Panel count data are one type of event-history data concerning recurrent events. The primary interest with panel count data is about the underlying recurrent event process which is observed only at several discrete observation times.

This dissertation consists of four parts. In the first part, we will consider regression analysis of panel count data with dependent observation processes, while the follow-up times may subject to an informative terminal event like death. Semiparametric transformation models are presented for the mean function of the underlying recurrent event process among survivals. To estimate the regression parameters, an estimating equation approach is proposed and the inverse survival probability weighting technique is used. In addition, the asymptotic distribution of the proposed estimate is derived and a model checking procedure is presented. Simulation studies are conducted to evaluate finite sample properties of the proposed approach, and the approach is applied to a bladder cancer study. The second part will focus on regression analysis of multivariate panel count data in the presence of a terminal event.

The third part will discuss two-sample nonparametric comparison based on panel count data. A new class of test procedures are proposed that allow unequal observation processes for the subjects from different treatment groups, and both univariate and multivariate panel count data are considered. The approach works especially well for sparsely distributed data. It is then applied to a skin cancer study which motivated our study. Finally, the last part will discuss some directions for future research.