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主　論　文　要　旨

No.1

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主 論 文 題 名：

Bayesian Analysis of Duration Data

（内容の要旨）

This doctoral thesis focuses on the development and application of Bayesian statistical estimation methods for time-related data, specifically inter-event intervals and survival times. For the analysis of inter-event intervals, we employ the Stochastic Conditional Duration (SCD) model and apply it to tick data from stock and commodity futures markets. Our particular interest lies in the phenomenon known as intraday seasonality—a common trading behavior observed daily where trading activity intensifies after market open and before market close. This results in a U-shaped pattern in volatility and an inverted U-shaped pattern in inter-trade intervals. We extend the basic SCD model to account for intraday seasonality and apply it to stock market data, demonstrating improved modeling of trading behaviors. We extend the basic SCD model to capture the pattern of intraday trading intervals and propose a new Markov chain Monte Carlo method to estimate this intraday seasonality simultaneously. To efficiently generate the Monte Carlo sample, we used a hybrid of the Gibbs/Metropolis--Hastings (MH) sampling scheme and also applied generalized Gibbs sampling. In addition to capturing this intraday seasonality, we also consider limit order book information.
Three-day tick data for three stocks obtained from Nikkei NEEDS are used for estimation, and model selection is performed on smooth parameters, Weibull distribution and Gamma distribution. The typical intraday regularity of frequent trading immediately after the start of trading is confirmed, and the spread of the limit order book information is also found to affect the trading time interval.

Additionally, we propose an extension of the SCD model to capture intraday seasonality and patterns specific to each bimonthly grouped contract month in gold futures trading intervals. We have also modeled the effects of the trading unit information and news on trading intervals simultaneously. The trading time intervals of financial data are known to

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have very slow-decaying autocorrelations, and the Ancillarity-Sufficiency Interweaving Strategy (ASIS) overcomes the disadvantage of instability in estimation by incorporating a centered parameterization of the model. The results shows that the trading intervals exhibit an inverted U-shaped intraday seasonality, consistent with the prior research, and the impacts of the trading unit information as well as the news effects are also naturally interpretable.

In the latter part of this dissertation, we propose a method for applying Positive-Unlabeled Learning (PU Learning) to survival analysis, where learning is conducted using positively labeled data (positive examples) and unlabeled data. In this framework, the survival time of a subject whose event occurred during the observation period is observed as positive data, while the censoring time is observed as unlabeled data. However, for unlabeled subjects, it remains unclear whether the event occurred or not. We consider two cases: (1) when censoring time is observed in positive data, and (2) when it is not observed. For both cases, we developed parametric models and nonparametric models, and the estimation strategies for these models.