Dynamical System Models in the Life Sciences

and Their Underlying Scientific Issues

Broadly speaking, there are two general approaches to teaching mathematical modeling: 1) the case study approach, and 2) the method based approach (that teaches mathematical techniques with applications to relevant mathematical models). This text emphasizes instead the scientific issues for modeling different phenomena. For the natural or harvested growth of a fish population, we may be interested in the evolution of the population, whether it reaches a steady state (equilibrium or cycle), stable or unstable with respect to a small perturbation from equilibrium, or whether a small change in the environment would cause a catastrophic change, etc. Each scientific issue requires an appropriate model and a different set of mathematical tools to extract information from the model. Models examined are chosen to help explain or justify empirical observations such as cocktail drug treatments being more effective and regeneration after injury or illness being fast-tracked (compared to original developments).

Volume I of this three-volume set limits its scope to phenomena and scientific issues that are modeled by ordinary differential equations (ODE). Scientific issues such as signal and wave propagation, diffusion, and shock formation involving spatial dynamics to be modeled by partial differential equations (PDE) will be treated in Vol. II. Scientific issues involving randomness and uncertainty are examined in Vol. III.

About the Author

Frederic Wan has been a Professor of Mathematics at the University of California, Irvine (UCI) since 1995 where he was also Vice Chancellor for Research and Dean of Graduate Studies, 1995–2000. Prior to UCI, Professor Wan received S.B., S.M. and Ph.D. in Mathematics at MIT (1955–1965) and was on the Faculty of the Mathematics Department (1965–1974). He was appointed Professor of Mathematics and the founding Director of the Institute of Applied Mathematics and Statistics at the University of British Columbia (1974–1983). In 1983, Professor Wan relocated to the University of Washington as Professor (1983–1995), the founding Chair of Department of Applied Mathematics (1983–1988) and later the Divisional Dean of Natural and Mathematical Sciences (1988–1992). At the request of the National Science Foundation (NSF), Professor Wan was re-assigned by the University to serve as the Director of the Foundation's Division of Mathematical Sciences (1992–1994). For his research contributions (supported by both NSF and the National Institute of Health (NIH)), Professor Wan was elected a Fellow of ASME, AAAS, SIAM and a Foreign Member of the *Russian Academy of Natural Sciences* among others.

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