RATE CURVES FOR GEOMETRIC SERIES

S. VERONA MALONE

Specify a simulation length T and a target N of undestroyed craters at simulation end.

Generate IID resurfacing event sizes $A_{1,\ldots,n}$ from some distribution with support $[0,1]$ such that $\sum_{i=1}^{n-1} A_i < 1 \leq \sum_{i=1}^{n} A_i$. Generate n IID resurfacing event dates $t_{1,\ldots,n}$ from some distribution with support $(0,T)$ such that $t_1 < t_2 < \cdots < t_n$.

Define $t_0 = 0$. Define $t_{n+1} = T$ and $A_{n+1} = 0$, effectively placing a dummy "resurfacing event" with zero area at simulation end.

Specify a nonnegative and not identically zero function $r(t) : \mathbb{R} \to \mathbb{R}$ which measures total impact events per unit time.

Given the A_i, t_i, and $r(t)$, we wish to find the unitless scaling factor X such that the simulation produces a mean of N craters at time T.

Define a sequence $\{Y_i\}_{i=0}^{n+1}$ by

$$Y_i = \begin{cases} 0, & i = 0, \\ \left[Y_{i-1} + \int_{t_{i-1}}^{t_i} r(t)\ \mathrm{d}t\right](1 - A_i), & i = 1, \ldots, n+1. \end{cases}$$

Y_i represents the unscaled mean of undestroyed craters at time t_i. It is apparent that $X = N/Y_{n+1}$.