

1. Consider the extended shoeshine case of Example 1 in the notes, where the shop may accommodate two customers simultaneously. Redo Example 6 for this extended case. That is, find the fraction of time that the shop is busy.
2. Potential customers arrive at a single-server station in accordance with a Poisson process with rate λ . However, if the arrival finds $n \geq 1$ customers already in the station, then he will enter the system with probability α_n . Assume an exponential service time μ .
 - (a) Set this up as a birth-death process and determine the birth death rates.
 - (b) Draw the transition diagram for this birth-death process.
3. Each individual in a biological population is assumed to give birth at an exponential rate λ , and to die at exponential rate μ . In addition there is an exponential rate of increase of θ per person due to immigration. However, immigration is not allowed when the population size is N or larger.
 - (a) Set this up as a birth and death process.
 - (b) Draw the transition diagram for this birth-death process.
 - (c) If $N = 3$, $\lambda = \theta = 1$, and $\mu = 2$, determine the proportion of time that immigration is restricted.