Bayesian Robustness
IMS Lecture Notes - Monograph Series (1996) Volume 29

NUMERICAL TECHNIQUES FOR SOLVING ESTIMATION PROBLEMS ON ROBUST BAYESIAN NETWORKS[1]

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The Bayesian net is a formalism for structuring multidimensional distribution when initial data are scarse. It proved to be very useful in modeling of systems which depend on random parameters, in particular in image processing, reliability analysis, processing of medical information. In these cases very often it is impossible to recover the distribution with reasonable precision, but it is possible to identify a set of distributions to which the true distribution belongs. We consider the problem to define the lower and the upper bound for the functional defined on such a set. This gives rise to nontrivial optimization problems in the space of probability measures. We describe some algorithms for solving such optimization problems based on random search and linear programming techniques.

1. Introduction. In this paper we present numerical algorithms for solving problems of a special type which arise in a priori and a posteriori estimation of functions defined on Bayesian Networks (Pearl (1988)). In particular we present some results on modelling and optimization of complex stochastic systems in the case when the distribution functions of random parameters are only partially known (Ermoliev *et. al* (1985), Gaivoronski (1986)).

We consider systems which can be described by means of a set of functions $f^k(x,\zeta) : X \times \Omega \to \Re, k = 0, 1, \dots n$, where $x \in X \subseteq \Re^q$ represents controlled parameters and ζ is the vector of random parameters defined on appropriate probability space.

Usually one is interested in estimate of some characteristics of a system for fixed values of control parameters x, i.e. in finding the estimates of

$$\mathbf{E}\, f^k(x,\zeta) = \int_\Omega f^k(x,\omega)\, \mathrm{d}H^*(\omega), \quad k = 0, 1, \dots n \tag{1}$$

where ω and H^* are respectively a realization and the distribution of random parameters ζ. The next and more difficult step is to select the control parameters x in an optimal way, i.e. solve the following optimization problem:

$$\min_{x \in X} \mathbf{E}\, f^0(x,\zeta) \tag{2}$$

with possible constraints on values of functions $\mathbf{E}\, f^k(x,\zeta)$.
In this paper we consider the case when the distribution function H^* is not

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[1] AMS 1991 *Subject Classifications.* Primary: 30E05, secondary: 65K10.

Key words and phrases. Generalized moment constraints, Bayesian Networks, estimations procedures, manufacturing.