

MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
Department of Electrical Engineering & Computer Science  
**6.041/6.431: Probabilistic Systems Analysis**  
(Fall 2010)

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**Recitation 14**  
**October 26, 2010**

1. You are visiting the rainforest, but unfortunately your insect repellent has run out. As a result, at each second, a mosquito lands on your neck with probability 0.5. If one lands, with probability 0.2 it bites you, and with probability 0.8 it never bothers you, independently of other mosquitoes.
  - (a) What is the expected time between successive mosquito bites? What is the variance of the time between successive mosquito bites?
  - (b) In addition, a tick lands on your neck with probability 0.1. If one lands, with probability 0.7 it bites you, and with probability 0.3, it never bothers you, independently of other ticks and mosquitoes. Now, what is expected time between successive bug bites? What is the variance of the time between successive bug bites?
2. Al performs an experiment comprising a series of independent trials. On each trial, he simultaneously flips a set of three fair coins.
  - (a) Given that Al has just had a trial with 3 *tails*, what is the probability that both of the next two trials will also have this result?
  - (b) Whenever all three coins land on the same side in any given trial, Al calls the trial a success.
    - i. Find the PMF for  $K$ , the number of trials up to, but *not* including, the second success.
    - ii. Find the expectation and variance of  $M$ , the number of tails that occur *before* the first success.
  - (c) Bob conducts an experiment like Al's, except that he uses 4 coins for the first trial, and then he obeys the following rule: Whenever all of the coins land on the same side in a trial, Bob permanently removes one coin from the experiment and continues with the trials. He follows this rule until the *third* time he removes a coin, at which point the experiment ceases. Find  $E[N]$ , where  $N$  is the number of trials in Bob's experiment.
3. Suppose there are  $n$  papers in a drawer. You draw a paper and sign it, and then, instead of filing it away, you place the paper back into the drawer. If any paper is equally likely to be drawn each time, independent of all other draws, what is the expected number of papers that you will draw before signing all  $n$  papers? You may leave your answer in the form of a summation.

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