Lecture 18 - Economics 113

Professor Spearot

- Agenda
  1. Interactions
  2. Dummy Variables
- Homework 1 due friday. - LONG!!!
- Midterm 4 is Friday, in class.
- Quote of the Day:
  Talent alone won't make you a usccess. Neither will being in the right place at the right time, unless you are ready. The most important question is: 'Are you ready?'
  -Johnny Carson

Regressions

Interaction terms

- The basic model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_1 x_2 + \beta_3 x_2 + u$$

- How do we interpret β_1 , β_2?
- Take the derivative w.r.t x_1.

$$\frac{\partial y}{\partial x_1} = \beta_1 + \beta_2 x_2$$

- How do we interpret $\frac{\partial y}{\partial x_1}$?

$\Rightarrow$ If $\beta_2 > 0$, then higher x_2 increases $\frac{\partial y}{\partial x_1}$

$\Rightarrow$ If $\beta_2 < 0$, then higher x_2 decreases $\frac{\partial y}{\partial x_1}$

Regressions

Interaction terms

- Interact *age* with *educ*

$$\log(wage) = \beta_0 + \beta_1 educ + \beta_2 educ * age + \beta_3 age + \beta_4 exper + u$$

- How do we interpret these results?
- Do the returns to education depend on age?
- Should we keep in the interaction term?

Regressions

Dummy variables

- The basic model
$$y = \beta_0 + \beta_1 x_1 + \beta_2 d + u$$
- $d = 1$ if a respondent is in a categorical group, 0 otherwise
- β_2 is the discrete effect of being in a group
- Type of dummy variables
  1. Race, gender
  2. State, County, City
- An equivalent regression:
$$y = \beta_1 x_1 + \beta_2 d + \beta_3 (1 - d) + u$$
- If you include d and $(1 - d)$ as regressors, you must get rid of β_0!
- Generally, remove β_0 if any combination of regressors can be combined to create a constant.

Regressions

Dummy variables

- Wage regression
- Add in, *urban*.

$$\log(wage) = \beta_0 + \beta_1 educ + \beta_2 \text{exper} + \beta_3 tenure + \beta_4 urban + u$$

- *urban* $= 1$ if the respondent lives in a SMSA, 0 otherwise.
- How do we interpret these results?
- Do they make sense?
- Should I keep in the *urban* dummy?

Regressions

Multiple Slopes

- The basic model

$$y = \beta_0 + \beta_1 x_1 * d + \beta_2 x_1 (1 - d) + \beta_3 d + u$$

- How do we interpret β_1 and β_2?
  - $\beta_1 = \frac{\partial y}{\partial x_1}$ for $d = 1$
  - $\beta_2 = \frac{\partial y}{\partial x_1}$ for $d = 0$
- Slope differences for groups.
- Test for differences in slopes?
- $\theta = \beta_1 - \beta_2$
- Insert $\beta_1 = \theta + \beta_2$ and simplify:

$$\begin{aligned}
y &= \beta_0 + \beta_1 x_1 * d + \beta_2 x_1 (1 - d) + \beta_3 d + u \\
y &= \beta_0 + (\theta + \beta_2) x_1 d + \beta_2 x_1 (1 - d) + \beta_3 d + u \\
y &= \beta_0 + \theta x_1 d + \beta_2 x_1 (d + 1 - d) + \beta_3 d + u \\
y &= \beta_0 + \theta x_1 d + \beta_2 x_1 + \beta_3 d + u
\end{aligned}$$

Regressions

Dummy variables

- Wage regression
- Are the returns to education different for urban residents?
- Interact *urban* and educ.

$$\begin{aligned} \log(wage) &= \beta_0 + \beta_1 educ + \beta_2 \text{exper} + \beta_3 tenure \\ &\quad + \beta_4 urban + \beta_4 urban\text{*}educ + u \end{aligned}$$

- Returns to education

$$\frac{\partial \widehat{\log(wage)}}{\partial educ} = \widehat{\beta}_1 + \widehat{\beta}_4 urban$$

- How do we interpret these results?
- Do they make sense?