

Probabilistic Graphical Models - Problem Set 9

Structure Learning in Bayesian Networks

We consider an idealized experiment where the empirical distribution is such that $P(x_1) = 0.5$, and $P(y_1 / x_1) = 0.5 + p$ and $P(y_1 / x_0) = 0.5 - p$, where p is a free parameter, that determines the experiment.

Note that larger values of p imply stronger dependence X and Y . However, the marginal distribution of X and Y is the same regardless of the value of p . Thus, the score of the empty structure G_\emptyset , does not depend on p . On the other hand, the score of the structure $G_{X \rightarrow Y}$ depends on p . The following figure illustrates how these scores change as function of the number of training samples for each one of the experiments. The graph compares the average score per instance for both structures, for different values of p .

Question 1

Explain each of the following in a few sentences:

- The results presented in the graph.
- How these results comply with what we've seen about the marginal likelihood (specifically, about the growth-rates of the different terms).
- Compare the score behavior described in (b) to the behavior of the Maximum Likelihood score in similar experiments.

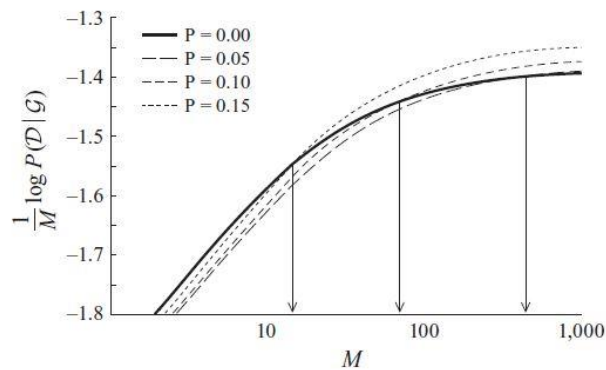


Figure 18.3 The effect of correlation on the Bayesian score. The solid line indicates the score of the independent model G_\emptyset . The remaining lines indicate the score of the more complex structure $G_{X \rightarrow Y}$, for different sampling distributions parameterized by p .