Solution

Let x = NumMDs, y = NumBeds.

H\_0: beta\_1 = 0 (there is no relationship between the number of medical doctors and the number of hospital beds)

H\_a: beta\_1 != 0 (there is a relationship between the number of medical doctors and the number of hospital beds).

Test statistic: t=26.367

Degrees of freedom: 83 – 2 = 81

P-value: <2.2e-16 (approximately 0)

Conclusion: At a significance level of alpha=0.05, we find that there is sufficient evidence to reject the null in favor of the alternative, and conclude that there is indeed a relationship between the number of medical doctors and the number of hospital beds. Though, this relationship is nonlinear, due to the model being fit to the logged data:

log(y) = beta\_0 + beta\_1 \* log(x)

y = e^{beta\_0} \* x^{beta\_1}

Begin by reading in the data.

library(readr)

## Warning: package 'readr' was built under R version 4.1.2

data <- read\_csv("data.csv")

## Rows: 83 Columns: 16  
## ── Column specification ────────────────────────────────────────────────────────  
## Delimiter: ","  
## chr (1): City  
## dbl (15): NumMDs, RateMDs, NumHospitals, NumBeds, RateBeds, NumMedicare, Pct...  
##   
## ℹ Use `spec()` to retrieve the full column specification for this data.  
## ℹ Specify the column types or set `show\_col\_types = FALSE` to quiet this message.

attach(data)

Let x = NumMDs, y = NumBeds. Fit a linear model to the logged data (see hw4) and print the model summary.

model = lm(log(NumBeds)~log(NumMDs))  
summary(model)

##   
## Call:  
## lm(formula = log(NumBeds) ~ log(NumMDs))  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1.1239 -0.1822 0.0056 0.2153 0.6277   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 1.45967 0.20894 6.986 7.17e-10 \*\*\*  
## log(NumMDs) 0.79960 0.03033 26.367 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 0.3031 on 81 degrees of freedom  
## Multiple R-squared: 0.8956, Adjusted R-squared: 0.8944   
## F-statistic: 695.2 on 1 and 81 DF, p-value: < 2.2e-16

Let H\_0: beta\_1 = 0 (there is no relationship between the number of medical doctors and the number of hospital beds), and H\_a: beta\_1 != 0 (there is a relationship between the number of medical doctors and the number of hospital beds).

From the model summary, we obtain a test statistic of t=26.367, with 81 degrees of freedom. This corresponds to a p-value of <2.2e-16, i.e. approximately 0.

At a significance level of alpha=0.05, we conclude that there is sufficient evidence to reject the null in favor of the alternative, and conclude that there is indeed a relationship between the number of medical doctors and the number of hospital beds. Note, though, that this relationship is nonlinear, due to the model being fit to the logged data: log(y) = beta\_0 + beta\_1 \* log(x) y = e^{beta\_0} \* x^{beta\_1}