

## ABSTRACT

Longitudinal analysis is important when individual effects are present. In this thesis some methods for different kinds of inference on longitudinal data are derived and evaluated in small sample settings. Appropriate evaluation criteria are determined from the actual inferential situation. It is based on three papers.

In Paper I two small sample tests of the hypothesis of random coefficients are derived from the Maximum Likelihood Ratio. The tests are evaluated in terms of power, and are found to complement each other with regard to the number of subjects and the number of measurements per subject. The two tests are suitable for testing in small sample settings. They could e.g. be used for preliminary testing of stochastic properties which is of great importance to achieve a subsequent efficient estimation.

In Paper II a preliminary test procedure for estimation in a mixed and possibly non-linear relationship is introduced. Non-sample based information about the relationship is incorporated in the procedure resulting in the use of a linear model when appropriate. Minimax regret optimal test sizes are determined and the pretest estimators are found to be preferable in many cases to an exclusive use of either the estimators of the linear or non-linear models.

In Paper III surveillance of foetal growth is studied. Following subjects over time statistical surveillance can be used to determine whether the process we observe is in- or out of-control. Here we say that the process is in-control if the foetus is growing at the expected rate, while it is out of-control if an intra-uterine growth restriction has occurred. The expected individual growth is modelled from a Swedish data set. Time is an important component when evaluating the surveillance procedures. Here, the probability of detection within a certain time period after the growth restriction has occurred is used for evaluation. The results from a simulation study indicate that the proposed method, which is a modification of the Shiryaev-Roberts method, performs considerably better than the gravidogram method used today.

**Key words:** Exact test; Intrauterine growth restriction; Longitudinal; Mixed model; Monitoring; Non-linear regression; Pharmacokinetics; Preliminary testing; Random coefficient regression; Small sample; Statistical surveillance.