Chapter 6

Gillespie Simulations

6.1 Simulating a stochastic process

Here is Bard Ermentrout's simplest Gillespie simulation, which simulates the conversion of a substance X to some product at rate r. There is initially some number of molecules of X which gradually gets converted. The algorithm computes the waiting time of the next event (tr), and updates the amount left. (See p 102 of his book).

```
# gillespie.ode
# this implements gillespies algorithm
#  X -> Z  at rate c
par c=.5,xin=1000
init X=1000,tr=0
a0=c*X
tr'=tr+log(1/ran(1))/a0
X'=max(X-1,1)
aux cts=xin*exp(-c*tr)
@ bound=100000000,meth=discrete,total=1000
@ xlo=0,xhi=10,ylo=0,yhi=1000,xp=tr,yp=x
done
```

6.2 Growing Polymer

Exercise 6.2.1 (Simulating stochastic polymer growth)

(a) Write a code for simulating the polymerization/depolymerization of a protein. Assume that the length of the protein is N and that the rates of

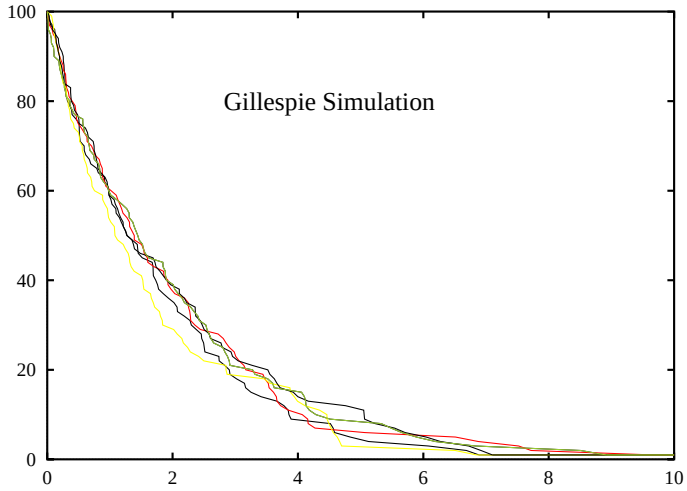

Figure 6.1: Simulation of the program gillespie.ode by B Ermentrout. (See p 102-103 in his book. The total number of molecules of X has been changed to 100 to emphasize the stochastic nature of the behaviour.

polymerization is r_p, and depolymerization is r_d and that the monomer level is kept constant, i.e. not depleted.

(b) Revise your code in (a) to consider a pool of monomer (subunits) that is depleted as the polymer grows. Assume that the polymerization rate is proportional to the number of available monomer subunits.