Lecture slides

Philip Murray

Lecture 1

- Introduction to nonlinear difference equations
- The Malthusian model
- The Ricker model

Why difference equations?

A general model

Consider the first order difference equation

$$N_{t+1} = N_t f(N_t) = H(N_t), \tag{1}$$

where $f(N_t)$ is a function that defines the per capita growth rate. The function $H(N_t)$ describes the total (net) growth rate.

The Malthusian model

The population size at time $t+1$ is

$$N_{t+1} = N_t + bN_t - dN_t = rN_t,$$

Exercise: solve the Malthusian model and classify qualitative behaviours

Nonlinear models

- Beverton-Holt

$$N_{t+1} = \frac{rN_t}{1 + \frac{N_t}{K}},$$

- Hassell model

$$N_{t+1} = \frac{rN_t}{(1 + \frac{N_t}{K})^b},$$

- Ricker model

$$N_{t+1} = N_t e^{r(1-\frac{N_t}{K})}.$$

Numerical simulation of the Ricker model

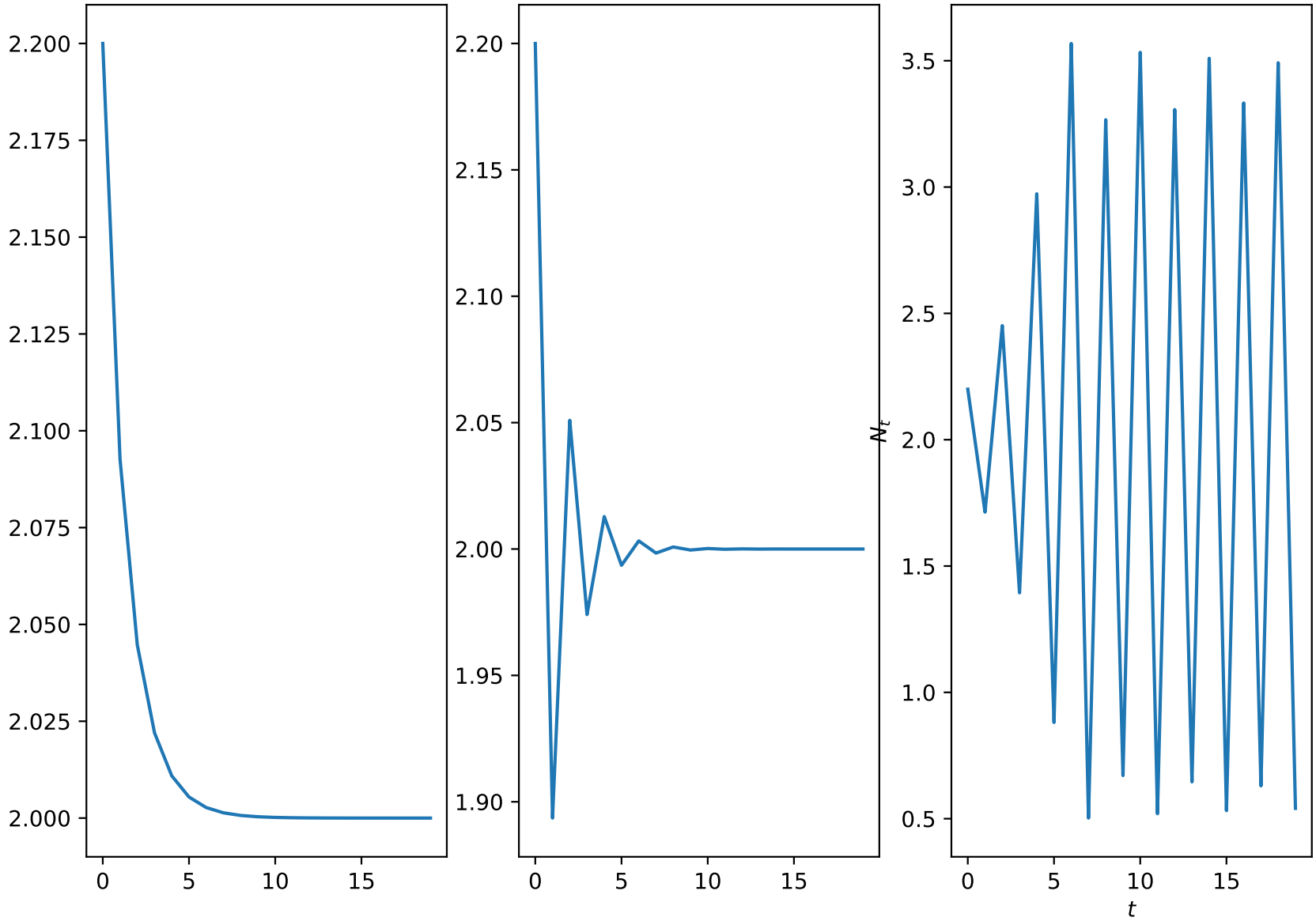

Figure 1: A plot of numerical solutions of the Ricker model. (a)r=0.5.

Summary

- Motivated use of difference equation models
- Introduced general model for one population
- Solved the Malthusian model
- Introduced nonlinear models