PLSC 502: "Statistical Methods for Political Research"

Exercise Eight
November 18, 2024

Part I

This part is largely unstructured, but also pretty easy. (In fact, the entire homework exercise is pretty easy.)

Consider the bivariate linear regression:

$$Y_i = \beta_0 + \beta_1 D_i + u_i$$

where D is a dichotomous explanatory / predictor variable.

Using simulations (and perhaps some logic), show that the t-statistic for the hypothesis that $\hat{\beta}_1 = 0$ is the same as the t- test for the difference of means between $\bar{Y}|D = 0$ and $\bar{Y}|D = 1$.

Part II

`mtcars` is one of a small number of datasets that is included with base-R. It is described as being "extracted from the 1974 *Motor Trend* U.S. magazine, and comprises fuel consumption and 10 aspects of automobile design and performance for 32 automobiles (1973-74 models)." It can be loaded into R by typing:

```
> data(mtcars)
```

and you can find out more about the data by typing:

```
> ?(mtcars)
```

Most of the time, the built-in datasets in R are used to illustrate how different commands / packages work. The `mtcars` data (perhaps along with Ronald Fisher's `iris` data) is arguably the most "famous" R dataframe used for this purpose.

In Part II of this exercise, we're going to get you familiar with some tools that are useful for linear regression analysis, using the `mtcars` data as an example. Your assignment is:

1. Calculate the (Pearson's) correlation between horsepower (`hp`, the "dependent" variable) and engine displacement (`disp`, the "independent" variable) in the `mtcars` data.
2. Fit a linear regression model of `hp` on `disp`, using R's `lm` command, and show your results.
3. Show and describe how the linear regression partitions the variation in `hp` into its model and residual components.
4. Create a scatterplot illustrating the linear relationship between the two variables in (1 - 3).

As is typically the case, this homework is worth 50 possible points. Your answers, along with all code necessary to reproduce those answers, is due by 11:59 p.m. EST on Monday, December 2, 2024, and should be submitted electronically (via e-mail attachment) to Morrgan (`mth5492@psu.edu`) *and* to me (`zorn@psu.edu`).