Continuous Bayes' theorem

- parametric (probabilistic) model $f(y|\theta)$
- parameters θ
- probability distribution π

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$$p(\theta|y) = \frac{f(y|\theta)\pi(\theta)}{\int f(y|\theta)\pi(\theta)\,\mathrm{d}\theta} = \frac{f(y|\theta)\pi(\theta)}{f(y)}$$

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Pierre-Simon de Laplace !

Bayes philosophy

Parameters are random variables ! – *no "true" value*

⇒ induces a marginal probability distribution $\pi(\theta)$ on the parameters: the ***prior*** distribution

- 😁 allows to **formally** take into account hypotheses in the modeling
- ☹️ necessarily introduces **subjectivity** into the analysis

Bayesian vs. Frequentists: a historical note

1. **Bayes** + **Laplace** ⇒ development of statistics in the **18-19$^{\text{th}}$ centuries**
2. Galton & Pearson, then Fisher & Neymann ⇒ **frequentist** theory became dominant during the **20$^{\text{th}}$ century**
3. turn of the **21$^{\text{th}}$ century**: rise of the computer
   ⇒ **Bayes' comeback**

Bayesian vs. Frequentists: an outdated debate

Fisher firmly rejected Bayesian reasoning

⇒ community split in 2 in the 20$^{\text{th}}$ century

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> *To be, or not to be, Bayesian, that is no longer the question: it is a matter of wisely using the right tools when necessary*

Gilbert Saporta