BAYESIAN DESIGNS FROM ASYMPTOTICS

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ABSTRACT. The paper sets forth a Bayesian nonparametric regression framework in which the principal issue is one of where observations should be taken. Specific criteria are advanced to measure information gained so that designs might be compared, and asymptotics are introduced so that problems found in this way are more manageable. Illustrations are drawn from different settings, and some remarks are made about the general program

0.   Introduction.

This is a paper in the optimal design tradition, begun with such prominent works as Kiefer ((1958) and (1959)) and Kiefer and Wolfowitz ((1959) and (1960)). Beyond review articles detailing developments in the area, Atkinson and Fedorov (1989), Bandemer, Nather and Pilz (1987), and Steinberg and Hunter (1984) for example, there are the books by Fedorov (1972), Pilz (1991) and Pukelsheim (1993), amongst others. Much of the research has featured observation of a parametric response surface in the presence of independent errors, posing the question of where should one observe to gain maximum information about the parameters of the model. Some of this work has reached a high level of mathematical sophistication, exemplified by Cheng (1978) in the case of discrete problems, and by Dette and Studden (1997) in continuous ones.

At the same time, the inherent difficulty of the accompanying optimization problems has led to work meant, in part, to ease the amount of labor involved. One method for doing this is to adopt a Bayesian stance - for practical, if not philosophical, reasons. See O'Hagan (1978), Sacks and Ylvisaker (1985) and Ylvisaker (1987) about this. A concomitant benefit of this approach is that one can downplay parametric models in the process, allowing the response surface to take a