INTERNATIONAL CENTRE FOR MECHANICAL SCIENCES

COURSES AND LECTURES - No. 114

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LINEAR ADAPTIVE DECISION FUNCTIONS AND THEIR APPLICATION TO CLINICAL DECISION

COURSE HELD AT THE DEPARTMENT
FOR AUTOMATION AND INFORMATION
JUNE - JULY 1971

Springer-Verlag Wien GmbH 1971

Originally published by Springer-Verlag Wien-New York in 1972

ISBN 978-3-211-81222-8 ISBN 978-3-7091-2876-3 (eBook)
DOI 10.1007/978-3-7091-2876-3

P R E F A C E

This lecture deals with the application of linear methods of pattern recognition theory to clinical, particularly diagnostic decision. Vector of symptoms (symptomcomplex) measured in a patient represents a pattern, that is necessary to be fit into one of the possible diagnostic classes. The knowledge a priori accumulated by medical science combined with the possible application of adaptive (trainable) clinical decision algorithms provide the best conditions for the use of computers in clinical practice as well as in clinical research.

It should be emphasized in the beginning that clinical decision differs in some regards from the current standard classification of geometrical patterns. First of all, the empirical evidence at our disposal does not suggest that the symptomcomplex (considered as a random vector defined by a statistical ensemble of patients) is distributed according to some of the standard parametric distributions. Therefore simple statistical methods based on parameters estimation cannot be used.

Another particularly is associated with the really obtainable range of empirical evidence. A standard symptomcomplex is composed of hundreds binary components. Hence, with regards to what was said in the preceding paragraph, it is necessary to esti-

mate $2^{100} - 2^{1000}$ parameters for the determination of information usable for adaptation forms as a rule a thousand, or in the best case a few thousands empirical symptomcomplexes. (That depends on concrete conditions under which the data are collected at clinics). This means that there is relatively very low ratio between the range of procurable empirical evidence and the dimension (informativeness) of the patterns in the clinical situation we have considered. This characteristic feature should be taken into account when the choice of clinical adaptive procedure is being made.

Let us characterize briefly the content of the following chapters. Chap. 1, 2 present a general statistical approach to the theory of adaptive decision functions. Wald's decision model is defined there and within its frame Bayes' optimum decision is introduced. Further, within the frame of the same model, the concept of general adaptive decision function is defined and asymptotic optimality and suboptimality of these functions is introduced.

In Chap. 3 there is the interpretation of a general model, as referred to in Chap. 1, 2 within the framework of clinical situations of the following three types: a) prognostic, b) therepeutic, c) diagnostic decision.

Chap. 4 is concerned in three concrete types of linear adaptive decision functions, which appear to be usable in diagnostic decision from both the theoretical point of view. These are in certain way modified adaptive functions known from the literature, called here Steinbuch, Bayes and stochastic-approximation functions. Each of these adaptive functions contains free optional parameters by means of which its properties can be modified and optimized.

In Chap. 5 a computer program for experimentation with the adaptive functions of Chap. 4 on the basis of concrete clinical data is described briefly. The program has been worked out in the Cybernetics research group of UHKT in Prague

Udine, July 1971