

Stat 423 Final Project

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Setup

```
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   3.5.1     v tibble    3.2.1
## v lubridate 1.9.3     v tidyverse 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

library(corrplot)

## corrplot 0.95 loaded

library(bestNormalize)
```

Read and Preprocess Data

```
sleep <- read.csv("sleep_cycle_productivity.csv")

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

rating_vars <- c("Sleep.Quality", "Productivity.Score", "Mood.Score", "Stress.Level")

for (var in rating_vars) {
  new_var <- paste0(var, "Cat")
  sleep[[new_var]] <- cut(sleep[[var]], breaks = c(0, 3, 7, 10),
                         labels = c("Low", "Medium", "High"), right = TRUE)
  sleep[[new_var]] <- as.factor(sleep[[new_var]])
}
```

```

head(sleep)

##           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

```

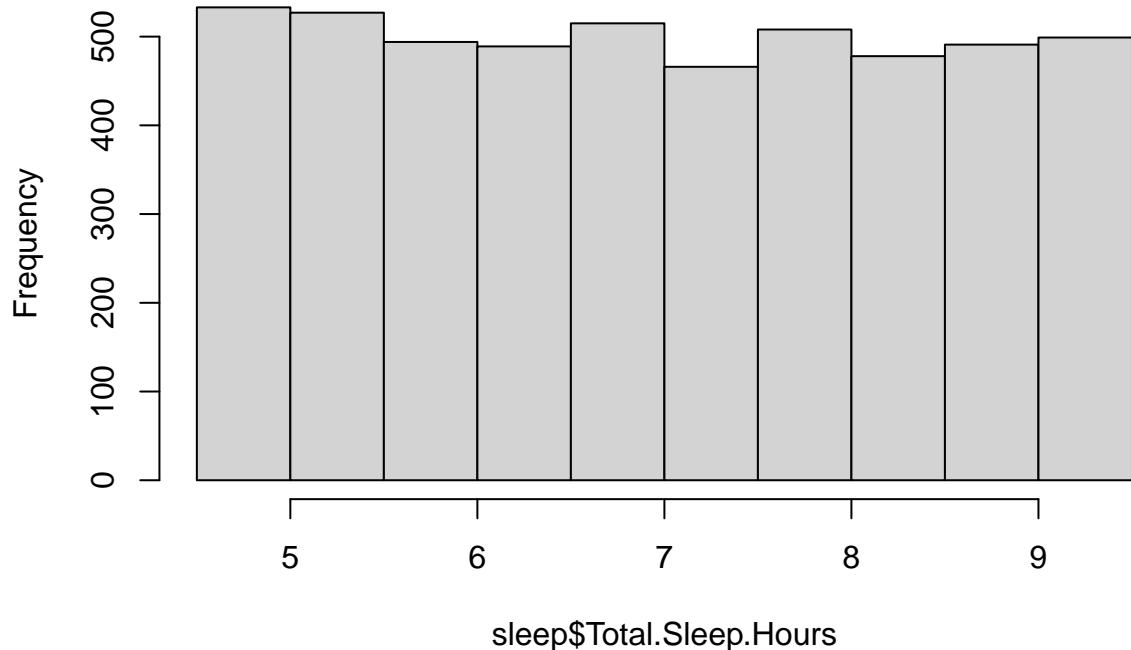
Exploratory Data Analysis

```

hist(sleep$Total.Sleep.Hours, main = "Histogram of Total Sleep Hours")

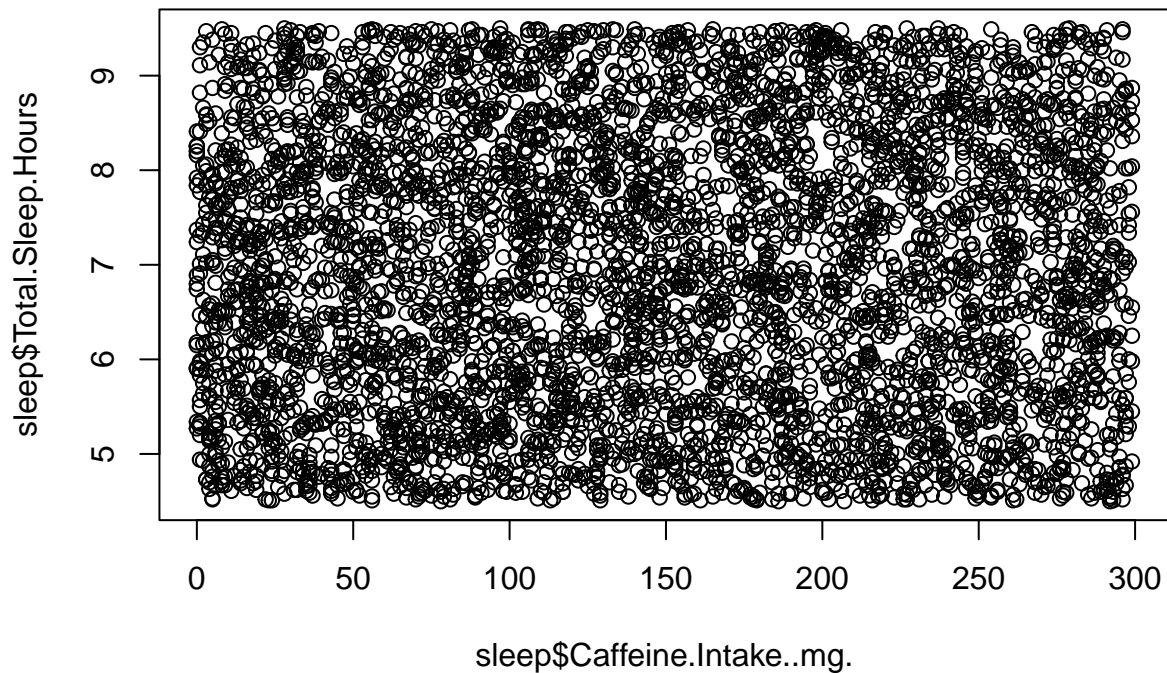
```

Histogram of Total Sleep Hours



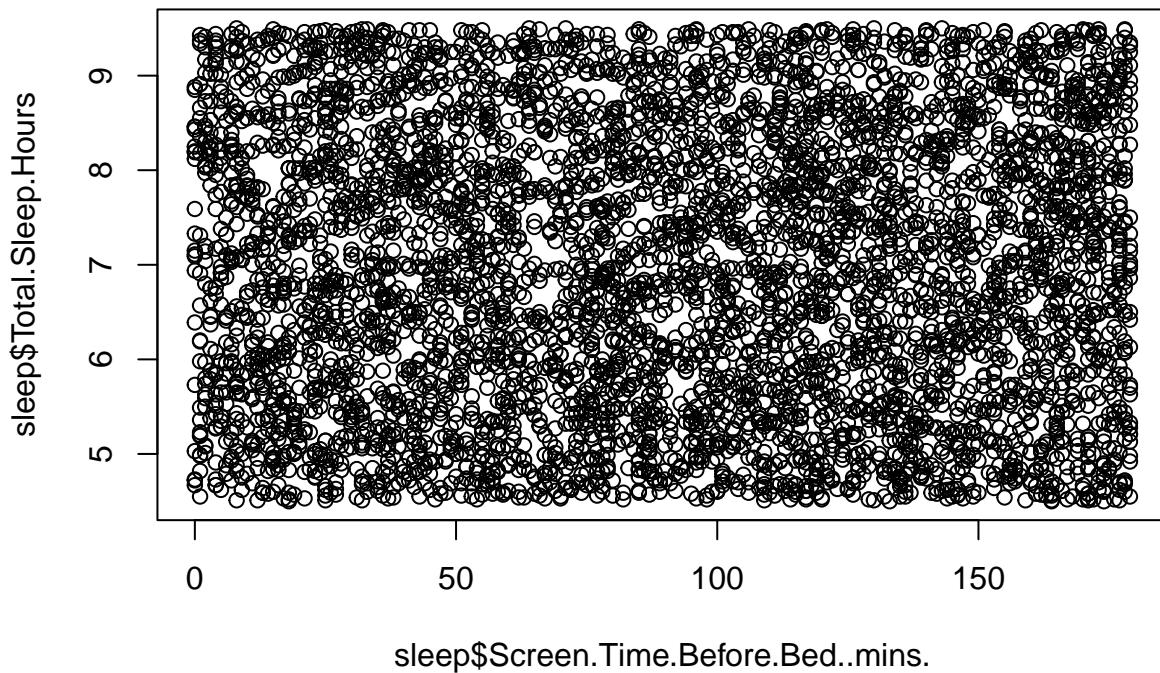
```
plot(sleep$Caffeine.Intake..mg., sleep$Total.Sleep.Hours, main = "Total Sleep Hours vs Caffeine Intake")
```

Total Sleep Hours vs Caffeine Intake



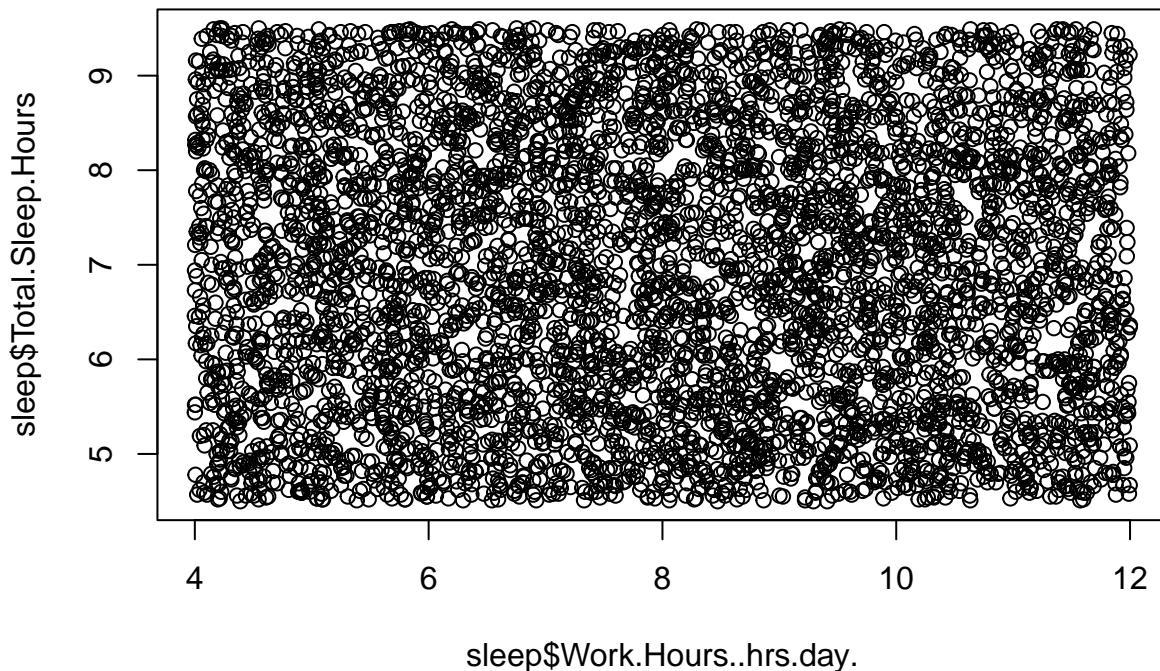
```
plot(sleep$Screen.Time.Before.Bed..mins., sleep$Total.Sleep.Hours, main = "Total Sleep Hours vs Screen Time Before Bed")
```

Total Sleep Hours vs Screen Time



```
plot(sleep$Work.Hours..hrs.day., sleep$Total.Sleep.Hours, main = "Total Sleep Hours vs Total Work Hours")
```

Total Sleep Hours vs Total Work Hours



Model Building

Non-Transformed Simple Models

```
model1 <- lm(Total.Sleep.Hours ~ (Age + Gender + Exercise..mins.day. + Caffeine.Intake..mg. +
  Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. + Sleep.QualityCat +
  Productivity.ScoreCat + Mood.ScoreCat + Stress.LevelCat)^2, data = sleep)
model2 <- lm(Work.Hours..hrs.day. ~ (Age + Gender + Exercise..mins.day. + Caffeine.Intake..mg. +
  Screen.Time.Before.Bed..mins. + Total.Sleep.Hours + Sleep.QualityCat + Productivity.ScoreCat +
  Mood.ScoreCat + Stress.LevelCat)^2, data = sleep)
summary(model1)

##
## Call:
## lm(formula = Total.Sleep.Hours ~ (Age + Gender + Exercise..mins.day. +
##   Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. +
##   Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
##   Stress.LevelCat)^2, data = sleep)
##
## Residuals:
##      Min       1Q     Median       3Q      Max 
## -2.99463 -1.25240  0.00504  1.20961  2.96678
```

	Estimate	Std. Error
##		
## Coefficients:		
##		
## (Intercept)	6.628e+00	5.973e-01
## Age	4.934e-03	9.971e-03
## GenderMale	4.581e-02	3.246e-01
## GenderOther	2.570e-02	3.340e-01
## Exercise..mins.day.	3.813e-03	5.147e-03
## Caffeine.Intake..mg.	-2.161e-03	1.548e-03
## Screen.Time.Before.Bed..mins.	-2.009e-04	2.503e-03
## Work.Hours..hrs.day.	3.789e-02	5.051e-02
## Sleep.QualityCatMedium	-1.315e-01	3.199e-01
## Sleep.QualityCatHigh	3.315e-01	3.417e-01
## Productivity.ScoreCatMedium	1.880e-01	3.324e-01
## Productivity.ScoreCatHigh	3.925e-01	3.440e-01
## Mood.ScoreCatMedium	7.797e-02	3.187e-01
## Mood.ScoreCatHigh	4.906e-02	3.530e-01
## Stress.LevelCatMedium	4.046e-02	3.242e-01
## Stress.LevelCatHigh	2.111e-01	3.363e-01
## Age:GenderMale	-3.176e-03	4.108e-03
## Age:GenderOther	6.948e-04	4.183e-03
## Age:Exercise..mins.day.	-1.606e-05	6.593e-05
## Age:Caffeine.Intake..mg.	4.377e-07	1.976e-05
## Age:Screen.Time.Before.Bed..mins.	1.237e-05	3.234e-05
## Age:Work.Hours..hrs.day.	-6.722e-04	7.477e-04
## Age:Sleep.QualityCatMedium	3.156e-03	4.088e-03
## Age:Sleep.QualityCatHigh	-5.725e-03	4.354e-03
## Age:Productivity.ScoreCatMedium	-3.506e-04	4.178e-03
## Age:Productivity.ScoreCatHigh	-7.976e-04	4.338e-03
## Age:Mood.ScoreCatMedium	-1.616e-03	4.015e-03
## Age:Mood.ScoreCatHigh	-2.895e-04	4.377e-03
## Age:Stress.LevelCatMedium	2.766e-03	4.115e-03
## Age:Stress.LevelCatHigh	1.011e-03	4.312e-03
## GenderMale:Exercise..mins.day.	-2.008e-03	1.956e-03
## GenderOther:Exercise..mins.day.	9.462e-04	1.977e-03
## GenderMale:Caffeine.Intake..mg.	1.213e-03	5.864e-04
## GenderOther:Caffeine.Intake..mg.	1.238e-03	5.947e-04
## GenderMale:Screen.Time.Before.Bed..mins.	1.494e-03	9.610e-04
## GenderOther:Screen.Time.Before.Bed..mins.	5.422e-04	9.882e-04
## GenderMale:Work.Hours..hrs.day.	3.904e-03	2.210e-02
## GenderOther:Work.Hours..hrs.day.	-3.046e-02	2.271e-02
## GenderMale:Sleep.QualityCatMedium	-1.984e-01	1.219e-01
## GenderOther:Sleep.QualityCatMedium	4.452e-02	1.239e-01
## GenderMale:Sleep.QualityCatHigh	-2.236e-01	1.307e-01
## GenderOther:Sleep.QualityCatHigh	5.564e-02	1.337e-01
## GenderMale:Productivity.ScoreCatMedium	5.780e-02	1.243e-01
## GenderOther:Productivity.ScoreCatMedium	-3.169e-02	1.267e-01
## GenderMale:Productivity.ScoreCatHigh	1.386e-01	1.296e-01
## GenderOther:Productivity.ScoreCatHigh	-1.395e-01	1.317e-01
## GenderMale:Mood.ScoreCatMedium	-1.239e-01	1.191e-01
## GenderOther:Mood.ScoreCatMedium	6.638e-02	1.217e-01
## GenderMale:Mood.ScoreCatHigh	-6.273e-02	1.319e-01
## GenderOther:Mood.ScoreCatHigh	7.783e-02	1.335e-01
## GenderMale:Stress.LevelCatMedium	-1.026e-01	1.226e-01

## GenderOther:Stress.LevelCatMedium	-2.286e-01	1.239e-01
## GenderMale:Stress.LevelCatHigh	5.448e-02	1.279e-01
## GenderOther:Stress.LevelCatHigh	-9.050e-02	1.317e-01
## Exercise..mins.day.:Caffeine.Intake..mg.	1.867e-05	9.532e-06
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-5.248e-06	1.550e-05
## Exercise..mins.day.:Work.Hours..hrs.day.	-3.783e-04	3.546e-04
## Exercise..mins.day.:Sleep.QualityCatMedium	1.239e-03	1.936e-03
## Exercise..mins.day.:Sleep.QualityCatHigh	1.741e-03	2.091e-03
## Exercise..mins.day.:Productivity.ScoreCatMedium	6.770e-04	1.972e-03
## Exercise..mins.day.:Productivity.ScoreCatHigh	-1.632e-03	2.070e-03
## Exercise..mins.day.:Mood.ScoreCatMedium	-3.645e-03	1.902e-03
## Exercise..mins.day.:Mood.ScoreCatHigh	-2.860e-03	2.078e-03
## Exercise..mins.day.:Stress.LevelCatMedium	9.161e-05	1.966e-03
## Exercise..mins.day.:Stress.LevelCatHigh	8.739e-04	2.072e-03
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-1.976e-06	4.633e-06
## Caffeine.Intake..mg.:Work.Hours..hrs.day.	-8.256e-05	1.065e-04
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	-8.386e-05	5.858e-04
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	1.245e-03	6.267e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	8.091e-04	5.960e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	6.674e-04	6.237e-04
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	9.536e-04	5.809e-04
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	1.978e-04	6.280e-04
## Caffeine.Intake..mg.:Stress.LevelCatMedium	1.006e-03	5.886e-04
## Caffeine.Intake..mg.:Stress.LevelCatHigh	2.047e-05	6.262e-04
## Screen.Time.Before.Bed..mins.:Work.Hours..hrs.day.	2.053e-04	1.744e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	1.470e-03	9.599e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-6.788e-04	1.035e-03
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-1.464e-03	9.719e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	-6.559e-04	1.018e-03
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	-1.173e-03	9.477e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	-9.523e-04	1.039e-03
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	-1.377e-03	9.710e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-1.057e-03	1.028e-03
## Work.Hours..hrs.day.:Sleep.QualityCatMedium	-2.416e-02	2.219e-02
## Work.Hours..hrs.day.:Sleep.QualityCatHigh	-2.823e-02	2.393e-02
## Work.Hours..hrs.day.:Productivity.ScoreCatMedium	-1.219e-02	2.271e-02
## Work.Hours..hrs.day.:Productivity.ScoreCatHigh	-8.037e-03	2.354e-02
## Work.Hours..hrs.day.:Mood.ScoreCatMedium	3.971e-02	2.165e-02
## Work.Hours..hrs.day.:Mood.ScoreCatHigh	2.295e-02	2.369e-02
## Work.Hours..hrs.day.:Stress.LevelCatMedium	-1.386e-02	2.211e-02
## Work.Hours..hrs.day.:Stress.LevelCatHigh	-2.269e-03	2.334e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-6.479e-02	1.238e-01
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-3.609e-02	1.327e-01
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	4.816e-02	1.302e-01
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	1.318e-01	1.384e-01
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	-1.083e-01	1.191e-01
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	-1.043e-01	1.285e-01
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	2.995e-01	1.300e-01
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	8.189e-02	1.398e-01
## Sleep.QualityCatMedium:Stress.LevelCatMedium	8.384e-02	1.222e-01
## Sleep.QualityCatHigh:Stress.LevelCatMedium	2.488e-02	1.320e-01
## Sleep.QualityCatMedium:Stress.LevelCatHigh	1.883e-01	1.282e-01
## Sleep.QualityCatHigh:Stress.LevelCatHigh	-3.880e-02	1.380e-01
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium	8.713e-02	1.215e-01

## Productivity.ScoreCatHigh:Mood.ScoreCatMedium	-2.031e-01	1.272e-01
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh	-1.162e-01	1.341e-01
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh	-3.209e-01	1.393e-01
## Productivity.ScoreCatMedium:Stress.LevelCatMedium	-1.066e-01	1.241e-01
## Productivity.ScoreCatHigh:Stress.LevelCatMedium	-1.758e-01	1.299e-01
## Productivity.ScoreCatMedium:Stress.LevelCatHigh	-1.866e-01	1.314e-01
## Productivity.ScoreCatHigh:Stress.LevelCatHigh	-1.399e-01	1.361e-01
## Mood.ScoreCatMedium:Stress.LevelCatMedium	1.054e-01	1.196e-01
## Mood.ScoreCatHigh:Stress.LevelCatMedium	4.704e-02	1.308e-01
## Mood.ScoreCatMedium:Stress.LevelCatHigh	-1.079e-01	1.264e-01
## Mood.ScoreCatHigh:Stress.LevelCatHigh	-2.280e-01	1.394e-01
##	t value	Pr(> t)
## (Intercept)	11.097	<2e-16 ***
## Age	0.495	0.6208
## GenderMale	0.141	0.8878
## GenderOther	0.077	0.9387
## Exercise..mins.day.	0.741	0.4589
## Caffeine.Intake..mg.	-1.396	0.1626
## Screen.Time.Before.Bed..mins.	-0.080	0.9360
## Work.Hours..hrs.day.	0.750	0.4532
## Sleep.QualityCatMedium	-0.411	0.6811
## Sleep.QualityCatHigh	0.970	0.3321
## Productivity.ScoreCatMedium	0.566	0.5716
## Productivity.ScoreCatHigh	1.141	0.2538
## Mood.ScoreCatMedium	0.245	0.8068
## Mood.ScoreCatHigh	0.139	0.8895
## Stress.LevelCatMedium	0.125	0.9007
## Stress.LevelCatHigh	0.628	0.5303
## Age:GenderMale	-0.773	0.4395
## Age:GenderOther	0.166	0.8681
## Age:Exercise..mins.day.	-0.244	0.8075
## Age:Caffeine.Intake..mg.	0.022	0.9823
## Age:Screen.Time.Before.Bed..mins.	0.382	0.7021
## Age:Work.Hours..hrs.day.	-0.899	0.3687
## Age:Sleep.QualityCatMedium	0.772	0.4401
## Age:Sleep.QualityCatHigh	-1.315	0.1886
## Age:Productivity.ScoreCatMedium	-0.084	0.9331
## Age:Productivity.ScoreCatHigh	-0.184	0.8541
## Age:Mood.ScoreCatMedium	-0.402	0.6874
## Age:Mood.ScoreCatHigh	-0.066	0.9473
## Age:Stress.LevelCatMedium	0.672	0.5014
## Age:Stress.LevelCatHigh	0.234	0.8146
## GenderMale:Exercise..mins.day.	-1.026	0.3048
## GenderOther:Exercise..mins.day.	0.479	0.6323
## GenderMale:Caffeine.Intake..mg.	2.068	0.0387 *
## GenderOther:Caffeine.Intake..mg.	2.082	0.0374 *
## GenderMale:Screen.Time.Before.Bed..mins.	1.555	0.1200
## GenderOther:Screen.Time.Before.Bed..mins.	0.549	0.5833
## GenderMale:Work.Hours..hrs.day.	0.177	0.8598
## GenderOther:Work.Hours..hrs.day.	-1.342	0.1798
## GenderMale:Sleep.QualityCatMedium	-1.628	0.1036
## GenderOther:Sleep.QualityCatMedium	0.359	0.7194
## GenderMale:Sleep.QualityCatHigh	-1.711	0.0872 .
## GenderOther:Sleep.QualityCatHigh	0.416	0.6773

## GenderMale:Productivity.ScoreCatMedium	0.465	0.6420
## GenderOther:Productivity.ScoreCatMedium	-0.250	0.8025
## GenderMale:Productivity.ScoreCatHigh	1.069	0.2851
## GenderOther:Productivity.ScoreCatHigh	-1.059	0.2895
## GenderMale:Mood.ScoreCatMedium	-1.040	0.2982
## GenderOther:Mood.ScoreCatMedium	0.545	0.5856
## GenderMale:Mood.ScoreCatHigh	-0.476	0.6344
## GenderOther:Mood.ScoreCatHigh	0.583	0.5599
## GenderMale:Stress.LevelCatMedium	-0.836	0.4030
## GenderOther:Stress.LevelCatMedium	-1.845	0.0651 .
## GenderMale:Stress.LevelCatHigh	0.426	0.6702
## GenderOther:Stress.LevelCatHigh	-0.687	0.4920
## Exercise..mins.day.:Caffeine.Intake..mg.	1.959	0.0502 .
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-0.339	0.7349
## Exercise..mins.day.:Work.Hours..hrs.day.	-1.067	0.2861
## Exercise..mins.day.:Sleep.QualityCatMedium	0.640	0.5221
## Exercise..mins.day.:Sleep.QualityCatHigh	0.833	0.4051
## Exercise..mins.day.:Productivity.ScoreCatMedium	0.343	0.7314
## Exercise..mins.day.:Productivity.ScoreCatHigh	-0.789	0.4303
## Exercise..mins.day.:Mood.ScoreCatMedium	-1.916	0.0554 .
## Exercise..mins.day.:Mood.ScoreCatHigh	-1.376	0.1688
## Exercise..mins.day.:Stress.LevelCatMedium	0.047	0.9628
## Exercise..mins.day.:Stress.LevelCatHigh	0.422	0.6732
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-0.427	0.6697
## Caffeine.Intake..mg.:Work.Hours..hrs.day.	-0.775	0.4381
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	-0.143	0.8862
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	1.987	0.0470 *
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	1.358	0.1747
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	1.070	0.2847
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	1.642	0.1007
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	0.315	0.7528
## Caffeine.Intake..mg.:Stress.LevelCatMedium	1.710	0.0874 .
## Caffeine.Intake..mg.:Stress.LevelCatHigh	0.033	0.9739
## Screen.Time.Before.Bed..mins.:Work.Hours..hrs.day.	1.177	0.2392
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	1.532	0.1257
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-0.656	0.5120
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-1.506	0.1321
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	-0.644	0.5194
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	-1.238	0.2158
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	-0.917	0.3593
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	-1.418	0.1563
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-1.028	0.3040
## Work.Hours..hrs.day.:Sleep.QualityCatMedium	-1.089	0.2763
## Work.Hours..hrs.day.:Sleep.QualityCatHigh	-1.179	0.2383
## Work.Hours..hrs.day.:Productivity.ScoreCatMedium	-0.537	0.5915
## Work.Hours..hrs.day.:Productivity.ScoreCatHigh	-0.341	0.7328
## Work.Hours..hrs.day.:Mood.ScoreCatMedium	1.834	0.0667 .
## Work.Hours..hrs.day.:Mood.ScoreCatHigh	0.969	0.3326
## Work.Hours..hrs.day.:Stress.LevelCatMedium	-0.627	0.5309
## Work.Hours..hrs.day.:Stress.LevelCatHigh	-0.097	0.9226
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-0.523	0.6008
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-0.272	0.7857
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	0.370	0.7115
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	0.953	0.3407

```

## Sleep.QualityCatMedium:Mood.ScoreCatMedium      -0.910  0.3630
## Sleep.QualityCatHigh:Mood.ScoreCatMedium       -0.812  0.4169
## Sleep.QualityCatMedium:Mood.ScoreCatHigh       2.303  0.0213 *
## Sleep.QualityCatHigh:Mood.ScoreCatHigh        0.586  0.5580
## Sleep.QualityCatMedium:Stress.LevelCatMedium   0.686  0.4926
## Sleep.QualityCatHigh:Stress.LevelCatMedium    0.189  0.8505
## Sleep.QualityCatMedium:Stress.LevelCatHigh    1.469  0.1418
## Sleep.QualityCatHigh:Stress.LevelCatHigh     -0.281  0.7786
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium 0.717  0.4735
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium  -1.597  0.1104
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh  -0.866  0.3863
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh    -2.303  0.0213 *
## Productivity.ScoreCatMedium:Stress.LevelCatMedium -0.859  0.3904
## Productivity.ScoreCatHigh:Stress.LevelCatMedium -1.353  0.1762
## Productivity.ScoreCatMedium:Stress.LevelCatHigh -1.420  0.1557
## Productivity.ScoreCatHigh:Stress.LevelCatHigh   -1.028  0.3040
## Mood.ScoreCatMedium:Stress.LevelCatMedium      0.881  0.3782
## Mood.ScoreCatHigh:Stress.LevelCatMedium        0.360  0.7191
## Mood.ScoreCatMedium:Stress.LevelCatHigh       -0.854  0.3934
## Mood.ScoreCatHigh:Stress.LevelCatHigh         -1.636  0.1019
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 1.451 on 4884 degrees of freedom
## Multiple R-squared:  0.02748,   Adjusted R-squared:  0.004586
## F-statistic:  1.2 on 115 and 4884 DF,  p-value: 0.07345

```

```
summary(model2)
```

```

##
## Call:
## lm(formula = Work.Hours..hrs.day. ~ (Age + Gender + Exercise..mins.day. +
##   Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. + Total.Sleep.Hours +
##   Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
##   Stress.LevelCat)^2, data = sleep)
##
## Residuals:
##    Min      1Q Median      3Q      Max
## -4.632 -1.899  0.030  1.824  4.677
##
## Coefficients:
##             Estimate Std. Error
## (Intercept) 6.513e+00  1.110e+00
## Age          3.265e-02  1.752e-02
## GenderMale   -2.257e-01  5.699e-01
## GenderOther   1.246e-01  5.823e-01
## Exercise..mins.day. 2.220e-02  9.122e-03
## Caffeine.Intake..mg. -1.404e-03  2.755e-03
## Screen.Time.Before.Bed..mins. -3.976e-03  4.407e-03
## Total.Sleep.Hours  9.101e-02  1.263e-01
## Sleep.QualityCatMedium 1.006e+00  5.611e-01
## Sleep.QualityCatHigh  7.294e-01  6.113e-01
## Productivity.ScoreCatMedium 4.764e-01  5.727e-01
## Productivity.ScoreCatHigh  2.035e-01  6.051e-01

```

## Mood.ScoreCatMedium	-9.675e-01	5.586e-01
## Mood.ScoreCatHigh	-6.808e-02	6.102e-01
## Stress.LevelCatMedium	9.844e-01	5.632e-01
## Stress.LevelCatHigh	9.474e-02	5.987e-01
## Age:GenderMale	1.501e-03	6.436e-03
## Age:GenderOther	8.230e-03	6.547e-03
## Age:Exercise..mins.day.	-3.176e-04	1.033e-04
## Age:Caffeine.Intake..mg.	2.799e-05	3.095e-05
## Age:Screen.Time.Before.Bed..mins.	2.345e-05	5.066e-05
## Age:Total.Sleep.Hours	-1.828e-03	1.807e-03
## Age:Sleep.QualityCatMedium	-1.427e-02	6.394e-03
## Age:Sleep.QualityCatHigh	-1.267e-02	6.822e-03
## Age:Productivity.ScoreCatMedium	-7.440e-03	6.540e-03
## Age:Productivity.ScoreCatHigh	-1.259e-03	6.802e-03
## Age:Mood.ScoreCatMedium	3.769e-03	6.293e-03
## Age:Mood.ScoreCatHigh	-1.255e-02	6.862e-03
## Age:Stress.LevelCatMedium	-1.908e-03	6.456e-03
## Age:Stress.LevelCatHigh	5.194e-03	6.757e-03
## GenderMale:Exercise..mins.day.	-2.162e-03	3.065e-03
## GenderOther:Exercise..mins.day.	-2.379e-03	3.101e-03
## GenderMale:Caffeine.Intake..mg.	6.789e-04	9.198e-04
## GenderOther:Caffeine.Intake..mg.	3.723e-04	9.329e-04
## GenderMale:Screen.Time.Before.Bed..mins.	-1.511e-03	1.507e-03
## GenderOther:Screen.Time.Before.Bed..mins.	2.891e-04	1.548e-03
## GenderMale:Total.Sleep.Hours	8.905e-03	5.440e-02
## GenderOther:Total.Sleep.Hours	-7.248e-02	5.541e-02
## GenderMale:Sleep.QualityCatMedium	3.766e-01	1.911e-01
## GenderOther:Sleep.QualityCatMedium	1.512e-01	1.941e-01
## GenderMale:Sleep.QualityCatHigh	2.421e-01	2.050e-01
## GenderOther:Sleep.QualityCatHigh	1.476e-01	2.095e-01
## GenderMale:Productivity.ScoreCatMedium	3.834e-01	1.945e-01
## GenderOther:Productivity.ScoreCatMedium	2.334e-01	1.985e-01
## GenderMale:Productivity.ScoreCatHigh	8.321e-02	2.032e-01
## GenderOther:Productivity.ScoreCatHigh	3.012e-01	2.062e-01
## GenderMale:Mood.ScoreCatMedium	-2.034e-01	1.866e-01
## GenderOther:Mood.ScoreCatMedium	-1.992e-01	1.909e-01
## GenderMale:Mood.ScoreCatHigh	-1.384e-01	2.066e-01
## GenderOther:Mood.ScoreCatHigh	-3.150e-01	2.091e-01
## GenderMale:Stress.LevelCatMedium	-2.407e-01	1.921e-01
## GenderOther:Stress.LevelCatMedium	-3.543e-01	1.940e-01
## GenderMale:Stress.LevelCatHigh	1.091e-01	2.006e-01
## GenderOther:Stress.LevelCatHigh	9.637e-02	2.062e-01
## Exercise..mins.day.:Caffeine.Intake..mg.	4.083e-06	1.494e-05
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-4.594e-06	2.428e-05
## Exercise..mins.day.:Total.Sleep.Hours	-1.065e-03	8.696e-04
## Exercise..mins.day.:Sleep.QualityCatMedium	-4.297e-03	3.032e-03
## Exercise..mins.day.:Sleep.QualityCatHigh	1.452e-03	3.277e-03
## Exercise..mins.day.:Productivity.ScoreCatMedium	6.314e-04	3.089e-03
## Exercise..mins.day.:Productivity.ScoreCatHigh	9.621e-05	3.242e-03
## Exercise..mins.day.:Mood.ScoreCatMedium	6.338e-04	2.987e-03
## Exercise..mins.day.:Mood.ScoreCatHigh	1.955e-03	3.258e-03
## Exercise..mins.day.:Stress.LevelCatMedium	-3.970e-03	3.080e-03
## Exercise..mins.day.:Stress.LevelCatHigh	1.777e-03	3.245e-03
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-4.647e-06	7.259e-06

```

## Caffeine.Intake..mg.:Total.Sleep.Hours -9.210e-05 2.656e-04
## Caffeine.Intake..mg.:Sleep.QualityCatMedium 1.225e-03 9.174e-04
## Caffeine.Intake..mg.:Sleep.QualityCatHigh 7.767e-04 9.824e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium 3.406e-04 9.327e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh 7.189e-04 9.758e-04
## Caffeine.Intake..mg.:Mood.ScoreCatMedium 1.085e-04 9.106e-04
## Caffeine.Intake..mg.:Mood.ScoreCatHigh 1.169e-03 9.835e-04
## Caffeine.Intake..mg.:Stress.LevelCatMedium -2.184e-04 9.235e-04
## Caffeine.Intake..mg.:Stress.LevelCatHigh -1.519e-03 9.809e-04
## Screen.Time.Before.Bed..mins.:Total.Sleep.Hours 4.492e-04 4.256e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium 9.668e-05 1.506e-03
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh -9.298e-04 1.622e-03
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium -7.747e-04 1.523e-03
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh 1.485e-03 1.595e-03
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium 2.372e-03 1.484e-03
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh 1.290e-03 1.628e-03
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium 3.767e-04 1.523e-03
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh -3.144e-04 1.612e-03
## Total.Sleep.Hours:Sleep.QualityCatMedium -6.278e-02 5.410e-02
## Total.Sleep.Hours:Sleep.QualityCatHigh -6.756e-02 5.839e-02
## Total.Sleep.Hours:Productivity.ScoreCatMedium -3.422e-02 5.462e-02
## Total.Sleep.Hours:Productivity.ScoreCatHigh -2.808e-02 5.790e-02
## Total.Sleep.Hours:Mood.ScoreCatMedium 9.857e-02 5.337e-02
## Total.Sleep.Hours:Mood.ScoreCatHigh 7.261e-02 5.843e-02
## Total.Sleep.Hours:Stress.LevelCatMedium -3.684e-02 5.413e-02
## Total.Sleep.Hours:Stress.LevelCatHigh 8.812e-03 5.761e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium -2.694e-01 1.939e-01
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium -7.274e-02 2.078e-01
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh -3.963e-01 2.040e-01
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh -2.594e-01 2.167e-01
## Sleep.QualityCatMedium:Mood.ScoreCatMedium 2.197e-01 1.866e-01
## Sleep.QualityCatHigh:Mood.ScoreCatMedium 4.158e-02 2.013e-01
## Sleep.QualityCatMedium:Mood.ScoreCatHigh 4.215e-01 2.041e-01
## Sleep.QualityCatHigh:Mood.ScoreCatHigh 1.713e-01 2.192e-01
## Sleep.QualityCatMedium:Stress.LevelCatMedium -3.965e-01 1.911e-01
## Sleep.QualityCatHigh:Stress.LevelCatMedium -1.113e-01 2.066e-01
## Sleep.QualityCatMedium:Stress.LevelCatHigh -1.681e-01 2.011e-01
## Sleep.QualityCatHigh:Stress.LevelCatHigh 3.162e-02 2.165e-01
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium 1.922e-01 1.904e-01
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium -3.186e-01 1.995e-01
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh -5.656e-02 2.103e-01
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh -1.685e-01 2.186e-01
## Productivity.ScoreCatMedium:Stress.LevelCatMedium -5.545e-02 1.942e-01
## Productivity.ScoreCatHigh:Stress.LevelCatMedium -1.464e-02 2.037e-01
## Productivity.ScoreCatMedium:Stress.LevelCatHigh -2.741e-02 2.060e-01
## Productivity.ScoreCatHigh:Stress.LevelCatHigh 2.048e-01 2.132e-01
## Mood.ScoreCatMedium:Stress.LevelCatMedium -4.230e-02 1.876e-01
## Mood.ScoreCatHigh:Stress.LevelCatMedium -1.795e-01 2.049e-01
## Mood.ScoreCatMedium:Stress.LevelCatHigh -5.603e-02 1.981e-01
## Mood.ScoreCatHigh:Stress.LevelCatHigh -4.799e-01 2.182e-01
##
## (Intercept) 5.866 4.75e-09 ***
## Age 1.864 0.06236 .
## GenderMale -0.396 0.69208
t value Pr(>|t|)


```

## GenderOther	0.214	0.83050
## Exercise..mins.day.	2.434	0.01497 *
## Caffeine.Intake..mg.	-0.510	0.61042
## Screen.Time.Before.Bed..mins.	-0.902	0.36693
## Total.Sleep.Hours	0.721	0.47111
## Sleep.QualityCatMedium	1.792	0.07316 .
## Sleep.QualityCatHigh	1.193	0.23283
## Productivity.ScoreCatMedium	0.832	0.40552
## Productivity.ScoreCatHigh	0.336	0.73667
## Mood.ScoreCatMedium	-1.732	0.08333 .
## Mood.ScoreCatHigh	-0.112	0.91116
## Stress.LevelCatMedium	1.748	0.08056 .
## Stress.LevelCatHigh	0.158	0.87427
## Age:GenderMale	0.233	0.81565
## Age:GenderOther	1.257	0.20879
## Age:Exercise..mins.day.	-3.073	0.00213 **
## Age:Caffeine.Intake..mg.	0.904	0.36595
## Age:Screen.Time.Before.Bed..mins.	0.463	0.64342
## Age:Total.Sleep.Hours	-1.012	0.31179
## Age:Sleep.QualityCatMedium	-2.231	0.02570 *
## Age:Sleep.QualityCatHigh	-1.857	0.06338 .
## Age:Productivity.ScoreCatMedium	-1.138	0.25533
## Age:Productivity.ScoreCatHigh	-0.185	0.85319
## Age:Mood.ScoreCatMedium	0.599	0.54926
## Age:Mood.ScoreCatHigh	-1.829	0.06748 .
## Age:Stress.LevelCatMedium	-0.296	0.76756
## Age:Stress.LevelCatHigh	0.769	0.44214
## GenderMale:Exercise..mins.day.	-0.705	0.48054
## GenderOther:Exercise..mins.day.	-0.767	0.44296
## GenderMale:Caffeine.Intake..mg.	0.738	0.46051
## GenderOther:Caffeine.Intake..mg.	0.399	0.68989
## GenderMale:Screen.Time.Before.Bed..mins.	-1.003	0.31597
## GenderOther:Screen.Time.Before.Bed..mins.	0.187	0.85186
## GenderMale:Total.Sleep.Hours	0.164	0.86997
## GenderOther:Total.Sleep.Hours	-1.308	0.19088
## GenderMale:Sleep.QualityCatMedium	1.971	0.04877 *
## GenderOther:Sleep.QualityCatMedium	0.779	0.43599
## GenderMale:Sleep.QualityCatHigh	1.181	0.23770
## GenderOther:Sleep.QualityCatHigh	0.705	0.48106
## GenderMale:Productivity.ScoreCatMedium	1.971	0.04877 *
## GenderOther:Productivity.ScoreCatMedium	1.176	0.23957
## GenderMale:Productivity.ScoreCatHigh	0.409	0.68227
## GenderOther:Productivity.ScoreCatHigh	1.461	0.14412
## GenderMale:Mood.ScoreCatMedium	-1.090	0.27593
## GenderOther:Mood.ScoreCatMedium	-1.043	0.29685
## GenderMale:Mood.ScoreCatHigh	-0.670	0.50305
## GenderOther:Mood.ScoreCatHigh	-1.507	0.13198
## GenderMale:Stress.LevelCatMedium	-1.253	0.21028
## GenderOther:Stress.LevelCatMedium	-1.826	0.06790 .
## GenderMale:Stress.LevelCatHigh	0.544	0.58639
## GenderOther:Stress.LevelCatHigh	0.467	0.64022
## Exercise..mins.day.:Caffeine.Intake..mg.	0.273	0.78463
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-0.189	0.84994
## Exercise..mins.day.:Total.Sleep.Hours	-1.225	0.22080

## Exercise..mins.day.:Sleep.QualityCatMedium	-1.417	0.15651
## Exercise..mins.day.:Sleep.QualityCatHigh	0.443	0.65772
## Exercise..mins.day.:Productivity.ScoreCatMedium	0.204	0.83804
## Exercise..mins.day.:Productivity.ScoreCatHigh	0.030	0.97633
## Exercise..mins.day.:Mood.ScoreCatMedium	0.212	0.83196
## Exercise..mins.day.:Mood.ScoreCatHigh	0.600	0.54846
## Exercise..mins.day.:Stress.LevelCatMedium	-1.289	0.19743
## Exercise..mins.day.:Stress.LevelCatHigh	0.548	0.58400
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-0.640	0.52212
## Caffeine.Intake..mg.:Total.Sleep.Hours	-0.347	0.72880
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	1.336	0.18171
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	0.791	0.42917
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	0.365	0.71496
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	0.737	0.46133
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	0.119	0.90513
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	1.189	0.23456
## Caffeine.Intake..mg.:Stress.LevelCatMedium	-0.236	0.81308
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-1.548	0.12165
## Screen.Time.Before.Bed..mins.:Total.Sleep.Hours	1.056	0.29124
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	0.064	0.94882
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-0.573	0.56645
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-0.509	0.61103
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	0.931	0.35189
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	1.598	0.11019
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	0.792	0.42822
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	0.247	0.80468
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-0.195	0.84538
## Total.Sleep.Hours:Sleep.QualityCatMedium	-1.161	0.24587
## Total.Sleep.Hours:Sleep.QualityCatHigh	-1.157	0.24726
## Total.Sleep.Hours:Productivity.ScoreCatMedium	-0.626	0.53102
## Total.Sleep.Hours:Productivity.ScoreCatHigh	-0.485	0.62772
## Total.Sleep.Hours:Mood.ScoreCatMedium	1.847	0.06479 .
## Total.Sleep.Hours:Mood.ScoreCatHigh	1.243	0.21402
## Total.Sleep.Hours:Stress.LevelCatMedium	-0.681	0.49621
## Total.Sleep.Hours:Stress.LevelCatHigh	0.153	0.87845
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-1.389	0.16482
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-0.350	0.72629
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	-1.943	0.05211 .
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	-1.197	0.23132
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	1.178	0.23901
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	0.207	0.83637
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	2.065	0.03901 *
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	0.782	0.43447
## Sleep.QualityCatMedium:Stress.LevelCatMedium	-2.075	0.03806 *
## Sleep.QualityCatHigh:Stress.LevelCatMedium	-0.539	0.58996
## Sleep.QualityCatMedium:Stress.LevelCatHigh	-0.836	0.40334
## Sleep.QualityCatHigh:Stress.LevelCatHigh	0.146	0.88386
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium	1.010	0.31269
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium	-1.596	0.11045
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh	-0.269	0.78796
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh	-0.771	0.44077
## Productivity.ScoreCatMedium:Stress.LevelCatMedium	-0.286	0.77527
## Productivity.ScoreCatHigh:Stress.LevelCatMedium	-0.072	0.94273
## Productivity.ScoreCatMedium:Stress.LevelCatHigh	-0.133	0.89414

```

## Productivity.ScoreCatHigh:Stress.LevelCatHigh          0.961  0.33682
## Mood.ScoreCatMedium:Stress.LevelCatMedium          -0.225  0.82163
## Mood.ScoreCatHigh:Stress.LevelCatMedium          -0.876  0.38093
## Mood.ScoreCatMedium:Stress.LevelCatHigh          -0.283  0.77731
## Mood.ScoreCatHigh:Stress.LevelCatHigh          -2.200  0.02787 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.273 on 4884 degrees of freedom
## Multiple R-squared:  0.02504,   Adjusted R-squared:  0.002088
## F-statistic: 1.091 on 115 and 4884 DF,  p-value: 0.2408

```

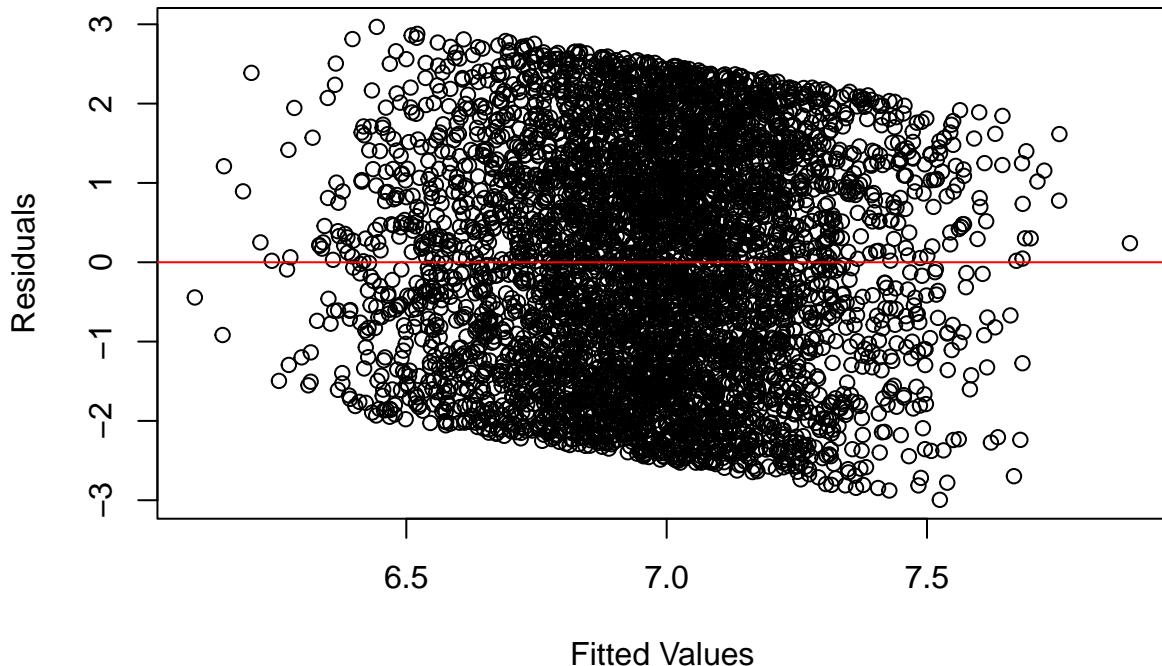
```
# Plot Residuals
```

```

plot(fitted(model1), residuals(model1),
      main = "Model 1Residuals vs Fitted",
      xlab = "Fitted Values",
      ylab = "Residuals")
abline(h = 0, col = 'red')

```

Model 1Residuals vs Fitted

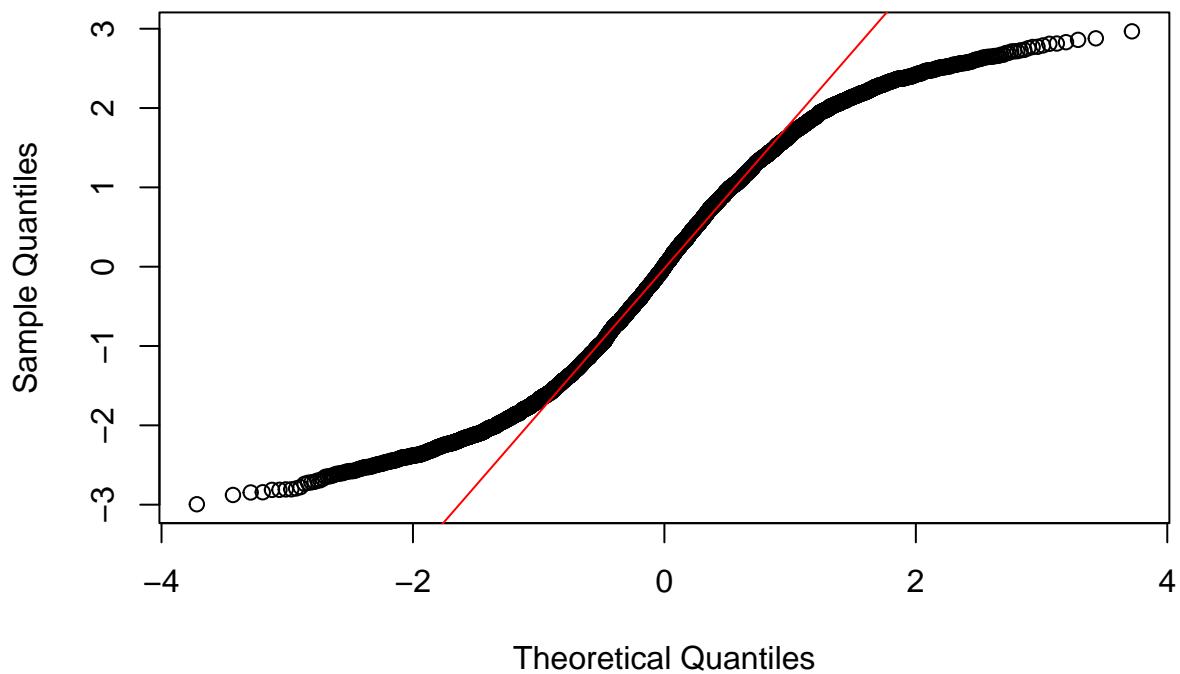


```

qqnorm(residuals(model1), main = "QQplot for Model 1")
qqline(residuals(model1), col = 'red')

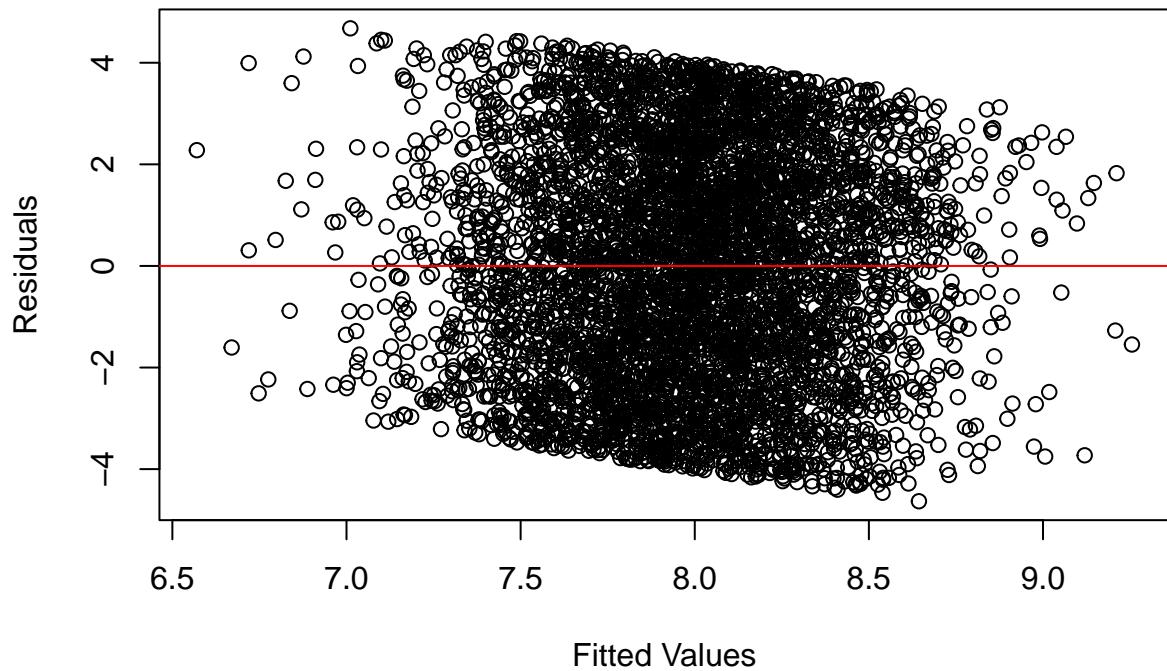
```

QQplot for Model 1



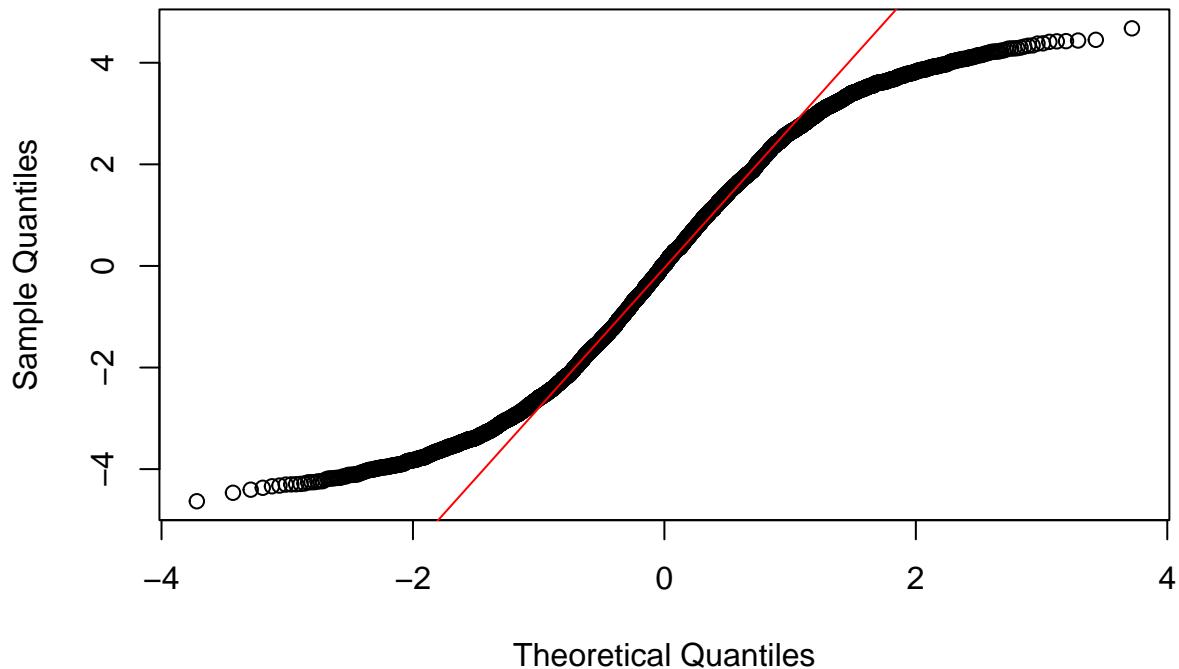
```
plot(fitted(model2), residuals(model2),
      main = "Model 2 Residuals vs Fitted",
      xlab = "Fitted Values",
      ylab = "Residuals")
abline(h = 0, col = 'red')
```

Model 2 Residuals vs Fitted



```
qqnorm(residuals(model2), main = "QQplot for Model 2")
qqline(residuals(model2), col = 'red')
```

QQplot for Model 2



There is a strong S shape visible in both QQ Plots. This implies that the data deviates significantly from the assumed normal distributed.

Normalizing Response Variables

Since it is unclear what relationship is present in our data we will use the Box Cox method to select the best transformation.

```
bc_sleep <- boxcox(sleep$Total.Sleep.Hours)
sleep$normalized_sleep <- predict(bc_sleep)

bn_sleep <- bestNormalize(sleep$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.

sleep$bn_sleep <- predict(bn_sleep)

bc_work_hours <- boxcox(sleep$Work.Hours..hrs.day.)
sleep$normalized_work_hours <- predict(bc_work_hours)

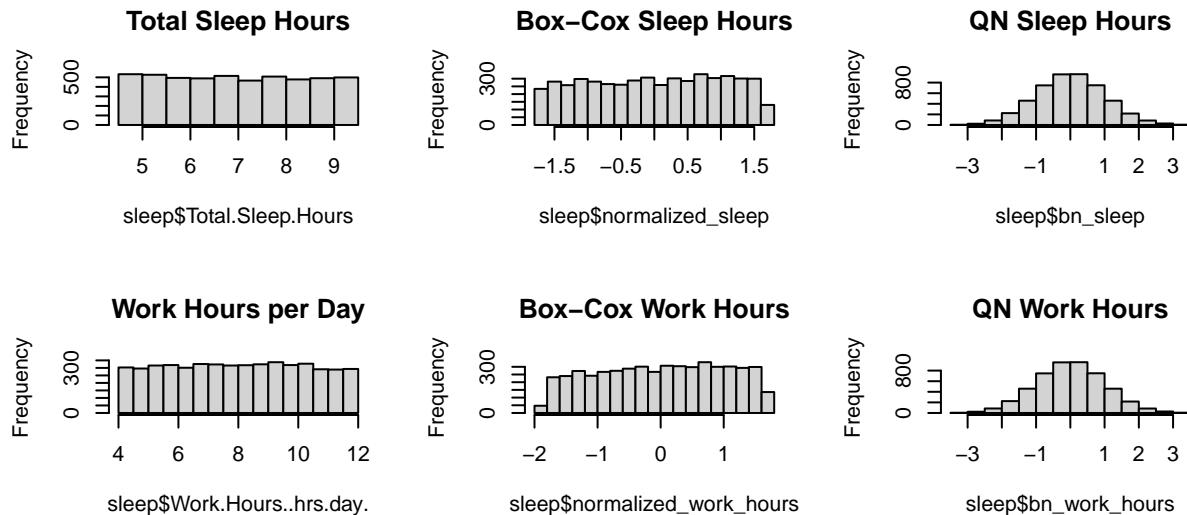
bn_work_hours <- bestNormalize(sleep$Total.Sleep.Hours)
```

```

sleep$bn_work_hours <- predict(bn_work_hours)

par(mfrow = c(3,3))
hist(sleep$Total.Sleep.Hours, main = "Total Sleep Hours")
hist(sleep$normalized_sleep, main = "Box-Cox Sleep Hours")
hist(sleep$bn_sleep, main = "QN Sleep Hours")
hist(sleep$Work.Hours..hrs.day., main = "Work Hours per Day")
hist(sleep$normalized_work_hours, main = "Box-Cox Work Hours")
hist(sleep$bn_work_hours, main = "QN Work Hours")

```



Transformed Two-Way Interaction Models

```

model3 <- lm(normalized_sleep ~ (Age + Gender + Exercise..mins.day. + Caffeine.Intake..mg. +
Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. + Sleep.QualityCat +
Productivity.ScoreCat + Mood.ScoreCat + Stress.LevelCat)^2, data = sleep)
model4 <- lm(normalized_work_hours ~ (Age + Gender + Exercise..mins.day. +
Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. +
Total.Sleep.Hours + Sleep.QualityCat + Productivity.ScoreCat +
Mood.ScoreCat + Stress.LevelCat)^2, data = sleep)

summary(model3)

```

##

```

## Call:
## lm(formula = normalized_sleep ~ (Age + Gender + Exercise..mins.day. +
##     Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. +
##     Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
##     Stress.LevelCat)^2, data = sleep)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -2.12416 -0.85004  0.03589  0.83912  1.98972
##
## Coefficients:
##                               Estimate Std. Error
## (Intercept)                -2.243e-01  4.108e-01
## Age                      3.322e-03  6.858e-03
## GenderMale                2.961e-02  2.233e-01
## GenderOther               2.393e-03  2.297e-01
## Exercise..mins.day.        2.579e-03  3.540e-03
## Caffeine.Intake..mg.       -1.473e-03  1.064e-03
## Screen.Time.Before.Bed..mins. -1.394e-04  1.722e-03
## Work.Hours..hrs.day.       2.588e-02  3.474e-02
## Sleep.QualityCatMedium    -9.307e-02  2.201e-01
## Sleep.QualityCatHigh      2.148e-01  2.351e-01
## Productivity.ScoreCatMedium 1.125e-01  2.286e-01
## Productivity.ScoreCatHigh  2.660e-01  2.366e-01
## Mood.ScoreCatMedium       4.912e-02  2.192e-01
## Mood.ScoreCatHigh          4.012e-02  2.428e-01
## Stress.LevelCatMedium     2.272e-02  2.230e-01
## Stress.LevelCatHigh        1.435e-01  2.313e-01
## Age:GenderMale             -2.195e-03  2.826e-03
## Age:GenderOther            5.308e-04  2.877e-03
## Age:Exercise..mins.day.    -8.705e-06  4.535e-05
## Age:Caffeine.Intake..mg.   3.297e-07  1.359e-05
## Age:Screen.Time.Before.Bed..mins. 8.477e-06  2.225e-05
## Age:Work.Hours..hrs.day.   -4.726e-04  5.143e-04
## Age:Sleep.QualityCatMedium 2.095e-03  2.812e-03
## Age:Sleep.QualityCatHigh  -3.835e-03  2.995e-03
## Age:Productivity.ScoreCatMedium -1.637e-04  2.874e-03
## Age:Productivity.ScoreCatHigh -4.838e-04  2.984e-03
## Age:Mood.ScoreCatMedium   -1.128e-03  2.762e-03
## Age:Mood.ScoreCatHigh     -4.212e-04  3.011e-03
## Age:Stress.LevelCatMedium 1.892e-03  2.830e-03
## Age:Stress.LevelCatHigh   7.534e-04  2.966e-03
## GenderMale:Exercise..mins.day. -1.380e-03  1.346e-03
## GenderOther:Exercise..mins.day. 6.531e-04  1.360e-03
## GenderMale:Caffeine.Intake..mg. 8.395e-04  4.034e-04
## GenderOther:Caffeine.Intake..mg. 8.655e-04  4.090e-04
## GenderMale:Screen.Time.Before.Bed..mins. 9.977e-04  6.610e-04
## GenderOther:Screen.Time.Before.Bed..mins. 3.749e-04  6.797e-04
## GenderMale:Work.Hours..hrs.day. 2.523e-03  1.520e-02
## GenderOther:Work.Hours..hrs.day. -2.038e-02  1.562e-02
## GenderMale:Sleep.QualityCatMedium -1.377e-01  8.382e-02
## GenderOther:Sleep.QualityCatMedium 3.165e-02  8.523e-02
## GenderMale:Sleep.QualityCatHigh -1.559e-01  8.992e-02
## GenderOther:Sleep.QualityCatHigh 4.291e-02  9.197e-02

```

## GenderMale:Productivity.ScoreCatMedium	4.495e-02	8.552e-02
## GenderOther:Productivity.ScoreCatMedium	-1.964e-02	8.717e-02
## GenderMale:Productivity.ScoreCatHigh	9.693e-02	8.915e-02
## GenderOther:Productivity.ScoreCatHigh	-9.759e-02	9.058e-02
## GenderMale:Mood.ScoreCatMedium	-8.262e-02	8.192e-02
## GenderOther:Mood.ScoreCatMedium	4.731e-02	8.373e-02
## GenderMale:Mood.ScoreCatHigh	-4.642e-02	9.073e-02
## GenderOther:Mood.ScoreCatHigh	5.205e-02	9.183e-02
## GenderMale:Stress.LevelCatMedium	-6.645e-02	8.434e-02
## GenderOther:Stress.LevelCatMedium	-1.530e-01	8.522e-02
## GenderMale:Stress.LevelCatHigh	4.121e-02	8.799e-02
## GenderOther:Stress.LevelCatHigh	-5.833e-02	9.058e-02
## Exercise..mins.day.:Caffeine.Intake..mg.	1.258e-05	6.556e-06
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-4.051e-06	1.066e-05
## Exercise..mins.day.:Work.Hours..hrs.day.	-2.635e-04	2.439e-04
## Exercise..mins.day.:Sleep.QualityCatMedium	8.415e-04	1.331e-03
## Exercise..mins.day.:Sleep.QualityCatHigh	1.169e-03	1.438e-03
## Exercise..mins.day.:Productivity.ScoreCatMedium	5.098e-04	1.357e-03
## Exercise..mins.day.:Productivity.ScoreCatHigh	-1.087e-03	1.423e-03
## Exercise..mins.day.:Mood.ScoreCatMedium	-2.490e-03	1.308e-03
## Exercise..mins.day.:Mood.ScoreCatHigh	-1.942e-03	1.429e-03
## Exercise..mins.day.:Stress.LevelCatMedium	7.248e-05	1.352e-03
## Exercise..mins.day.:Stress.LevelCatHigh	6.182e-04	1.425e-03
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-1.488e-06	3.186e-06
## Caffeine.Intake..mg.:Work.Hours..hrs.day.	-5.791e-05	7.323e-05
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	-5.880e-05	4.029e-04
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	8.429e-04	4.310e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	5.495e-04	4.100e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	4.435e-04	4.290e-04
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	6.752e-04	3.995e-04
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	1.696e-04	4.320e-04
## Caffeine.Intake..mg.:Stress.LevelCatMedium	6.853e-04	4.048e-04
## Caffeine.Intake..mg.:Stress.LevelCatHigh	1.532e-05	4.307e-04
## Screen.Time.Before.Bed..mins.:Work.Hours..hrs.day.	1.459e-04	1.200e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	1.017e-03	6.602e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-4.683e-04	7.119e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-9.856e-04	6.685e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	-4.586e-04	7.001e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	-8.303e-04	6.518e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	-6.567e-04	7.144e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	-9.265e-04	6.679e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-7.154e-04	7.073e-04
## Work.Hours..hrs.day.:Sleep.QualityCatMedium	-1.597e-02	1.526e-02
## Work.Hours..hrs.day.:Sleep.QualityCatHigh	-1.849e-02	1.646e-02
## Work.Hours..hrs.day.:Productivity.ScoreCatMedium	-7.796e-03	1.562e-02
## Work.Hours..hrs.day.:Productivity.ScoreCatHigh	-5.086e-03	1.619e-02
## Work.Hours..hrs.day.:Mood.ScoreCatMedium	2.723e-02	1.489e-02
## Work.Hours..hrs.day.:Mood.ScoreCatHigh	1.540e-02	1.629e-02
## Work.Hours..hrs.day.:Stress.LevelCatMedium	-9.633e-03	1.521e-02
## Work.Hours..hrs.day.:Stress.LevelCatHigh	-2.187e-03	1.606e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-4.110e-02	8.517e-02
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-1.879e-02	9.129e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	2.784e-02	8.957e-02
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	8.984e-02	9.518e-02

## Sleep.QualityCatMedium:Mood.ScoreCatMedium	-7.345e-02	8.190e-02
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	-7.126e-02	8.837e-02
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	2.092e-01	8.945e-02
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	5.728e-02	9.614e-02
## Sleep.QualityCatMedium:Stress.LevelCatMedium	5.779e-02	8.403e-02
## Sleep.QualityCatHigh:Stress.LevelCatMedium	2.231e-02	9.078e-02
## Sleep.QualityCatMedium:Stress.LevelCatHigh	1.282e-01	8.816e-02
## Sleep.QualityCatHigh:Stress.LevelCatHigh	-2.604e-02	9.494e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium	5.944e-02	8.359e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium	-1.356e-01	8.747e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh	-8.173e-02	9.226e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh	-2.173e-01	9.581e-02
## Productivity.ScoreCatMedium:Stress.LevelCatMedium	-7.204e-02	8.533e-02
## Productivity.ScoreCatHigh:Stress.LevelCatMedium	-1.200e-01	8.937e-02
## Productivity.ScoreCatMedium:Stress.LevelCatHigh	-1.275e-01	9.040e-02
## Productivity.ScoreCatHigh:Stress.LevelCatHigh	-9.701e-02	9.359e-02
## Mood.ScoreCatMedium:Stress.LevelCatMedium	7.351e-02	8.225e-02
## Mood.ScoreCatHigh:Stress.LevelCatMedium	2.950e-02	8.996e-02
## Mood.ScoreCatMedium:Stress.LevelCatHigh	-7.190e-02	8.695e-02
## Mood.ScoreCatHigh:Stress.LevelCatHigh	-1.579e-01	9.586e-02
##		
## (Intercept)	-0.546	0.5852
## Age	0.484	0.6281
## GenderMale	0.133	0.8945
## GenderOther	0.010	0.9917
## Exercise..mins.day.	0.728	0.4664
## Caffeine.Intake..mg.	-1.383	0.1666
## Screen.Time.Before.Bed..mins.	-0.081	0.9355
## Work.Hours..hrs.day.	0.745	0.4563
## Sleep.QualityCatMedium	-0.423	0.6724
## Sleep.QualityCatHigh	0.914	0.3609
## Productivity.ScoreCatMedium	0.492	0.6227
## Productivity.ScoreCatHigh	1.124	0.2609
## Mood.ScoreCatMedium	0.224	0.8227
## Mood.ScoreCatHigh	0.165	0.8688
## Stress.LevelCatMedium	0.102	0.9188
## Stress.LevelCatHigh	0.620	0.5350
## Age:GenderMale	-0.777	0.4374
## Age:GenderOther	0.184	0.8536
## Age:Exercise..mins.day.	-0.192	0.8478
## Age:Caffeine.Intake..mg.	0.024	0.9807
## Age:Screen.Time.Before.Bed..mins.	0.381	0.7032
## Age:Work.Hours..hrs.day.	-0.919	0.3582
## Age:Sleep.QualityCatMedium	0.745	0.4562
## Age:Sleep.QualityCatHigh	-1.281	0.2004
## Age:Productivity.ScoreCatMedium	-0.057	0.9546
## Age:Productivity.ScoreCatHigh	-0.162	0.8712
## Age:Mood.ScoreCatMedium	-0.409	0.6829
## Age:Mood.ScoreCatHigh	-0.140	0.8887
## Age:Stress.LevelCatMedium	0.669	0.5038
## Age:Stress.LevelCatHigh	0.254	0.7995
## GenderMale:Exercise..mins.day.	-1.025	0.3053
## GenderOther:Exercise..mins.day.	0.480	0.6311
## GenderMale:Caffeine.Intake..mg.	2.081	0.0375 *

## GenderOther:Caffeine.Intake..mg.	2.116	0.0344 *
## GenderMale:Screen.Time.Before.Bed..mins.	1.509	0.1312
## GenderOther:Screen.Time.Before.Bed..mins.	0.552	0.5813
## GenderMale:Work.Hours..hrs.day.	0.166	0.8682
## GenderOther:Work.Hours..hrs.day.	-1.305	0.1919
## GenderMale:Sleep.QualityCatMedium	-1.643	0.1005
## GenderOther:Sleep.QualityCatMedium	0.371	0.7104
## GenderMale:Sleep.QualityCatHigh	-1.734	0.0829 .
## GenderOther:Sleep.QualityCatHigh	0.467	0.6408
## GenderMale:Productivity.ScoreCatMedium	0.526	0.5991
## GenderOther:Productivity.ScoreCatMedium	-0.225	0.8218
## GenderMale:Productivity.ScoreCatHigh	1.087	0.2769
## GenderOther:Productivity.ScoreCatHigh	-1.077	0.2814
## GenderMale:Mood.ScoreCatMedium	-1.009	0.3132
## GenderOther:Mood.ScoreCatMedium	0.565	0.5721
## GenderMale:Mood.ScoreCatHigh	-0.512	0.6089
## GenderOther:Mood.ScoreCatHigh	0.567	0.5709
## GenderMale:Stress.LevelCatMedium	-0.788	0.4308
## GenderOther:Stress.LevelCatMedium	-1.795	0.0727 .
## GenderMale:Stress.LevelCatHigh	0.468	0.6396
## GenderOther:Stress.LevelCatHigh	-0.644	0.5196
## Exercise..mins.day.:Caffeine.Intake..mg.	1.918	0.0551 .
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-0.380	0.7039
## Exercise..mins.day.:Work.Hours..hrs.day.	-1.080	0.2801
## Exercise..mins.day.:Sleep.QualityCatMedium	0.632	0.5274
## Exercise..mins.day.:Sleep.QualityCatHigh	0.813	0.4163
## Exercise..mins.day.:Productivity.ScoreCatMedium	0.376	0.7071
## Exercise..mins.day.:Productivity.ScoreCatHigh	-0.764	0.4452
## Exercise..mins.day.:Mood.ScoreCatMedium	-1.903	0.0571 .
## Exercise..mins.day.:Mood.ScoreCatHigh	-1.359	0.1742
## Exercise..mins.day.:Stress.LevelCatMedium	0.054	0.9573
## Exercise..mins.day.:Stress.LevelCatHigh	0.434	0.6645
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-0.467	0.6406
## Caffeine.Intake..mg.:Work.Hours..hrs.day.	-0.791	0.4291
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	-0.146	0.8840
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	1.956	0.0506 .
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	1.340	0.1802
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	1.034	0.3013
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	1.690	0.0911 .
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	0.393	0.6947
## Caffeine.Intake..mg.:Stress.LevelCatMedium	1.693	0.0906 .
## Caffeine.Intake..mg.:Stress.LevelCatHigh	0.036	0.9716
## Screen.Time.Before.Bed..mins.:Work.Hours..hrs.day.	1.216	0.2241
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	1.540	0.1236
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-0.658	0.5107
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-1.474	0.1404
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	-0.655	0.5125
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	-1.274	0.2028
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	-0.919	0.3581
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	-1.387	0.1654
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-1.012	0.3118
## Work.Hours..hrs.day.:Sleep.QualityCatMedium	-1.047	0.2953
## Work.Hours..hrs.day.:Sleep.QualityCatHigh	-1.123	0.2615
## Work.Hours..hrs.day.:Productivity.ScoreCatMedium	-0.499	0.6178

```

## Work.Hours..hrs.day.:Productivity.ScoreCatHigh      -0.314  0.7535
## Work.Hours..hrs.day.:Mood.ScoreCatMedium          1.828  0.0676 .
## Work.Hours..hrs.day.:Mood.ScoreCatHigh             0.945  0.3447
## Work.Hours..hrs.day.:Stress.LevelCatMedium        -0.633  0.5265
## Work.Hours..hrs.day.:Stress.LevelCatHigh           -0.136  0.8917
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium -0.483  0.6294
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium    -0.206  0.8369
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh     0.311  0.7559
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh       0.944  0.3452
## Sleep.QualityCatMedium:Mood.ScoreCatMedium          -0.897  0.3699
## Sleep.QualityCatHigh:Mood.ScoreCatMedium            -0.806  0.4201
## Sleep.QualityCatMedium:Mood.ScoreCatHigh              2.338  0.0194 *
## Sleep.QualityCatHigh:Mood.ScoreCatHigh                0.596  0.5513
## Sleep.QualityCatMedium:Stress.LevelCatMedium         0.688  0.4917
## Sleep.QualityCatHigh:Stress.LevelCatMedium           0.246  0.8059
## Sleep.QualityCatMedium:Stress.LevelCatHigh            1.454  0.1460
## Sleep.QualityCatHigh:Stress.LevelCatHigh              -0.274  0.7839
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium      0.711  0.4771
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium         -1.550  0.1211
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh          -0.886  0.3757
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh            -2.268  0.0234 *
## Productivity.ScoreCatMedium:Stress.LevelCatMedium     -0.844  0.3986
## Productivity.ScoreCatHigh:Stress.LevelCatMedium       -1.342  0.1795
## Productivity.ScoreCatMedium:Stress.LevelCatHigh        -1.411  0.1584
## Productivity.ScoreCatHigh:Stress.LevelCatHigh          -1.037  0.3000
## Mood.ScoreCatMedium:Stress.LevelCatMedium              0.894  0.3715
## Mood.ScoreCatHigh:Stress.LevelCatMedium                0.328  0.7430
## Mood.ScoreCatMedium:Stress.LevelCatHigh                 -0.827  0.4083
## Mood.ScoreCatHigh:Stress.LevelCatHigh                  -1.648  0.0995 .

## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ',' 1
##
## Residual standard error: 0.9978 on 4884 degrees of freedom
## Multiple R-squared:  0.02725,   Adjusted R-squared:  0.004347
## F-statistic:  1.19 on 115 and 4884 DF,  p-value: 0.08364

```

```
summary(model4)
```

```

##
## Call:
## lm(formula = normalized_work_hours ~ (Age + Gender + Exercise..mins.day. +
##   Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. + Total.Sleep.Hours +
##   Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
##   Stress.LevelCat)^2, data = sleep)
##
## Residuals:
##      Min      1Q      Median      3Q      Max 
## -2.11810 -0.82410  0.04822  0.80726  2.00874 
##
## Coefficients:
## (Intercept)               Estimate Std. Error
## Age                      -6.616e-01  4.878e-01
## GenderMale                1.468e-02  7.697e-03
## 
```

## GenderOther	5.763e-02	2.558e-01
## Exercise..mins.day.	9.869e-03	4.008e-03
## Caffeine.Intake..mg.	-5.561e-04	1.210e-03
## Screen.Time.Before.Bed..mins.	-1.739e-03	1.936e-03
## Total.Sleep.Hours	3.908e-02	5.548e-02
## Sleep.QualityCatMedium	4.463e-01	2.466e-01
## Sleep.QualityCatHigh	3.305e-01	2.686e-01
## Productivity.ScoreCatMedium	2.082e-01	2.516e-01
## Productivity.ScoreCatHigh	9.385e-02	2.659e-01
## Mood.ScoreCatMedium	-4.324e-01	2.454e-01
## Mood.ScoreCatHigh	-3.518e-02	2.681e-01
## Stress.LevelCatMedium	4.311e-01	2.475e-01
## Stress.LevelCatHigh	4.463e-02	2.630e-01
## Age:GenderMale	5.332e-04	2.828e-03
## Age:GenderOther	3.576e-03	2.877e-03
## Age:Exercise..mins.day.	-1.410e-04	4.541e-05
## Age:Caffeine.Intake..mg.	1.263e-05	1.360e-05
## Age:Screen.Time.Before.Bed..mins.	1.015e-05	2.226e-05
## Age:Total.Sleep.Hours	-7.968e-04	7.940e-04
## Age:Sleep.QualityCatMedium	-6.515e-03	2.809e-03
## Age:Sleep.QualityCatHigh	-5.817e-03	2.997e-03
## Age:Productivity.ScoreCatMedium	-3.254e-03	2.874e-03
## Age:Productivity.ScoreCatHigh	-5.427e-04	2.989e-03
## Age:Mood.ScoreCatMedium	1.571e-03	2.765e-03
## Age:Mood.ScoreCatHigh	-5.599e-03	3.015e-03
## Age:Stress.LevelCatMedium	-8.492e-04	2.837e-03
## Age:Stress.LevelCatHigh	2.132e-03	2.969e-03
## GenderMale:Exercise..mins.day.	-9.302e-04	1.347e-03
## GenderOther:Exercise..mins.day.	-9.620e-04	1.362e-03
## GenderMale:Caffeine.Intake..mg.	2.910e-04	4.042e-04
## GenderOther:Caffeine.Intake..mg.	1.751e-04	4.099e-04
## GenderMale:Screen.Time.Before.Bed..mins.	-6.665e-04	6.619e-04
## GenderOther:Screen.Time.Before.Bed..mins.	1.188e-04	6.802e-04
## GenderMale:Total.Sleep.Hours	3.627e-03	2.390e-02
## GenderOther:Total.Sleep.Hours	-3.308e-02	2.435e-02
## GenderMale:Sleep.QualityCatMedium	1.644e-01	8.396e-02
## GenderOther:Sleep.QualityCatMedium	6.808e-02	8.530e-02
## GenderMale:Sleep.QualityCatHigh	1.071e-01	9.007e-02
## GenderOther:Sleep.QualityCatHigh	6.513e-02	9.203e-02
## GenderMale:Productivity.ScoreCatMedium	1.697e-01	8.545e-02
## GenderOther:Productivity.ScoreCatMedium	1.035e-01	8.720e-02
## GenderMale:Productivity.ScoreCatHigh	3.420e-02	8.930e-02
## GenderOther:Productivity.ScoreCatHigh	1.315e-01	9.060e-02
## GenderMale:Mood.ScoreCatMedium	-9.080e-02	8.201e-02
## GenderOther:Mood.ScoreCatMedium	-8.691e-02	8.389e-02
## GenderMale:Mood.ScoreCatHigh	-6.121e-02	9.078e-02
## GenderOther:Mood.ScoreCatHigh	-1.358e-01	9.188e-02
## GenderMale:Stress.LevelCatMedium	-1.048e-01	8.441e-02
## GenderOther:Stress.LevelCatMedium	-1.554e-01	8.525e-02
## GenderMale:Stress.LevelCatHigh	4.348e-02	8.814e-02
## GenderOther:Stress.LevelCatHigh	4.258e-02	9.059e-02
## Exercise..mins.day.:Caffeine.Intake..mg.	1.252e-06	6.565e-06
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-1.946e-06	1.067e-05
## Exercise..mins.day.:Total.Sleep.Hours	-4.636e-04	3.821e-04

## Exercise..mins.day.:Sleep.QualityCatMedium	-1.874e-03	1.332e-03
## Exercise..mins.day.:Sleep.QualityCatHigh	6.059e-04	1.440e-03
## Exercise..mins.day.:Productivity.ScoreCatMedium	2.207e-04	1.357e-03
## Exercise..mins.day.:Productivity.ScoreCatHigh	-1.700e-05	1.425e-03
## Exercise..mins.day.:Mood.ScoreCatMedium	2.794e-04	1.312e-03
## Exercise..mins.day.:Mood.ScoreCatHigh	8.966e-04	1.431e-03
## Exercise..mins.day.:Stress.LevelCatMedium	-1.732e-03	1.353e-03
## Exercise..mins.day.:Stress.LevelCatHigh	7.606e-04	1.426e-03
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-2.115e-06	3.190e-06
## Caffeine.Intake..mg.:Total.Sleep.Hours	-4.514e-05	1.167e-04
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	5.419e-04	4.031e-04
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	3.242e-04	4.316e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	1.236e-04	4.098e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	2.879e-04	4.288e-04
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	5.110e-05	4.001e-04
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	5.151e-04	4.321e-04
## Caffeine.Intake..mg.:Stress.LevelCatMedium	-8.926e-05	4.058e-04
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-6.513e-04	4.310e-04
## Screen.Time.Before.Bed..mins.:Total.Sleep.Hours	1.975e-04	1.870e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	3.252e-05	6.617e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-4.101e-04	7.126e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-3.643e-04	6.692e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	6.679e-04	7.007e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	1.079e-03	6.522e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	5.560e-04	7.153e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	1.735e-04	6.694e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-1.147e-04	7.083e-04
## Total.Sleep.Hours:Sleep.QualityCatMedium	-2.665e-02	2.377e-02
## Total.Sleep.Hours:Sleep.QualityCatHigh	-2.848e-02	2.565e-02
## Total.Sleep.Hours:Productivity.ScoreCatMedium	-1.403e-02	2.400e-02
## Total.Sleep.Hours:Productivity.ScoreCatHigh	-1.206e-02	2.544e-02
## Total.Sleep.Hours:Mood.ScoreCatMedium	4.418e-02	2.345e-02
## Total.Sleep.Hours:Mood.ScoreCatHigh	3.277e-02	2.567e-02
## Total.Sleep.Hours:Stress.LevelCatMedium	-1.611e-02	2.378e-02
## Total.Sleep.Hours:Stress.LevelCatHigh	4.044e-03	2.531e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-1.176e-01	8.519e-02
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-3.177e-02	9.130e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	-1.786e-01	8.964e-02
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	-1.173e-01	9.521e-02
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	9.802e-02	8.199e-02
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	1.595e-02	8.845e-02
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	1.847e-01	8.969e-02
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	7.191e-02	9.630e-02
## Sleep.QualityCatMedium:Stress.LevelCatMedium	-1.790e-01	8.396e-02
## Sleep.QualityCatHigh:Stress.LevelCatMedium	-5.307e-02	9.077e-02
## Sleep.QualityCatMedium:Stress.LevelCatHigh	-7.847e-02	8.836e-02
## Sleep.QualityCatHigh:Stress.LevelCatHigh	1.032e-02	9.511e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium	8.362e-02	8.365e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium	-1.398e-01	8.768e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh	-2.722e-02	9.239e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh	-7.488e-02	9.604e-02
## Productivity.ScoreCatMedium:Stress.LevelCatMedium	-2.532e-02	8.533e-02
## Productivity.ScoreCatHigh:Stress.LevelCatMedium	-6.152e-03	8.951e-02
## Productivity.ScoreCatMedium:Stress.LevelCatHigh	-9.324e-03	9.049e-02

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## Productivity.ScoreCatHigh:Stress.LevelCatHigh          9.029e-02  9.368e-02
## Mood.ScoreCatMedium:Stress.LevelCatMedium          -1.537e-02  8.243e-02
## Mood.ScoreCatHigh:Stress.LevelCatMedium          -7.307e-02  9.001e-02
## Mood.ScoreCatMedium:Stress.LevelCatHigh          -2.185e-02  8.704e-02
## Mood.ScoreCatHigh:Stress.LevelCatHigh          -2.070e-01  9.586e-02
##                                         t value Pr(>|t|)
## (Intercept)                                -1.356   0.17510
## Age                                         1.907   0.05658 .
## GenderMale                                 -0.365   0.71506
## GenderOther                                 0.225   0.82178
## Exercise..mins.day.                      2.462   0.01384 *
## Caffeine.Intake..mg.                     -0.459   0.64598
## Screen.Time.Before.Bed..mins.            -0.898   0.36924
## Total.Sleep.Hours                         0.704   0.48123
## Sleep.QualityCatMedium                   1.810   0.07035 .
## Sleep.QualityCatHigh                     1.231   0.21850
## Productivity.ScoreCatMedium              0.827   0.40812
## Productivity.ScoreCatHigh                0.353   0.72411
## Mood.ScoreCatMedium                      -1.762   0.07819 .
## Mood.ScoreCatHigh                        -0.131   0.89561
## Stress.LevelCatMedium                   1.742   0.08154 .
## Stress.LevelCatHigh                      0.170   0.86528
## Age:GenderMale                            0.189   0.85044
## Age:GenderOther                           1.243   0.21390
## Age:Exercise..mins.day.                 -3.106   0.00191 **
## Age:Caffeine.Intake..mg.                  0.929   0.35319
## Age:Screen.Time.Before.Bed..mins.        0.456   0.64830
## Age:Total.Sleep.Hours                   -1.004   0.31565
## Age:Sleep.QualityCatMedium              -2.319   0.02043 *
## Age:Sleep.QualityCatHigh                -1.941   0.05234 .
## Age:Productivity.ScoreCatMedium         -1.132   0.25755
## Age:Productivity.ScoreCatHigh           -0.182   0.85591
## Age:Mood.ScoreCatMedium                 0.568   0.56995
## Age:Mood.ScoreCatHigh                  -1.857   0.06337 .
## Age:Stress.LevelCatMedium               -0.299   0.76466
## Age:Stress.LevelCatHigh                 0.718   0.47276
## GenderMale:Exercise..mins.day.          -0.691   0.48974
## GenderOther:Exercise..mins.day.         -0.706   0.48014
## GenderMale:Caffeine.Intake..mg.         0.720   0.47158
## GenderOther:Caffeine.Intake..mg.        0.427   0.66924
## GenderMale:Screen.Time.Before.Bed..mins. -1.007   0.31401
## GenderOther:Screen.Time.Before.Bed..mins. 0.175   0.86130
## GenderMale:Total.Sleep.Hours            0.152   0.87940
## GenderOther:Total.Sleep.Hours           -1.359   0.17424
## GenderMale:Sleep.QualityCatMedium      1.958   0.05026 .
## GenderOther:Sleep.QualityCatMedium     0.798   0.42482
## GenderMale:Sleep.QualityCatHigh        1.189   0.23444
## GenderOther:Sleep.QualityCatHigh       0.708   0.47918
## GenderMale:Productivity.ScoreCatMedium 1.985   0.04715 *
## GenderOther:Productivity.ScoreCatMedium 1.187   0.23544
## GenderMale:Productivity.ScoreCatHigh    0.383   0.70175
## GenderOther:Productivity.ScoreCatHigh   1.451   0.14678
## GenderMale:Mood.ScoreCatMedium         -1.107   0.26825
## GenderOther:Mood.ScoreCatMedium        -1.036   0.30028

```

## GenderMale:Mood.ScoreCatHigh	-0.674	0.50022
## GenderOther:Mood.ScoreCatHigh	-1.478	0.13956
## GenderMale:Stress.LevelCatMedium	-1.242	0.21428
## GenderOther:Stress.LevelCatMedium	-1.822	0.06844 *
## GenderMale:Stress.LevelCatHigh	0.493	0.62181
## GenderOther:Stress.LevelCatHigh	0.470	0.63832
## Exercise..mins.day.:Caffeine.Intake..mg.	0.191	0.84881
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-0.182	0.85525
## Exercise..mins.day.:Total.Sleep.Hours	-1.213	0.22505
## Exercise..mins.day.:Sleep.QualityCatMedium	-1.407	0.15957
## Exercise..mins.day.:Sleep.QualityCatHigh	0.421	0.67393
## Exercise..mins.day.:Productivity.ScoreCatMedium	0.163	0.87082
## Exercise..mins.day.:Productivity.ScoreCatHigh	-0.012	0.99048
## Exercise..mins.day.:Mood.ScoreCatMedium	0.213	0.83140
## Exercise..mins.day.:Mood.ScoreCatHigh	0.626	0.53111
## Exercise..mins.day.:Stress.LevelCatMedium	-1.280	0.20063
## Exercise..mins.day.:Stress.LevelCatHigh	0.533	0.59377
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-0.663	0.50734
## Caffeine.Intake..mg.:Total.Sleep.Hours	-0.387	0.69893
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	1.344	0.17894
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	0.751	0.45262
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	0.302	0.76302
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	0.672	0.50190
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	0.128	0.89837
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	1.192	0.23331
## Caffeine.Intake..mg.:Stress.LevelCatMedium	-0.220	0.82589
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-1.511	0.13081
## Screen.Time.Before.Bed..mins.:Total.Sleep.Hours	1.056	0.29101
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	0.049	0.96081
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-0.576	0.56498
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-0.544	0.58625
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	0.953	0.34054
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	1.654	0.09827 *
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	0.777	0.43701
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	0.259	0.79554
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-0.162	0.87132
## Total.Sleep.Hours:Sleep.QualityCatMedium	-1.121	0.26235
## Total.Sleep.Hours:Sleep.QualityCatHigh	-1.110	0.26698
## Total.Sleep.Hours:Productivity.ScoreCatMedium	-0.585	0.55878
## Total.Sleep.Hours:Productivity.ScoreCatHigh	-0.474	0.63537
## Total.Sleep.Hours:Mood.ScoreCatMedium	1.884	0.05961 *
## Total.Sleep.Hours:Mood.ScoreCatHigh	1.277	0.20181
## Total.Sleep.Hours:Stress.LevelCatMedium	-0.677	0.49824
## Total.Sleep.Hours:Stress.LevelCatHigh	0.160	0.87307
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-1.380	0.16757
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-0.348	0.72787
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	-1.992	0.04643 *
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	-1.232	0.21784
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	1.196	0.23190
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	0.180	0.85695
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	2.060	0.03947 *
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	0.747	0.45527
## Sleep.QualityCatMedium:Stress.LevelCatMedium	-2.133	0.03301 *
## Sleep.QualityCatHigh:Stress.LevelCatMedium	-0.585	0.55884

```

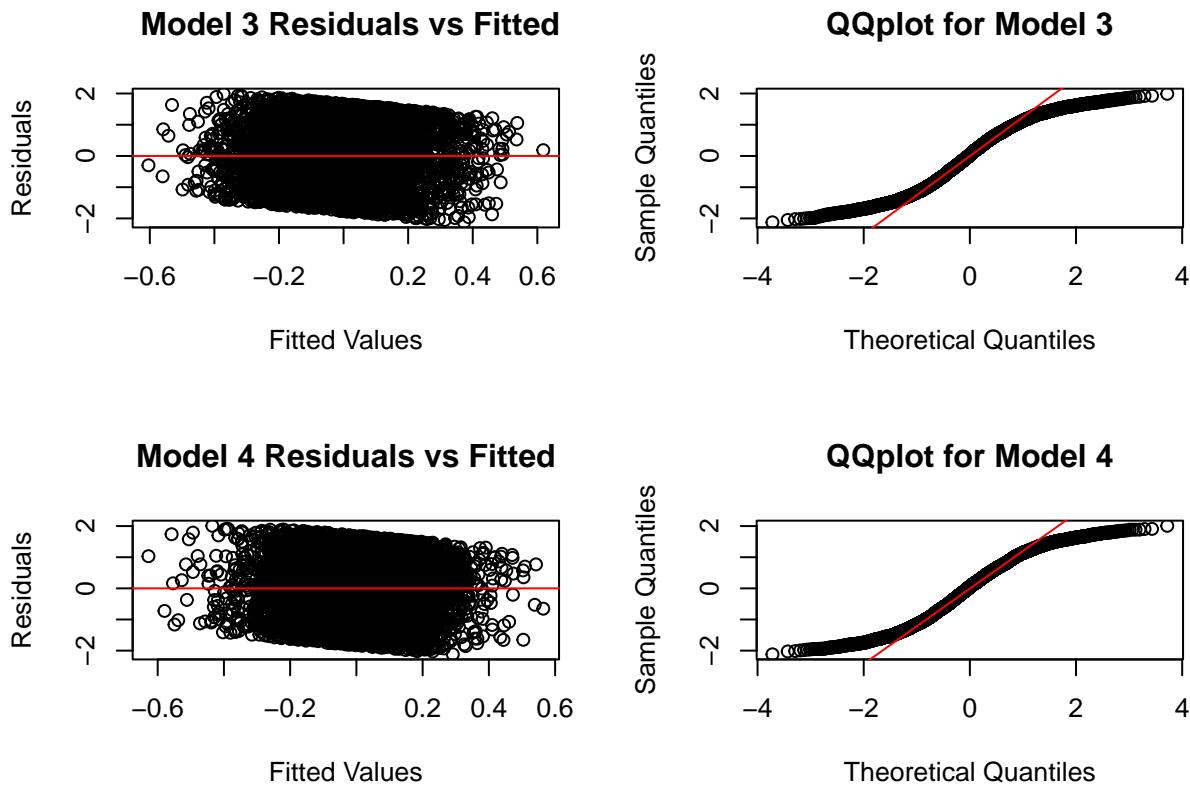
## Sleep.QualityCatMedium:Stress.LevelCatHigh           -0.888  0.37457
## Sleep.QualityCatHigh:Stress.LevelCatHigh          0.109  0.91358
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium   1.000  0.31756
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium     -1.595  0.11082
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh     -0.295  0.76832
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh       -0.780  0.43564
## Productivity.ScoreCatMedium:Stress.LevelCatMedium -0.297  0.76667
## Productivity.ScoreCatHigh:Stress.LevelCatMedium   -0.069  0.94521
## Productivity.ScoreCatMedium:Stress.LevelCatHigh    -0.103  0.91794
## Productivity.ScoreCatHigh:Stress.LevelCatHigh      0.964  0.33519
## Mood.ScoreCatMedium:Stress.LevelCatMedium         -0.186  0.85210
## Mood.ScoreCatHigh:Stress.LevelCatMedium          -0.812  0.41692
## Mood.ScoreCatMedium:Stress.LevelCatHigh          -0.251  0.80178
## Mood.ScoreCatHigh:Stress.LevelCatHigh            -2.160  0.03086 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9989 on 4884 degrees of freedom
## Multiple R-squared:  0.02521,   Adjusted R-squared:  0.002252
## F-statistic: 1.098 on 115 and 4884 DF,  p-value: 0.2254

par(mfrow = c(2,2))

plot(fitted(model3), residuals(model3),
      main = " Model 3 Residuals vs Fitted",
      xlab = "Fitted Values",
      ylab = "Residuals")
abline(h = 0, col = 'red')
qqnorm(residuals(model3), main = "QQplot for Model 3")
qqline(residuals(model3), col = 'red')

plot(fitted(model4), residuals(model4),
      main = "Model 4 Residuals vs Fitted",
      xlab = "Fitted Values",
      ylab = "Residuals")
abline(h = 0, col = 'red')
qqnorm(residuals(model4), main = "QQplot for Model 4")
qqline(residuals(model4), col = 'red')

```



```

model5 <- lm(bn_sleep ~ (Age + Gender + Exercise..mins.day. + Caffeine.Intake..mg. +
                           Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. + Sleep.QualityCat +
                           Productivity.ScoreCat + Mood.ScoreCat + Stress.LevelCat)^2, data = sleep)
model6 <- lm(bn_work_hours ~ (Age + Gender + Exercise..mins.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 = sleep)

summary(model5)

##
## Call:
## lm(formula = bn_sleep ~ (Age + Gender + Exercise..mins.day. +
##     Caffeine.Intake..mg. + Screen.Time.Before.Bed..mins. + Work.Hours..hrs.day. +
##     Sleep.QualityCat + Productivity.ScoreCat + Mood.ScoreCat +
##     Stress.LevelCat)^2, data = sleep)
## 
## Residuals:
##      Min        1Q    Median        3Q       Max 
## -3.3414 -0.6721  0.0065  0.6615  3.4248 
## 
## Coefficients:
##             Estimate Std. Error
## (Intercept) -1.589e-01  4.102e-01
## Age          2.977e-03  6.848e-03

```

## GenderMale	5.562e-02	2.229e-01
## GenderOther	-5.298e-02	2.294e-01
## Exercise..mins.day.	1.281e-03	3.535e-03
## Caffeine.Intake..mg.	-1.376e-03	1.063e-03
## Screen.Time.Before.Bed..mins.	7.009e-05	1.719e-03
## Work.Hours..hrs.day.	2.300e-02	3.469e-02
## Sleep.QualityCatMedium	-2.893e-02	2.197e-01
## Sleep.QualityCatHigh	2.966e-01	2.347e-01
## Productivity.ScoreCatMedium	1.037e-01	2.283e-01
## Productivity.ScoreCatHigh	2.512e-01	2.362e-01
## Mood.ScoreCatMedium	-4.093e-03	2.189e-01
## Mood.ScoreCatHigh	-2.766e-02	2.424e-01
## Stress.LevelCatMedium	-2.848e-02	2.226e-01
## Stress.LevelCatHigh	9.539e-02	2.310e-01
## Age:GenderMale	-2.062e-03	2.822e-03
## Age:GenderOther	9.953e-04	2.873e-03
## Age:Exercise..mins.day.	-9.964e-06	4.528e-05
## Age:Caffeine.Intake..mg.	1.681e-06	1.357e-05
## Age:Screen.Time.Before.Bed..mins.	6.905e-06	2.221e-05
## Age:Work.Hours..hrs.day.	-5.463e-04	5.135e-04
## Age:Sleep.QualityCatMedium	1.984e-03	2.808e-03
## Age:Sleep.QualityCatHigh	-4.441e-03	2.990e-03
## Age:Productivity.ScoreCatMedium	-4.491e-04	2.869e-03
## Age:Productivity.ScoreCatHigh	-8.276e-04	2.979e-03
## Age:Mood.ScoreCatMedium	6.227e-05	2.757e-03
## Age:Mood.ScoreCatHigh	8.535e-04	3.006e-03
## Age:Stress.LevelCatMedium	2.448e-03	2.826e-03
## Age:Stress.LevelCatHigh	5.740e-04	2.962e-03
## GenderMale:Exercise..mins.day.	-1.159e-03	1.344e-03
## GenderOther:Exercise..mins.day.	6.821e-04	1.358e-03
## GenderMale:Caffeine.Intake..mg.	7.158e-04	4.028e-04
## GenderOther:Caffeine.Intake..mg.	8.372e-04	4.084e-04
## GenderMale:Screen.Time.Before.Bed..mins.	7.365e-04	6.600e-04
## GenderOther:Screen.Time.Before.Bed..mins.	4.359e-04	6.787e-04
## GenderMale:Work.Hours..hrs.day.	5.469e-03	1.518e-02
## GenderOther:Work.Hours..hrs.day.	-2.079e-02	1.559e-02
## GenderMale:Sleep.QualityCatMedium	-1.397e-01	8.370e-02
## GenderOther:Sleep.QualityCatMedium	2.055e-02	8.510e-02
## GenderMale:Sleep.QualityCatHigh	-1.895e-01	8.978e-02
## GenderOther:Sleep.QualityCatHigh	2.382e-02	9.183e-02
## GenderMale:Productivity.ScoreCatMedium	2.791e-02	8.539e-02
## GenderOther:Productivity.ScoreCatMedium	-1.296e-03	8.704e-02
## GenderMale:Productivity.ScoreCatHigh	8.055e-02	8.901e-02
## GenderOther:Productivity.ScoreCatHigh	-8.791e-02	9.045e-02
## GenderMale:Mood.ScoreCatMedium	-8.711e-02	8.180e-02
## GenderOther:Mood.ScoreCatMedium	7.238e-02	8.360e-02
## GenderMale:Mood.ScoreCatHigh	-5.757e-02	9.059e-02
## GenderOther:Mood.ScoreCatHigh	5.954e-02	9.169e-02
## GenderMale:Stress.LevelCatMedium	-6.750e-02	8.422e-02
## GenderOther:Stress.LevelCatMedium	-1.388e-01	8.509e-02
## GenderMale:Stress.LevelCatHigh	3.983e-02	8.786e-02
## GenderOther:Stress.LevelCatHigh	-4.775e-02	9.044e-02
## Exercise..mins.day.:Caffeine.Intake..mg.	1.255e-05	6.546e-06
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-1.596e-06	1.064e-05

## Exercise..mins.day.:Work.Hours..hrs.day.	-1.426e-04	2.435e-04
## Exercise..mins.day.:Sleep.QualityCatMedium	1.122e-03	1.329e-03
## Exercise..mins.day.:Sleep.QualityCatHigh	1.492e-03	1.436e-03
## Exercise..mins.day.:Productivity.ScoreCatMedium	4.183e-04	1.355e-03
## Exercise..mins.day.:Productivity.ScoreCatHigh	-1.211e-03	1.421e-03
## Exercise..mins.day.:Mood.ScoreCatMedium	-2.303e-03	1.306e-03
## Exercise..mins.day.:Mood.ScoreCatHigh	-1.817e-03	1.427e-03
## Exercise..mins.day.:Stress.LevelCatMedium	-1.304e-04	1.350e-03
## Exercise..mins.day.:Stress.LevelCatHigh	5.536e-04	1.423e-03
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-2.755e-06	3.182e-06
## Caffeine.Intake..mg.:Work.Hours..hrs.day.	-5.510e-05	7.311e-05
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	-1.054e-04	4.023e-04
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	7.945e-04	4.304e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	4.497e-04	4.093e-04
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	4.189e-04	4.284e-04
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	7.364e-04	3.989e-04
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	1.241e-04	4.313e-04
## Caffeine.Intake..mg.:Stress.LevelCatMedium	7.273e-04	4.042e-04
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-1.355e-05	4.300e-04
## Screen.Time.Before.Bed..mins.:Work.Hours..hrs.day.	1.276e-04	1.198e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	1.029e-03	6.592e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-3.710e-04	7.108e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-1.074e-03	6.674e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	-4.943e-04	6.990e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	-1.025e-03	6.509e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	-5.624e-04	7.134e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	-8.109e-04	6.669e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-5.847e-04	7.062e-04
## Work.Hours..hrs.day.:Sleep.QualityCatMedium	-2.406e-02	1.524e-02
## Work.Hours..hrs.day.:Sleep.QualityCatHigh	-2.604e-02	1.644e-02
## Work.Hours..hrs.day.:Productivity.ScoreCatMedium	-8.640e-04	1.560e-02
## Work.Hours..hrs.day.:Productivity.ScoreCatHigh	-1.509e-03	1.617e-02
## Work.Hours..hrs.day.:Mood.ScoreCatMedium	2.988e-02	1.487e-02
## Work.Hours..hrs.day.:Mood.ScoreCatHigh	1.785e-02	1.627e-02
## Work.Hours..hrs.day.:Stress.LevelCatMedium	-8.094e-03	1.519e-02
## Work.Hours..hrs.day.:Stress.LevelCatHigh	3.011e-03	1.603e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-4.532e-02	8.504e-02
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-2.904e-02	9.115e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	3.330e-02	8.943e-02
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	1.016e-01	9.503e-02
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	-8.713e-02	8.178e-02
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	-7.513e-02	8.824e-02
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	2.174e-01	8.932e-02
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	3.900e-02	9.599e-02
## Sleep.QualityCatMedium:Stress.LevelCatMedium	7.228e-02	8.391e-02
## Sleep.QualityCatHigh:Stress.LevelCatMedium	3.386e-02	9.064e-02
## Sleep.QualityCatMedium:Stress.LevelCatHigh	1.426e-01	8.802e-02
## Sleep.QualityCatHigh:Stress.LevelCatHigh	-1.989e-02	9.480e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium	4.250e-02	8.347e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium	-1.485e-01	8.734e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh	-9.162e-02	9.212e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh	-2.268e-01	9.567e-02
## Productivity.ScoreCatMedium:Stress.LevelCatMedium	-7.519e-02	8.520e-02
## Productivity.ScoreCatHigh:Stress.LevelCatMedium	-1.185e-01	8.924e-02

```

## Productivity.ScoreCatMedium:Stress.LevelCatHigh      -1.265e-01  9.026e-02
## Productivity.ScoreCatHigh:Stress.LevelCatHigh      -8.240e-02  9.345e-02
## Mood.ScoreCatMedium:Stress.LevelCatMedium         7.548e-02  8.213e-02
## Mood.ScoreCatHigh:Stress.LevelCatMedium           2.395e-02  8.982e-02
## Mood.ScoreCatMedium:Stress.LevelCatHigh          -9.020e-02  8.682e-02
## Mood.ScoreCatHigh:Stress.LevelCatHigh            -1.721e-01  9.571e-02
##
## (Intercept)                                     t value Pr(>|t|)
## Age                                              -0.387   0.6985
## GenderMale                                      0.435   0.6638
## GenderOther                                      0.249   0.8030
## Exercise..mins.day.                            -0.231   0.8173
## Caffeine.Intake..mg.                           0.362   0.7170
## Screen.Time.Before.Bed..mins.                  -1.294   0.1956
## Work.Hours..hrs.day.                          0.041   0.9675
## Sleep.QualityCatMedium                        0.663   0.5073
## Sleep.QualityCatHigh                         -0.132   0.8953
## Productivity.ScoreCatMedium                   1.264   0.2064
## Productivity.ScoreCatHigh                     0.454   0.6497
## Mood.ScoreCatMedium                           1.063   0.2877
## Mood.ScoreCatHigh                            -0.019   0.9851
## Stress.LevelCatMedium                        -0.114   0.9092
## Stress.LevelCatHigh                          -0.128   0.8982
## Stress.LevelCatHigh                           0.413   0.6797
## Age:GenderMale                                -0.731   0.4649
## Age:GenderOther                                0.346   0.7290
## Age:Exercise..mins.day.                      -0.220   0.8258
## Age:Caffeine.Intake..mg.                      0.124   0.9014
## Age:Screen.Time.Before.Bed..mins.             0.311   0.7559
## Age:Work.Hours..hrs.day.                      -1.064   0.2875
## Age:Sleep.QualityCatMedium                  0.707   0.4799
## Age:Sleep.QualityCatHigh                     -1.485   0.1375
## Age:Productivity.ScoreCatMedium              -0.157   0.8756
## Age:Productivity.ScoreCatHigh                -0.278   0.7812
## Age:Mood.ScoreCatMedium                      0.023   0.9820
## Age:Mood.ScoreCatHigh                        0.284   0.7765
## Age:Stress.LevelCatMedium                   0.866   0.3864
## Age:Stress.LevelCatHigh                      0.194   0.8463
## GenderMale:Exercise..mins.day.               -0.862   0.3885
## GenderOther:Exercise..mins.day.              0.502   0.6154
## GenderMale:Caffeine.Intake..mg.              1.777   0.0756 .
## GenderOther:Caffeine.Intake..mg.              2.050   0.0404 *
## GenderMale:Screen.Time.Before.Bed..mins.    1.116   0.2645
## GenderOther:Screen.Time.Before.Bed..mins.    0.642   0.5207
## GenderMale:Work.Hours..hrs.day.              0.360   0.7187
## GenderOther:Work.Hours..hrs.day.              -1.333   0.1825
## GenderMale:Sleep.QualityCatMedium           -1.669   0.0952 .
## GenderOther:Sleep.QualityCatMedium          0.241   0.8092
## GenderMale:Sleep.QualityCatHigh             -2.111   0.0349 *
## GenderOther:Sleep.QualityCatHigh            0.259   0.7953
## GenderMale:Productivity.ScoreCatMedium     0.327   0.7438
## GenderOther:Productivity.ScoreCatMedium    -0.015   0.9881
## GenderMale:Productivity.ScoreCatHigh       0.905   0.3655
## GenderOther:Productivity.ScoreCatHigh      -0.972   0.3311
## GenderMale:Mood.ScoreCatMedium             -1.065   0.2870

```

## GenderOther:Mood.ScoreCatMedium	0.866	0.3867
## GenderMale:Mood.ScoreCatHigh	-0.635	0.5251
## GenderOther:Mood.ScoreCatHigh	0.649	0.5161
## GenderMale:Stress.LevelCatMedium	-0.802	0.4229
## GenderOther:Stress.LevelCatMedium	-1.631	0.1030
## GenderMale:Stress.LevelCatHigh	0.453	0.6503
## GenderOther:Stress.LevelCatHigh	-0.528	0.5976
## Exercise..mins.day.:Caffeine.Intake..mg.	1.916	0.0554 .
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	-0.150	0.8808
## Exercise..mins.day.:Work.Hours..hrs.day.	-0.585	0.5582
## Exercise..mins.day.:Sleep.QualityCatMedium	0.844	0.3988
## Exercise..mins.day.:Sleep.QualityCatHigh	1.039	0.2987
## Exercise..mins.day.:Productivity.ScoreCatMedium	0.309	0.7575
## Exercise..mins.day.:Productivity.ScoreCatHigh	-0.852	0.3943
## Exercise..mins.day.:Mood.ScoreCatMedium	-1.763	0.0780 .
## Exercise..mins.day.:Mood.ScoreCatHigh	-1.273	0.2029
## Exercise..mins.day.:Stress.LevelCatMedium	-0.097	0.9231
## Exercise..mins.day.:Stress.LevelCatHigh	0.389	0.6973
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-0.866	0.3866
## Caffeine.Intake..mg.:Work.Hours..hrs.day.	-0.754	0.4512
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	-0.262	0.7933
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	1.846	0.0649 .
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	1.099	0.2720
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	0.978	0.3282
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	1.846	0.0650 .
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	0.288	0.7736
## Caffeine.Intake..mg.:Stress.LevelCatMedium	1.799	0.0720 .
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-0.032	0.9749
## Screen.Time.Before.Bed..mins.:Work.Hours..hrs.day.	1.065	0.2869
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	1.561	0.1187
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	-0.522	0.6017
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-1.610	0.1075
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	-0.707	0.4795
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	-1.575	0.1154
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	-0.788	0.4305
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	-1.216	0.2240
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	-0.828	0.4077
## Work.Hours..hrs.day.:Sleep.QualityCatMedium	-1.579	0.1143
## Work.Hours..hrs.day.:Sleep.QualityCatHigh	-1.584	0.1133
## Work.Hours..hrs.day.:Productivity.ScoreCatMedium	-0.055	0.9558
## Work.Hours..hrs.day.:Productivity.ScoreCatHigh	-0.093	0.9256
## Work.Hours..hrs.day.:Mood.ScoreCatMedium	2.010	0.0445 *
## Work.Hours..hrs.day.:Mood.ScoreCatHigh	1.097	0.2726
## Work.Hours..hrs.day.:Stress.LevelCatMedium	-0.533	0.5941
## Work.Hours..hrs.day.:Stress.LevelCatHigh	0.188	0.8510
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-0.533	0.5941
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-0.319	0.7501
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	0.372	0.7096
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	1.069	0.2850
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	-1.065	0.2868
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	-0.851	0.3945
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	2.434	0.0150 *
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	0.406	0.6846
## Sleep.QualityCatMedium:Stress.LevelCatMedium	0.861	0.3891

```

## Sleep.QualityCatHigh:Stress.LevelCatMedium          0.374  0.7087
## Sleep.QualityCatMedium:Stress.LevelCatHigh        1.620  0.1054
## Sleep.QualityCatHigh:Stress.LevelCatHigh         -0.210  0.8338
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium   0.509  0.6106
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium     -1.700  0.0891 .
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh     -0.995  0.3200
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh       -2.371  0.0178 *
## Productivity.ScoreCatMedium:Stress.LevelCatMedium -0.883  0.3775
## Productivity.ScoreCatHigh:Stress.LevelCatMedium   -1.328  0.1843
## Productivity.ScoreCatMedium:Stress.LevelCatHigh   -1.401  0.1612
## Productivity.ScoreCatHigh:Stress.LevelCatHigh     -0.882  0.3779
## Mood.ScoreCatMedium:Stress.LevelCatMedium         0.919  0.3581
## Mood.ScoreCatHigh:Stress.LevelCatMedium           0.267  0.7897
## Mood.ScoreCatMedium:Stress.LevelCatHigh          -1.039  0.2989
## Mood.ScoreCatHigh:Stress.LevelCatHigh            -1.798  0.0722 .

## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.9963 on 4884 degrees of freedom
## Multiple R-squared:  0.02863,    Adjusted R-squared:  0.005763
## F-statistic: 1.252 on 115 and 4884 DF,  p-value: 0.0369

```

```
summary(model6)
```

```

##
## Call:
## lm(formula = bn_work_hours ~ (Age + Gender + Exercise..mins.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 = sleep)
##
## Residuals:
##      Min        1Q        Median        3Q        Max 
## -1.64922 -0.12357 -0.00051  0.12443  1.62513 
##
## Coefficients:
## (Intercept)               Estimate Std. Error
## Age                      -4.717e+00  4.438e-01
## GenderMale                -1.610e-03  4.930e-03
## GenderOther                3.510e-01  1.510e-01
## Exercise..mins.day.       1.673e-01  1.523e-01
## Sleep.Start.Time          1.764e-03  2.404e-03
## Caffeine.Intake..mg.      1.494e-02  1.953e-02
## Screen.Time.Before.Bed..mins. 9.786e-04  7.279e-04
## Total.Sleep.Hours         1.067e-05  1.184e-03
## Sleep.QualityCatMedium   6.372e-01  4.173e-02
## Sleep.QualityCatHigh     -2.628e-01  1.483e-01
## Productivity.ScoreCatMedium -2.180e-03  1.613e-01
## Productivity.ScoreCatHigh  5.635e-02  1.513e-01
## Mood.ScoreCatMedium       6.417e-03  1.466e-01
## Mood.ScoreCatHigh         3.554e-02  1.594e-01
## Stress.LevelCatMedium    -3.219e-01  1.510e-01
## Stress.LevelCatHigh      -2.837e-01  1.583e-01

```

## Age:GenderMale	5.514e-05	6.050e-04
## Age:GenderOther	4.753e-04	6.148e-04
## Age:Exercise..mins.day.	6.421e-07	9.713e-06
## Age:Sleep.Start.Time	-7.511e-05	2.123e-04
## Age:Caffeine.Intake..mg.	1.339e-06	2.907e-06
## Age:Screen.Time.Before.Bed..mins.	-1.318e-06	4.759e-06
## Age:Total.Sleep.Hours	3.384e-04	1.697e-04
## Age:Sleep.QualityCatMedium	-1.846e-04	6.001e-04
## Age:Sleep.QualityCatHigh	-7.562e-04	6.406e-04
## Age:Productivity.ScoreCatMedium	-1.833e-04	6.138e-04
## Age:Productivity.ScoreCatHigh	-2.328e-04	6.381e-04
## Age:Mood.ScoreCatMedium	1.081e-03	5.905e-04
## Age:Mood.ScoreCatHigh	9.145e-04	6.445e-04
## Age:Stress.LevelCatMedium	4.179e-04	6.068e-04
## Age:Stress.LevelCatHigh	-1.829e-04	6.343e-04
## GenderMale:Exercise..mins.day.	1.673e-04	2.875e-04
## GenderOther:Exercise..mins.day.	-6.298e-06	2.911e-04
## GenderMale:Sleep.Start.Time	-1.492e-02	6.441e-03
## GenderOther:Sleep.Start.Time	-1.098e-02	6.514e-03
## GenderMale:Caffeine.Intake..mg.	-8.503e-05	8.637e-05
## GenderOther:Caffeine.Intake..mg.	2.118e-05	8.752e-05
## GenderMale:Screen.Time.Before.Bed..mins.	-2.733e-04	1.414e-04
## GenderOther:Screen.Time.Before.Bed..mins.	9.871e-05	1.453e-04
## GenderMale:Total.Sleep.Hours	3.208e-03	5.109e-03
## GenderOther:Total.Sleep.Hours	6.264e-04	5.199e-03
## GenderMale:Sleep.QualityCatMedium	-2.946e-03	1.795e-02
## GenderOther:Sleep.QualityCatMedium	-8.605e-03	1.822e-02
## GenderMale:Sleep.QualityCatHigh	-3.279e-02	1.924e-02
## GenderOther:Sleep.QualityCatHigh	-1.187e-02	1.965e-02
## GenderMale:Productivity.ScoreCatMedium	-1.236e-02	1.825e-02
## GenderOther:Productivity.ScoreCatMedium	1.611e-02	1.863e-02
## GenderMale:Productivity.ScoreCatHigh	-1.630e-02	1.908e-02
## GenderOther:Productivity.ScoreCatHigh	8.470e-04	1.935e-02
## GenderMale:Mood.ScoreCatMedium	-6.552e-03	1.752e-02
## GenderOther:Mood.ScoreCatMedium	2.713e-02	1.792e-02
## GenderMale:Mood.ScoreCatHigh	-1.589e-02	1.939e-02
## GenderOther:Mood.ScoreCatHigh	6.764e-03	1.967e-02
## GenderMale:Stress.LevelCatMedium	1.790e-03	1.805e-02
## GenderOther:Stress.LevelCatMedium	1.187e-02	1.822e-02
## GenderMale:Stress.LevelCatHigh	4.142e-03	1.884e-02
## GenderOther:Stress.LevelCatHigh	1.214e-02	1.937e-02
## Exercise..mins.day.:Sleep.Start.Time	-7.928e-05	1.020e-04
## Exercise..mins.day.:Caffeine.Intake..mg.	3.400e-07	1.404e-06
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	2.204e-06	2.281e-06
## Exercise..mins.day.:Total.Sleep.Hours	-6.969e-05	8.177e-05
## Exercise..mins.day.:Sleep.QualityCatMedium	2.823e-04	2.845e-04
## Exercise..mins.day.:Sleep.QualityCatHigh	3.467e-04	3.075e-04
## Exercise..mins.day.:Productivity.ScoreCatMedium	-4.146e-05	2.899e-04
## Exercise..mins.day.:Productivity.ScoreCatHigh	-8.869e-05	3.044e-04
## Exercise..mins.day.:Mood.ScoreCatMedium	1.602e-04	2.805e-04
## Exercise..mins.day.:Mood.ScoreCatHigh	1.050e-04	3.061e-04
## Exercise..mins.day.:Stress.LevelCatMedium	-1.614e-04	2.892e-04
## Exercise..mins.day.:Stress.LevelCatHigh	5.793e-06	3.045e-04
## Sleep.Start.Time:Caffeine.Intake..mg.	-5.518e-05	3.110e-05

## Sleep.Start.Time:Screen.Time.Before.Bed..mins.	-2.839e-05	5.078e-05
## Sleep.Start.Time:Total.Sleep.Hours	-3.786e-05	1.824e-03
## Sleep.Start.Time:Sleep.QualityCatMedium	1.102e-02	6.363e-03
## Sleep.Start.Time:Sleep.QualityCatHigh	4.415e-03	6.815e-03
## Sleep.Start.Time:Productivity.ScoreCatMedium	2.364e-03	6.467e-03
## Sleep.Start.Time:Productivity.ScoreCatHigh	-3.150e-03	6.785e-03
## Sleep.Start.Time:Mood.ScoreCatMedium	-6.410e-04	6.253e-03
## Sleep.Start.Time:Mood.ScoreCatHigh	-6.271e-03	6.851e-03
## Sleep.Start.Time:Stress.LevelCatMedium	1.245e-02	6.422e-03
## Sleep.Start.Time:Stress.LevelCatHigh	1.117e-02	6.743e-03
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-1.452e-06	6.819e-07
## Caffeine.Intake..mg.:Total.Sleep.Hours	4.126e-05	2.496e-05
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	-4.434e-05	8.611e-05
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	-3.522e-05	9.218e-05
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	-9.133e-05	8.756e-05
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	-2.674e-05	9.154e-05
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	1.032e-04	8.551e-05
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	-1.379e-05	9.232e-05
## Caffeine.Intake..mg.:Stress.LevelCatMedium	6.021e-05	8.669e-05
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-3.121e-05	9.212e-05
## Screen.Time.Before.Bed..mins.:Total.Sleep.Hours	1.033e-04	3.994e-05
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	6.378e-05	1.413e-04
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	7.989e-05	1.524e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-1.131e-04	1.431e-04
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	-7.225e-05	1.497e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	-2.357e-04	1.394e-04
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	8.140e-05	1.528e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	1.110e-04	1.432e-04
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	1.067e-04	1.516e-04
## Total.Sleep.Hours:Sleep.QualityCatMedium	2.651e-03	5.082e-03
## Total.Sleep.Hours:Sleep.QualityCatHigh	-1.025e-02	5.484e-03
## Total.Sleep.Hours:Productivity.ScoreCatMedium	1.107e-02	5.128e-03
## Total.Sleep.Hours:Productivity.ScoreCatHigh	4.500e-03	5.439e-03
## Total.Sleep.Hours:Mood.ScoreCatMedium	-3.115e-03	5.011e-03
## Total.Sleep.Hours:Mood.ScoreCatHigh	9.489e-03	5.487e-03
## Total.Sleep.Hours:Stress.LevelCatMedium	1.747e-03	5.084e-03
## Total.Sleep.Hours:Stress.LevelCatHigh	4.793e-03	5.412e-03
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium	-2.487e-03	1.820e-02
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium	-6.458e-03	1.950e-02
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh	-1.080e-03	1.916e-02
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh	1.162e-02	2.034e-02
## Sleep.QualityCatMedium:Mood.ScoreCatMedium	-1.810e-02	1.751e-02
## Sleep.QualityCatHigh:Mood.ScoreCatMedium	-2.638e-03	1.889e-02
## Sleep.QualityCatMedium:Mood.ScoreCatHigh	1.407e-02	1.916e-02
## Sleep.QualityCatHigh:Mood.ScoreCatHigh	-1.645e-02	2.057e-02
## Sleep.QualityCatMedium:Stress.LevelCatMedium	1.148e-02	1.796e-02
## Sleep.QualityCatHigh:Stress.LevelCatMedium	1.216e-02	1.939e-02
## Sleep.QualityCatMedium:Stress.LevelCatHigh	1.538e-02	1.890e-02
## Sleep.QualityCatHigh:Stress.LevelCatHigh	2.710e-03	2.033e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium	-1.339e-02	1.788e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium	-8.598e-03	1.873e-02
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh	-1.048e-02	1.977e-02
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh	-7.510e-03	2.052e-02
## Productivity.ScoreCatMedium:Stress.LevelCatMedium	-3.598e-03	1.824e-02

```

## Productivity.ScoreCatHigh:Stress.LevelCatMedium      1.942e-04  1.913e-02
## Productivity.ScoreCatMedium:Stress.LevelCatHigh     -2.145e-03  1.935e-02
## Productivity.ScoreCatHigh:Stress.LevelCatHigh       1.288e-02  2.002e-02
## Mood.ScoreCatMedium:Stress.LevelCatMedium          2.479e-03  1.763e-02
## Mood.ScoreCatHigh:Stress.LevelCatMedium            -1.009e-02  1.925e-02
## Mood.ScoreCatMedium:Stress.LevelCatHigh             -1.807e-02  1.860e-02
## Mood.ScoreCatHigh:Stress.LevelCatHigh              -1.917e-02  2.049e-02
##
t value Pr(>|t|)

## (Intercept)           -10.629 < 2e-16 ***
## Age                   -0.327  0.74394
## GenderMale             2.325  0.02013 *
## GenderOther             1.099  0.27201
## Exercise..mins.day.    0.734  0.46320
## Sleep.Start.Time.      0.765  0.44427
## Caffeine.Intake..mg.   1.344  0.17888
## Screen.Time.Before.Bed..mins. 0.009  0.99281
## Total.Sleep.Hours.     15.271 < 2e-16 ***
## Sleep.QualityCatMedium -1.773  0.07635 .
## Sleep.QualityCatHigh   -0.014  0.98922
## Productivity.ScoreCatMedium -0.596  0.55133
## Productivity.ScoreCatHigh  0.352  0.72489
## Mood.ScoreCatMedium.    0.044  0.96508
## Mood.ScoreCatHigh.      0.223  0.82357
## Stress.LevelCatMedium. -2.132  0.03305 *
## Stress.LevelCatHigh.    -1.792  0.07323 .
## Age:GenderMale.         0.091  0.92738
## Age:GenderOther.        0.773  0.43953
## Age:Exercise..mins.day. 0.066  0.94729
## Age:Sleep.Start.Time.   -0.354  0.72351
## Age:Caffeine.Intake..mg. 0.461  0.64501
## Age:Screen.Time.Before.Bed..mins. -0.277  0.78182
## Age:Total.Sleep.Hours.  1.994  0.04625 *
## Age:Sleep.QualityCatMedium -0.308  0.75840
## Age:Sleep.QualityCatHigh -1.180  0.23788
## Age:Productivity.ScoreCatMedium -0.299  0.76526
## Age:Productivity.ScoreCatHigh. -0.365  0.71529
## Age:Mood.ScoreCatMedium.  1.830  0.06734 .
## Age:Mood.ScoreCatHigh.   1.419  0.15596
## Age:Stress.LevelCatMedium. 0.689  0.49106
## Age:Stress.LevelCatHigh. -0.288  0.77307
## GenderMale:Exercise..mins.day.  0.582  0.56074
## GenderOther:Exercise..mins.day. -0.022  0.98274
## GenderMale:Sleep.Start.Time.    -2.317  0.02056 *
## GenderOther:Sleep.Start.Time.   -1.686  0.09189 .
## GenderMale:Caffeine.Intake..mg. -0.985  0.32488
## GenderOther:Caffeine.Intake..mg. 0.242  0.80879
## GenderMale:Screen.Time.Before.Bed..mins. -1.932  0.05338 .
## GenderOther:Screen.Time.Before.Bed..mins.  0.679  0.49694
## GenderMale:Total.Sleep.Hours.   0.628  0.53011
## GenderOther:Total.Sleep.Hours.  0.120  0.90411
## GenderMale:Sleep.QualityCatMedium -0.164  0.86962
## GenderOther:Sleep.QualityCatMedium -0.472  0.63682
## GenderMale:Sleep.QualityCatHigh. -1.704  0.08844 .
## GenderOther:Sleep.QualityCatHigh. -0.604  0.54576

```

## GenderMale:Productivity.ScoreCatMedium	-0.677	0.49842
## GenderOther:Productivity.ScoreCatMedium	0.864	0.38743
## GenderMale:Productivity.ScoreCatHigh	-0.855	0.39275
## GenderOther:Productivity.ScoreCatHigh	0.044	0.96509
## GenderMale:Mood.ScoreCatMedium	-0.374	0.70837
## GenderOther:Mood.ScoreCatMedium	1.514	0.13018
## GenderMale:Mood.ScoreCatHigh	-0.819	0.41275
## GenderOther:Mood.ScoreCatHigh	0.344	0.73091
## GenderMale:Stress.LevelCatMedium	0.099	0.92100
## GenderOther:Stress.LevelCatMedium	0.652	0.51470
## GenderMale:Stress.LevelCatHigh	0.220	0.82601
## GenderOther:Stress.LevelCatHigh	0.627	0.53061
## Exercise..mins.day.:Sleep.Start.Time	-0.777	0.43723
## Exercise..mins.day.:Caffeine.Intake..mg.	0.242	0.80864
## Exercise..mins.day.:Screen.Time.Before.Bed..mins.	0.966	0.33398
## Exercise..mins.day.:Total.Sleep.Hours	-0.852	0.39408
## Exercise..mins.day.:Sleep.QualityCatMedium	0.992	0.32105
## Exercise..mins.day.:Sleep.QualityCatHigh	1.127	0.25961
## Exercise..mins.day.:Productivity.ScoreCatMedium	-0.143	0.88631
## Exercise..mins.day.:Productivity.ScoreCatHigh	-0.291	0.77081
## Exercise..mins.day.:Mood.ScoreCatMedium	0.571	0.56797
## Exercise..mins.day.:Mood.ScoreCatHigh	0.343	0.73159
## Exercise..mins.day.:Stress.LevelCatMedium	-0.558	0.57672
## Exercise..mins.day.:Stress.LevelCatHigh	0.019	0.98482
## Sleep.Start.Time:Caffeine.Intake..mg.	-1.775	0.07604 .
## Sleep.Start.Time:Screen.Time.Before.Bed..mins.	-0.559	0.57605
## Sleep.Start.Time:Total.Sleep.Hours	-0.021	0.98344
## Sleep.Start.Time:Sleep.QualityCatMedium	1.732	0.08326 .
## Sleep.Start.Time:Sleep.QualityCatHigh	0.648	0.51711
## Sleep.Start.Time:Productivity.ScoreCatMedium	0.366	0.71475
## Sleep.Start.Time:Productivity.ScoreCatHigh	-0.464	0.64247
## Sleep.Start.Time:Mood.ScoreCatMedium	-0.103	0.91834
## Sleep.Start.Time:Mood.ScoreCatHigh	-0.915	0.36012
## Sleep.Start.Time:Stress.LevelCatMedium	1.938	0.05266 .
## Sleep.Start.Time:Stress.LevelCatHigh	1.657	0.09764 .
## Caffeine.Intake..mg.:Screen.Time.Before.Bed..mins.	-2.130	0.03324 *
## Caffeine.Intake..mg.:Total.Sleep.Hours	1.653	0.09836 .
## Caffeine.Intake..mg.:Sleep.QualityCatMedium	-0.515	0.60661
## Caffeine.Intake..mg.:Sleep.QualityCatHigh	-0.382	0.70244
## Caffeine.Intake..mg.:Productivity.ScoreCatMedium	-1.043	0.29696
## Caffeine.Intake..mg.:Productivity.ScoreCatHigh	-0.292	0.77017
## Caffeine.Intake..mg.:Mood.ScoreCatMedium	1.206	0.22770
## Caffeine.Intake..mg.:Mood.ScoreCatHigh	-0.149	0.88124
## Caffeine.Intake..mg.:Stress.LevelCatMedium	0.695	0.48734
## Caffeine.Intake..mg.:Stress.LevelCatHigh	-0.339	0.73480
## Screen.Time.Before.Bed..mins.:Total.Sleep.Hours	2.587	0.00971 **
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatMedium	0.451	0.65178
## Screen.Time.Before.Bed..mins.:Sleep.QualityCatHigh	0.524	0.60015
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatMedium	-0.790	0.42942
## Screen.Time.Before.Bed..mins.:Productivity.ScoreCatHigh	-0.483	0.62930
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatMedium	-1.692	0.09080 .
## Screen.Time.Before.Bed..mins.:Mood.ScoreCatHigh	0.533	0.59421
## Screen.Time.Before.Bed..mins.:Stress.LevelCatMedium	0.775	0.43832
## Screen.Time.Before.Bed..mins.:Stress.LevelCatHigh	0.704	0.48145

```

## Total.Sleep.Hours:Sleep.QualityCatMedium          0.522  0.60193
## Total.Sleep.Hours:Sleep.QualityCatHigh          -1.870  0.06158 .
## Total.Sleep.Hours:Productivity.ScoreCatMedium   2.160  0.03084 *
## Total.Sleep.Hours:Productivity.ScoreCatHigh     0.827  0.40804
## Total.Sleep.Hours:Mood.ScoreCatMedium          -0.622  0.53426
## Total.Sleep.Hours:Mood.ScoreCatHigh            1.729  0.08380 .
## Total.Sleep.Hours:Stress.LevelCatMedium        0.344  0.73118
## Total.Sleep.Hours:Stress.LevelCatHigh          0.886  0.37583
## Sleep.QualityCatMedium:Productivity.ScoreCatMedium -0.137  0.89131
## Sleep.QualityCatHigh:Productivity.ScoreCatMedium -0.331  0.74058
## Sleep.QualityCatMedium:Productivity.ScoreCatHigh -0.056  0.95503
## Sleep.QualityCatHigh:Productivity.ScoreCatHigh   0.571  0.56777
## Sleep.QualityCatMedium:Mood.ScoreCatMedium      -1.034  0.30122
## Sleep.QualityCatHigh:Mood.ScoreCatMedium        -0.140  0.88894
## Sleep.QualityCatMedium:Mood.ScoreCatHigh        0.735  0.46258
## Sleep.QualityCatHigh:Mood.ScoreCatHigh          -0.800  0.42390
## Sleep.QualityCatMedium:Stress.LevelCatMedium    0.639  0.52288
## Sleep.QualityCatHigh:Stress.LevelCatMedium      0.627  0.53050
## Sleep.QualityCatMedium:Stress.LevelCatHigh       0.814  0.41582
## Sleep.QualityCatHigh:Stress.LevelCatHigh         0.133  0.89396
## Productivity.ScoreCatMedium:Mood.ScoreCatMedium -0.748  0.45423
## Productivity.ScoreCatHigh:Mood.ScoreCatMedium    -0.459  0.64627
## Productivity.ScoreCatMedium:Mood.ScoreCatHigh    -0.530  0.59614
## Productivity.ScoreCatHigh:Mood.ScoreCatHigh      -0.366  0.71443
## Productivity.ScoreCatMedium:Stress.LevelCatMedium -0.197  0.84366
## Productivity.ScoreCatHigh:Stress.LevelCatMedium   0.010  0.99190
## Productivity.ScoreCatMedium:Stress.LevelCatHigh   -0.111  0.91171
## Productivity.ScoreCatHigh:Stress.LevelCatHigh     0.643  0.51993
## Mood.ScoreCatMedium:Stress.LevelCatMedium        0.141  0.88819
## Mood.ScoreCatHigh:Stress.LevelCatMedium          -0.524  0.60012
## Mood.ScoreCatMedium:Stress.LevelCatHigh          -0.972  0.33128
## Mood.ScoreCatHigh:Stress.LevelCatHigh            -0.936  0.34948
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2131 on 4868 degrees of freedom
## Multiple R-squared:  0.9557, Adjusted R-squared:  0.9545
## F-statistic: 801.7 on 131 and 4868 DF,  p-value: < 2.2e-16

```

```

par(mfrow = c(2,2))

plot(fitted(model5), residuals(model5),
      main = " Model 5 Residuals vs Fitted",
      xlab = "Fitted Values",
      ylab = "Residuals")
abline(h = 0, col = 'red')
qqnorm(residuals(model5), main = "QQplot for Model 5")
qqline(residuals(model5), col = 'red')

plot(fitted(model6), residuals(model6),
      main = "Model 6 Residuals vs Fitted",
      xlab = "Fitted Values",
      ylab = "Residuals")
abline(h = 0, col = 'red')

```

```
qqnorm(residuals(model6), main = "QQplot for Model 6")
qqline(residuals(model6), col = 'red')
```

