

Exercise Session 7

Submission: If you *cannot attend* the exercise session then you are required to submit a report *before the start of exercise session on Thursday (28th Nov 2013)*.

Lectures Covered: Bayesian networks

1. Bayesian network structure

- a. Install package Bnlearn. See what it contains.
- b. b. Learn Bayesian network structure for "learning.test" data using a score based method Hill-climbing. Discuss the network and how it is produced.
- c. Use the Grow-shrink algorithm which is a constraint based method to learn alternative structure for the data. Compare two networks. Discuss the possible differences and highlight them in a plot.
- d. You have expert knowledge about the links in the network. Say, links in the network obtained using the Hill-climbing method Include your information as a constraint when relearning the structure using Grow-shrink algorithm. Verify that the new structure is equivalent to the structure learned using the Hill-climbing method

(Hint: You may want to check script learn_bn.r.)

2. More Bayesian networks

Load Sach data. Discretize the data using Bnlearn package. Create networks 500 random networks and use the Hill-climbing method to learn Bayesian networks. Measure the strength of the probabilistic relationships expressed by the arcs of the Bayesian networks and use model averaging to build a network containing only the significant arcs. Do similar analysis using bootstrapping with 500 replicates. Compare the averaged networks. Discuss your findings and the methods.

(Hint: See script Sachs.R.)

References:

1. Marco Scutari: Learning Bayesian Networks with the bnlearn R Package *Journal of Statistical Software*: July 2010, Volume 35, Issue 3. <http://www.jstatsoft.org/>
2. <http://www.bnlearn.com/book-useR/>
3. Sachs K et al. (2005). Causal Protein-Signaling Networks Derived from Multiparameter Single-Cell Data. *Science*, 308(5721), pages 523-529.