

# Introduction to nonlinear statistical models

(STATS545.6: Topics in nonlinear statistical models (draft 0))

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May 28, 2013

## The assumptions - and what goes wrong

$$\mathbf{y} \sim n(\mathbf{X}\boldsymbol{\beta}, \sigma^2 \mathbf{I})$$

may be wrong.

Simple variance exceptions are easy to handle:

- $Vy_i = u_i\sigma^2$  where  $u_i$  are known
- $\Sigma_{\mathbf{y}} = \sigma^2 B$  where  $B$  is known
- $\Sigma_{\mathbf{y}}$  may contain “a few” unknown parameters

# Maximum likelihood

The MLE is usually a good estimator

Applies to very many estimation problems

Need to specify the complete likelihood function

Can take into account dependence, different variances, non-normality, non-linear response etc

Examples: Gamma mean, fish growth, length-weight relationships.

# Nonlinear regression

Common model:

$$E y_i = g(\mathbf{x}_i, \boldsymbol{\beta}), \quad 1 \leq i \leq n$$

Common estimation method:

$$\min_{\boldsymbol{\beta}} \sum_i (y_i - g(\mathbf{x}_i, \boldsymbol{\beta}))^2$$