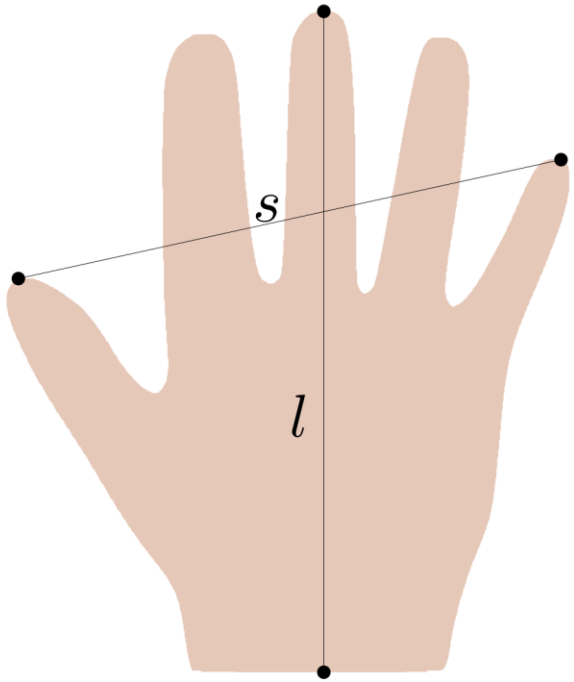
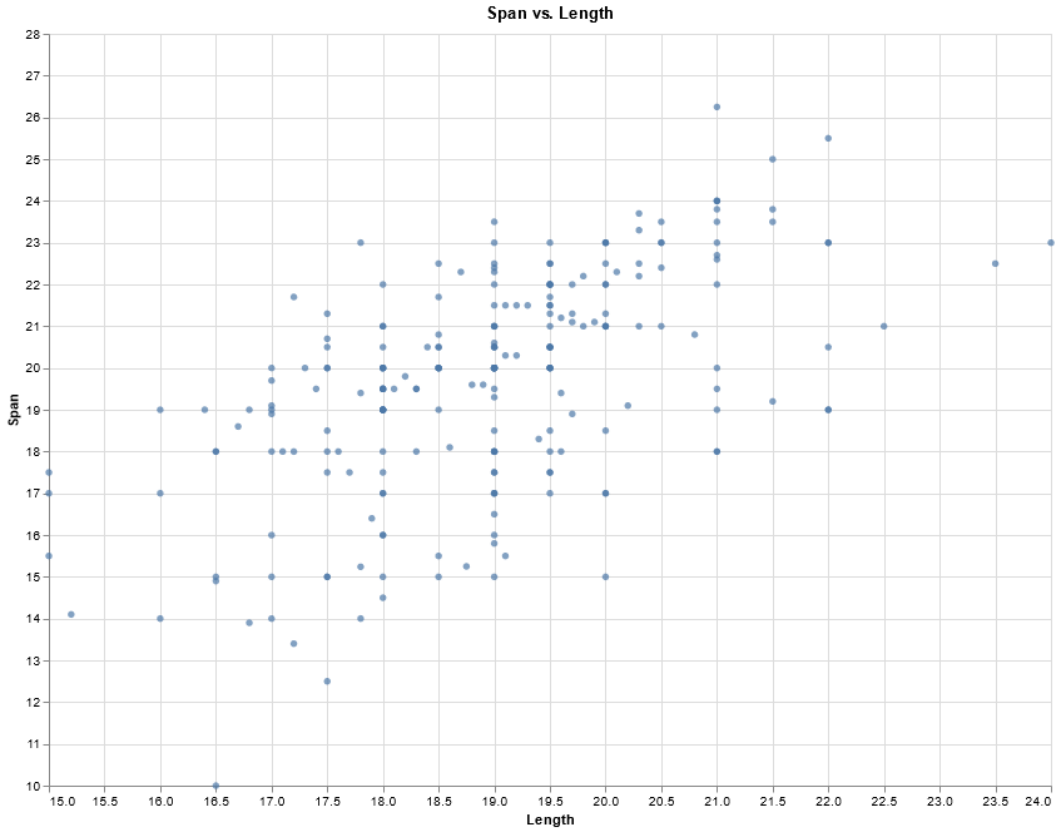
University of Basel

Bayesian linear regression on a toy problem

Marcel Lüthi, Departement of Mathematics and Computer Science, University of Basel

Toy problem: Data

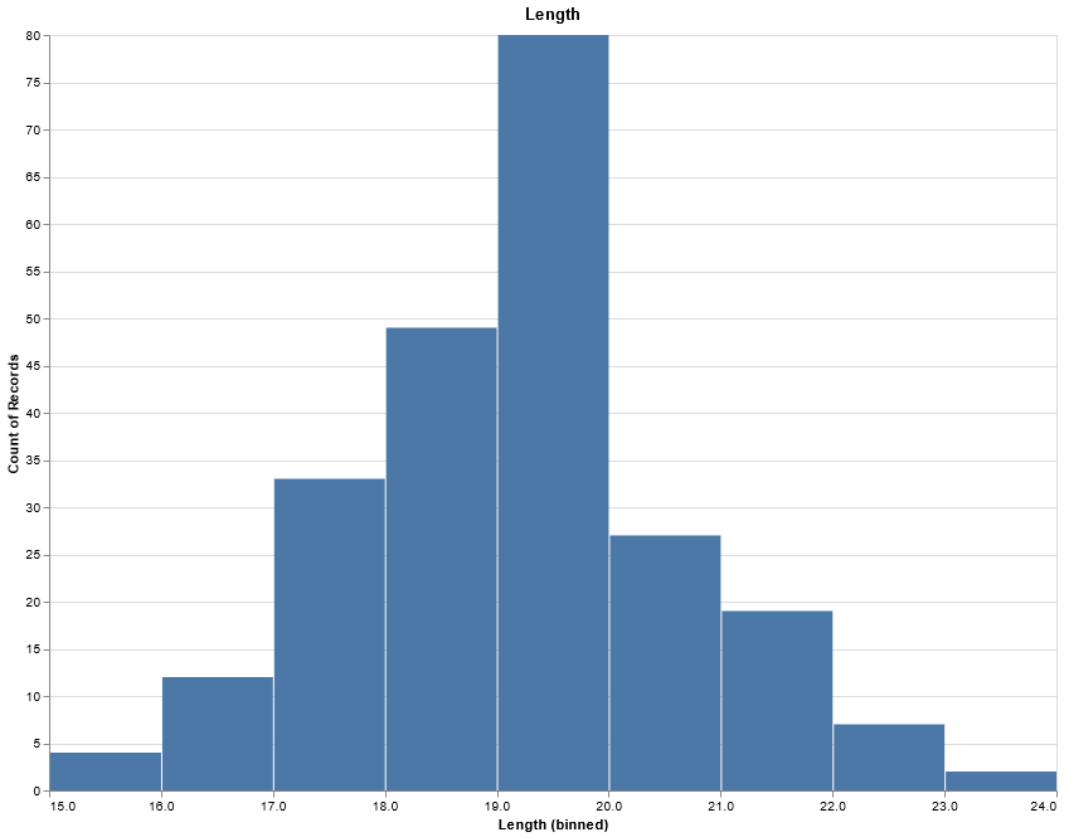


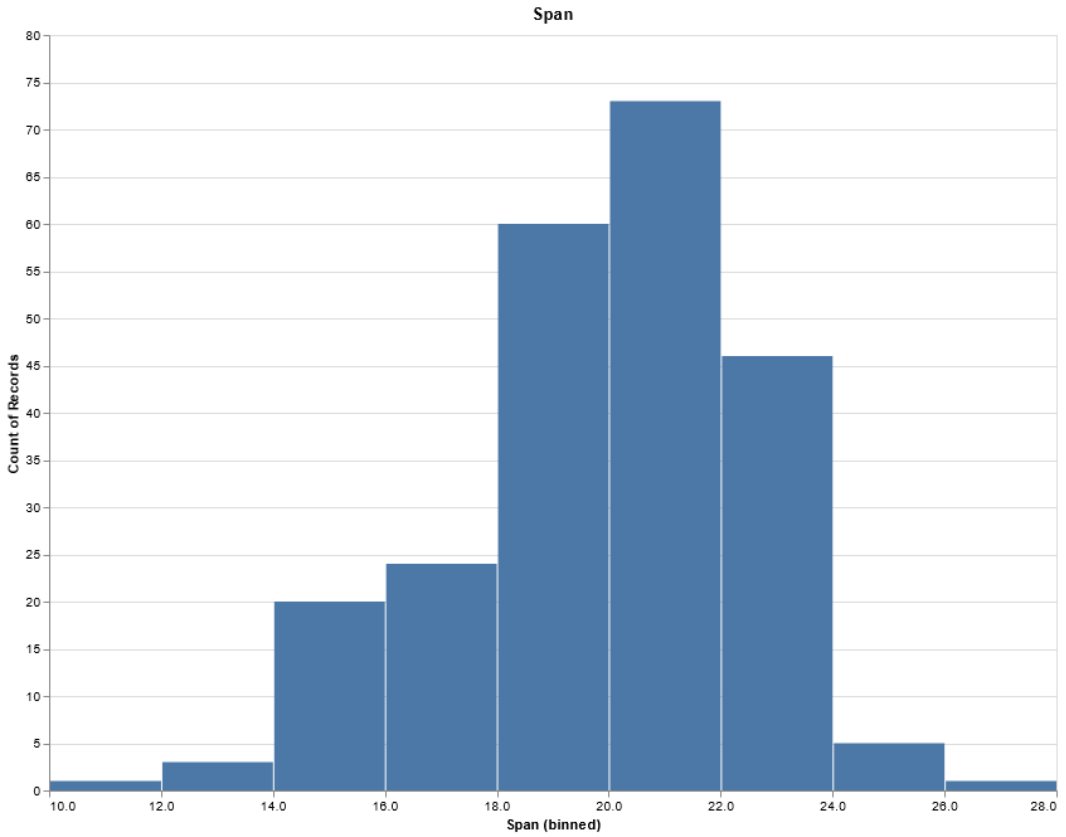


Measurements of length and span of 233 individuals

Toy problem: Data

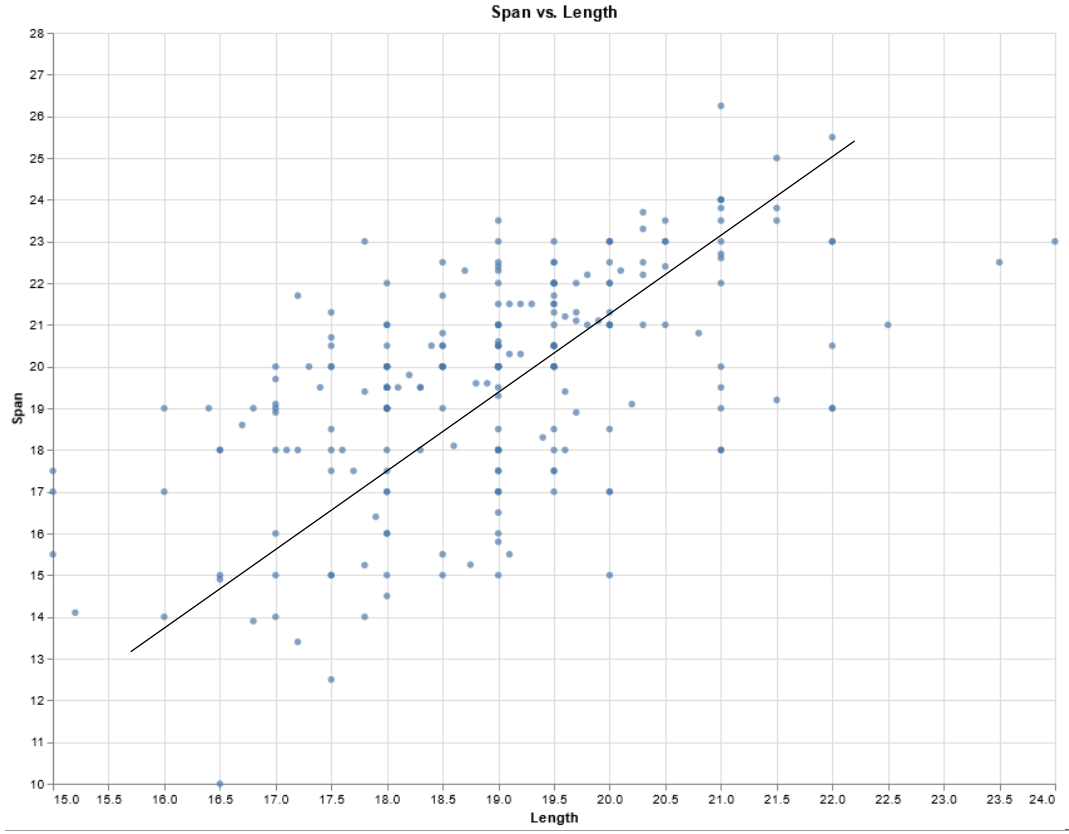
Marginal distributions: $p(l)$ and $p(s)$





Toy problem: Goal

Find a distribution of the span given only the length.
Mathematical problem: (Bayesian) Linear regression



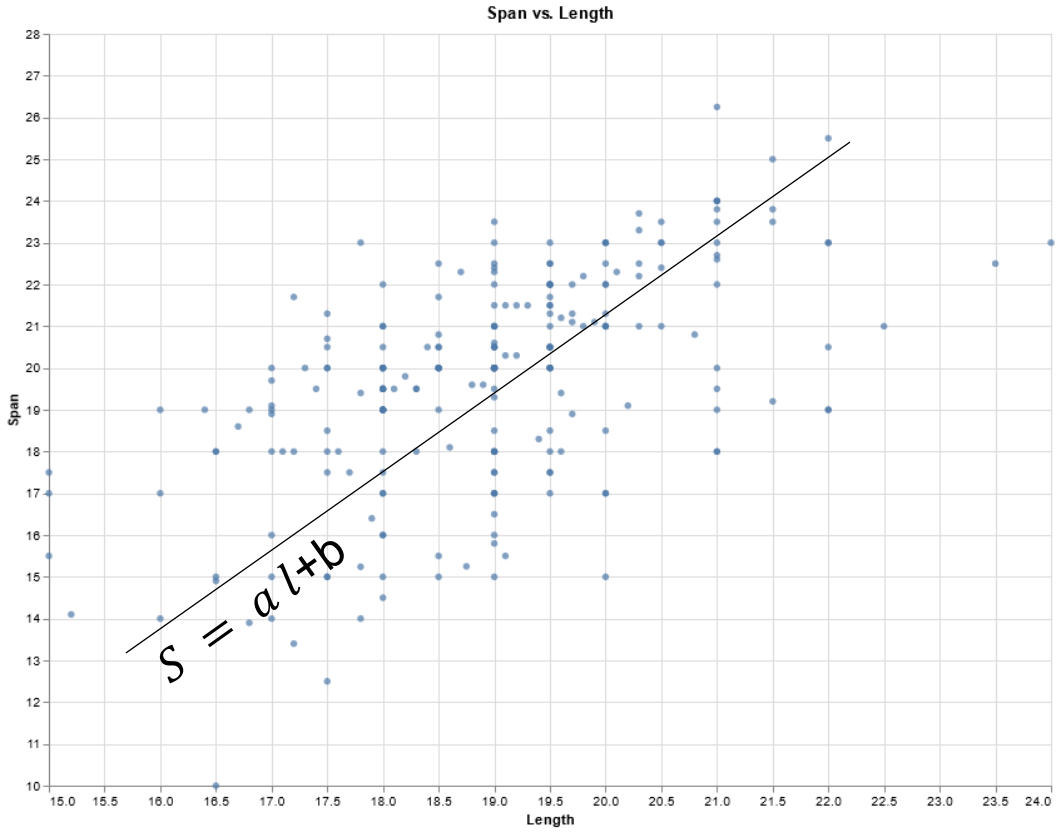
Bayesian linear regression

Mathematical model:

$$s = a \cdot \left(l - \bar{l}\right) + b + \varepsilon, \qquad \varepsilon \sim N(0, \sigma^2)$$

Parameters:

- Slope a
- Intercept b
- Variance σ^2



Bayesian model

$$p(s, a, b, \sigma^2 | l) = p(s | a, b, \sigma^2, l) p(a) p(b) p(\sigma^2)$$

Bayesian linear regression

Model specification

$$s|a,b,\sigma^2,l \sim N\left(a \cdot \left(l - \bar{l}\right) + b, \sigma^2\right)$$

$$a \sim N(1,1)$$
$$b \sim N(0,2)$$
$$\sigma^2 \sim logNormal(0, 0.25)$$