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Bayesian Design and Analysis of clinical Experiments

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ABSTRACT

In this dissertation we focus on the design and analysis of data from clinical experiments in three problems. First, sample size determination is considered from two perspectives -- Bayesian and frequentist. Under the frequentist approach, sample size is determined by means of hypothesis testing, assuming some relevant clinical difference. The latter is a subjective element. By formally incorporating it through a prior distribution on the unknown clinical difference, we show that if a Bayesian seeks the minimum sample size to achieve some particular amount of information, then his or her design is essentially the same as the one produced by a frequentist statistician.

In the second problem, clinical information is available from previous modifications of a medical device (or formulations of a drug) for augmenting the information on the current modification. We consider an approach for combining data by linking historical with current data. We provide analytical and numerical results on the information provided by linked experiments and show some implications of using links in the design of experiments. We propose a prior elicitation method for linked experiments which is based on an expert's assessments of predictive probabilities.

In the third problem considered in this thesis, a Bayesian decision--theoretic approach is considered for optimally designing follow-up visits for patients when a health outcome may occur over an extended period of time. We develop closed form expressions for inferences about the hazard rate, and we use them to determine optimal choices of the visit time assuming quadratic loss. We extend this analysis in several directions. For example, we find a workable approximation to the optimal follow-up time that can be implemented on-line without the need of intensive computing.

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