論 文 の 要 旨

題 目　A Study on Nonparametric Inference Approaches for Stochastic Point Processes and Their Reliability Applications（確率点過程のノンパラメトリック統計的推論とその信頼性問題への応用に関する研究）

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Stochastic point processes can be used as a powerful tool to describe stochastic behaviors of cumulative number of events occurred as time goes by. The occurrence of failures in repairable systems or the detection of faults in software testing is modeled by representative stochastic point processes. Non-homogeneous Poisson process (NHPP) is well known as the simplest but most useful method for modeling such phenomena.

Stochastic point processes are characterized by a conditional intensity function or the corresponding cumulative intensity function which is called mean value function especially for NHPP. By assuming whether we can know the intensity function (or the corresponding cumulative intensity function) or not, two types of statistical inference approaches are considered. If the intensity function is known in advance, the model with the parametric intensity function is called parametric model. On the other hand, if the intensity function is unknown completely, it is called nonparametric model.

In this thesis, we mainly consider nonparametric estimation methods for stochastic point processes which include NHPP and a more generalized stochastic point process called the trend renewal process. In details, we discuss several nonparametric approaches for two different research areas; preventive maintenance scheduling problem of repairable systems and software reliability assessment.

Firstly, we focus on parametric and nonparametric estimation methods for a periodic replacement problem with minimal repair which is a representative preventive maintenance scheduling problem. By modeling the occurrence of failures in repairable systems with NHPPs, we obtain the optimal periodic replacement time and its corresponding long-run average cost per unit time. We also discuss not only point estimation but also interval estimation for this problem by applying several bootstrap techniques. It is revealed which method is the best one in the both viewpoints of point estimation and interval estimation, throughout our simulation experiments and a real failure data analysis.

Secondly, we pay our attention to the software reliability assessment method. Since NHPP-based Software reliability models (SRMs) are widely used for modeling the detection of software faults in software testing, a variety of nonparametric estimation methods for NHPP models are considered. On the other hand, we also use a more generalized stochastic point

process including NHPP, which is called non-homogeneous gamma process. By comparing our proposed models with conventional ones, we show the utility of our nonparametric models.

Finally, we concern a software release problem (SRP) based on a nonparametric NHPP-based SRM, where the intensity function of an NHPP-based SRM is unknown. To our best knowledge, there have no research result on the optimal software release problems under the assumption that the knowledge on the underlying software fault-detection process is incomplete. We calculate the predictive confidence interval as well as the point estimate of the optimal software release time which minimizes the expected total software cost. Finally, we conclude the thesis with some remarks in Chapter 7.