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Stochastic Moment Equations - Case Closed BARUCH BARZEL, Northeastern university, OFER BIHAM, The Hebrew University — Reaction networks frequently appear in many natural systems, such as chemistry, biology and ecology. The modelling of these networks is commonly based on rate equations models, incorporating the law of mass action kinetics. However, when the system is microscopic, it becomes governed by fluctuations, the law of mass action kinetics no longer applies, and the rate equations fail. To obtain an accurate description of microscopic reaction networks, one must refer to stochastic methods based on the master equation. The problem is that the number of equations rises exponentially with the number of species, rendering the treatment of the master equation infeasible. Moment equations are known to be more efficient, however the equations are not closed, and become prohibitively complicated when moments of high order are included. In this talk we present the binomial moment equations. The binomial moments are linear combinations of the ordinary moments related to the population size of the reactive species. They capture the essential combinatorics of the reaction processes reflecting their stoichiometric structure. This leads to a simple and transparent form of the equations, allows a highly efficient and surprisingly simple truncation scheme and enables the inclusion of moments up to any desired order. The result is a set of equations that enables an equation-based stochastic analysis of reaction networks under a very broad range of conditions.

Baruch Barzel
Northeastern university

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