreCatMedium -1.156 0.24772
## Age:Productivity.ScoreCatHigh -0.197 0.84414
## Age:Mood.ScoreCatMedium 0.521 0.60264
## Age:Mood.ScoreCatHigh -1.836 0.06644 .
## Age:Stress.LevelCatMedium -0.415 0.67833
## Age:Stress.LevelCatHigh 0.701 0.48333
## GenderMale:Sleep.End.Time 0.005 0.99594
## GenderOther:Sleep.End.Time 0.576 0.56452
## GenderMale:Total.Sleep.Hours 0.117 0.90710
## GenderOther:Total.Sleep.Hours -1.254 0.20985
## GenderMale:Exercise..mins.day. -0.739 0.45998
## GenderOther:Exercise..mins.day. -0.772 0.44019
## GenderMale:Caffeine.Intake..mg. 0.725 0.46865
## GenderOther:Caffeine.Intake..mg. 0.384 0.70116
## GenderMale:Screen.Time.Before.Bed..mins. -0.987 0.32393
## GenderOther:Screen.Time.Before.Bed..mins. 0.081 0.93510
## GenderMale:Sleep.QualityCatMedium 1.956 0.05053 .

```

## GenderOther:Sleep.QualityCatMedium	0.845	0.39799
## GenderMale:Sleep.QualityCatHigh	1.203	0.22898
## GenderOther:Sleep.QualityCatHigh	0.778	0.43675
## GenderMale:Productivity.ScoreCatMedium	1.997	0.04592 *
## GenderOther:Productivity.ScoreCatMedium	1.223	0.22134
## GenderMale:Productivity.ScoreCatHigh	0.486	0.62697
## GenderOther:Productivity.ScoreCatHigh	1.522	0.12800
## GenderMale:Mood.ScoreCatMedium	-1.104	0.26943
## GenderOther:Mood.ScoreCatMedium	-1.058	0.29005
## GenderMale:Mood.ScoreCatHigh	-0.691	0.48990
## GenderOther:Mood.ScoreCatHigh	-1.496	0.13477
## GenderMale:Stress.LevelCatMedium	-1.312	0.18961
## GenderOther:Stress.LevelCatMedium	-1.794	0.07291 .
## GenderMale:Stress.LevelCatHigh	0.514	0.60713
## GenderOther:Stress.LevelCatHigh	0.463	0.64332
## Sleep.End.Time:Total.Sleep.Hours	0.305	0.76039
## Sleep.End.Time:Exercise..mins.day.	-0.341	0.73315
## Sleep.End.Time:Caffeine.Intake..mg.	1.511	0.13090
## Sleep.End.Time:Screen.Time.Before.Bed..mins.	-0.341	0.73301
## Sleep.End.Time:Sleep.QualityCatMedium	0.990	0.32243
## Sleep.End.Time:Sleep.QualityCatHigh	1.366	0.17196
## Sleep.End.Time:Productivity.ScoreCatMedium	0.340	0.73362
## Sleep.End.Time:Productivity.ScoreCatHigh	-0.071	0.94321
## Sleep.End.Time:Mood.ScoreCatMedium	-2.497	0.01255 *
## Sleep.End.Time:Mood.ScoreCatHigh	-0.814	0.41566
## Sleep.End.Time:Stress.LevelCatMedium	-0.873	0.38273
## Sleep.End.Time:Stress.LevelCatHigh	-1.104	0.26984
## Total.Sleep.Hours:Exercise..mins.day.	-0.470	0.63832
## Total.Sleep.Hours:Caffeine.Intake..mg.	-1.409	0.15898
## Total.Sleep.Hours:Screen.Time.Before.Bed..mins.	0.931	0.35176
## Total.Sleep.Hours:Sleep.QualityCatMedium	-1.492	0.13582
## Total.Sleep.Hours:Sleep.QualityCatHigh	-1.810	0.07030 .
## Total.Sleep.Hours:Productivity.ScoreCatMedium	-0.679	0.49706
## Total.Sleep.Hours:Productivity.ScoreCatHigh	-0.262	0.79324
## Total.Sleep.Hours:Mood.ScoreCatMedium	3.121	0.00182 **
## Total.Sleep.Hours:Mood.ScoreCatHigh	1.384	0.16632
## Total.Sleep.Hours:Stress.LevelCatMedium	0.214	0.83079
## Total.Sleep.Hours:Stress.LevelCatHigh	0.888	0.37441
## Exercise..mins.day.:Caffeine.Intake..mg.	0.227	0.82017
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-0.220	0.82596
## Exercise..mins.day.:Sleep.QualityCatMedium	-1.425	0.15424
## Exercise..mins.day.:Sleep.QualityCatHigh	0.451	0.65170
## Exercise..mins.day.:Productivity.ScoreCatMedium	0.216	0.82932
## Exercise..mins.day.:Productivity.ScoreCatHigh	-0.054	0.95676
## Exercise..mins.day.:Mood.ScoreCatMedium	0.287	0.77404
## Exercise..mins.day.:Mood.ScoreCatHigh	0.663	0.50710
## Exercise..mins.day.:Stress.LevelCatMedium	-1.389	0.16492
## Exercise..mins.day.:Stress.LevelCatHigh	0.509	0.61107
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-0.636	0.52478
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	1.336	0.18159
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	0.834	0.40431
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	0.347	0.72834
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	0.807	0.41978
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	0.123	0.90208

```

## Caffeine.Intake..mg.:Mood.ScoreCatHigh           1.273  0.20303
## Caffeine.Intake..mg.:Stress.LevelCatMedium      -0.245  0.80677
## Caffeine.Intake..mg.:Stress.LevelCatHigh         -1.653  0.09835 .
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium 0.113  0.91037
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh -0.601  0.54762
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium -0.495  0.62057
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh  0.858  0.39110
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium   1.558  0.11926
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh     0.839  0.40174
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium 0.211  0.83256
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh    -0.167  0.86710
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium -1.418  0.15631
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium    -0.312  0.75504
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh     -1.944  0.05192 .
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh       -1.162  0.24510
## Sleep.QualityCatMedium:Mood.ScoreCatMedium          1.186  0.23580
## Sleep.QualityCatHigh:Mood.ScoreCatMedium            0.225  0.82177
## Sleep.QualityCatMedium:Mood.ScoreCatHigh             2.089  0.03674 *
## Sleep.QualityCatHigh:Mood.ScoreCatHigh              0.811  0.41764
## Sleep.QualityCatMedium:Stress.LevelCatMedium        -2.150  0.03163 *
## Sleep.QualityCatHigh:Stress.LevelCatMedium          -0.522  0.60203
## Sleep.QualityCatMedium:Stress.LevelCatHigh          -0.916  0.35989
## Sleep.QualityCatHigh:Stress.LevelCatHigh            0.126  0.89976
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium     1.019  0.30804
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium       -1.644  0.10015
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh        -0.235  0.81435
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh          -0.771  0.44077
## Productivity.ScoreCatMedium:Stress.LevelCatMedium    -0.270  0.78746
## Productivity.ScoreCatHigh:Stress.LevelCatMedium      -0.088  0.93015
## Productivity.ScoreCatMedium:Stress.LevelCatHigh      -0.024  0.98066
## Productivity.ScoreCatHigh:Stress.LevelCatHigh        0.992  0.32136
## Mood.ScoreCatMedium:Stress.LevelCatMedium            -0.119  0.90555
## Mood.ScoreCatHigh:Stress.LevelCatMedium              -0.870  0.38426
## Mood.ScoreCatMedium:Stress.LevelCatHigh              -0.168  0.86676
## Mood.ScoreCatHigh:Stress.LevelCatHigh                -2.223  0.02625 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.274 on 4868 degrees of freedom
## Multiple R-squared:  0.02793,   Adjusted R-squared:  0.001767
## F-statistic: 1.068 on 131 and 4868 DF,  p-value: 0.2854
coefs <- summary(full_model)$coefficients
vars <- rownames(coefs)[which(coefs[, 4] < 0.05)]
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] "GenderMale:Productivity.ScoreCatMedium"
## [9] "Sleep.End.Time:Mood.ScoreCatMedium"
## [10] "Total.Sleep.Hours:Mood.ScoreCatMedium"
## [11] "Sleep.QualityCatMedium:Mood.ScoreCatHigh"
## [12] "Sleep.QualityCatMedium:Stress.LevelCatMedium"
## [13] "Mood.ScoreCatHigh:Stress.LevelCatHigh"

anova(full_model, additive_model)

## 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 25167
## 2   4983 25831 -115   -664.56 1.1178 0.1863

# Bonferroni corection:
p_vals <- coefs[, 4]
m <- length(p_vals) # Number of hypothesis tests (coefficients)
alpha_bonf <- 0.05 / m # Adjusted significance level

# Identify significant variables after Bonferroni correction
vars_bonf <- rownames(coefs)[which(p_vals < alpha_bonf)]
vars_bonf

## [1] "(Intercept)"

# Holm correction
p_vals_holm <- p.adjust(p_vals, method = "holm")

# Identify significant variables after Holm correction
vars_holm <- rownames(coefs)[which(p_vals_holm < 0.05)]
vars_holm

## [1] "(Intercept)"

# FDR Correction
p_vals_fdr <- p.adjust(p_vals, method = "fdr")

# Identify significant variables after FDR correction
vars_fdr <- rownames(coefs)[which(p_vals_fdr < 0.05)]
vars_fdr

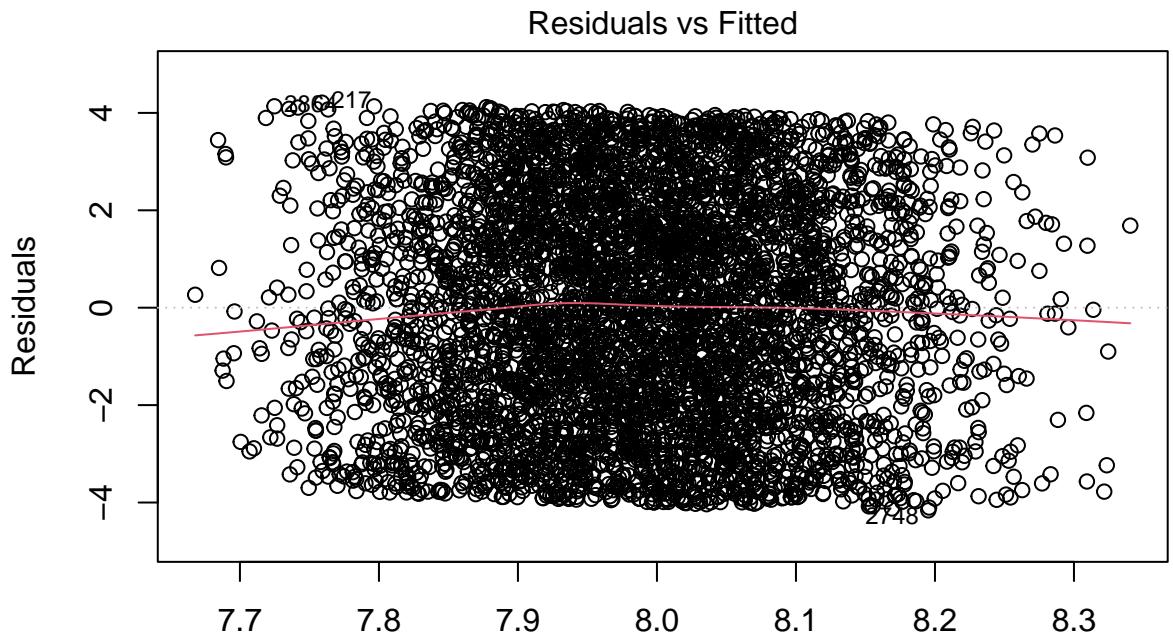
## [1] "(Intercept)"

```

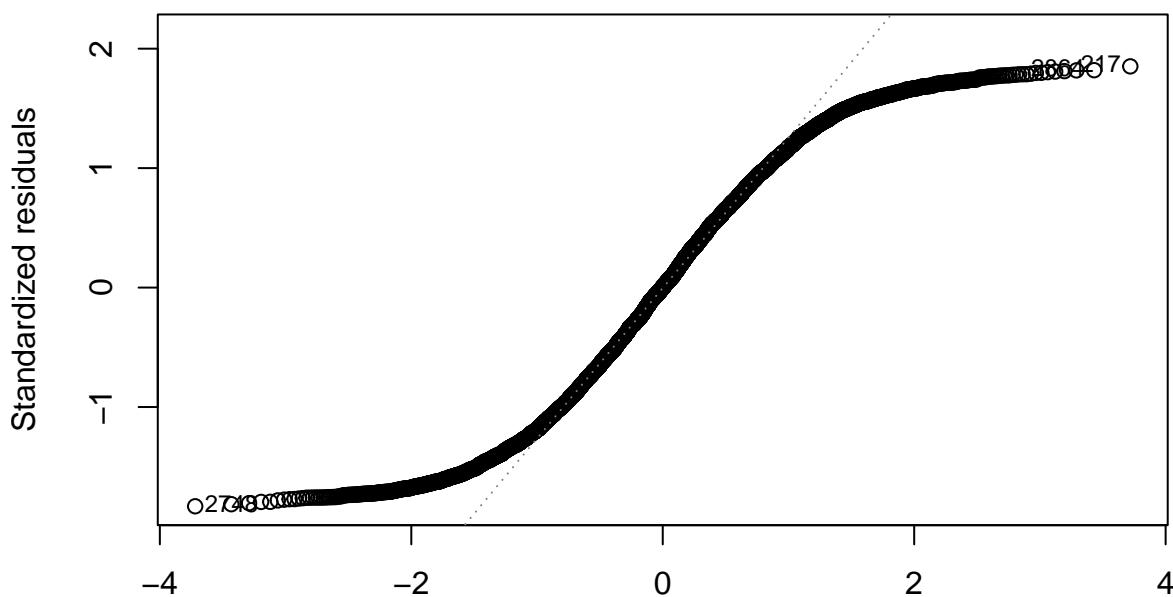
Findings:

Using a significance level of 0.05 there are some significant interactions, but they are no longer significant after FWER Corrections Using an anova test the p-value is high....

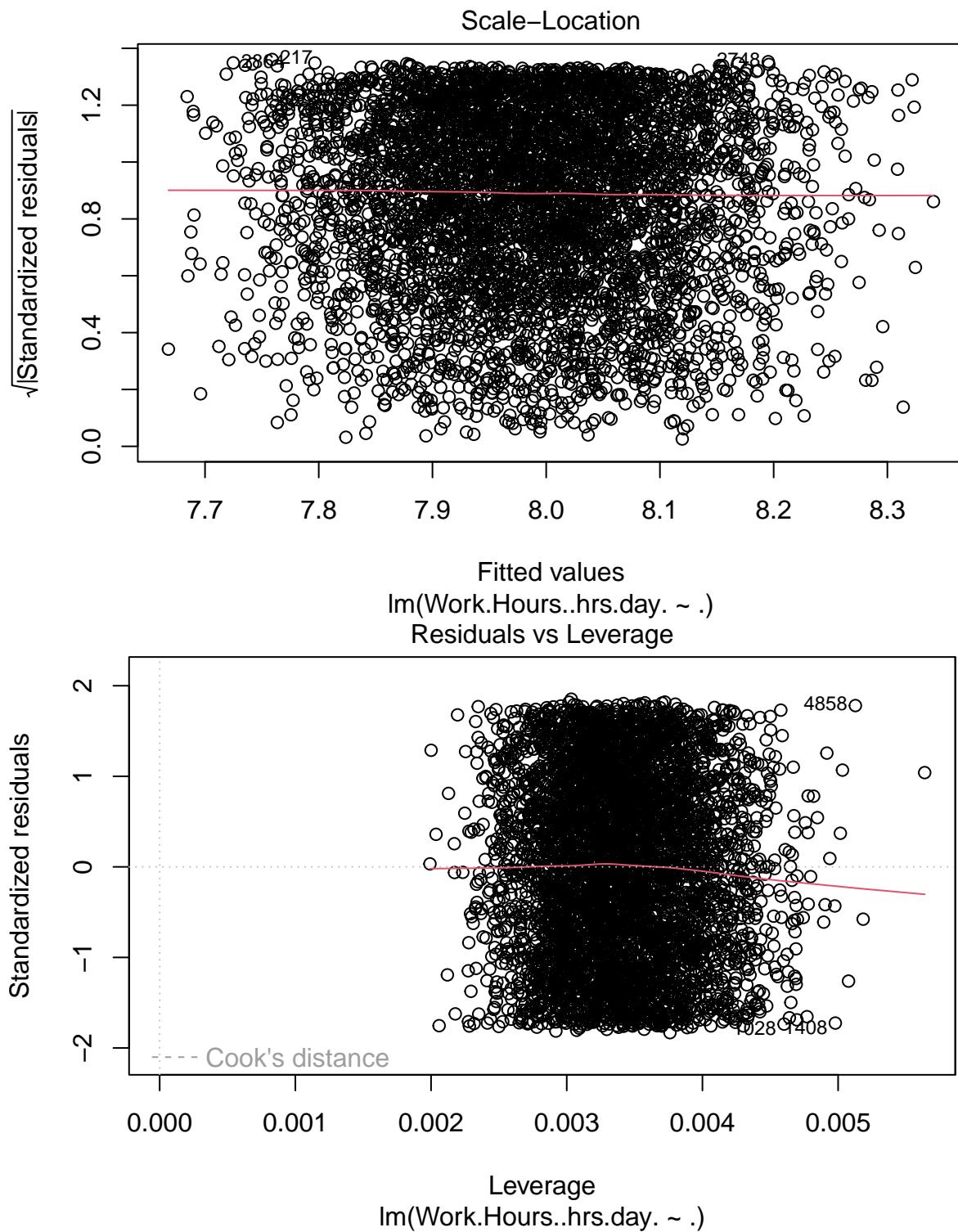
```
plot(additive_model)
```

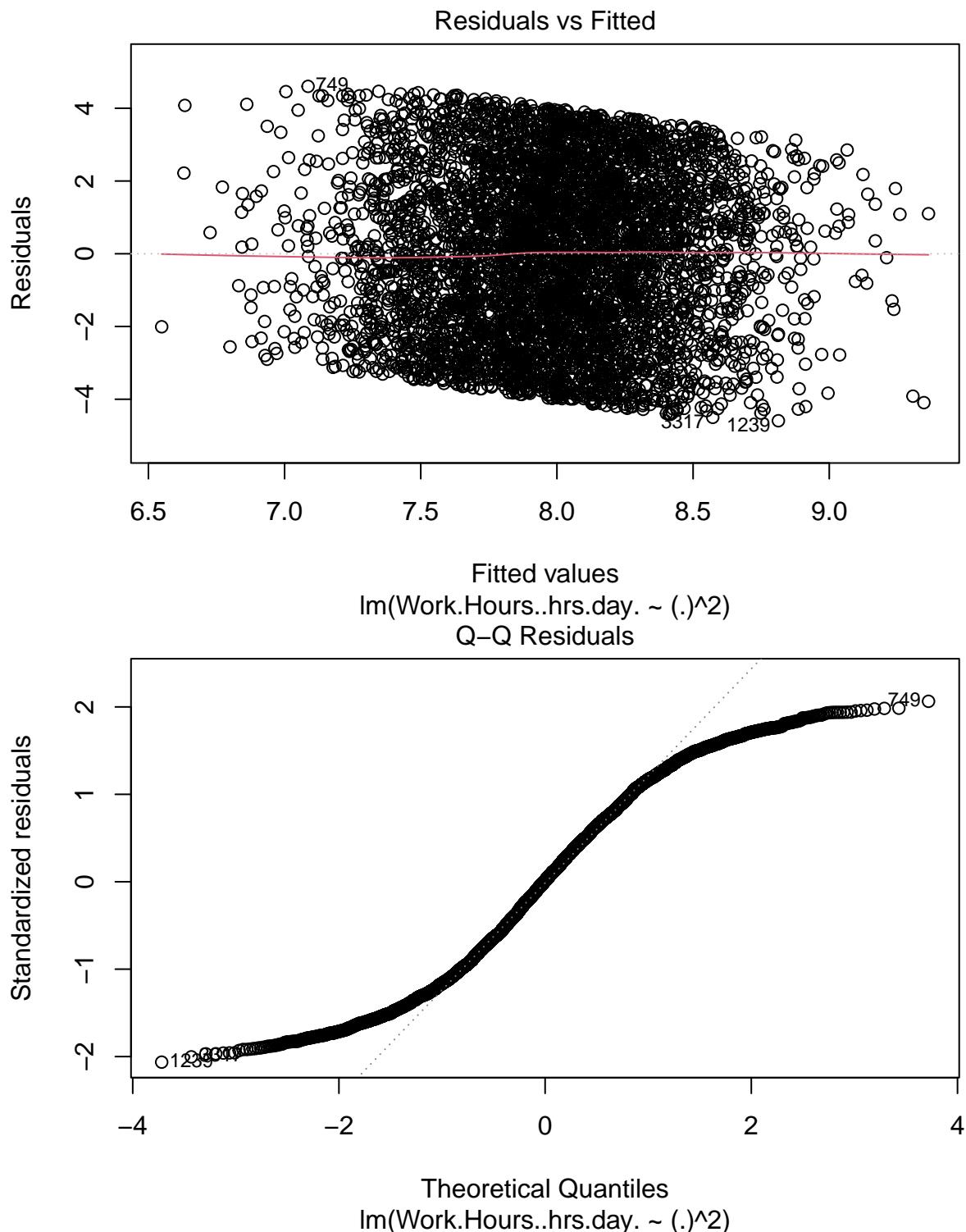


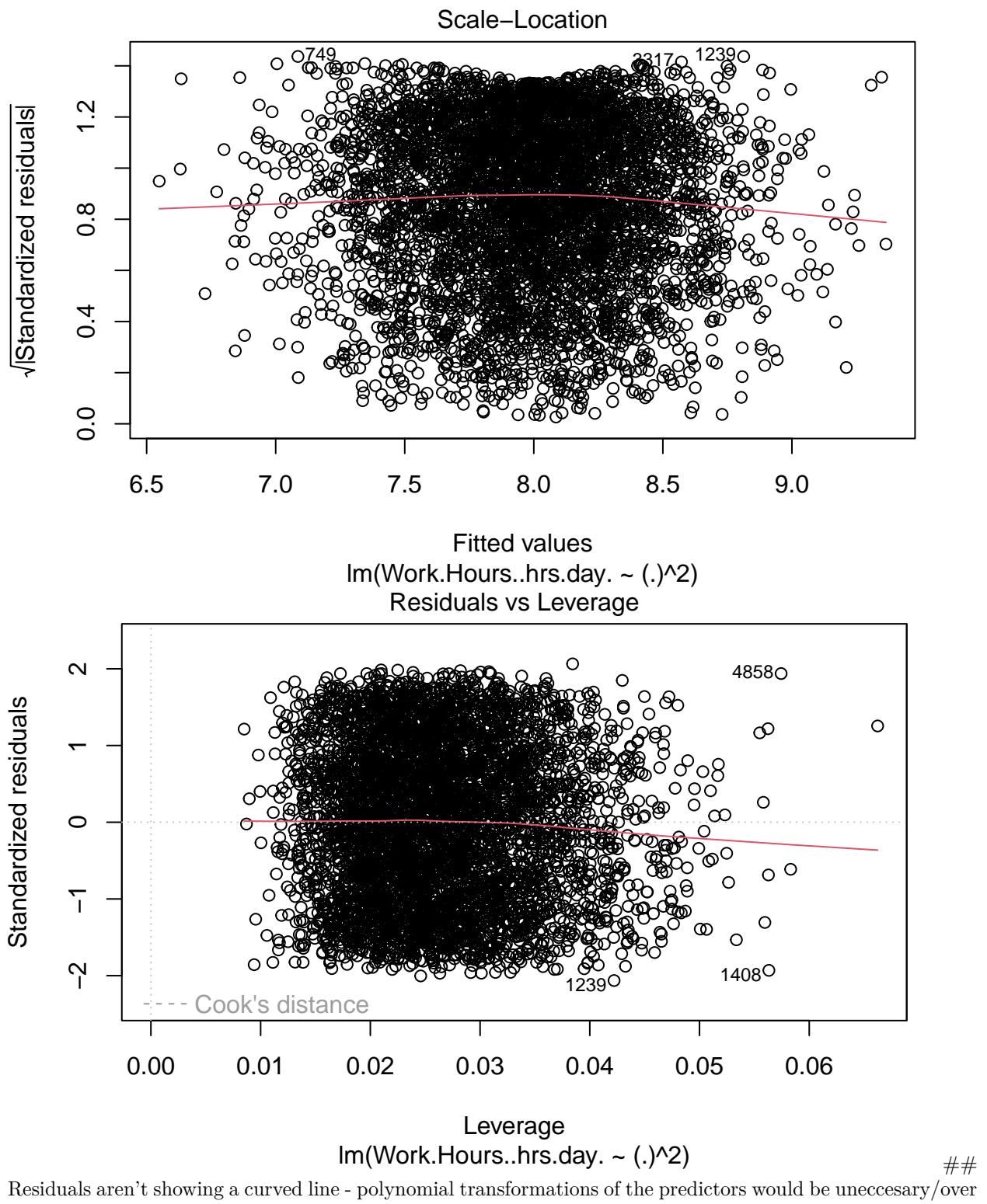
Fitted values
Im(Work.Hours..hrs.day. ~ .)
Q-Q Residuals



Theoretical Quantiles
Im(Work.Hours..hrs.day. ~ .)







Residuals aren't showing a curved line - polynomial transformations of the predictors would be unnecessary/over fitting.

Last attempt at model selection to test for significant predictors

```

## Need to pick BIC or AIC (For BIC: k = log(nrow(df_bc))) before trace)
# Using AIC, since the slides state it to be more accurate than BIC (also, overfitting is not a concern)
stepwise_model <- stepAIC(full_model, direction = "both", trace = FALSE)

# Display the summary of the selected model
summary(stepwise_model)

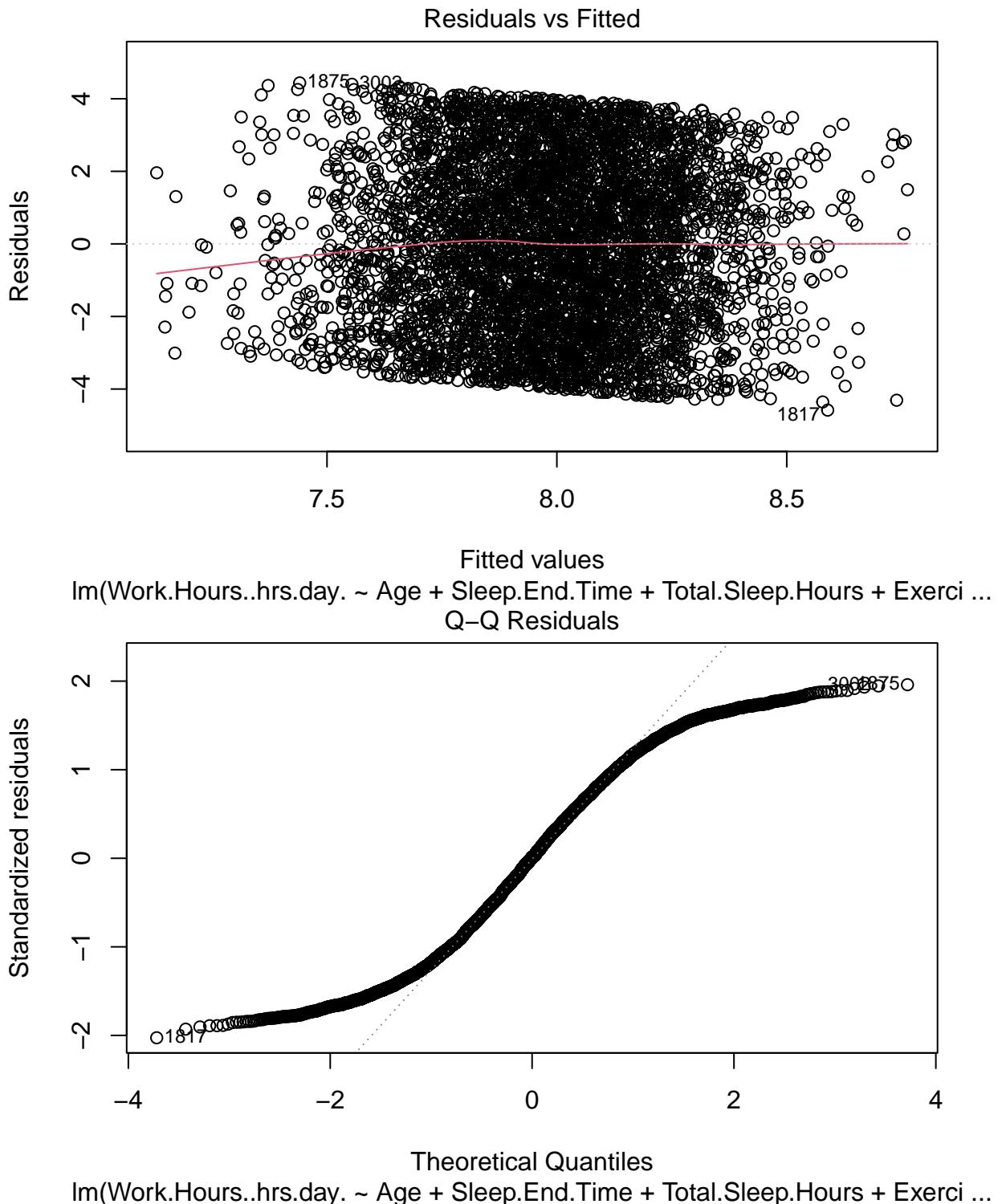
## 
## Call:
## lm(formula = Work.Hours..hrs.day. ~ Age + Sleep.End.Time + Total.Sleep.Hours +
##     Exercise..mins.day. + Caffeine.Intake..mg. + Sleep.QualityCat +
##     Productivity.ScoreCat + Mood.ScoreCat + Age:Exercise..mins.day. +
##     Age:Sleep.QualityCat + Age:Mood.ScoreCat + Sleep.End.Time:Caffeine.Intake..mg. +
##     Sleep.End.Time:Mood.ScoreCat + Total.Sleep.Hours:Caffeine.Intake..mg. +
##     Total.Sleep.Hours:Mood.ScoreCat + Exercise..mins.day.:Sleep.QualityCat +
##     Productivity.ScoreCat:Mood.ScoreCat, data = df_filtered)
##
## Residuals:
##      Min      1Q Median      3Q      Max
## -4.5814 -1.9326  0.0211  1.8896  4.4367
##
## Coefficients:
##                               Estimate Std. Error t value
## (Intercept)                7.4434120  0.5384811 13.823
## Age                      0.0259032  0.0076666  3.379
## Sleep.End.Time            0.0315214  0.0691137  0.456
## Total.Sleep.Hours         -0.1051131  0.0887827 -1.184
## Exercise..mins.day.        0.0136840  0.0045652  2.997
## Caffeine.Intake..mg.       0.0021680  0.0019567  1.108
## Sleep.QualityCatMedium   0.6937333  0.2877354  2.411
## Sleep.QualityCatHigh     0.2875609  0.3077839  0.934
## Productivity.ScoreCatMedium -0.0094452  0.1430943 -0.066
## Productivity.ScoreCatHigh  0.1469362  0.1487323  0.988
## Mood.ScoreCatMedium       -1.0898038  0.4813673 -2.264
## Mood.ScoreCatHigh          0.0629670  0.5320839  0.118
## Age:Exercise..mins.day.    -0.0003144  0.0001020 -3.081
## Age:Sleep.QualityCatMedium -0.0136739  0.0063261 -2.161
## Age:Sleep.QualityCatHigh  -0.0111778  0.0067511 -1.656
## Age:Mood.ScoreCatMedium   0.0039431  0.0062124  0.635
## Age:Mood.ScoreCatHigh     -0.0117715  0.0067821 -1.736
## Sleep.End.Time:Caffeine.Intake..mg.  0.0004803  0.0003269  1.469
## Sleep.End.Time:Mood.ScoreCatMedium -0.1572842  0.0659372 -2.385
## Sleep.End.Time:Mood.ScoreCatHigh   -0.0519702  0.0722716 -0.719
## Total.Sleep.Hours:Caffeine.Intake..mg. -0.0006490  0.0004155 -1.562
## Total.Sleep.Hours:Mood.ScoreCatMedium  0.2565001  0.0845115  3.035
## Total.Sleep.Hours:Mood.ScoreCatHigh    0.1201555  0.0938618  1.280
## Exercise..mins.day.:Sleep.QualityCatMedium -0.0047212  0.0029979 -1.575
## Exercise..mins.day.:Sleep.QualityCatHigh   0.0012498  0.0032437  0.385
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium  0.1990204  0.1881790  1.058
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium -0.3232027  0.1967645 -1.643
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh   -0.0484044  0.2081450 -0.233
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh    -0.1849050  0.2163547 -0.855

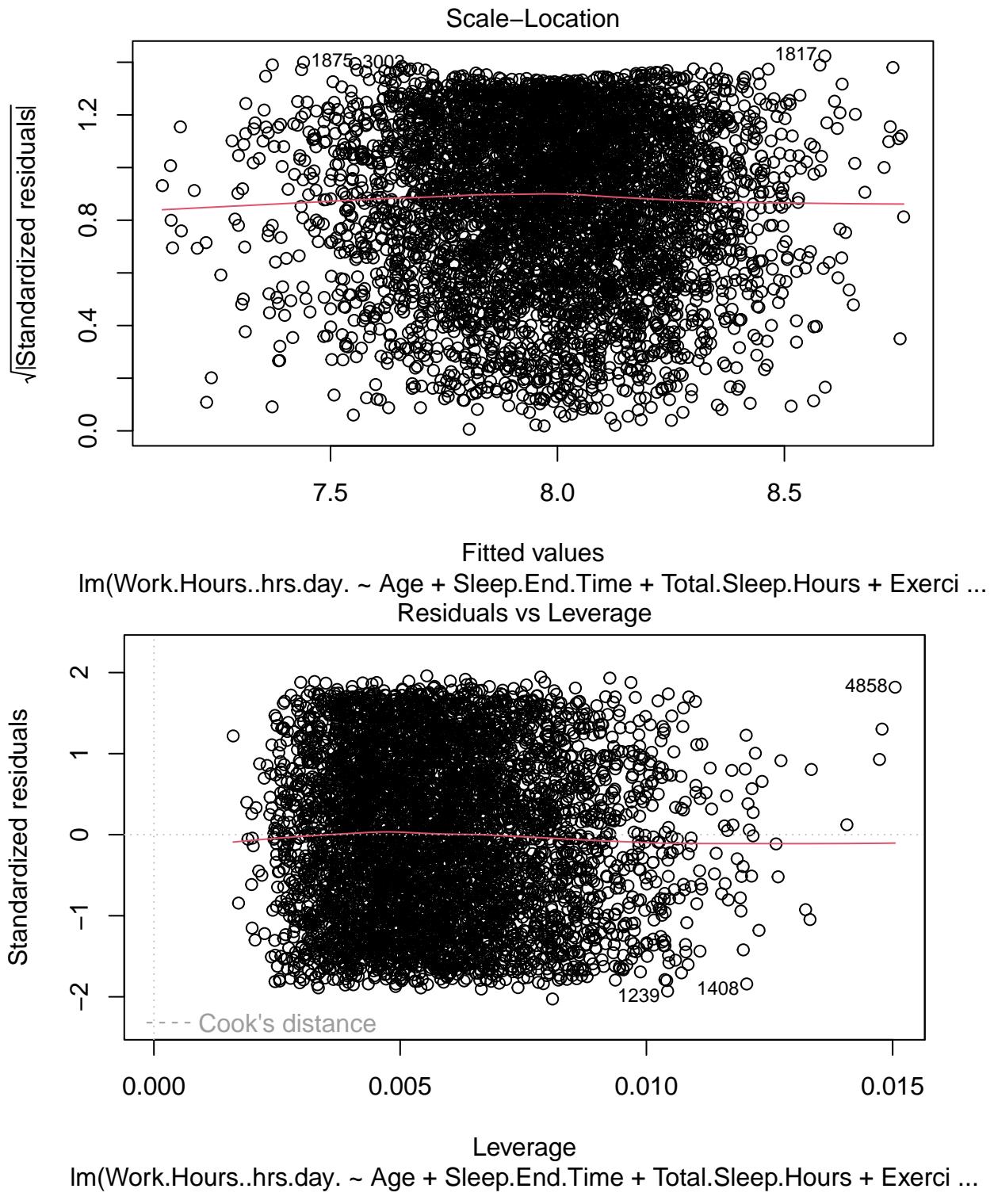
```

```

##                                     Pr(>|t|)
## (Intercept)                         < 2e-16 ***
## Age                                      0.000734 ***
## Sleep.End.Time                          0.648352
## Total.Sleep.Hours                      0.236495
## Exercise..mins.day.                     0.002736 **
## Caffeine.Intake..mg.                   0.267916
## Sleep.QualityCatMedium                0.015944 *
## Sleep.QualityCatHigh                  0.350197
## Productivity.ScoreCatMedium            0.947375
## Productivity.ScoreCatHigh              0.323238
## Mood.ScoreCatMedium                   0.023619 *
## Mood.ScoreCatHigh                     0.905803
## Age:Exercise..mins.day.               0.002073 **
## Age:Sleep.QualityCatMedium            0.030705 *
## Age:Sleep.QualityCatHigh              0.097842 .
## Age:Mood.ScoreCatMedium               0.525649
## Age:Mood.ScoreCatHigh                 0.082684 .
## Sleep.End.Time:Caffeine.Intake..mg.   0.141817
## Sleep.End.Time:Mood.ScoreCatMedium    0.017099 *
## Sleep.End.Time:Mood.ScoreCatHigh      0.472116
## Total.Sleep.Hours:Caffeine.Intake..mg. 0.118416
## Total.Sleep.Hours:Mood.ScoreCatMedium 0.002417 **
## Total.Sleep.Hours:Mood.ScoreCatHigh    0.200558
## Exercise..mins.day.:Sleep.QualityCatMedium 0.115354
## Exercise..mins.day.:Sleep.QualityCatHigh 0.700039
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium 0.290284
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium 0.100532
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh 0.816119
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh 0.392793
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.27 on 4971 degrees of freedom
## Multiple R-squared:  0.01075,  Adjusted R-squared:  0.005177
## F-statistic: 1.929 on 28 and 4971 DF,  p-value: 0.002323
plot(stepwise_model)

```





```
anova(full_model, stepwise_model)

## 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 + Sleep.End.Time + Total.Sleep.Hours +
##      Exercise..mins.day. + Caffeine.Intake..mg. + Sleep.QualityCat +
##      Productivity.ScoreCat + Mood.ScoreCat + Age:Exercise..mins.day. +
##      Age:Sleep.QualityCat + Age:Mood.ScoreCat + Sleep.End.Time:Caffeine.Intake..mg. +
##      Sleep.End.Time:Mood.ScoreCat + Total.Sleep.Hours:Caffeine.Intake..mg. +
##      Total.Sleep.Hours:Mood.ScoreCat + Exercise..mins.day.:Sleep.QualityCat +
##      Productivity.ScoreCat:Mood.ScoreCat
##      Res.Df   RSS   Df Sum of Sq    F Pr(>F)
## 1    4868  25167
## 2    4971  25611 -103     -444.7 0.8351 0.8845
anova(additive_model, stepwise_model)

## 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
## Model 2: Work.Hours..hrs.day. ~ Age + Sleep.End.Time + Total.Sleep.Hours +
##      Exercise..mins.day. + Caffeine.Intake..mg. + Sleep.QualityCat +
##      Productivity.ScoreCat + Mood.ScoreCat + Age:Exercise..mins.day. +
##      Age:Sleep.QualityCat + Age:Mood.ScoreCat + Sleep.End.Time:Caffeine.Intake..mg. +
##      Sleep.End.Time:Mood.ScoreCat + Total.Sleep.Hours:Caffeine.Intake..mg. +
##      Total.Sleep.Hours:Mood.ScoreCat + Exercise..mins.day.:Sleep.QualityCat +
##      Productivity.ScoreCat:Mood.ScoreCat
##      Res.Df   RSS Df Sum of Sq    F   Pr(>F)
## 1    4983  25831
## 2    4971  25611 12     219.86 3.5561 2.707e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

LOOCV not useful (5,000 folds), k-fold cross validation - not useful since the response data is uniform and each fold will likely look the same

Final Thoughts

No predictors are significant when looking at the anova tests, some predictors in the full model are significant

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