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## Bayesian and Frequentist Inference for a Partially Observed Stochastic SIR Model Using the Skellam Distribution

### Communication Info

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- (1) Stochastic SIR model
- (2) Bayesian inference
- (3) Maximum likelihood estimation
- (4) Data augmentation
- (5) Basic reproduction number

### Abstract

We investigate Bayesian and frequentist inference for a partially observed stochastic SIR epidemic model formulated as a continuous-time Markov chain. The epidemic transitions are characterized through a Poisson process representation, leading to a Skellam distribution for the difference between infection and recovery counts, which allows an exact likelihood construction without diffusion approximation [1,2].

To handle discrete and incomplete observations, we employ a data-augmentation strategy combined with Markov Chain Monte Carlo (MCMC) methods [3]. Maximum likelihood estimators of the basic reproduction number  $\mathcal{R}_0$  [5] is derived, and its weak consistency and asymptotic normality is established [4]. Within the Bayesian framework, Gamma priors lead to tractable posterior distributions and efficient Gibbs sampling. Numerical results confirm the accuracy and robustness of the proposed inference procedures.

The methodology is applied to Ebola epidemic data from Sierra Leone.

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