

The Stochastic Logistic Map: Theory and Applications

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[Burkle 16, Claremont Graduate University](#)
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Abstract

The logistic map is one of the most famous examples in dynamical systems. Originally introduced as a simple model of population growth, it exhibits a surprisingly rich range of behavior: as a single parameter varies, stable equilibria give way to periodic orbits and eventually to chaos. But in real populations, quantities such as reproductive and death rates are unlikely to remain constant over time. What happens when we allow this parameter to vary randomly from one generation to the next?

In this talk, we explore a stochastic version of the logistic map in which the parameter is chosen randomly at each iteration. Introducing randomness changes the questions we ask: rather than studying individual fixed points or periodic orbits, we investigate probability distributions that describe the long-term behavior of the system. We will see how tools from dynamical systems and Markov processes can be used to show that, under appropriate conditions, the stochastic system settles into a unique long-term statistical behavior that is independent of its initial state. We conclude with simulations illustrating this invariant distribution and discuss several questions about how the system's behavior changes as the amount and type of randomness vary.



Kimberly Ayers is an Associate Professor of Mathematics at California State University San Marcos. Her research interests include dynamical systems, stochastic processes, and mathematical biology, with an emphasis on using mathematical models to understand complex biological systems. She is also engaged in mathematics education initiatives focused on improving calculus instruction for the life sciences. Ayers serves on the Executive Committee of the Association for Women in Mathematics.