Mathematics > Probability

Wiener-Hopf factorization and distribution of extrema for a family of Lévy processes

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(Submitted on 8 Nov 2010)

In this paper we introduce a ten-parameter family of L\'{e}vy processes for which we obtain Wiener-Hopf factors and distribution of the supremum process in semi-explicit form. This family allows an arbitrary behavior of small jumps and includes processes similar to the generalized tempered stable, KoBoL and CGMY processes. Analytically it is characterized by the property that the characteristic exponent is a meromorphic function, expressed in terms of beta and digamma functions. We prove that the Wiener-Hopf factors can be expressed as infinite products over roots of a certain transcendental equation, and the density of the supremum process can be computed as an exponentially converging infinite series. In several special cases when the roots can be found analytically, we are able to identify the Wiener-Hopf factors and distribution of the supremum in closed form. In the general case we prove that all the roots are real and simple, and we provide localization results and asymptotic formulas which allow an efficient numerical evaluation. We also derive a convergence acceleration algorithm for infinite products and a simple and efficient procedure to compute the Wiener-Hopf factors for complex values of parameters. As a numerical example we discuss computation of the density of the supremum process.

Comments:	Published in at this http URL the Annals of Applied Probability (this http URL) by the Institute of Mathematical Statistics (this http URL)
Subjects:	**Probability (math.PR)**
Journal reference:	Annals of Applied Probability 2010, Vol. 20, No. 5, 1801-1830
DOI:	10.1214/09-AAP673
Report number:	IMS-AAP-AAP673
Cite as:	**arXiv:1011.1790v1 [math.PR]**

Submission history

From: Alexey Kuznetsov [view email]
[v1] Mon, 8 Nov 2010 13:05:06 GMT (388kb)

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