Bayesian Networks Winter 2008/2009
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2. Exercise Sheet

Exercise 5 Conditional Probabilities

a) Four balls are placed into four boxes one after another. All 4^4 orders be equally likely. What is the probability that a box contains exactly three balls given the fact that the first two balls have been placed into different boxes?

b) A family has two children. What is the probability of both being girls if is known that at least one of them is a girl?

c) What is the probability of b) if it is known that the younger child is a girl?

Exercise 6 Stochastic Independence

a) A wheel of fortune has 36 numbered sectors (numbers 1 to 36). These sectors are colored in red (R) or blue (B) according the following scheme:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
R	R	R	R	R	B	B	B	B	R	R	R	R	B	B	B	B	B
36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20	19

We consider the three events

A : the wheel stops in a red sector,
B : the wheel stops in a sector with an even number,
C : the wheel stops in a sector with a number ≤ 18.

Show that these events are pairwise independent but that $P(A \cap B \cap C) = P(A)P(B)P(C)$ does not hold.

b) Two fair dice, red and white, are cast. We consider the following three events:

A : the red die shows up 1 or 2,
B : the white die shows up 3, 4 or 5,
C : the sum of the spots of both dice is 4, 11 or 12.

Show that $P(A \cap B \cap C) = P(A)P(B)P(C)$ holds but not the pairwise independence.

Exercise 7 Bayes Theorem

a) A weather satellite sends a binary encoded description of a developing storm. Inevitable noise (atmospheric inferences) causes transmission errors. Assume the message contains 70% zeros and the probability of correctly receiving a sent bit is 80%. What is the probability of having sent a zero if a one was received?

b) Color blindness affects 5 out of 100 men and 25 out of 10000 women. A color blind person is randomly picked. What is the probability of this person being male?

Exercise 8 Bayes Theorem

a) In a given population, 2% of all persons suffer a certain desease. Let a test have the property that it correctly recognizes an ill person with 95% probability whereas the rate of correctly revealing a healthy person in 99%. What is the probability that a person does (not) suffer from the desease if the test does (not) reveal the desease?

b) Consider two urns. Urn 1 contains two white and one red ball, urn 2 one white and two red. First, a ball from urn 1 is randomly chosen and placed into urn 2. Finally, a ball from urn 2 is picked. This ball be red: What is the probability that the ball transferred from urn 1 to urn 2 was white?

Additional Exercise Probabilities: Triple Duel

A, B and C compete against each other in a duel with pistols simultaneously. A is the worst shooter: His chance of hitting the target is 0.3. The chance of C is 0.5 whereas B never misses his target. The three shot in order A, B, C, A, ... at a target of their choice (of course, who was shot, quits the game) until just one of them is left. Which is A's best strategy?