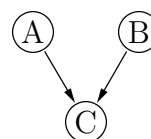**Exercise Sheet 5**

Exercise 15   Bayesian Networks

Consider the following three-dimensional probability distribution:

| p_{ABC} | $A = a_1$ | | $A = a_2$ | |
	$B = b_1$	$B = b_2$	$B = b_1$	$B = b_2$
$C = c_1$	$4/24$	$3/24$	$3/24$	$2/24$
$C = c_2$	$2/24$	$3/24$	$3/24$	$4/24$

Check whether the graph depicted next to the table can be the underlying network structure describing the distribution! If yes, specify the probability distributions that are needed to define the Bayesian network!

Exercise 16   Bayesian Networks

Consider the following four-dimensional probability distribution:

| p_{ABCD} | | $A = a_1$ | | $A = a_2$ | |
		$B = b_1$	$B = b_2$	$B = b_1$	$B = b_2$
$C = c_1$	$D = d_1$	$16/82$	$4/82$	$4/82$	$4/82$
	$D = d_2$	$4/82$	$1/82$	$4/82$	$4/82$
$C = c_2$	$D = d_1$	$4/82$	$4/82$	$1/82$	$4/82$
	$D = d_2$	$4/82$	$4/82$	$4/82$	$16/82$
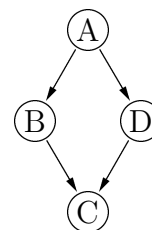
Check whether the graph depicted next to the table can be the underlying network structure describing the distribution! If yes, specify the probability distributions that are needed to define the Bayesian network!

Exercise 17   Constructing Bayesian Networks

Construct the graph of a Bayesian network that models the following situation [Finn V. Jensen: An Introduction to Bayesian Networks, UCL Press, London, UK 1996]:

> Mr Holmes is working at his office when he receives a telephone call from Watson, who tells him that Holmes burglar alarm has gone off. Convinced that a burglar has broken into his house, Holmes rushes to his car and

heads for home. On the way he listens to the radio, and in the news it is reported that there has been a small earthquake in the area. Knowing that earthquakes have a tendency to turn the burglar alarm on, he returns to his work leaving his neighbours the pleasure of the noise.

Of course, there a various ways of modelling this scenario. Please keep you model simple and introduce only variables that are necessary for Mr Holmes to assess the situation! Specify the factorization that is implied by your graph! Finally, determine the probability distributions from the following facts:

- Burglary is rare, earthquakes even rarer.
- There are very little earthquakes about which there is no news report.
- A false report about an earthquake is extremely rare.
- The alarm is quite reliable, however, during an earthquake it might easily produce a false alarm.
- A false alarm with another cause is possible, albeit unlikely.

The phrases, of course, do not fix any numbers. Choose meaningful values that model the linguistic propositions adequately!

Exercise 18   Conditional Independence

Which conditional and unconditional (marginal) dependencies and independencies hold true between the following variables:

a) Position of accelerartor pedal, engine rotation speed, vehicle speed
b) Amount of precipitation, amount of deployed fertilizer, crop yield
c) Number of swimming accidents, amount of consumed ice cream, outside temperature
d) Number of storks, birth rate, coffee price

What do the respective graph structures look like?