A class of continuous-time Gaussian mean-variance mixture state-space models

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Abstract

The generalized inverse Gaussian (GIG) distribution is central to the construction of generalized hyperbolic (GH) distributions, widely used in Gaussian mean–variance mixtures for modeling skewness and heavy tails. However, the class of GIG distributions, which are infinitely divisible (ID), in general, is not closed under convolution, which limits its applicability in continuous-time and Lévy-based modeling frameworks. This paper introduces an alternative, although related, class of mixing ID distributions, denoted by IGG, defined as a convex combination of inverse Gaussian and gamma distributions. The IGG class has as many parameters as GIG, with an additional parameter controlling the mixing proportion between its components. Subordinating Brownian motion with drift to an IGG Lévy process then yields a new family of Gaussian mixtures, referred to as Gaussian–IGG (NIGG) distributions, which contain the normal–inverse Gaussian and generalized asymmetric Laplace distributions as special cases. This framework also clarifies a confusion about the role of scale and infinite divisibility in models such as NIG, and provides a flexible alternative for constructing state-space models.