HOCHSCHULE BONN-RHEIN-SIEG

PMR, Quiz 03

SUMMER SEMESTER 2018

1. Answer the following questions:

   (a) What is marginalisation?

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   (b) Write down the law of total probability (the conditioning rule).

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   (c) What is the qualification problem?

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   (d) What is conditional independence?

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   (e) Why is Bayes' rule useful in practice?

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   (f) What are mutually exclusive and exhaustive events?

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   (g) What is inference? How can we infer the distribution of a variable X given an evidence set of variables e?

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   (h) When do we say that two events are independent? Why do we care about independence when specifying probability distributions?

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2. Show that $P(A, B|C) = P(A|C)P(B|C)$ is equivalent to $P(A|B, C) = P(A|C)$.

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3. Assume that we are given two random variables X and Y, both of which are discrete, such that X takes the values 0 and 1, while Y takes the values 0, 1, and 2. The probability distribution functions of the random variables are given as follows:

$$f(x) = \begin{cases} \frac{1}{3}, & x = 0 \\ \frac{2}{3}, & x = 1 \\ 0, & \text{otherwise} \end{cases} \qquad f(y) = \begin{cases} \frac{1}{4}, & y = 0, 2 \\ \frac{1}{2}, & y = 1 \\ 0, & \text{otherwise} \end{cases}$$

Calculate the joint probability distribution of X and Y under the assumption that the variables are independent. Write your results in the following table:

X \ Y	**0**	**1**	**2**
0			
1			

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4. Let's revisit the youBot tool picking problem from last week's quiz and assignment. In the problem, we assumed that a box in the RoboCup@Work lab has 100 tools inside - 20 wrenches, 50 screwdrivers, and 30 pairs of pliers. If the robot picks up a wrench, there is a 0.2 probability that it will drop it; similarly, there is a 0.1 probability that it will drop a screwdriver and a 0.3 probability that it will drop a pair of pliers.

   (a) What is the prior probability that the robot will pick up a wrench?

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   (b) What is the probability that a tool will be dropped?

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   (c) If we know that a tool was dropped, what is the probability that a screwdriver had been picked up?

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