Homework 4

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```
setwd("/cloud/project")

sleepdata <- read.csv("Sleep_health_and_lifestyle_dataset.csv", header = TRUE)

attach(sleepdata)
#this will allows to name variables the way they are

names(sleepdata)
```

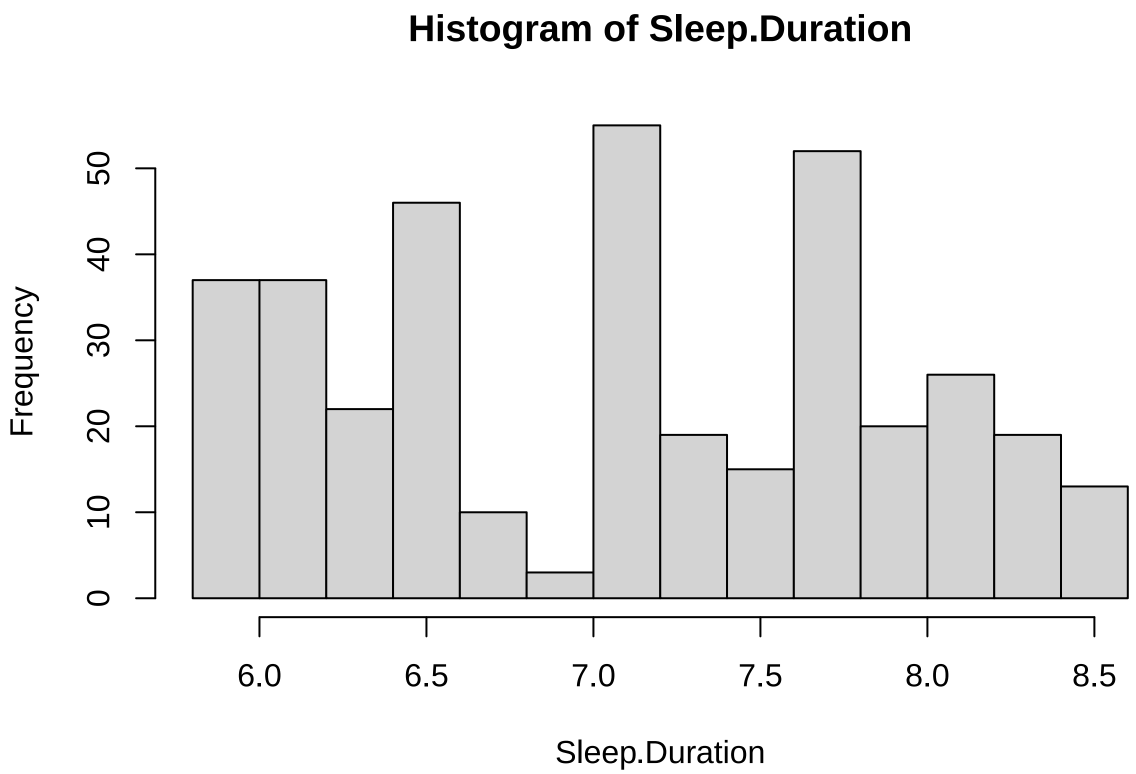
```
##  [1] "Person.ID"               "Gender"
##  [3] "Age"                     "Occupation"
##  [5] "Sleep.Duration"          "Quality.of.Sleep"
##  [7] "Physical.Activity.Level" "Stress.Level"
##  [9] "BMI.Category"            "Blood.Pressure"
## [11] "Heart.Rate"              "Daily.Steps"
## [13] "Sleep.Disorder"
```

```
#Ho: data is not normal; ha: data is normal type I error set to 0.05 reject null
#hypothesis that the outcome is not normal and conclude data is normal
shapiro.test(Sleep.Duration)
```

```
##
##  Shapiro-Wilk normality test
##
## data:  Sleep.Duration
## W = 0.93577, p-value = 1.268e-11
```

```
#Histogram of the outcome shows to be a bimodal distribution.
#This could be an indication that sleep duration might differ
#by a particular group - maybe gender.
#Given our large sample size of n=374 observations, by the
#central limit theorem, we can conclude normality approximation.
#P-value is normal

hist(Sleep.Duration)
```



```
#creates a new variable systolic extracting the first 3 digits of
#the bloodpressure

is.character(Blood.Pressure)
```

```
## [1] TRUE
```

```
sleepdata$systolic = substr(Blood.Pressure, 1, 3)

sleepdata$systolic = as.numeric(sleepdata$systolic)

sleepdata$diastolic = substr(Blood.Pressure, 5, 6)

sleepdata$diastolic = as.numeric(sleepdata$diastolic)

install.packages("leaps")

library(leaps)

#Now we run the regsubsets to find the best model

output <- regsubsets(Sleep.Duration ~ Gender + Age + Occupation + Quality.of.Sleep + Physical.Activity.
                       Stress.Level + BMI.Category + Heart.Rate + Daily.Steps +
                       Sleep.Disorder + systolic + diastolic, data=sleepdata, nvmax=12)

summOut1 <- summary(output)

summOut1
```

```
## Subset selection object
## Call: regsubsets.formula(Sleep.Duration ~ Gender + Age + Occupation +
##     Quality.of.Sleep + Physical.Activity.Level + Stress.Level +
##     BMI.Category + Heart.Rate + Daily.Steps + Sleep.Disorder +
##     systolic + diastolic, data = sleepdata, nvmax = 12)
## 24 Variables  (and intercept)
##                                Forced in Forced out
## GenderMale                         FALSE      FALSE
## Age                                FALSE      FALSE
## OccupationDoctor                   FALSE      FALSE
## OccupationEngineer                 FALSE      FALSE
## OccupationLawyer                   FALSE      FALSE
## OccupationManager                  FALSE      FALSE
## OccupationNurse                    FALSE      FALSE
## OccupationSales Representative     FALSE      FALSE
## OccupationSalesperson              FALSE      FALSE
## OccupationScientist                FALSE      FALSE
## OccupationSoftware Engineer        FALSE      FALSE
## OccupationTeacher                  FALSE      FALSE
## Quality.of.Sleep                   FALSE      FALSE
## Physical.Activity.Level            FALSE      FALSE
## Stress.Level                       FALSE      FALSE
## BMI.CategoryNormal Weight          FALSE      FALSE
## BMI.CategoryObese                  FALSE      FALSE
## BMI.CategoryOverweight             FALSE      FALSE
## Heart.Rate                         FALSE      FALSE
## Daily.Steps                        FALSE      FALSE
## Sleep.DisorderNone                 FALSE      FALSE
## Sleep.DisorderSleep Apnea          FALSE      FALSE
## systolic                           FALSE      FALSE
## diastolic                          FALSE      FALSE
## 1 subsets of each size up to 12
## Selection Algorithm: exhaustive
##           GenderMale Age OccupationDoctor OccupationEngineer OccupationLawyer
## 1  ( 1 )  " "        " " " "              " "                " "
## 2  ( 1 )  " "        " " "*"              " "                " "
## 3  ( 1 )  " "        " " "*"              "*"                " "
## 4  ( 1 )  " "        " " "*"              "*"                " "
## 5  ( 1 )  " "        " " "*"              "*"                " "
## 6  ( 1 )  " "        " " "*"              "*"                " "
## 7  ( 1 )  " "        " " "*"              "*"                " "
## 8  ( 1 )  " "        " " "*"              "*"                "*"
## 9  ( 1 )  " "        " " "*"              "*"                "*"
## 10  ( 1 ) " "        " " "*"              "*"                "*"
## 11  ( 1 ) " "        " " "*"              "*"                "*"
## 12  ( 1 ) " "        "*" "*"              "*"                "*"
##           OccupationManager OccupationNurse OccupationSales Representative
## 1  ( 1 )  " "               " "             " "
## 2  ( 1 )  " "               " "             " "
## 3  ( 1 )  " "               " "             " "
## 4  ( 1 )  " "               " "             " "
## 5  ( 1 )  " "               " "             " "
## 6  ( 1 )  " "               " "             " "
## 7  ( 1 )  " "               " "             " "
## 8  ( 1 )  " "               " "             " "
## 9  ( 1 )  " "               " "             " "
## 10  ( 1 ) " "               " "             "*"
## 11  ( 1 ) " "               " "             "*"
## 12  ( 1 ) " "               " "             "*"
##           OccupationSalesperson OccupationScientist OccupationSoftware Engineer
## 1  ( 1 )  " "                   " "                 " "
## 2  ( 1 )  " "                   " "                 " "
## 3  ( 1 )  " "                   " "                 " "
## 4  ( 1 )  " "                   " "                 " "
## 5  ( 1 )  " "                   " "                 " "
## 6  ( 1 )  " "                   " "                 " "
## 7  ( 1 )  "*"                   " "                 " "
## 8  ( 1 )  "*"                   " "                 " "
## 9  ( 1 )  "*"                   " "                 " "
## 10  ( 1 ) "*"                   " "                 " "
## 11  ( 1 ) "*"                   " "                 " "
## 12  ( 1 ) "*"                   " "                 " "
##           OccupationTeacher Quality.of.Sleep Physical.Activity.Level
## 1  ( 1 )  " "               "*"              " "
## 2  ( 1 )  " "               "*"              " "
## 3  ( 1 )  " "               "*"              " "
## 4  ( 1 )  " "               "*"              " "
## 5  ( 1 )  " "               "*"              "*"
## 6  ( 1 )  "*"               "*"              "*"
## 7  ( 1 )  " "               "*"              "*"
## 8  ( 1 )  " "               "*"              "*"
## 9  ( 1 )  " "               "*"              " "
## 10  ( 1 ) " "               "*"              "*"
## 11  ( 1 ) " "               "*"              " "
## 12  ( 1 ) " "               "*"              "*"
##           Stress.Level BMI.CategoryNormal Weight BMI.CategoryObese
## 1  ( 1 )  " "          " "                       " "
## 2  ( 1 )  " "          " "                       " "
## 3  ( 1 )  " "          " "                       " "
## 4  ( 1 )  " "          " "                       " "
## 5  ( 1 )  " "          " "                       " "
## 6  ( 1 )  "*"          " "                       " "
## 7  ( 1 )  "*"          " "                       " "
## 8  ( 1 )  "*"          " "                       " "
## 9  ( 1 )  "*"          " "                       " "
## 10  ( 1 ) "*"          " "                       "*"
## 11  ( 1 ) "*"          " "                       "*"
## 12  ( 1 ) "*"          " "                       " "
##           BMI.CategoryOverweight Heart.Rate Daily.Steps Sleep.DisorderNone
## 1  ( 1 )  " "                    " "        " "         " "
## 2  ( 1 )  " "                    " "        " "         " "
## 3  ( 1 )  " "                    " "        " "         " "
## 4  ( 1 )  " "                    "*"        " "         " "
## 5  ( 1 )  " "                    " "        "*"         " "
## 6  ( 1 )  " "                    " "        " "         " "
## 7  ( 1 )  " "                    "*"        " "         " "
## 8  ( 1 )  " "                    "*"        " "         " "
## 9  ( 1 )  " "                    "*"        " "         " "
## 10  ( 1 ) " "                    "*"        " "         " "
## 11  ( 1 ) " "                    "*"        " "         " "
## 12  ( 1 ) " "                    " "        "*"         " "
##           Sleep.DisorderSleep Apnea systolic diastolic
## 1  ( 1 )  " "                       " "      " "
## 2  ( 1 )  " "                       " "      " "
## 3  ( 1 )  " "                       " "      " "
## 4  ( 1 )  " "                       " "      " "
## 5  ( 1 )  " "                       " "      " "
## 6  ( 1 )  " "                       " "      " "
## 7  ( 1 )  " "                       " "      " "
## 8  ( 1 )  " "                       " "      " "
## 9  ( 1 )  " "                       "*"      "*"
## 10  ( 1 ) " "                       " "      " "
## 11  ( 1 ) " "                       "*"      "*"
## 12  ( 1 ) " "                       "*"      "*"
```

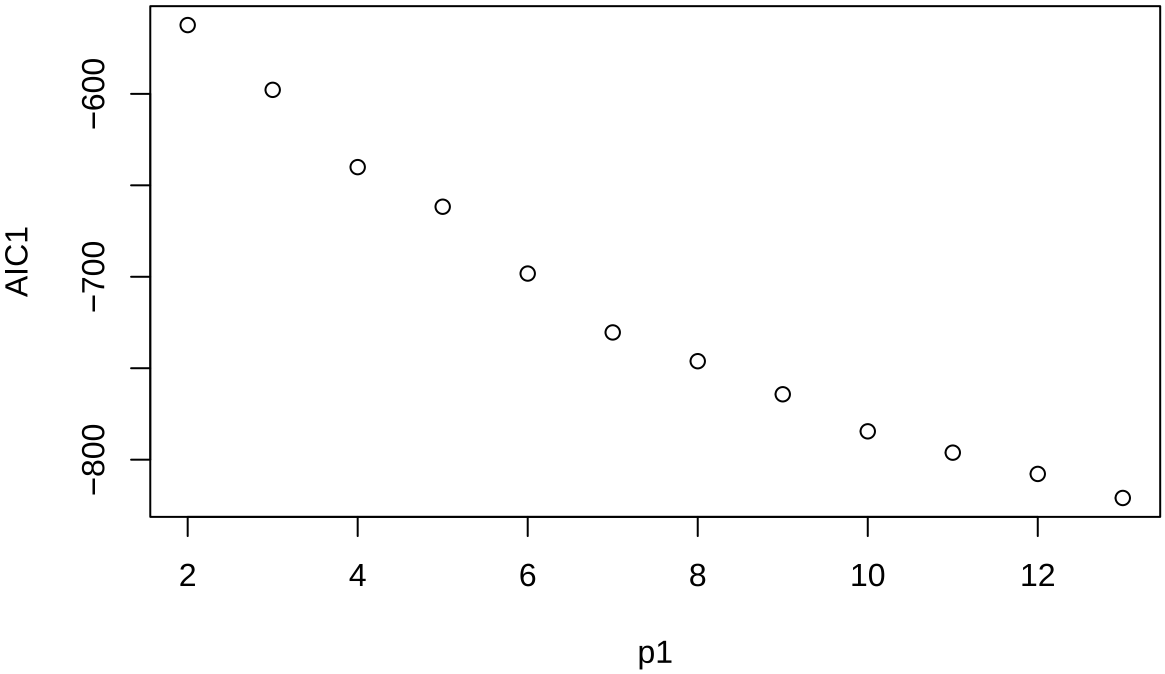
```r
n1 <- length(Sleep.Duration)
n1
```

```
## [1] 374
```

```r
p1 <- apply(summOut1$which, 1, sum)

aic1 <- summOut1$bic - log(n1) * p1 + 2 * p1

plot(p1, aic1, ylab = "AIC1")
```



```r
#best model is the one with all the predictors as it has the lowest AIC
model1 <- lm(Sleep.Duration ~ Gender + Age + Occupation + Quality.of.Sleep +
               Physical.Activity.Level +
               Stress.Level + BMI.Category + Heart.Rate + Daily.Steps +
               Sleep.Disorder + systolic + diastolic, data=sleepdata)

summary(model1)
```

```
##
## Call:
## lm(formula = Sleep.Duration ~ Gender + Age + Occupation + Quality.of.Sleep +
##     Physical.Activity.Level + Stress.Level + BMI.Category + Heart.Rate +
##     Daily.Steps + Sleep.Disorder + systolic + diastolic, data = sleepdata)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.71735 -0.14289 -0.03386  0.13013  0.97101
##
## Coefficients:
##                                 Estimate Std. Error t value Pr(>|t|)
## (Intercept)                     6.5255127  1.1566767   5.642 3.49e-08 ***
## GenderMale                     -0.0163363  0.0852287  -0.192 0.848107
## Age                             0.0274491  0.0065377   4.199 3.41e-05 ***
## OccupationDoctor                0.8323400  0.0861232   9.665  < 2e-16 ***
## OccupationEngineer              0.7772756  0.0867901   8.956  < 2e-16 ***
## OccupationLawyer                0.7294035  0.0989878   7.369 1.26e-12 ***
## OccupationManager               0.1027142  0.2601035   0.395 0.693160
## OccupationNurse                 0.2427417  0.1128672   2.151 0.032187 *
## OccupationSales Representative  1.4483922  0.2358399   6.141 2.23e-09 ***
## OccupationSalesperson           0.6357357  0.1080311   5.885 9.35e-09 ***
## OccupationScientist             0.4568531  0.1701922   2.684 0.007614 **
## OccupationSoftware Engineer     0.6326634  0.1507845   4.196 3.45e-05 ***
## OccupationTeacher               0.2883608  0.0883850   3.263 0.001213 **
## Quality.of.Sleep                0.2860928  0.0561463   5.095 5.71e-07 ***
## Physical.Activity.Level         0.0092998  0.0015524   5.991 5.20e-09 ***
## Stress.Level                   -0.1628751  0.0341770  -4.766 2.77e-06 ***
## BMI.CategoryNormal Weight      -0.0338319  0.0682966  -0.495 0.620653
## BMI.CategoryObese              -0.6002143  0.1938760  -3.096 0.002121 **
## BMI.CategoryOverweight         -0.3467385  0.1028555  -3.371 0.000832 ***
## Heart.Rate                      0.0332898  0.0101959   3.265 0.001203 **
## Daily.Steps                    -0.0001284  0.0000219  -5.863 1.05e-08 ***
## Sleep.DisorderNone             -0.1020383  0.0602559  -1.693 0.091268 .
## Sleep.DisorderSleep Apnea      -0.0549659  0.0674340  -0.815 0.415567
## systolic                       -0.1212507  0.0164668  -7.363 1.30e-12 ***
## diastolic                       0.1359929  0.0221031   6.153 2.09e-09 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.2442 on 349 degrees of freedom
## Multiple R-squared:  0.9119, Adjusted R-squared:  0.9058
## F-statistic: 150.4 on 24 and 349 DF,  p-value: < 2.2e-16
```

```
table(Occupation)
```

```
## Occupation
##           Accountant               Doctor             Engineer
##                   37                   71                   63
##               Lawyer              Manager                Nurse
##                   47                    1                   73
## Sales Representative          Salesperson            Scientist
##                    2                   32                    4
##    Software Engineer              Teacher
##                    4                   40
```

```r
table(BMI.Category)
```

```
## BMI.Category
##        Normal Normal Weight         Obese    Overweight 
##           195            21            10           148 
```

```r
table(Sleep.Disorder)
```

```
## Sleep.Disorder
##    Insomnia        None Sleep Apnea 
##          77         219          78 
```

```r
#interpretation of the significant variables from this model:
#Sleep duration increases significantly by 0.027 units for every unit
#increase in age, adjusting for everything else

#Sleep Duration increases significantly by 0.027 units for every unit
#increase in age, adjusting for everything else

#Sleep Duration increases significantly by 0.83 units for Doctors
# vs accountants, adjusting for everything else

#Sleep Duration increases significantly by 0.78 units for Engineers
# vs. Accountants, adjusting for everything else

#Sleep Duration increases significantly by 0.73 units for Lawyers
#vs Accountants, adjusting for everything else

#Sleep Duration increases significantly by 0.24 units for Nurses
#vs Accountants, adjusting for everything else

#Sleep Duration increases significantly by 1.45 units for Sales Reps
#vs Accountants, adjusting for everything else

#Sleep Duration increases significantly by 0.63 units for SalesPerson
#vs Accountants, adjusting for everything else

#Sleep Duration increases significantly by 0.46 units for Scientists
#vs Accountants, adjusting for everything else

#Sleep Duration increases significantly by 0.63 units for SoftwareEngineers
#vs Accountants, adjusting for everything else

#Sleep Duration increases significantly by 0.29 units for Teachers
#vs Accountants, adjusting for everything else

#Sleep Duration increases significantly by 0.29 units for every unit
#increase in quality of sleep score, adjusting for everything else

#Sleep Duration increases significantly by 0.009 units for every unit
#increase in physical activity level score, adjusting for everything else

#Sleep Duration decreases significantly by 0.16 units for every unit
#increase in stress level score, adjusting for everything else
```

```r
#Increase in daily steps, adjusting for everything else

#Sleep Duration decreases significantly by 0.121 units for every unit
#Increase in systolic reading, adjusting for everything else

#Sleep Duration increases significantly by 0.13 units for every unit
#increase in diastolic reading, adjusting for everything else

#we check for multicollinearity using vif and tolerance

install.packages("car")
library(car)

vif(model1)
```

```
##                                GVIF Df GVIF^(1/(2*Df))
## Gender                    11.386299  1        3.374359
## Age                       20.107382  1        4.484126
## Occupation              2933.052016 10        1.490617
## Quality.of.Sleep          28.246011  1        5.314698
## Physical.Activity.Level    6.539635  1        2.557271
## Stress.Level              23.003395  1        4.796185
## BMI.Category             110.831848  3        2.191681
## Heart.Rate                11.120014  1        3.334668
## Daily.Steps                7.851678  1        2.802085
## Sleep.Disorder            11.655508  2        1.847706
## systolic                 101.805454  1       10.089869
## diastolic                115.998380  1       10.770254
```

```r
#if the vif shows greater than 10, it means that there is such a strong
#relationship between the variables, like that these may be collinear
#If collinear, this will bias the results of the model from our results
#we see that systolic and diastolic might be collinear

#tolerance the inverse of vif; we run this as an extra check
1/vif(model1)
```

```
##                                 GVIF        Df GVIF^(1/(2*Df))
## Gender                  0.0878248485 1.0000000      0.29635257
## Age                     0.0497329793 1.0000000      0.22300892
## Occupation              0.0003409418 0.1000000      0.67086327
## Quality.of.Sleep        0.0354032289 1.0000000      0.18815746
## Physical.Activity.Level 0.1529137380 1.0000000      0.39104186
## Stress.Level            0.0434718439 1.0000000      0.20849903
## BMI.Category            0.0090226773 0.3333333      0.45627069
## Heart.Rate              0.0899279456 1.0000000      0.29987989
## Daily.Steps             0.1273613137 1.0000000      0.35687717
## Sleep.Disorder          0.0857963433 0.5000000      0.54121172
## systolic                0.0098226564 1.0000000      0.09910932
## diastolic               0.0086208100 1.0000000      0.09284832
```

```r
#With these results we look for the last column to be >0.10, if its less, than
#this means its collinear, the two variables are systolic and diastolic
```