UNIVERSITY OF SUSSEX

UCL

Bayesian Model Comparison applied to COVID 19

Pablo Lemos, Constantina Nicolaou, Ben Henghes, Ofer Lahav

Where Earth Meets the Sky — 28/05/2021

p.lemos@sussex.ac.uk

Bayes' Theorem

$$P(A \mid B) = \frac{P(B \mid A) P(A)}{P(B)}$$

Bayes' Theorem

- $\boldsymbol{\vartheta}$: *Parameters*
- **D**: *Data*
- **M**: *Model*

$$P(\theta|D,M) = \frac{P(D|\theta,M) \cdot P(\theta|M)}{P(D|M)}$$

$$\mathcal{P} = \frac{\mathcal{L} \times \Pi}{\mathcal{Z}}$$

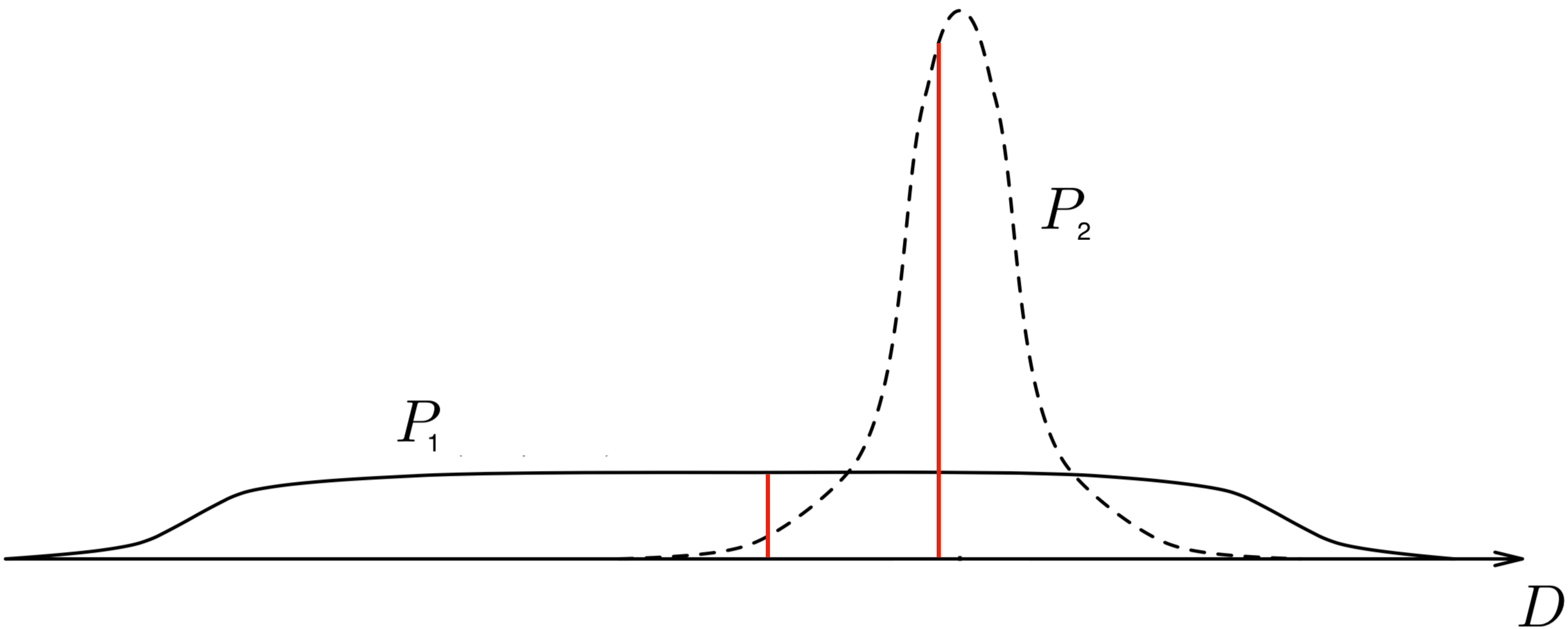
Model comparison

Given data D, and two models M1 and M2, which model is preferred by my data?

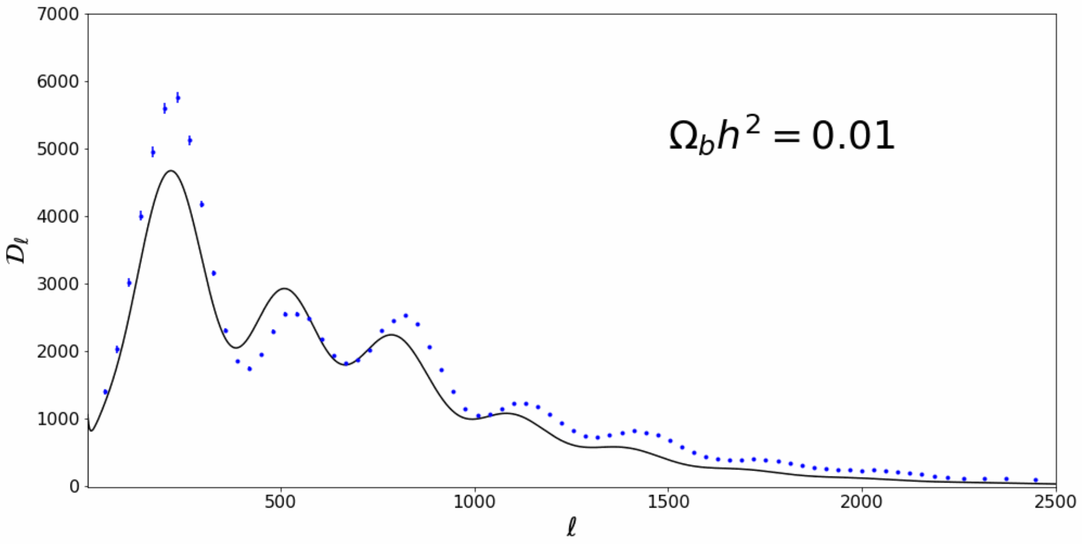
$$\frac{P(M_1 | D)}{P(M_2 | D)} \rightarrow \frac{P(D | M_1)}{P(D | M_2)} \cdot \cancel{\frac{P(M_1)}{P(M_2)}}$$

$$\frac{P(M_1 | D)}{P(M_2 | D)} = \frac{\mathcal{Z}_1}{\mathcal{Z}_2}$$

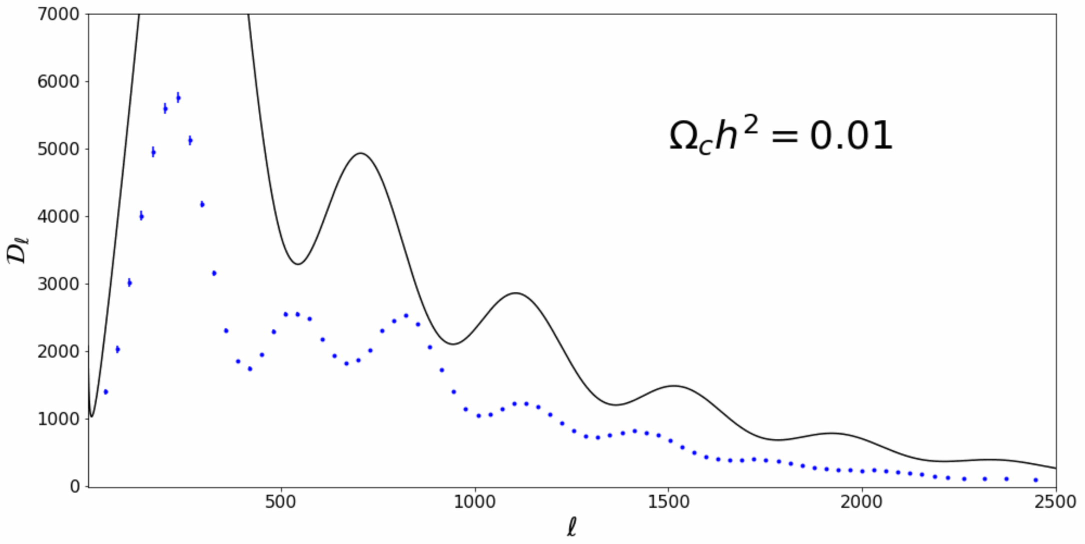
Occam's razor



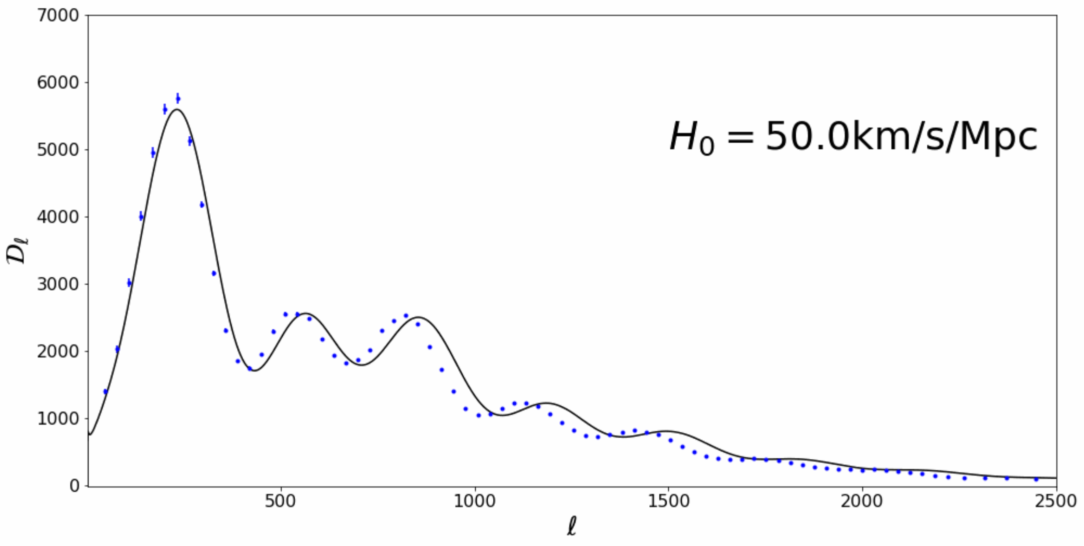
How much dark energy?



How much dark matter?



How fast does it expand?



Bayes' Theorem

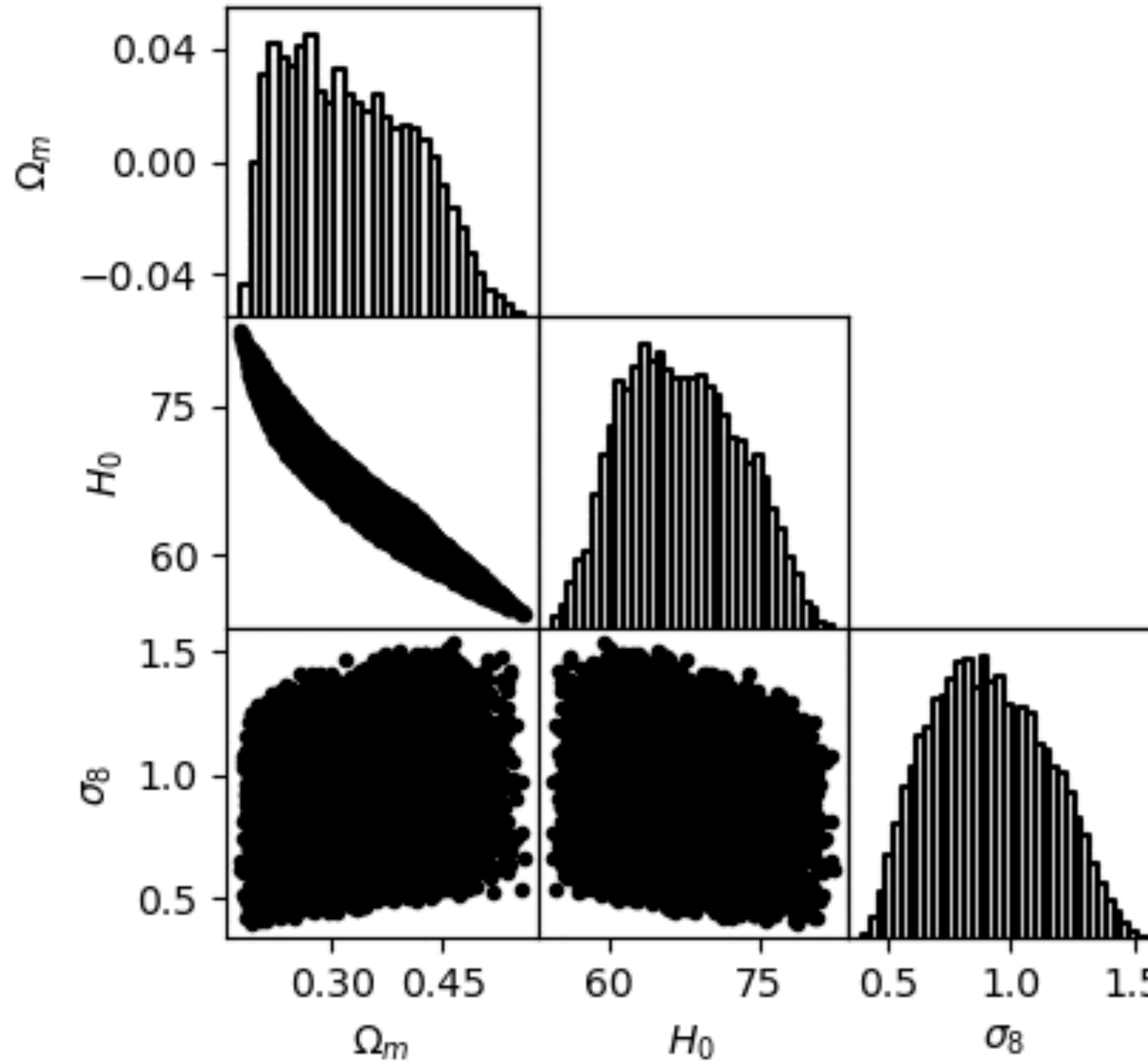
$$P(\theta|D,M) = \frac{P(D|\theta,M)\cdot P(\theta|M)}{P(D|M)}$$

$$\mathcal{P} = \frac{\mathcal{L}\times\Pi}{\mathcal{Z}}$$

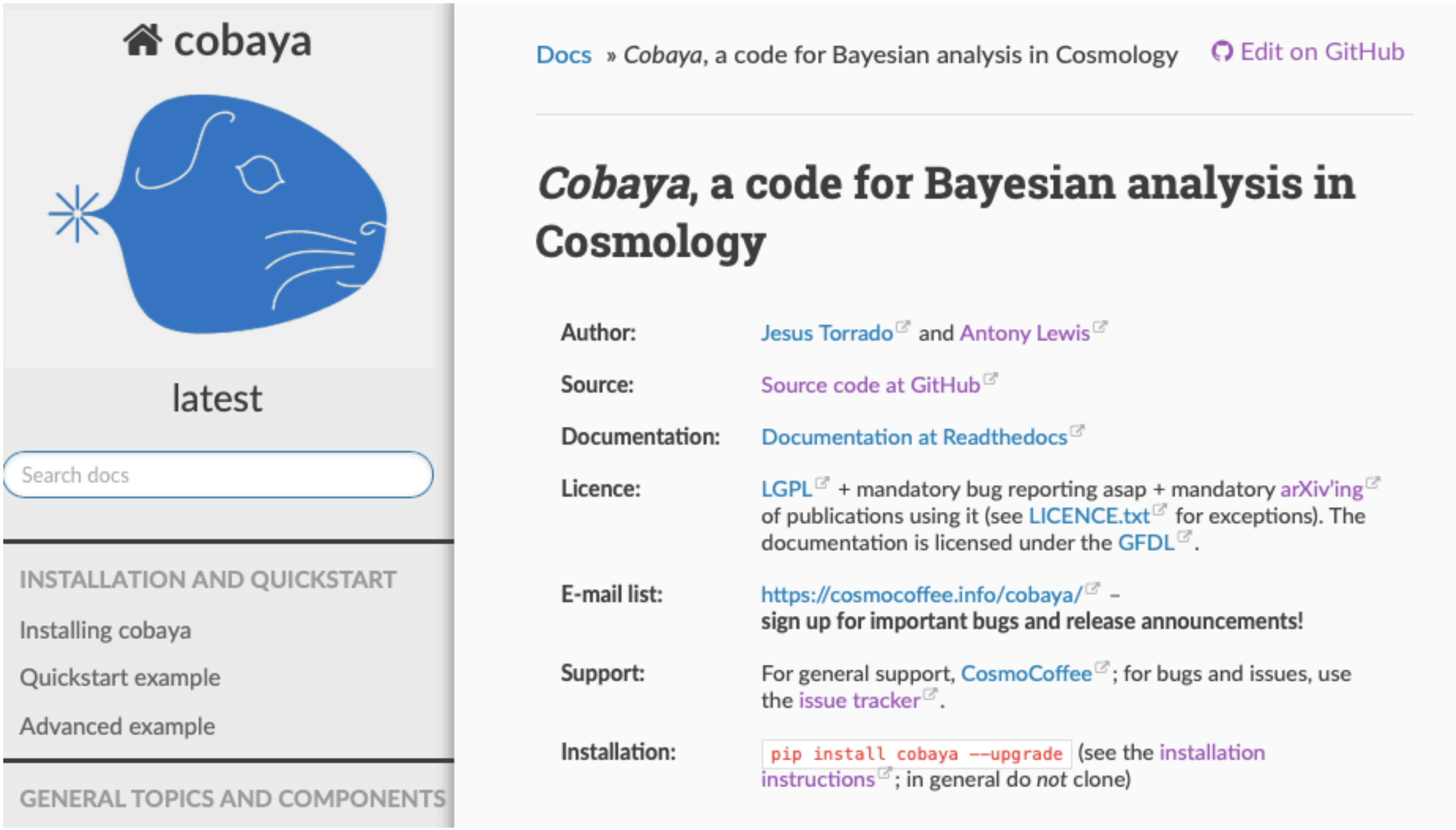
$$\int \mathrm{d}\theta \mathscr{P} = 1 \rightarrow \mathscr{Z} = \int \mathrm{d}\theta\ \mathscr{L}\cdot\Pi$$

Nested Sampling

$$\mathcal{Z} = \int \mathrm{d}\theta \; \mathscr{L} \cdot \Pi$$



Cobaya



cobaya

latest

Search docs

INSTALLATION AND QUICKSTART

Installing cobaya

Quickstart example

Advanced example

GENERAL TOPICS AND COMPONENTS

Docs » *Cobaya*, a code for Bayesian analysis in Cosmology   Edit on GitHub

Cobaya, a code for Bayesian analysis in Cosmology

Author:	Jesus Torrado and Antony Lewis
Source:	Source code at GitHub
Documentation:	Documentation at Readthedocs
Licence:	LGPL + mandatory bug reporting asap + mandatory arXiv'ing of publications using it (see LICENCE.txt for exceptions). The documentation is licensed under the GFDL.
E-mail list:	https://cosmocoffee.info/cobaya/ – **sign up for important bugs and release announcements!**
Support:	For general support, CosmoCoffee; for bugs and issues, use the issue tracker.
Installation:	`pip install cobaya --upgrade` (see the installation instructions; in general do *not* clone)

https://cobaya.readthedocs.io/en/latest/

Application to COVID19

Susceptible $$\frac{dS}{dt} = -\frac{\beta SI}{N}$$

Infected $$\frac{dI}{dt} = \frac{\beta SI}{N} - \gamma I - qI - \mu I$$

Quarantined $$\frac{dQ}{dt} = qI$$

Recovered $$\frac{dR}{dt} = \gamma I + \gamma Q$$

Deceased $$\frac{dD}{dt} = \mu I$$

Application to COVID19