

# Bayesian Approaches

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# Statistics

The world of statistics is divided into

- ▶ **Frequentists** and
- ▶ **Bayesians**

Divergence in

- ▶ understanding of probability
- ▶ differentiation between components of a model and the data
- ▶ techniques to estimate parameters

## F vs B

Topic	Frequentists	Bayesians
Probability	Ratio between cardinalities of sets	Measure of uncertainty
Model and Data	Parameter are unknown, data are known	Differentiation between knowns and unknowns
Parameter Estimation	ML or REML are used for parameter estimation	MCMC techniques to approximate posterior distributions

# Linear Model

$$y_i = \beta_0 + \beta_1 x_{i1} + \epsilon_i$$

Table 1: Separation Into Knowns And Unknowns

Term	Known	Unknown
$y_i$	X	
$x_1$	X	
$\beta_0$		X
$\beta_1$		X
$\sigma^2$	X	

## Example Dataset

Table 2: Dataset for Regression of Body Weight on Breast Circumference for ten Animals

Animal	Breast Circumference	Body Weight
1	176	471
2	177	463
3	178	481
4	179	470
5	179	496
6	180	491
7	181	518
8	182	511
9	183	510
10	184	541

## Estimation Of Unknowns

- ▶ Estimates of unknowns  $\beta = \begin{bmatrix} \beta_0 \\ \beta_1 \end{bmatrix}$
- ▶ Using Bayes Theorem:

$$\begin{aligned} f(\beta|y) &= \frac{f(\beta, y)}{f(y)} \\ &= \frac{f(y|\beta)f(\beta)}{f(y)} \\ &\propto f(y|\beta)f(\beta) \end{aligned}$$

where  $f(\beta)$ : prior distribution and  $f(y|\beta)$ : likelihood

# Prior and Posterior

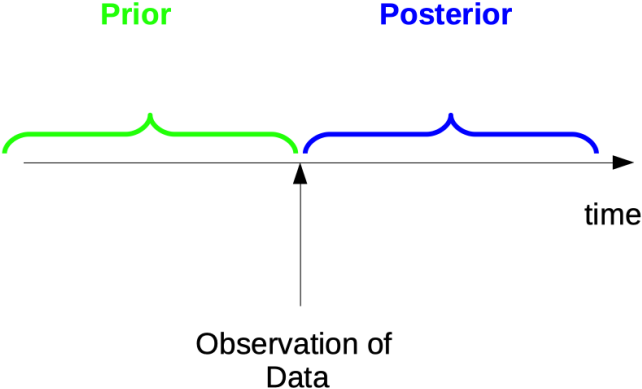


Figure 1: Distinctions between Prior and Posterior in Bayesian Statistics