1. Let \( T \) be a r.v. with
   \[
   P(T \leq t) = 1 - \frac{1}{(1 + t)^3}, \quad t \geq 0.
   \]
   Let \( N_t \) be a Poisson process with rate \( \lambda = 5 \).
   (a) Find \( E(N_T) \) and \( Var(N_T) \) by simulation.
   (b) Find \( E(N_T) \) analytically.
   (c) Find \( Var(N_T) \) analytically.

2. A queue has Poisson arrivals with rate \( \lambda \) and exponential service times with rate \( \mu \). When a customer arrives it joins the queue with probability \( 1/(n+1) \) if there are \( n \) customers present, otherwise it disappears (does not join the queue).
   (a) Draw the transition diagram for the model.
   (b) Find the steady state probabilities for the states, and find the expected number in the system when \( \lambda = 10 \) and \( \mu = 1 \). (You can do this numerically with Matlab.)
   (c) Check your answer to (b) by simulating the model.

3. Let \( X_t = BM(2, 9) \), i.e., Brownian motion with drift \( \mu = 2 \) and variance parameter \( \sigma^2 = 9 \). Use simulation to find the probability that \( X_t \) reaches +10 before reaching -10.