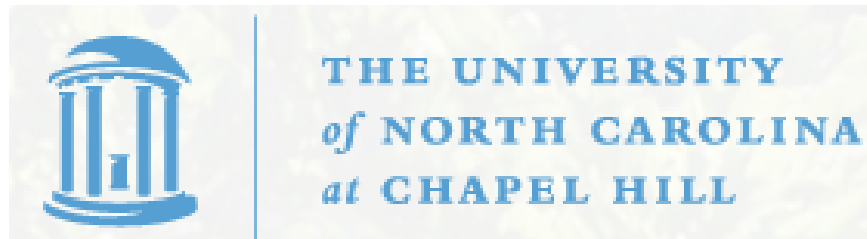


***STOR 590:***  
***ADVANCED LINEAR MODELS***  
***Instructor: Richard L. Smith***

**Class Notes:**  
**August 31, 2020**



## CLASS ANNOUNCEMENTS

- New grading policy — P/F grades allowed, but see registrar's web page for details
- If you drop the course after today, you will get a "WCV" grade
- **Next assignment: Chapter 2, questions 2 and 4, due 11:55 pm Friday, September 11**
- Still plan September 28 date for midterm, will firm this up after Labor Day
- I may decide after all to hold a class on October 12, but will confirm later
- After Chapter 2, we will jump to Chapter 8. See "GLM" handout in Resources/Handouts section of sakai page

## Deviance Residuals

- Define the *deviance* as

$$\begin{aligned} D &= 2\ell(\hat{\theta}) \\ &= 2 \sum_i \left[ \log\{1 + \exp(\hat{\beta}_0 + \hat{\beta}_1 x_i)\} - y_i(\hat{\beta}_0 + \hat{\beta}_1 x_i) \right] \\ &= \sum_i r_i^2 \end{aligned}$$

where

$$r_i^2 = 2 \left[ \log\{1 + \exp(\hat{\beta}_0 + \hat{\beta}_1 x_i)\} - y_i(\hat{\beta}_0 + \hat{\beta}_1 x_i) \right]$$

Ensure correct sign by defining

$$r_i = \text{sign}(y_i - \hat{p}_i) \sqrt{r_i^2}.$$

We call  $r_i$  the  $i$ 'th *deviance residual* (text, page 36).

In R: `residuals(lmod)`

## Side Comment

- We defined

$$r_i^2 = 2 \left[ \log\{1 + \exp(\hat{\beta}_0 + \hat{\beta}_1 x_i)\} - y_i(\hat{\beta}_0 + \hat{\beta}_1 x_i) \right]$$

Do we know this is  $> 0$ ?

- Claim:  $\log(1 + e^z) - yz > 0$  when  $-\infty < z < \infty$ ,  $y = 0$  or  $1$
- $y = 0$  :  $\log(1 + e^z) > \log(1) > 0$
- $y = 1$  :  $\log(1 + e^z) - z > \log(e^z) - z = 0$
- So OK either way.