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# An iterative approach for studying the Lotka-Volterra equilibrium in high dimensional regime.

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## Résumé

The challenge of studying the statistical properties of an equilibrium point in a system governed by Lotka-Volterra-type differential equations naturally arises when we seek to model the complex dynamics of species interactions in ecological systems. This equilibrium point has an interesting relationship with a well-established mathematical problem known as the Linear Complementarity Problem (LCP). We shall focus here on the study of statistical properties of this equilibrium in the case where the interaction matrix is large-dimensional random and non-symmetric. This choice represents a more realistic model of species interactions, which often involve intricate and asymmetric relationships in natural ecosystems. To understand the statistical properties of this equilibrium point, we rely on a class of iterative algorithms called Approximate Message Passing (AMP). These algorithms have traditionally been developed in scenarios where the random matrix exhibits symmetry. Yet, our focus in this study is their generalization to the case of non-symmetric, elliptical matrices. We rigorously recover results by Bunin and Galla.

**Mots-Clés:** Approximate Message Passing, Random Matrix Theory, Ecological systems, Lotka, Volterra, Linear Complementarity Problem.

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