

BAYESIAN ANALYSIS OF COMPOUND POISSON MIXTURE MODEL AND ITS APPLICATION TO FINANCIAL DATA

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ABSTRACT. *We consider jump diffusion processes with compound Poisson process whose jump ranges follow the normal or double exponential distributions and also their Bernoulli approximations. We also assume that the intensity of compound Poisson process and the Bernoulli probability are random variables, which we refer to these processes as compound Poisson mixture models. In this paper, we shall estimate the parameters of these models by using MCMC-based Bayes formula, which generalizes our previous result [5] in the case where the intensity and the Bernoulli probability are constants. As an application, we shall make model selection with respect to Nikkei financial data in terms of the EIC-criterion.*

Keywords: Compound Poisson mixture model, Double exponential distribution, Bayesian analysis, Hybrid MCMC, EIC

1. **Introduction.** In the mathematical finance, it is well known that the Lévy process with jumps is a representative stochastic model of asset prices in the incomplete market ([3], e.g.). Therefore, it is quite important to estimate of the parameters of Lévy process with jumps from the theoretical and also practical point of view, particularly in calculation of the derivatives, model selection, etc.. In this paper, we shall consider as underlying process jump diffusion processes with compound Poisson process whose jump ranges follow the normal or double exponential distributions and also their Bernoulli approximations. We also assume that the intensity of compound Poisson process and the Bernoulli probability of jump are random variables or stochastic process, to which we refer as compound Poisson mixture model. In order to estimate parameters, there are several methodologies such as GMM (general moment method), FFT (fast Fourier transform), MLE (most likelihood estimate), MCMC (Markov Chain Monte Carlo), etc. The MCMC scheme is widely used in estimating the joint posterior density of parameters of models and, in addition, it is efficient even when the exact transition functions are complicated and/or unknown (see [5], [6], [7]). The aim of the paper is to estimate the parameters of our compound Poisson mixture models using MCMC-based Bayesian analysis and, moreover, to apply it data analysis. This paper is the mixture modification of [5] where the underlying process is a compound Poisson process with constant intensity and Bernoulli probability. In [7], P.Gray explores an MCMC-based Bayesian method in order to estimate the parameters of continuous-time short-rate models in the cases where exact likelihood-based estimation is impossible.

From the practical point of view in the financial market, many data analyses indicate that the intensity and /or the probability of jump are random variables in a given observed