HST.950 /6.872

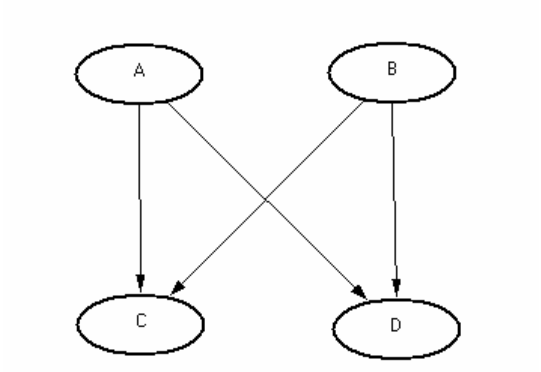
Problem Set 8

Due 11/9/2004

1. You have a patient with cancer who has a choice between surgery and chemotherapy. If the patient chooses surgery, she has a 2 percent chance of dying from the operation (life expectancy = 0), a 50 percent chance of being cured (life expectancy = 15 years), and a 48 percent chance of not being cured (life expectancy = 1 year). If the patient chooses chemotherapy, she has a 5 percent chance of death (life expectancy = 0), a 65 percent chance of cure (life expectancy = 15 years), and a 30 percent chance that her cancer will be slowed but not cured (life expectancy = 2 years). Calculate the patient's expected life expectancy while assuming rational and informed decisions.

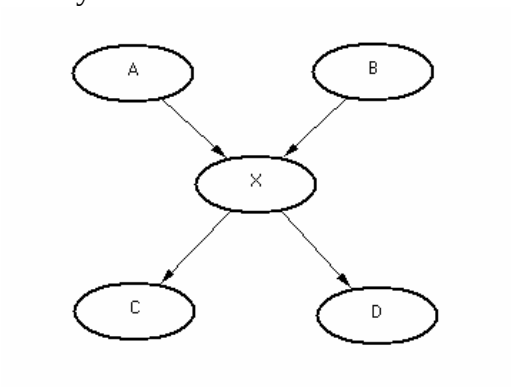
2. You are asked to interpret a PCR HIV test in an asymptomatic man whose test was positive when he volunteered to donate blood. After taking his history, you learn that he is an intravenous-drug user. You know that the overall prevalence of HIV infection in your community is 1 in 500 and that the prevalence in intravenous-drug users is 20 times as high as in the community at large.
   a. Estimate the pretest probability that this man is infected with HIV (please include your calculation).
   b. Suppose the PCR HIV test performed has a sensitivity of 0.9 and a specificity of 0.8, and assume the pretest probability is 0.1. Calculate the post-test probability that the patient has HIV.

3. Answer the following questions according to the given Bayesian networks (assume all variables are binary):



   a. What are the parameters we need to have in this model?
   b. If we use Noisy-Or model to model the same structure, i.e. C and D may both be caused by A and B, how many parameters do we need? What underlining assumptions are we making in addition to those in the Bayesian model?

c. Suppose we introduce another variable X (a hidden variable), and the model can be transformed into the following structure. What parameters does this new Bayesian Network have?



4. Please represent the following probabilities using the parameters in 3(c):
   a. P(C=0 | A=0)
   b. P(A=1 | B=0)
   c. P(D=1 | A=1, X=0)
   d. P(B=0 | A=0, X=1)
   e. P (D=0)