

Multiple Regression: Nonlinear Models

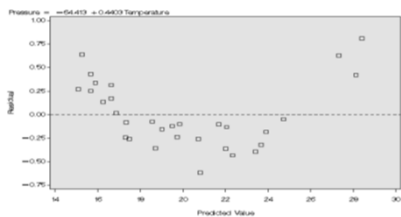
PSY 512: Advanced Statistics for
Psychological and Behavioral Research 2

Goals

- ◉ Introduce the idea of curvilinear regression
- ◉ Polynomials
 - Quadratic
 - Cubic

Review

- ◉ The estimated residuals provide the best method for checking for curvilinear associations
- ◉ In a residual plot, you are looking for curvature



Polynomial Regression

- ◉ To account for curvature, we can perform something called “polynomial regression” which consists of fitting a polynomial (a quadratic or cubic typically) instead of a line
- ◉ Linear model
 - $Y = A + \beta_1 X + e$
- ◉ Quadratic model (1 bend in the data)
 - $Y = A + \beta_1 X + \beta_2 X^2 + e$
- ◉ Cubic model (2 bends in the data)
 - $Y = A + \beta_1 X + \beta_2 X^2 + \beta_3 X^3 + e$
- ◉ The higher the order of the polynomial, the more curvature for which it can account

Which to Choose: Quadratic or Cubic?

- ◉ In general, choose the LOWEST order polynomial possible (e.g., prefer linear to quadratic...quadratic to cubic)
- ◉ This is aimed at (1) “Occam’s razor” meaning that simpler models are preferred and (2) the higher the order of the polynomial term, the more parameters to estimate (it is easier to estimate a few parameters than it is to estimate many)

Selecting the Polynomials

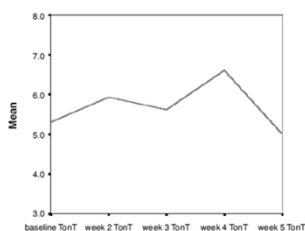
- ◉ The regression output provides a formal method for selecting the appropriate polynomial
 - This method typically agrees with looking at the residual plot
- ◉ The regression output provides p-values for each term in the regression
- ◉ These p-values can be used to guide decisions about which polynomial terms to include in the model

Selecting the Polynomials

- ◉ Begin by fitting the cubic model
 - If the cubic term is significant, use the cubic model
- ◉ If the cubic term is NOT significant, remove it, and rerun the model
 - Look to see whether the quadratic term is significant
- ◉ If the quadratic term is not significant, remove it, and rerun the model (i.e., simple linear regression)

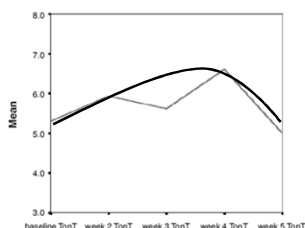
Example of Quadratic Effect

- ◉ Time spent on work tasks across time
- ◉ Music made available at work during weeks 2 and 3
- ◉ Music removed during week 4
- ◉ Music reinstated during week 5



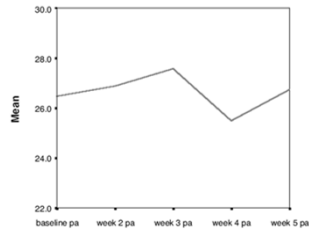
Example of Quadratic Effect

- ◉ Time spent on work tasks across time
- ◉ Music made available at work during weeks 2 and 3
- ◉ Music removed during week 4
- ◉ Music reinstated during week 5



Example of Cubic Effect

- Positive affect across time
- Music made available at work during weeks 2 and 3
- Music removed during week 4
- Music reinstated during week 5



Example of Cubic Effect

- Positive affect across time
- Music made available at work during weeks 2 and 3
- Music removed during week 4
- Music reinstated during week 5

