Applied Stochastic Processes

Homework 2

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Please send your simulation file to `cheungyinglun@cueb.edu.cn`. You can use any programming language to perform the simulation.

Exercise 1 *An epidemic caused by a new virus is spreading in City A. You are asked to evaluate the effect of several strategies in controlling the epidemic. Suppose the basic reproduction number (R_0) is estimated to be 2.3 (new cases from each old case per week). Three strategies are proposed to deal with the situation. The effective reproduction numbers (R_e) in the presence of control efforts are predicted to be 0.8, 1.2 and 1.8 respectively. Model the epidemic as a branching process and answer the following questions by means of simulation.*

1. *Suppose the epidemic has already been left to grow without intervention for 8 weeks since the first case. What is the mean and variance number of new cases this week?*
2. *For each strategy, plot the mean number of new cases after 1-52 weeks.*
3. *For each strategy, what is the probability of zero new cases after 52 weeks?*

Hint: Suppose the number of new cases from each old case follows a geometric distribution $Z_{n,i} \sim Geo(p) - 1$. Then, $\mathbb{E}[Z_{n,i}] = (1-p)/p$.