On the Influence of High-Order Nonlinear Fluctuations in the Multivariate SIR Master Equation

Basil S. Bayati and Philip A. Eckhoff

Intellectual Ventures Laboratory, 1600 132nd Ave NE, Bellevue, WA 98004, USA

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We perform a high-order analytical expansion of the epidemiological susceptible-infected-recovered multivariate master equation, and include terms up to and beyond single-particle fluctuations. It is shown that higher-order approximations yield qualitatively different results compared with low-order approximations, which is incident to the influence of additional nonlinear fluctuations. The fluctuations can be related to a meaningful physical parameter, the basic reproductive number, which is shown to dictate the rate of divergence in absolute terms from the continuum equations more so than the total number of particles in the system. In epidemiological terms, the affect of single-particle fluctuations ought to be taken into account as the reproductive number approaches unity.