

Pre-class assignment #19

PHY-905-005
Computational Astrophysics and Astrostatistics
Spring 2023

This assignment is due the evening of Wednesday April 12, 2023. Turn in all materials via GitHub.

Reading:

1. Wikipedia article on [Markov Chain Monte Carlo](#) techniques.
2. Wikipedia article on the [Metropolis-Hastings Algorithm](#).
3. Tutorial on [MCMC and fitting models to data](#).
4. [Chapter 1](#) of the *The MCMC Handbook* by Brooks et al. (PDF included; Optional, but highly recommended).
5. Reference for later: Annual Review article on “Markov Chain Monte Carlo Methods for Bayesian Data Analysis in Astronomy,” by Sharma ([Publisher version](#); [arXiv version](#))
6. Reference for later: “Data Analysis Recipes: Using Markov Chain Monte Carlo” by Hogg & Foreman-Mackey (2018, *ApJS*, 236, 11)

Your assignment:

1. Work through the tasks in the included Jupyter notebook, and answer the questions at the bottom of the notebook. Make sure to work through the MCMC code and see how it behaves!
2. In the file `ANSWERS.md`, write down any questions that you have about the material you read or the work you did in the Jupyter notebook, any points that are not clear, or anything you’d like to know more about. Aim for at least 3 questions/unclear points/etc.

Handing it in: Include your modified notebook and your answers to the questions (in the file `ANSWERS.md`) in your assignment.

Some open-source MCMC Python packages: This will probably be useful for you in the future!

1. [emcee - the MCMC hammer](#). This package is widely used in astronomy.
2. [PyMC](#) - a package that implements Bayesian statistical models and fitting tools, including MCMC.
3. [bmcmc](#) - a general-purpose Bayesian MCMC package ([GitHub repository](#)). Note: this is less mature than emcee and PyMC, but by the author of the Annual Reviews article linked to above.