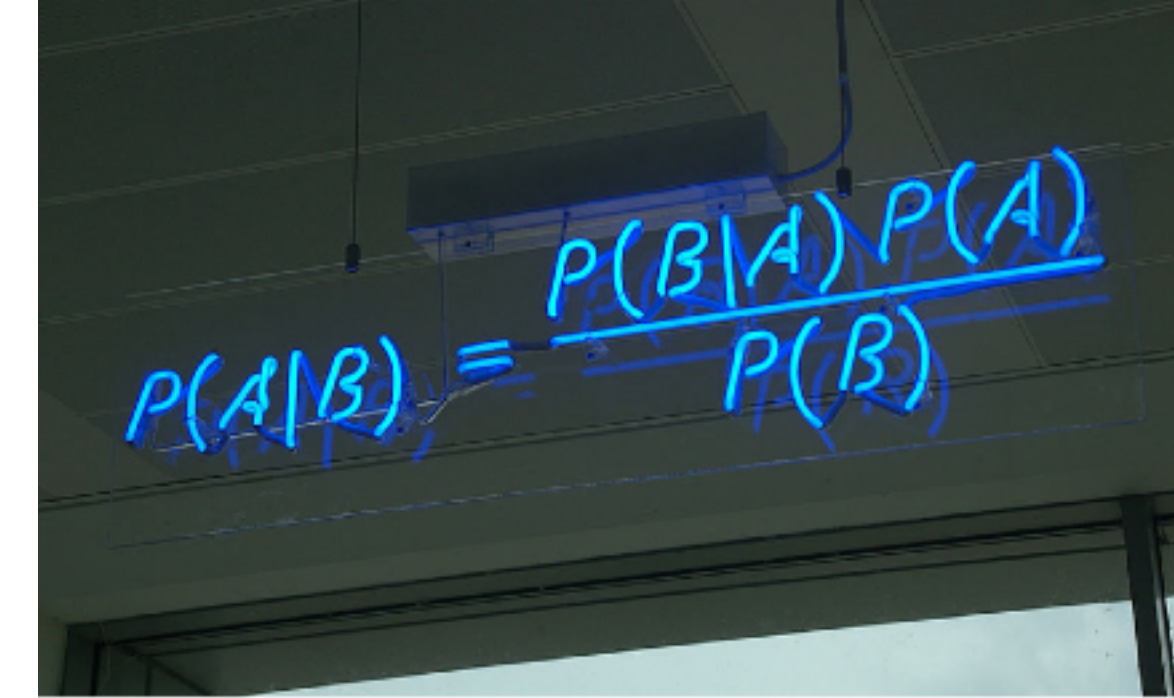


Bayesian Inference



A photograph of a chalkboard with the formula for Bayes' theorem written in blue chalk: $P(A|B) = \frac{P(B|A)P(A)}{P(B)}$.

- Suppose you have data sampled from a parametric distribution with parameter θ .
- Our goal is to estimate θ , given the data samples.

$$\mathbb{P}(\theta | \text{data}) = \frac{\mathbb{P}(\text{data} | \theta) \times \mathbb{P}(\theta)}{\mathbb{P}(\text{data})}$$

- Let the data samples be x_1, x_2, \dots, x_n .
- Then the posterior update given a new data sample x_{n+1} is

$$\mathbb{P}(\theta | x_1, \dots, x_n, x_{n+1}) = \frac{\mathbb{P}(x_{n+1} | \theta) \mathbb{P}(\theta | x_1, \dots, x_n)}{\sum_{\theta \in \Theta} \mathbb{P}(\theta | x_1, \dots, x_n) \mathbb{P}(x_{n+1} | \theta)}$$

Background: beta distribution

- Bounded distribution between [0,1] with parameters α and β denoted as $\text{beta}(\alpha, \beta)$
- Mean = $\frac{\alpha}{\alpha + \beta}$ and variance = $\frac{\alpha\beta}{(\alpha + \beta)^2(\alpha + \beta + 1)}$

