UNIVERSITÀ DEGLI STUDI DI PADOVA

Dipartimento di Fisica e Astronomia "Galileo Galilei"

Advanced Statistic for Physical Analysis

Project on:

Bayesian Inference on SIR-like Systems

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1   Abstract

With this project we would like to explore the world of Bayesian Inference in compartment models. We know indeed that simulations of such models are rather simple, for example using the Gillespie's algorithm while inference is much harder.

With this project first, we will implement the Gillespie's algorithm that allows us to generate stochastic trajectories with a fixed R_0, and after that we will give these trajectories to STAN/-JAGS and we will see if we are able to recover the chosen R_0.

The main goal of this project is to learn and understand how simulate in STAN/-JAGS models that are described via ODE.

Our road-map is composed by the following steps:

- Implementation of Gillespie's Algorithm.

- Learn the math and the physics behind Inference of a SIR model.

- Implementation in STAN/JAGS of our model.

- Judge the inference done by MCMC procedure and maybe tune some parameters in order to obtain better chains.

- Provide the best estimate of R_0 with its confidence interval and make predictions of new data, i.e learn $p(\boldsymbol{y}_{pred}|\boldsymbol{y})$.

- (If there is time left) Perform an hypothesis test respect true covid-data, and figure out if they could be described by a SIR model.

As reference, we would go trough all steps done in chapters 1 and 2, in the link below:
`https://mc-stan.org/users/documentation/case-studies/boarding_school_case_study.`
`html#1_simple_sir`