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Semigroups in Biology

The general approach that allows to construct the Markov processes describing various processes in mathematical biology (or in other applied sciences) is presented. The Markov processes are of a jump type and the starting point is the related linear equations. They describe at the micro–scale level the behavior of a large number N of interacting individuals (entities). The large individual limit ("$N \to \infty$") is studied and the intermediate level (the meso–scale level) is given in terms of nonlinear kinetic–type equations. Finally the corresponding systems of nonlinear ODEs (or PDEs) at the macroscopic level (in terms of densities of the interacting subpopulations) are obtained. Mathematical relationships between these three possible descriptions are presented and explicit error estimates are given. The general framework is applied to propose the microscopic and mesoscopic models that correspond to well known systems of nonlinear equations in biomathematics.

References

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