AME 630: Transition to Chaos in Dynamical Systems
Prof. P.K. Newton, OHE 4th Floor, 740-7782 (newton@usc.edu)
Spring 2021
Time: M,W 12:00-1:50, GFS 118 & ONLINE

The course will focus on the main ideas and techniques in dynamical systems and chaos theory by introducing examples that have served as useful prototypes. There are 4 parts to the course:

1. Review of basic dynamics
2. Iterated maps
3. Bifurcation theory
4. Evolutionary games

Part 1 will briefly survey some of the main ideas of basic dynamics including phase space techniques, fixed points, stability theory, Lyapunov functions. Part 2 focuses on the dynamics of iterated maps, the simplest setting in which chaotic behavior can occur. This will lead to a discussion of bifurcation phenomena, Feigenbaum scaling theory and Lyapunov exponents in prototype maps such as the logistic map, the 'standard' map, and the Hénon map. Part 3 will outline basic techniques of bifurcation theory related to differentiable dynamics, including discussions of center manifolds, unfolding a bifurcation, and the Hopf bifurcation. Part 4 will focus on the dynamics of evolutionary games using the replicator equations and the prisoner's dilemma game.

Books:
• K.T. Alligood, T.D. Sauer, J.A. Yorke, *Chaos: An Introduction to Dynamical Systems*, Springer-Verlag, (Paperback)
• M.A. Nowak, *Evolutionary Dynamics: Exploring the Equations of Life*, Harvard University Press (2006) (Handouts provided)