MECH481A6: Engineering Data Analysis in R

Chapter 11 Homework: Modeling

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Load packages

Chapter 11 Homework

This homework will give you experience with OLS linear models and testing their assumptions.

For this first problem set, we will examine issues of ***collinearity among predictor variables*** when fitting an OLS model with two variables. As you recall, assumption 3 from OLS regression requires there be no *collinearity* among predictor variables (the X_i's) in a linear model. The reason is that the model struggles to assign the correct β_i values to each predictor when they are strongly correlated.

Question 1

Fit a series of three linear models on the `bodysize.csv` data frame using `lm()` with `height` as the dependent variable:
1. Model 1: use `waist` as the independent predictor variable:
   - `formula = height ~ waist`
2. Model 2: use `mass` as the independent predictor variable:
   - `formula = height ~ mass`
3. Model 3: use `mass + waist` as a linear combination of predictor variables:
   - `formula = waist + mass`

Report the coefficients for each of these models. What happens to the sign and magnitude of the `mass` and `waist` coefficients when the two variables are included together? Contrast that with the coefficients when they are used alone.

Evaluate assumption 3 about whether there is collinearity among these variables. Do you trust the coefficients from model 3 after having seen the individual coefficients reported in models 1 and 2?

Question 2

Create a new variable in the `bodysize` data frame using `dplyr::mutate`. Call this variable `volume` and make it equal to $waist^2 * height$. Use this new variable to predict `mass`.

Does this variable explain more of the variance in `mass` from the NHANES data? How do you know? (hint: there is both *process* and *quantitative* proof here)

Create a scatterplot of `mass` vs. `volume` to examine the fit. Draw a fit line using `geom_smooth()`.

Question 3

Load the `cal_aod.csv` data file and fit a linear model with `aeronet` as the independent variable and `AMOD` as the independent variable.

Evaluate model assumptions 4-7 from the coursebook. Are all these assumptions valid?