Zuse Institute Berlin (ZIB)
Freie Universität Berlin
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2. Homework
Numerical Modelling in Systems Biology
WS 2016/17

Deadline: November 9, 10:00 (**before** the lecture)

The homework should be worked out in groups of two or three students. Each solution sheet must contain the names and 'Matrikulationnummer' of all group members and the exercise group (Wednesday/Friday). Please staple all sheets. Programming tasks must be submitted to BioInf-Numerik@hotmail.com by email. Before sending it, please 'zip' it.

1 Stochastics

Exercise 1 (2 points)
Show that the cumulative distribution of the Exponential distribution is given by

$$P(x) = \int_0^x p(y)dy = 1 - e^{-\lambda x},$$

where $\Omega = (0, \infty)$, $x \in \Omega$ and $\lambda > 0$.

Exercise 2 (4 points)
Poisson Distribution: The state space $\Omega = \mathbb{N}_0$. Let X be distributed according to a Poisson distribution for a parameter $\lambda > 0$. Show that

$$\mathbb{V}[X] = \lambda.$$

Exercise 3 (2 points)
Let $\tau \sim U[0, 1)$. Let $P(x) = 1 - e^{-\lambda x}$ be the cumulative distribution for of the exponential distribution. Then reduce

$$\tau = 1 - e^{-\lambda x},$$

to show that the exponentially distribution random variable x can be computed using

$$x = \frac{1}{\lambda} log\left(\frac{1}{\tau}\right).$$

2 Computation

Exercise 4 (2 points)
Consider the Birth Process: Let $\Omega = \mathbb{N}_0$.

$$R_1 : \emptyset \xrightarrow{2.0} A.$$

$$X_t = 10 + \mathcal{P}\left(2t\right).$$

Compute 100 trajectories in the time interval [0, 30]. Plot these trajectories in a single plot. With time at the x–axis and population of A as the y–axis.