Econometrics Discussion Section 2: nonlinear methods

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Linearity assumption

- We talk a lot about the OLS assumptions: conditional mean 0 of the error, finite 4th moments, no multicolinearity ...
- Lurking under the hood: assumption the relationship is linear
- This is a very strong assumption: think about relationship between earnings and wages
- So we may try to relax the assumption of linearity and estimate a more flexible form; but we will focus on models which still fit into the framework of OLS

Polynomial function

- If relationship between Y and X is not linear, we can try to approximate it by adding polynomials of X into the regression:
  - $Y = \beta_0 + \beta_1 X + \beta_2 X^2 + \cdots + \beta_3 X^n + u$
- OLS works the same way! Just with new variables which are powers of X
- Difficult to interpret coefficients
- Question: How many factors should we had?

Log approximation

- To a first approximation, $\log(1+x) \approx x$ for small x (though be careful)
  - This means we can think about a change in $\log(x)$ as a percentage change in x
- Different ways to introduce logs into $Y = X\beta + u$. How should we interpret:
  - log-linear
  - linear-log
  - log-log

Log approximation

- To a first approximation, $\log(1+x) \approx x$ for small x (though be careful)
  - This means we can think about a change in $\log(x)$ as a percentage change in x
- Different ways to introduce logs into $Y = X\beta + u$. How should we interpret:
  - **log-linear**: a change of z in X is associated with a $\beta z\%$ change in Y
  - **linear-log**: a change of $z\%$ in X is associated with a $\beta.0z$ change in Y
  - **log-log**: a change of $z\%$ in X is associated with a $\beta z\%$ change in Y
- Other (actual) nonlinear forms are possible too