```
> #HW12
> #The FACTORS data set is described in Exercise 3.68 (7th edition) and Exercise 9.31 (8th
edition) and is available here.
>
> #libraries needed
> library(faraway)
> library(psych)

Attaching package: 'psych'

The following object is masked from 'package:faraway':

    logit

The following objects are masked from 'package:ggplot2':

    %+%, alpha

The following objects are masked from 'package:epiDisplay':

    alpha, cs, lookup

> library(lmtest)
Loading required package: zoo

Attaching package: 'zoo'

The following objects are masked from 'package:base':

    as.Date, as.Date.numeric


Attaching package: 'lmtest'

The following object is masked from 'package:epiDisplay':

    lrtest

Warning message:
package 'zoo' was built under R version 3.6.3
>
> if (FALSE)
+ {"
+ a) Find the mean and variance of the dependent variable y= length of stay.
+ b) Plot LOS versus FACTORS
+ c) Fit a Poisson model of y (LOS) on the number of factors (FACTORS).
+ d) Determine whether the quadratic term FACTORS^2 should be added to the model.
+ e) What is the difference in the AICs between the model including only FACTORS in the model
with the model containing both FACTORS and FACTORS^2.
+
+ Submit the plot and output and responses to d) and e) into Canvas.
+
+ Perform Poisson regression for Ex9.31 page 523
+ x=number of FACTORS
+ y=length of stay
+ "}
>
> #read in the data which is in a csv file
> #change the directory below to your directory
> hw12 <-
read.csv(file="C:/Users/jmard/OneDrive/Desktop/RegressionMethodsSpring2020/Homework/FACTORS.csv",
header = TRUE)
>
> library(faraway)
> library(psych)
```

```
> library(lmtest)
>
> describe(hw12)
        vars  n    mean     sd median trimmed    mad min max range skew kurtosis    se
LOS        1 50    6.54   2.63      6    6.38   2.97   2  15    13 0.70     0.70  0.37
FACTORS    2 50  219.18 108.93    204  211.50 114.90  55 525   470 0.68    -0.14 15.41
>
> windows(7,7)
> #save graph(s) in pdf
>
pdf(file="C:/Users/jmard/OneDrive/Desktop/RegressionMethodsSpring2020/Homework/HW12_Figures.pdf")
>
> #first plot the data
> plot(LOS~FACTORS,data=hw12)
>
> hw12_analysis <- glm(LOS ~ FACTORS, family=poisson(link=log),data=hw12)
> summary(hw12_analysis)

Call:
glm(formula = LOS ~ FACTORS, family = poisson(link = log), data = hw12)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-1.76066  -0.65548  -0.05779   0.53674   2.01245

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) 1.3922337  0.1295925  10.743  < 2e-16 ***
FACTORS     0.0020937  0.0004776   4.384 1.16e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 51.030  on 49  degrees of freedom
Residual deviance: 32.641  on 48  degrees of freedom
AIC: 219.77

Number of Fisher Scoring iterations: 4

> hw12_analysis2 <- glm(LOS ~ FACTORS + I(FACTORS^2), family=poisson(link=log),data=hw12)
> lrtest(hw12_analysis,hw12_analysis2)
Likelihood ratio test

Model 1: LOS ~ FACTORS
Model 2: LOS ~ FACTORS + I(FACTORS^2)
  #Df  LogLik Df  Chisq Pr(>Chisq)
1   2 -107.89
2   3 -107.36  1 1.0571     0.3039
> summary(hw12_analysis2)

Call:
glm(formula = LOS ~ FACTORS + I(FACTORS^2), family = poisson(link = log),
    data = hw12)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.8172  -0.5890  -0.1303   0.4460   2.0093

Coefficients:
              Estimate Std. Error z value Pr(>|z|)
(Intercept)   1.162e+00  2.630e-01   4.417    1e-05 ***
FACTORS       4.153e-03  2.083e-03   1.993   0.0462 *
I(FACTORS^2) -3.756e-06  3.709e-06  -1.013   0.3112
---
```

Annotations:
- 2.63^2 = 6.92
- for Poisson mean=lambda variance=lambda
- HO: do not add Factors^2 to the model
- H1: add Factors^2 to the model.
- Wald's test

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 51.030  on 49  degrees of freedom
Residual deviance: 31.584  on 47  degrees of freedom
AIC: 220.71

Number of Fisher Scoring iterations: 4

>
> ##----------------------------------------------------------##
> dev.off()
null device
          1
>
```