1.010 Uncertainty in Engineering
Fall 2008

1.010 – Mini-Quiz #2
(45 min – open books and notes)

Problem 1 (40 Points)
A community of bacteria initially includes 1000 individuals. Given favorable conditions (light, temperature, nutrients), the community doubles in size during a unit time period, for example one day. If conditions are unfavorable, the community downsizes by a factor of 2.

Suppose that favorable conditions occur with probability 0.6, and unfavorable conditions with probability 0.4, and that favorable/unfavorable conditions are independent in different time periods (days). Find the probability mass function of the number of individuals after 3 time periods.

Problem 2 (20 Points)
At a given site, flood-producing storms occur infrequently. Considering the three conditions under which a point process is Poisson, state reasons for or against modeling the storm arrival times as a Poisson point process.

Problem 3 (40 Points)
The lifetime T of electric bulbs (e.g. the number of hours in operation before they fail) has an exponential distribution with cumulative distribution function:

$$F_T(t) = 1 - e^{-\left(\frac{1}{1000}\right)t} \quad \text{for } t \geq 0 \text{, with t in hours.}$$

Suppose you have used a bulb for 500 hours without failure. Find the probability that the bulb will last at least 500 more hours.

Hint: Use $P[A|B] = P[A \cap B]/P[B]$, with appropriately defined events A and B.