Bilkent University Physics Department
Phys 552 (Spring 2009) Homework 1 Due February 27 2009

Question 1: In a paper published in year 2000 Aykut Barka and colleagues estimated the probability of occurance of a major earthquake in Istanbul in the following 30 years as 60%. (The paper may be accessed through the link
http://quake.usgs.gov/research/deformation/modeling/papers/istanbul/istanbul.pdf)

(a) Assuming a constant event rate for the process, determine this rate. (In your answers to this question, use "years" as your basic unit of time.)

(b) What is the expected waiting time $< t >$?

(c) Find the fluctuation $\Delta t = \sqrt{< t^2 > - < t >^2}$ in this variable.

(d) In how many years does the probability of occurance reach 90%?

(e) Assume that the event rate was zero at the time the paper was published, but has been increasing linearly since then, *i.e.* $\omega(t) = \alpha t$, where $t = 0$ corresponds to year 2000. Find the value of α that would result in the same 60% event probability in 30 years.

(f) Repeat parts (b), (c), and (d) above for this rate.

Question 2: A system can be in one of two states. Transition rates between these states are given as $\omega_{1\to 2}$ and $\omega_{2\to 1}$. Given that at time $t = 0$ the system is known to be in state 1.

(a) Find the probabilities $P_1(t)$ and $P_2(t)$ of the system being in state 1 or state 2 as functions of time.

(b) Show that the probabilities will behave as expected from our discussion in class when $\omega_{2\to 1} = 0$.