46th Annual Iranian Mathematics Conference
25-28 August 2015
Yazd University

Continuous Single-Species Population Model with Delay

Tayebe Waezizadeh*
Shahid Bahonar University of Kerman

Abstract

In this paper, the logistic equation with two different delay times is considered. Firstly, consider time delay depends on food resources in population and stability at equilibrium point is investigated. Secondly, consider delay distributed over time and the stability conditions at equilibrium point is determined.

Keywords: Dynamical system, logistic equation, Time Delay, Population dynamic
Mathematics Subject Classification [2010]: 37C75, 34D05

1 Introduction

Time delay have been incorporated into biological models to represent resource regeneration times. By many researchers such as, Cushing(1977), Gopalsamy(1992) and Kuang (1993) time delay differential equations in Biology have investigated [3, 4].
Delay differential equations exhibit much more complicated dynamics than ODEs. Since a time delay could cause a stable equilibrium to become unstable.
In this paper, consider logistic equation for population model. Let $r(>0)$ be intrinsic growth rate and $K(>0)$ be the carry capicity of the population. The logistic model is

$$\frac{dX}{dt} = rX(t)(1 - \frac{X(t)}{K}) \tag{1}$$

where $X(t)$ is the population size. Set $\frac{X(t)}{K} = x(t)$, so

$$\frac{dx}{dt} = rx(t)(1 - x(t)) \tag{2}$$

In model 2, when x is small, the population grows and when x is large the number of the species compete with each other for the limit resources. In the above logistic equation, it is assumed that the growth rate of a population at any time t depends on the relative number of individuals at time t. But in fact, the population size at time t is not only dependent at that time but also at time $(t - \tau)$, where τ is time delay. Thus the model is

$$\frac{dx}{dt} = rx(t)(1 - x(t - \tau)) \tag{3}$$

*Speaker