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On stability of equations with a distributed delay

We study delay-independent stability in nonlinear models with a distributed delay and one or several positive equilibrium points which occur in population dynamics and other applications. It is assumed that the distributed delay is incorporated into the production term only. In particular, for models with one positive equilibrium we construct a relevant difference equation such that its stability implies stability of the equation with a distributed delay and a finite memory. This result is, generally speaking, incorrect for systems with infinite memory. If the relevant difference equation is unstable, we describe the general delay-independent lower and upper solution bounds and also demonstrate that the equation with a distributed delay is stable for small enough delays.

In the case when the production function incorporating the delay is monotone increasing, the dynamics is very similar to that of the ordinary differential equation. The qualitative behaviour of such equations can be comprehensively described also in the case of multiple positive equilibrium points.