NASA TECH BRIEF

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Computer Program Calculates Monotonic Maximum Likelihood Estimates Using Method of Reversals

The problem:

To devise a method for rapidly calculating the maximum likelihood estimates of a monotonic non-decreasing response function. The method must apply to the analysis of univariate or multivariate sensitivity experiments. In univariate sensitivity experiments, the threshold at which an increase in stimulus produces a measured response has an assumed monotonicity. That is, with increasing stimulus, the probability of a response is at least nondecreasing. Commonly used methods for the design and analysis of such experiments use the binomial distribution as a model for analyzing the data generated at a particular stimulus level. However, if these estimates exhibit a "reversal" (response decreases with increasing stimulus) then a procedure is necessary for "correcting" the estimates so that they conform to the monotonicity assumption. To avoid tedious and time consuming study of the response and individually replacing estimates which are nondecreasing, it is desired to find initially the estimates with maximum likelihood properties within the framework of monotonicity.

The solution:

A Fortran II computer program for the complete ordering of sensitivity response probabilities by using an algorithm called the method of reversals.

How it's done:

Univariate response probabilities are completely or linearly ordered, and the estimates can be found by the method of reversals. Multivariate response probabilities are only partially ordered, and a second, more complicated algorithm, based on the known partial ordering, is given to find a complete ordering. The method of reversals may then be applied as in the univariate case. The multivariate response estimates are at a maximum likelihood under the initial assumption that the sensitivity parameters are monotone non-decreasing in each stress variable. However, a complete ordering resulting from the application of the second algorithm need not be unique. Any ordering arrived at through the second algorithm will give identical estimates, which are at a maximum of the likelihood function, when the method of reversals is subsequently applied.

Notes:

1. Available information concerning this program includes the mathematical analysis of the basic theory, a program flowchart, and a complete listing of the computer program.
2. Inquiries concerning this innovation may be directed to:
   COSMIC
   Computer Center
   The University of Georgia
   Athens, Georgia 30601
   Reference: B67-10136

Patent status:

No patent action is contemplated by NASA.

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