Tutorial

Bayesian Networks

(Basics of probability theory)

October 29, 2007
Solutions should be given till November 5, 2007, 16:00

1. Suppose, the following joint probability distribution is given.
   The variables are P=Payment (good/bad) , T=Term of year (summer/winter), D=Delay of a train (no/low/high), S=Strike (yes/no)

	P=g						P=b					
	T=s			T=w			T=s			T=w		
	D=n	D=l	D=h	D=n	D=l	D=h	D=n	D=l	D=h	D=n	D=l	D=h
S=y	0.001	0.002	0.005	0.001	0.002	0.005	0.01	0.05	0.1	0.01	0.05	0.1
S=n	0.25	0.05	0.001	0.25	0.05	0.001	0.02	0.01	0.001	0.02	0.01	0.001

   Questions:
   (a) What is the marginal probability distribution of D? (2 points)
   (b) What is the marginal probability distribution of T? (2 points)
   (c) What is the conditional probability distribution of D conditioned by S? (5 points)
   (d) Give a short discussion (1-2 sentences), whether it is possible to reconstruct the original joint probability distribution from the conditioned distribution? (3 points)
   (e) Is any of the variables independent from the set of the others? If your answer is yes, show at least one such variable. If your answer is no, show that none of the variables is independent from the set of the others. (6 points)
   (f) Is any of the variables conditionally independent from any other variable (or set of variables) conditioned by any variable (or set of variables)? Explain your answer. (6 points)

2. Suppose, that a doctor knows that stress causes asthma with a probability of 0.05, i.e. the conditional probability of asthma conditioned by stress is P(Asthma=YES | Stress=YES) = 0.005. Suppose, that the probability of stress is P(Stress = YES) = 0.3 and the probability of asthma is P (Asthma = YES) = 0.1 . If the doctor diagnoses that the patient has asthma, what is the probability that the patient has stress as well?
   (What is P(Stress = YES | Asthma = YES) ?) (5 points)