RESEARCH PAPER

High dimensional nuisance parameters: an example from parametric survival analysis

H. S. Battey[1] · D. R. Cox[2]

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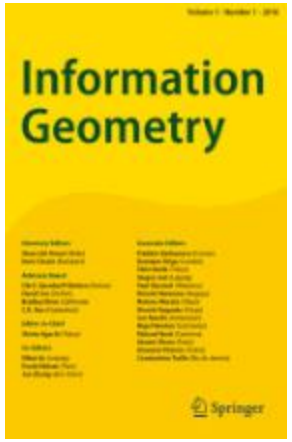
Abstract
Parametric statistical problems involving both large amounts of data and models with many parameters raise issues that are explicitly or implicitly differential geometric. When the number of nuisance parameters is comparable to the sample size, alternative approaches to inference on interest parameters treat the nuisance parameters either as random variables or as arbitrary constants. The two approaches are compared in the context of parametric survival analysis, with emphasis on the effects of misspecification of the random effects distribution. Notably, we derive a detailed expression for the precision of the maximum likelihood estimator of an interest parameter when the assumed random effects model is erroneous, recovering simply derived results based on the Fisher information in the correctly specified situation but otherwise illustrating complex dependence on other aspects. Methods of assessing model adequacy are given. The results are both directly applicable and illustrate general principles of inference when there is a high-dimensional nuisance parameter. Open problems with an information geometrical bearing are outlined.

Keywords Conditional likelihood · Exponential distribution · Marginal likelihood · Matched pairs · Model comparison · Poisson process · Random effects · Model misspecification



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Holonomic extended least angle regression

Marc Härkönen[1] · Tomonari Sei[2] · Yoshihiro Hirose[3]

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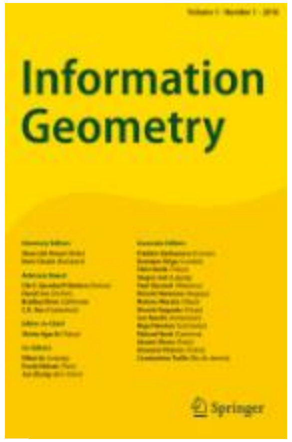
Abstract

One of the main problems studied in statistics is the fitting of models. Ideally, we would like to explain a large dataset with as few parameters as possible. There have been numerous attempts at automatizing this process. Most notably, the Least Angle Regression algorithm, or LARS, is a computationally efficient algorithm that ranks the covariates of a linear model. The algorithm is further extended to a class of distributions in the generalized linear model by using properties of the manifold of exponential families as dually flat manifolds. However this extension assumes that the normalizing constant of the joint distribution of observations is easy to compute. This is often not the case, for example the normalizing constant may contain a complicated integral. We circumvent this issue if the normalizing constant satisfies a holonomic system, a system of linear partial differential equations with a finite-dimensional space of solutions. In this paper we present a modification of the holonomic gradient method and add it to the extended LARS algorithm. We call this the holonomic extended least angle regression algorithm, or HELARS. The algorithm was implemented using the statistical software R, and was tested with real and simulated datasets.

Keywords Generalized linear model · Holonomic gradient method · Least angle regression



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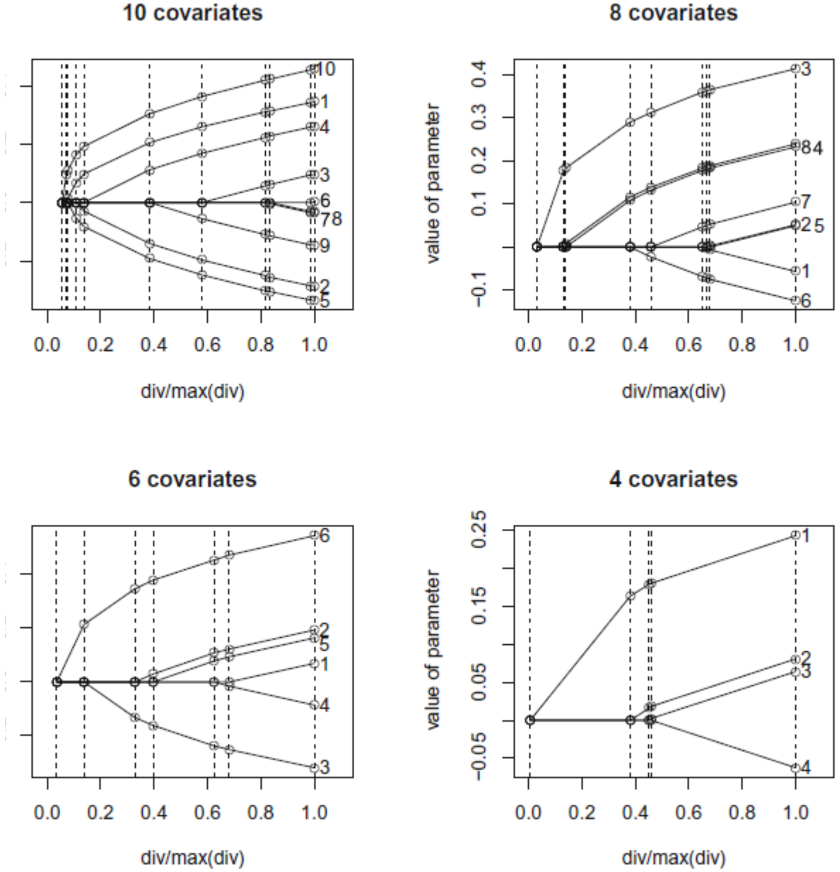

imulation of 100 observations with uncorrelated covariates

RESEARCH PAPER

Geometry of Arimoto algorithm

Shoji Toyota[1]

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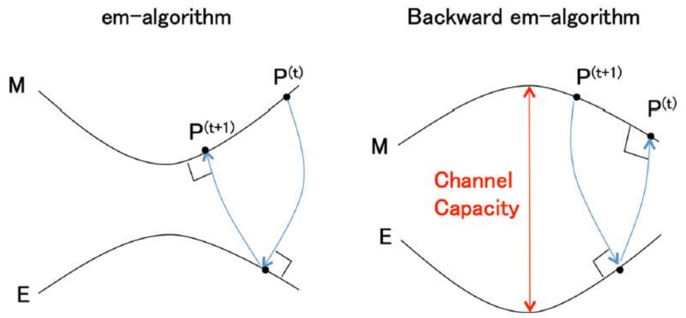
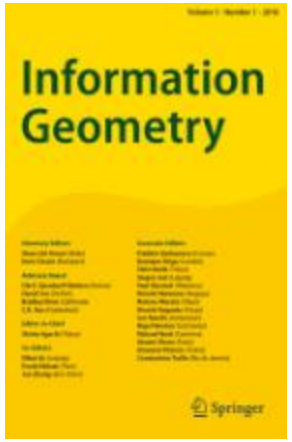


Fig. 1 Comparison between em-algorithm and Backward em-algorithm



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Abstract

In information theory, the channel capacity, which indicates how efficient a given channel is, plays an important role. The best-used algorithm for evaluating the channel capacity is Arimoto algorithm [3]. This paper aims to reveal an information geometric structure of Arimoto algorithm. In the process of trying to reveal an information geometric structure of Arimoto algorithm, a new algorithm that monotonically increases the Kullback-Leibler divergence is proposed, which is called "the Backward em-algorithm." Since the Backward em-algorithm is available in many cases where we need to increase the Kullback-Leibler divergence, it has a rich potential for application to many problems of statistics and information theory.

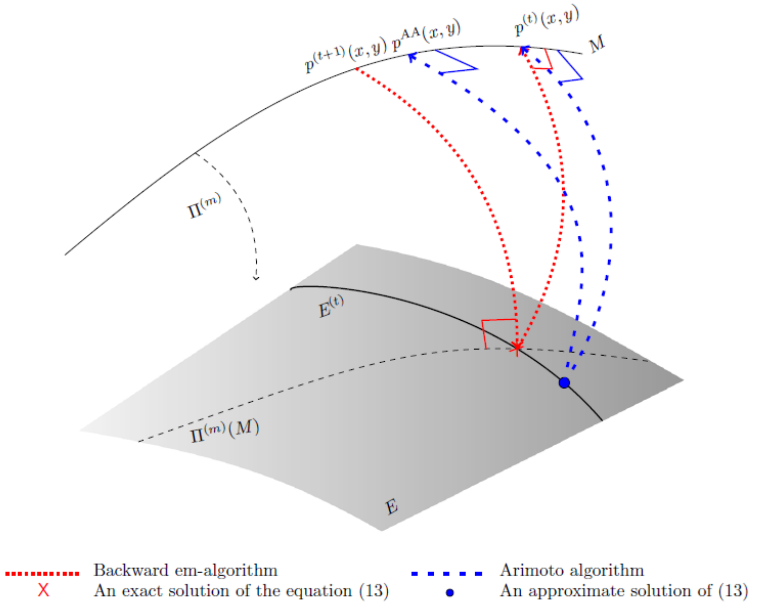

Fig. 2 Information geometric view of Arimoto algorithm. For the given probability distribution $p^{(t)}(x, y)$, $p^{(t+1)}(x, y)$ and $p^{AA}(x, y)$ is determined by the Backward em-algorithm and Arimoto algorithm respectively

Keywords Information geometry · Arimoto algorithm · Channel capacity · Em-algorithm · Backword em-algorithm