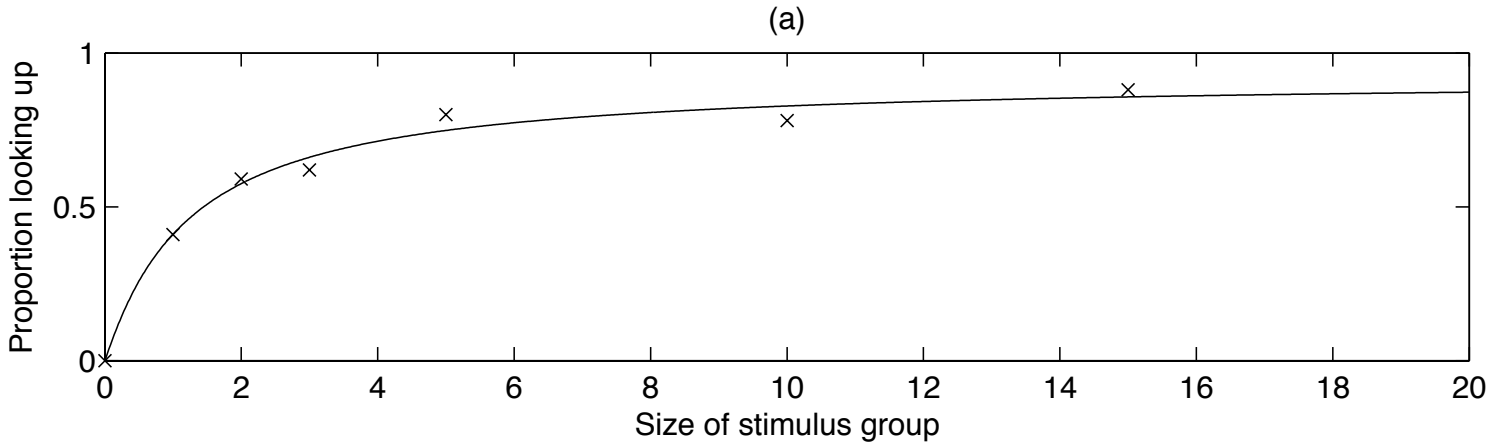
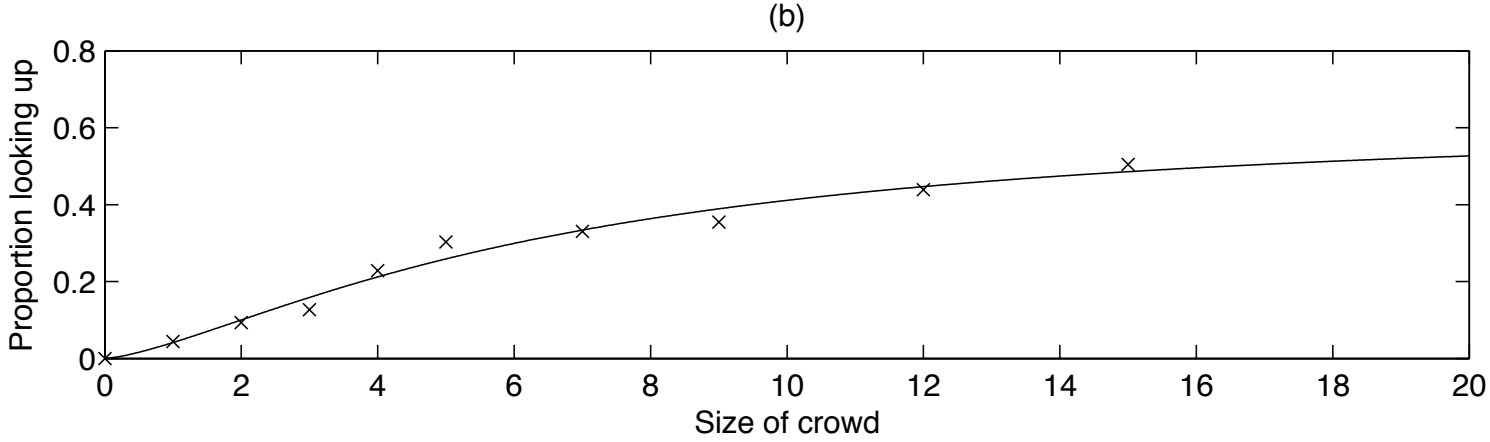
Looking up

Looking up

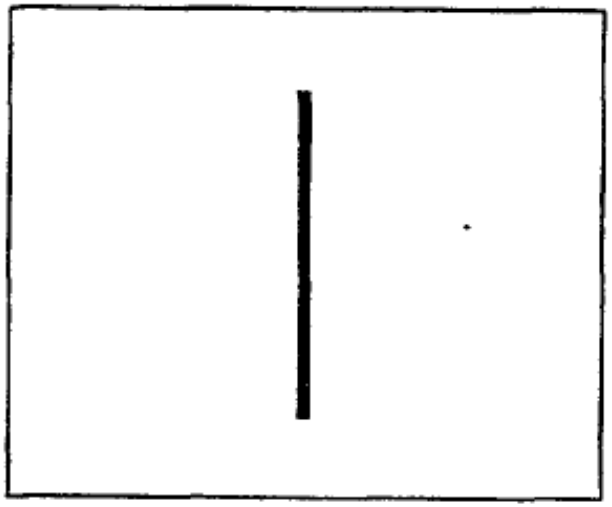


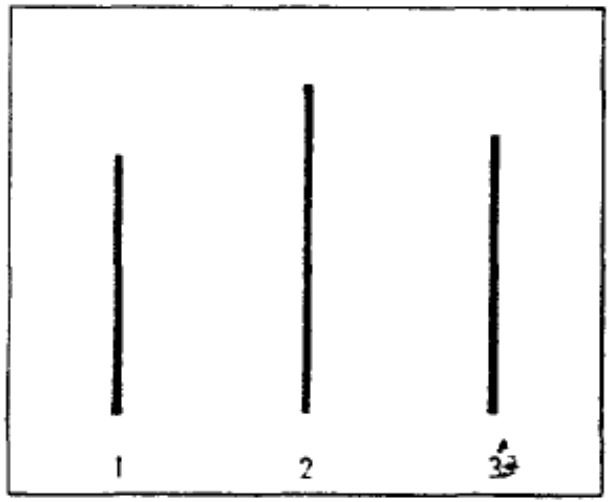
New York 1969



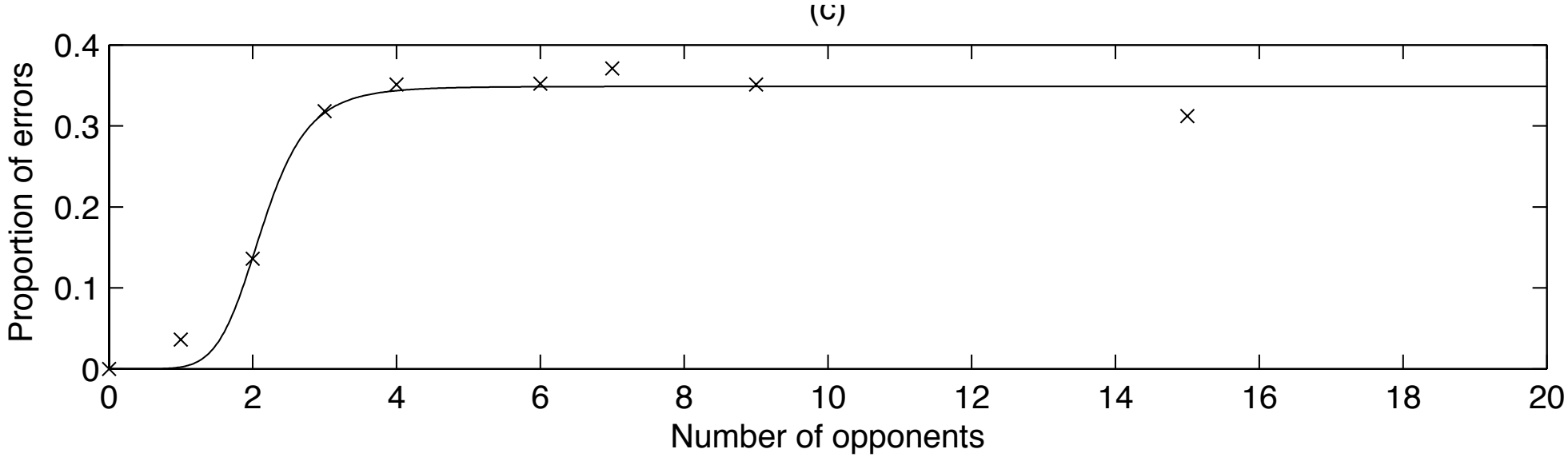
Oxford 2005

Peer pressure





Peer pressure



$$P(\mathrm{N}) = m(\mathrm{N}^k/T^k - \mathrm{N}^k),$$

$$m = 0.35,\ T = 2.13, \text{ and } k = 6.66.$$

Population dynamics

Consider the following model of a population of reproducing animals:

- Assume that a_t individuals are distributed randomly among *n* sites. This could for example be mites among bees or larvae among apples.

- At each site the individuals compete and reproduce. There are limited resources at the sites, so usually only a small number of individuals reproduce.

- The emerging individuals are then again distributed among the *n* sites and the process continues.

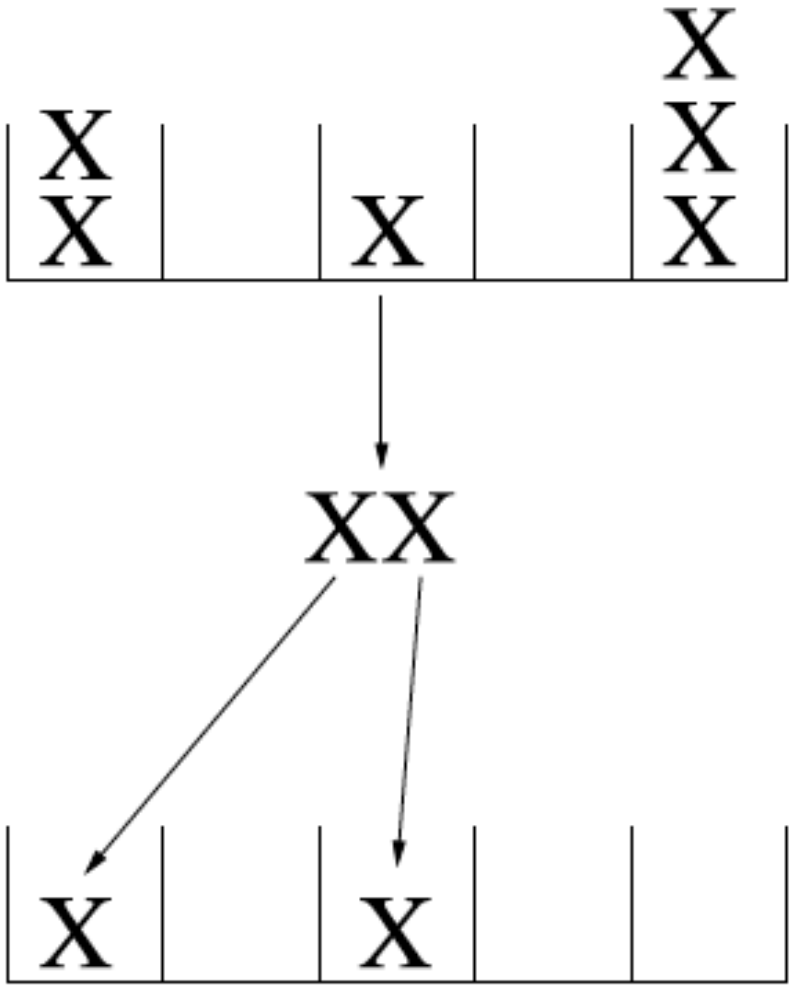
Scramble competition

Scramble competition assumes that one site can only sustain one individual but more than one leads to everyone dying. This gives the interaction function:

$$\phi(k) = \begin{cases} b & \text{if } k = 1 \\ 0 & \text{otherwise} \end{cases}$$

where *b* is the average number of offspring.

Scramble competition



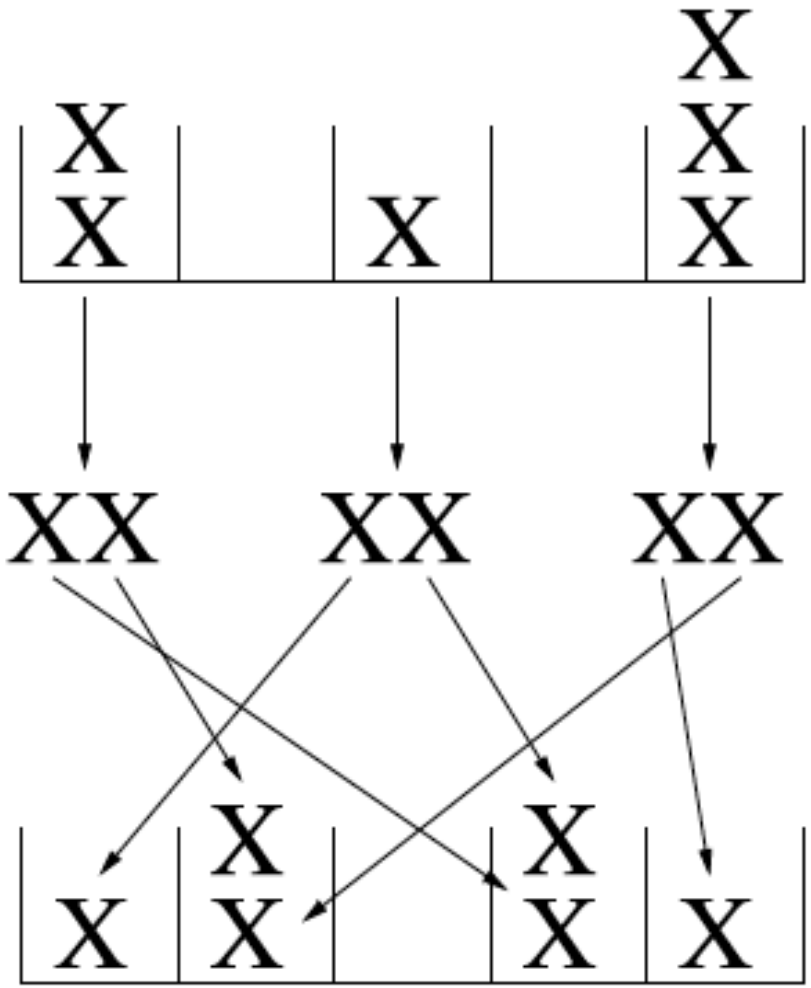
Contest competition

In contest competition a single individual takes all of the resource, but further individuals have no effect on this individual. This gives the following interaction function:

$$\phi(k) = \begin{cases} 0 & \text{if } k = 0 \\ b & \text{otherwise} \end{cases}$$

where *b* is the average number of offspring.

Contest competition



Mean-field approximation

Mean-field

Simulation (n=4000)

b=6

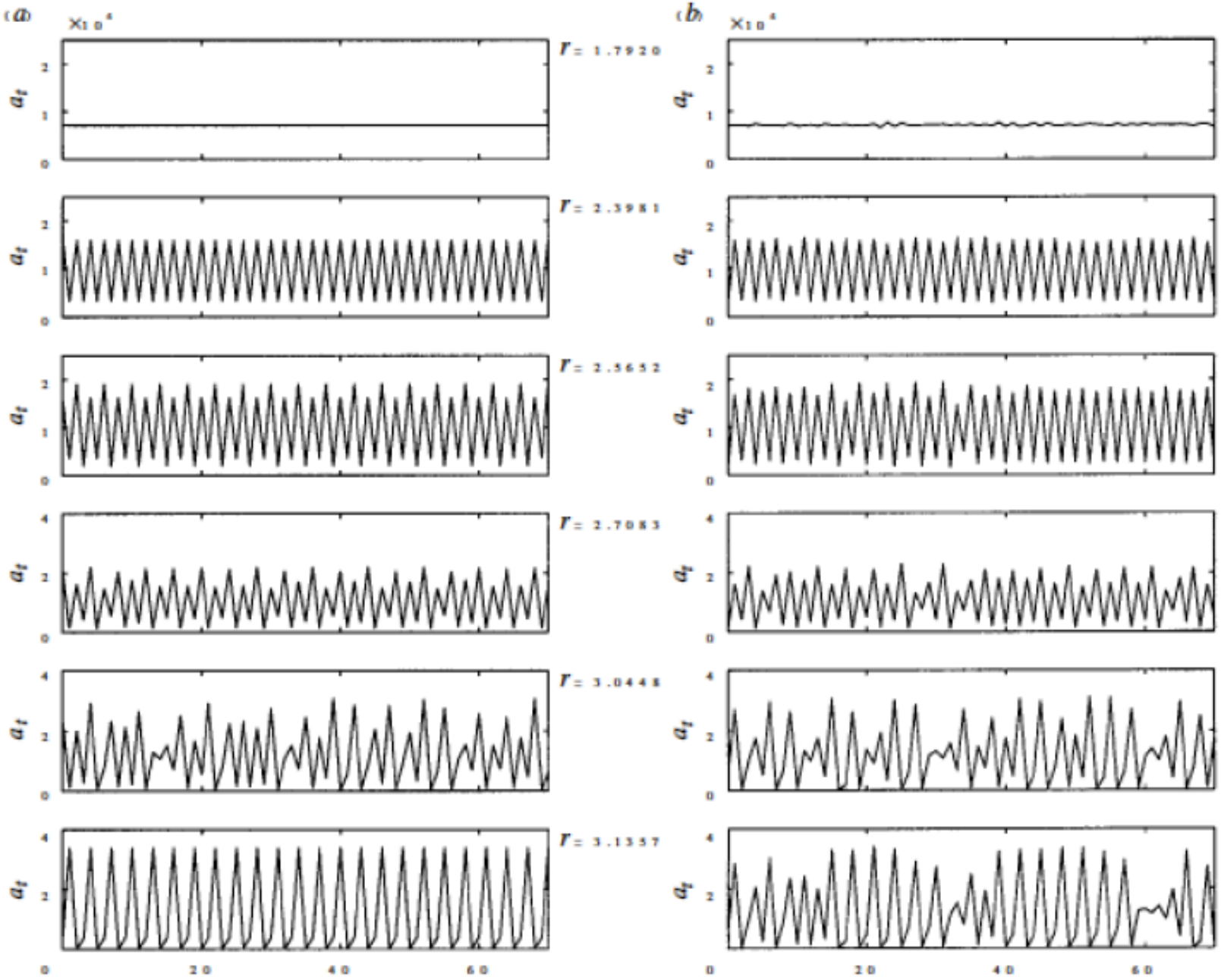
b=11

b=13

b=15

b=21

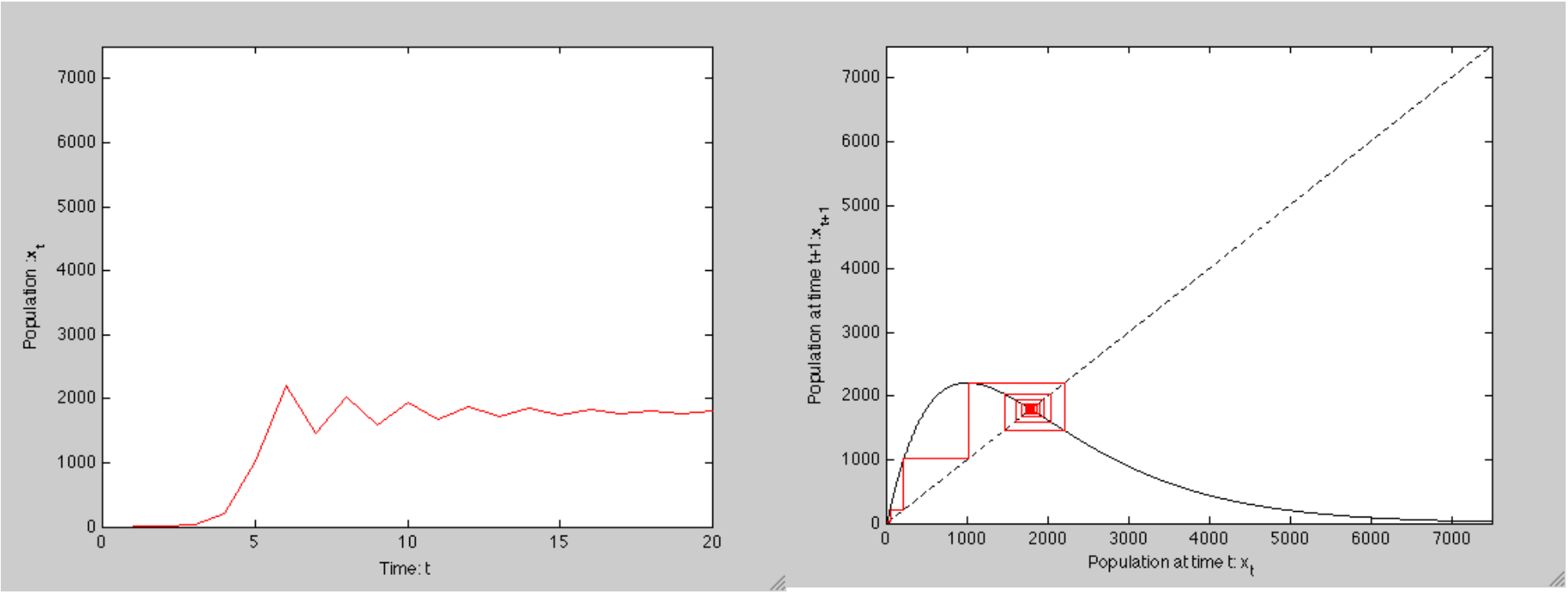
b=23



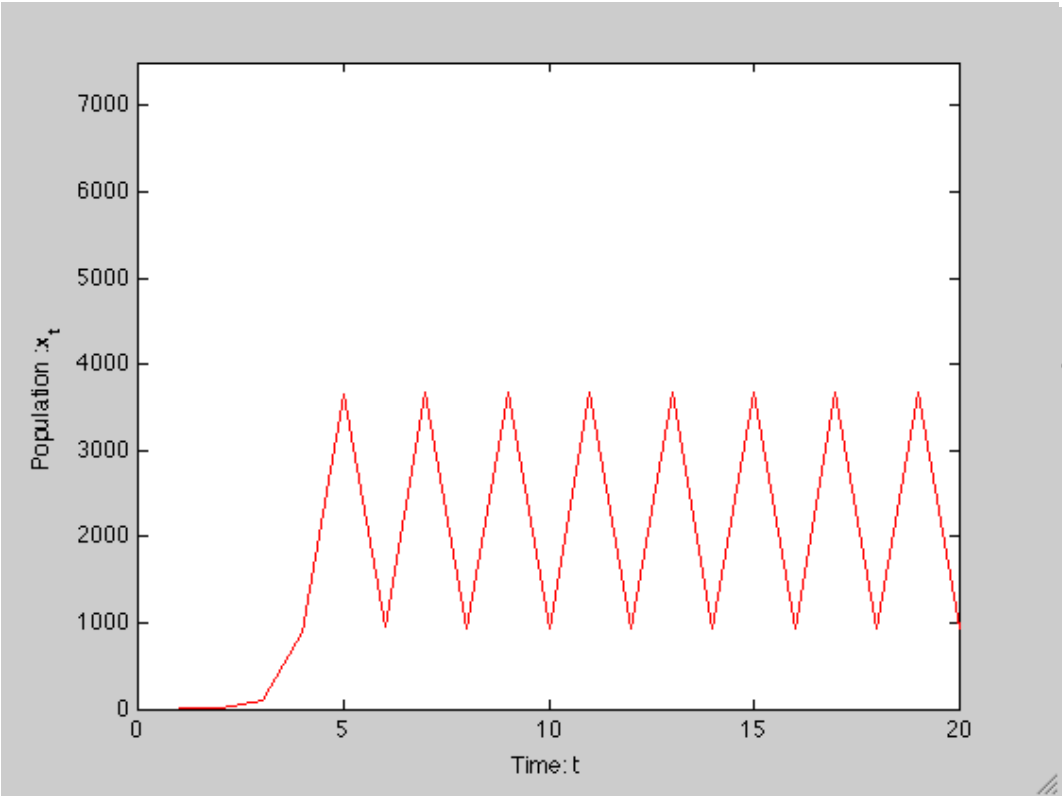
generations

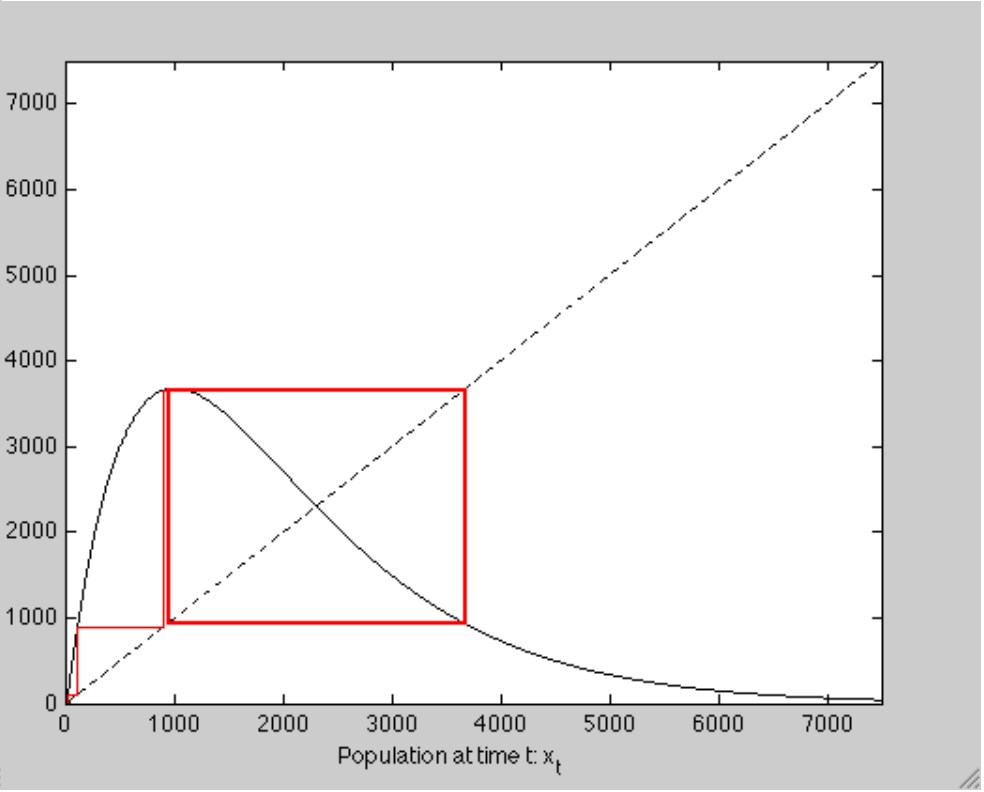
generations

b=6

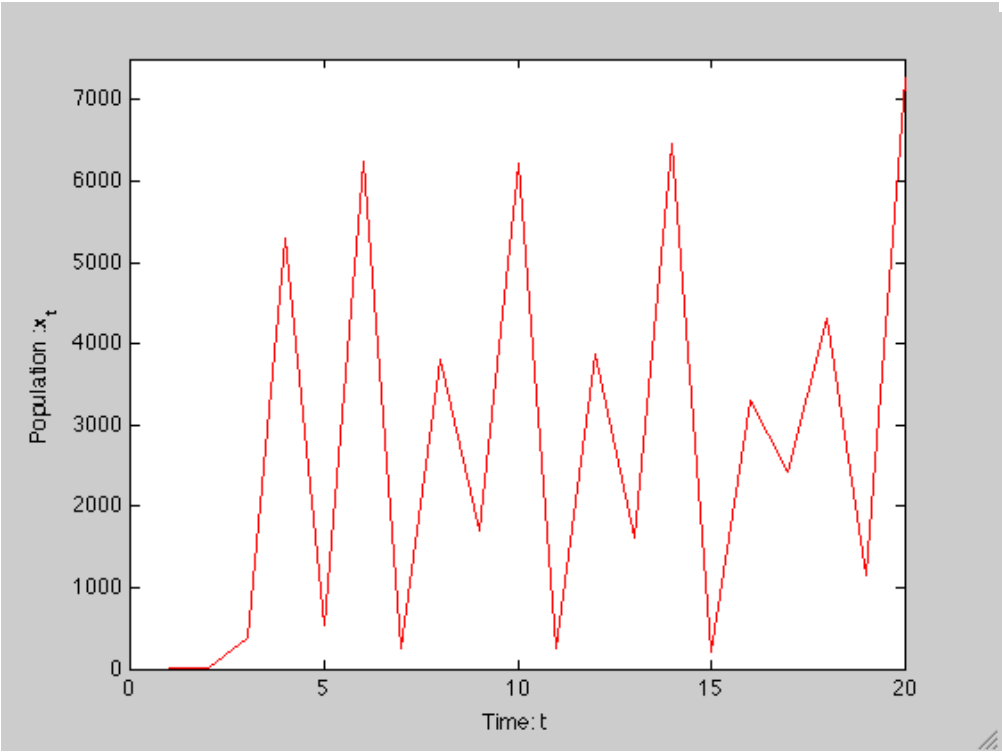

Population :x_t
Time: t
0
1000
2000
3000
4000
5000
6000
7000
0
5
10
15
20
Population at time t+1 :x_{t+1}
Population at time t: x_t
0
1000
2000
3000
4000
5000
6000
7000

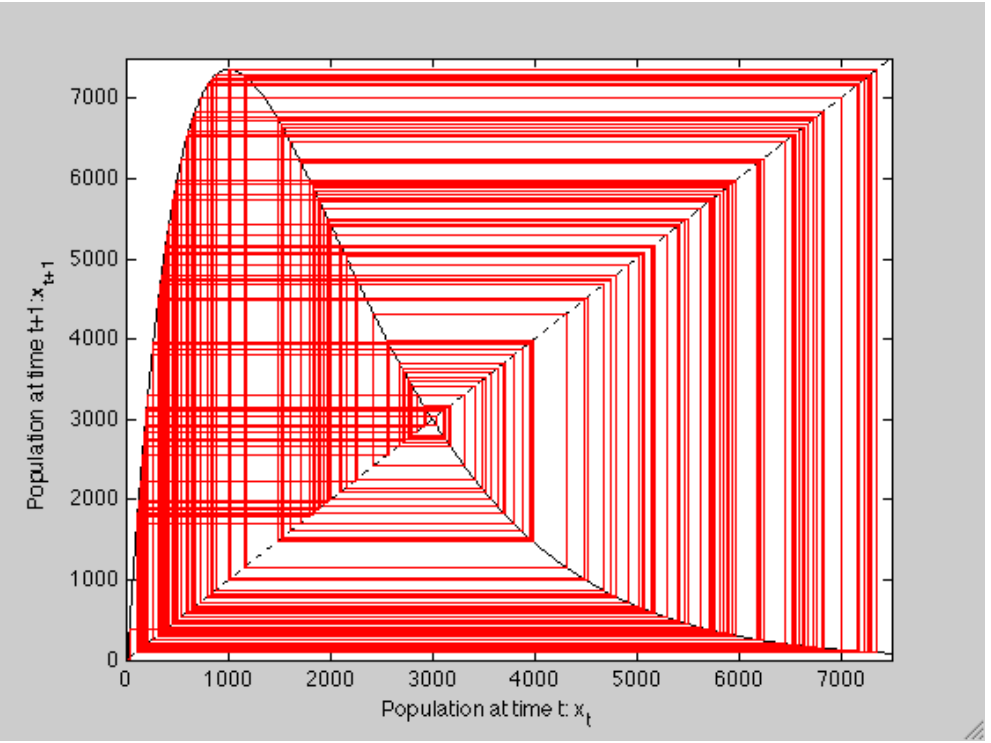
b=10

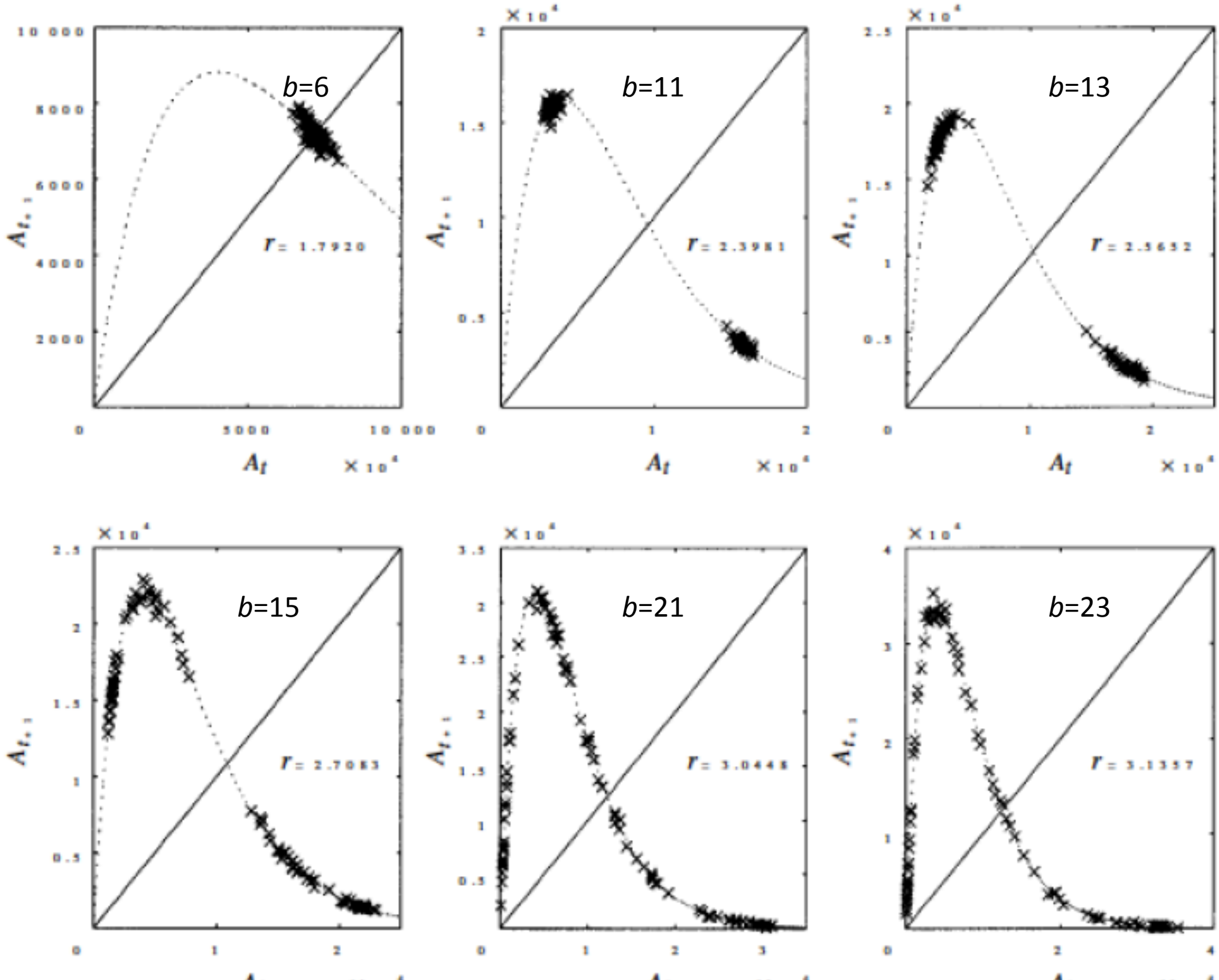

7000
6000
5000
4000
3000
2000
1000
0
Population : x_t
0
5
10
15
20
Time: t


7000
6000
5000
4000
3000
2000
1000
0
0
1000
2000
3000
4000
5000
6000
7000
Population at time t: x_t

b=20


Population :x_t
Time: t
0
1000
2000
3000
4000
5000
6000
7000
0
5
10
15
20


Population at time t+1 :x_{t+1}
Population at time t: x_t
0
1000
2000
3000
4000
5000
6000
7000


b=6
r= 1.7920
b=11
r= 2.3981
b=13
r= 2.5652
b=15
r= 2.7083
b=21
r= 3.0448
b=23
r= 3.1357
A_t
A_{t+1}
× 10^4

Entropy

Entropy measures the degree to which the probability of the system is spread out over different possible states.

Lyapunov Exponent

Lyapunov exponent gives the rate at which nearby starting values of a model diverge.