Non Linear Models

Bayesian approach

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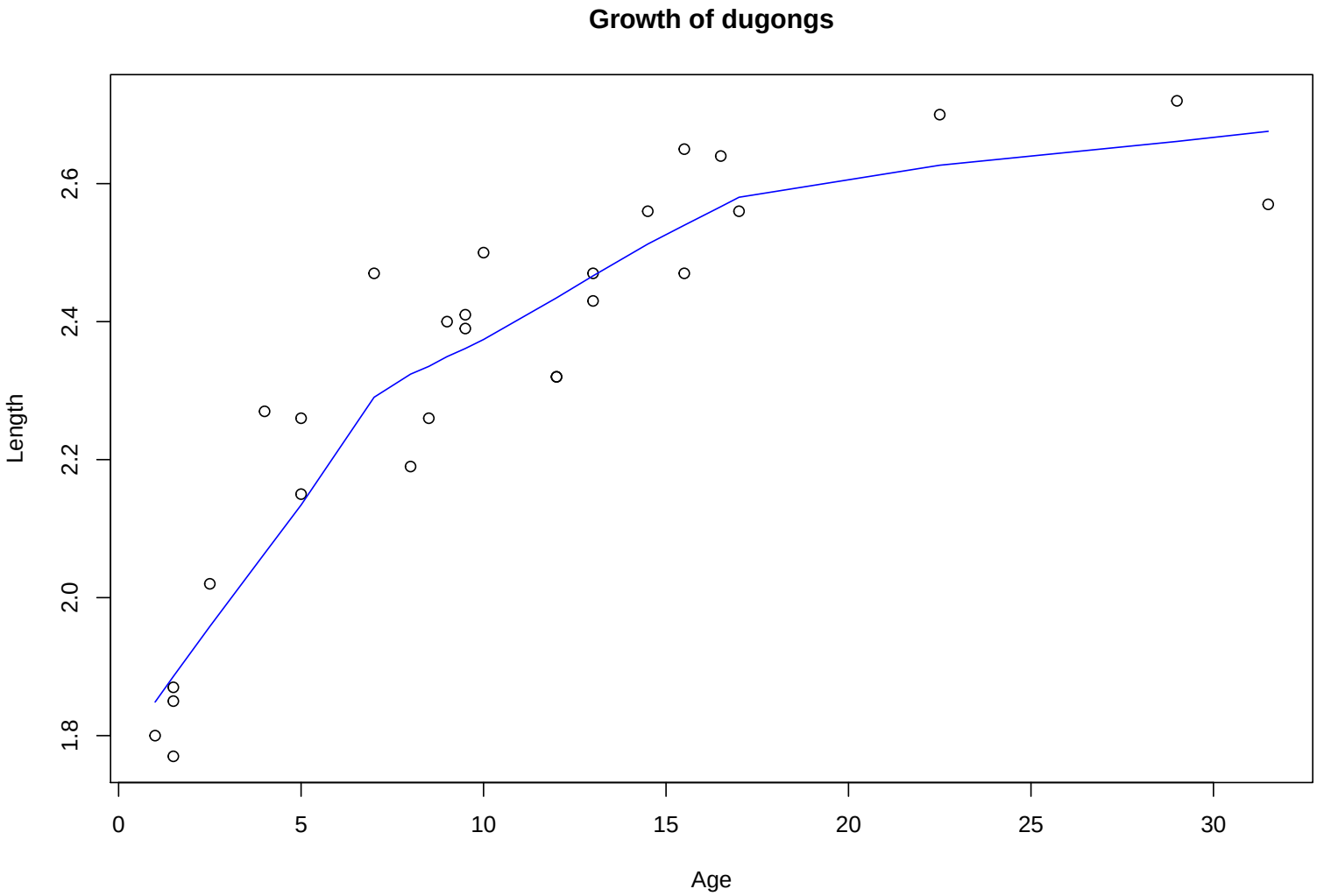
Non linear vs Linear approach

- the linear mean structure is: $Y_i = x_i'\beta + \epsilon_i$
- the generic form: $Y_i = g(x_i, \beta) + \epsilon_i$ for a known function g
- **Lets consider a non linear mean structure**
- The idea is to model non transformed data

Non transformed data

- The data are length and age measurements for 27 captured dugongs (sea cows).
- **Carlin and Gelfand (1991)** model this data using a nonlinear growth


Growth of dugongs
Length
Age
1.8
2.0
2.2
2.4
2.6
0
5
10
15
20
25
30

Non-linear Dugong growth model

$$Y_i = \alpha - \beta * \gamma^{x^i} + \epsilon_i, i = 1, 2, ..., n$$

- Where $\alpha > 0$, $\beta > 0$, $0 \leq \gamma \leq 1$ and as usual $\epsilon_i \sim N(0, \sigma^2)$
- And α corresponds to the average length of a fully grown dugong
- And $\alpha - \beta$ length of a dugong at birth and γ determines the growth rate

Sampling approach: why?

- The nonlinearity of the model eliminates any hope for a closed form full conditional for γ
- **Sampling** is the best approach - types of sampling?
- We use **Gibbs** Sampling

OpenBugs Model ..

- We run three parallel Gibbs sampling chains of 20,000 iterations each following a 1000-iteration burn-in
- Obtain posterior density estimates and autocorrelation plots for $\alpha > 0$, $\beta > 0$, γ and σ
- **Investigate the bivariate posterior of (α, γ) using the Correlation tool on the inference menu**