Lévy-Driven Asset Pricing Models

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(Dated: 15 October 2023)

The geometric Brownian motion model is well known historically, both in its one-dimensional form and its multidimensional form, for its numerous applications in the theory of finance, ranging from portfolio optimization to option pricing. The more general class of geometric Lévy models has also been subject to extensive studies, but the results are less well known and there are complications when it comes to asset pricing on account of the incompleteness of Lévy markets. Here we take a pricing kernel approach, following the principles laid out in Brody, Hughston & Mackie (2012), in order to present an overview of such models and to analyze the relation between risk and return when asset prices can jump. We consider the role of the orthogonal group in determining the true degrees of freedom in multidimensional Brownian models and ask to what extent a similar analysis can be carried out in the case of multidimensional Lévy models. We look, in particular, at group theoretic properties of a certain multidimensional generalization of the variance-gamma process, constructed by subordinating a multidimensional Brownian motion with a single common gamma process. Work carried out in collaboration with L P Hughston.

Key words: Lévy processes, Brownian motion, Poisson process, gamma process, variance gamma process, asset pricing, pricing kernel, market price of risk, risk premium.