Yin, Chuancun; **Yuen, Kam C.**

Exact joint laws associated with spectrally negative Lévy processes and applications to insurance risk theory. (English) Zbl 1310.60058

Front. Math. China 9, No. 6, 1453-1471 (2014).

Summary: We consider the spectrally negative Lévy processes and determine the joint laws for quantities such as the first and last passage times over a fixed level, the overshoots and undershoots at first passage, the minimum, the maximum, and the duration of negative values. We apply our results to insurance risk theory to find an explicit expression for the generalized expected discounted penalty function in terms of scale functions. Furthermore, a new expression for the generalized Dickson's formula is provided.

MSC:

60G51 Processes with independent increments; Lévy processes
60G50 Sums of independent random variables; random walks
60J75 Jump processes (MSC2010)
91B30 Risk theory, insurance (MSC2010)

Keywords:

spectrally negative Lévy processes; fluctuation identity; generalized Dickson's formula; scale function; occupation time; insurance risk theory

Full Text: DOI arXiv

References:

[1] Alili, L; Kyprianou, A E, Some remarks on first passage of Lévy processes, the American put and pasting principles, Ann Appl Probab, 15, 2062-2080, (2005) · Zbl 1083.60034

[2] Asmussen S. Ruin Probabilities. Singapore: World Scientific, 2000

[3] Avram, F; Kyprianou, A E; Pistorius, M R, Exit problems for spectrally negative Lévy processes and applications to (canadized) Russian options, Ann Appl Probab, 14, 215-238, (2004) · Zbl 1042.60023

[4] Avram, F; Palmowski, Z; Pistorius, M R, On the optimal dividend problem for a spectrally negative Lévy process, Ann Appl Probab, 17, 156-180, (2007) · Zbl 1136.60032

[5] Bertoin J. Lévy Processes. Cambridge Tracts in Mathematics, Vol 121. Cambridge: Cambridge University Press, 1996 · Zbl 0861.60003

[6] Bertoin, J, Exponential decay and ergodicity of completely asymmetric Lévy processes in a finite interval, Ann Appl Probab, 7, 156-169, (1997) · Zbl 0880.60077

[7] Biffis, E; Kyprianou, A E, A note on scale functions and the time value of ruin for Lévy insurance risk processes, Insurance Math Econom, 46, 85-91, (2010) · Zbl 1231.91145

[8] Biffis, E; Morales, M, On a generalization of the gerber-shiu function to path-dependent penalties, Insurance Math Econom, 46, 92-97, (2010) · Zbl 1231.91146

[9] Bingham, N H, Fluctuation theory in continuous time, Adv Appl Probab, 7, 705-766, (1975) · Zbl 0322.60068

[10] Chaumont, C; Kyprianou, A; Pardo, J, Some explicit identities associated with positive self-similar Markov processes, Stoch Proc Appl, 119, 980-1000, (2009) · Zbl 1170.60017

[11] Chiu, S N; Yin, C C, Passage times for a spectrally negative Lévy process with applications to risk theory, Bernoulli, 11, 511-522, (2005) · Zbl 1076.60038

[12] Doney R A. Fluctuation Theory for Lévy Processes. Lecture Notes in Mathematics, Vol 1897. Berlin: Springer, 2007 · Zbl 1128.60036

[13] Doney, R A; Kyprianou, A E, Overshoots and undershoots of Lévy processes, Ann Appl Probab, 16, 91-106, (2006) · Zbl 1101.60029

[14] Reis, A D E, How long is the surplus below zero?, Insurance Math Econom, 12, 23-38, (1993) · Zbl 0777.62096

[15] Emery, D J, Exit problem for a spectrally positive process, Adv Appl Probab, 5, 498-520, (1973) · Zbl 0297.60035

[16] Erder, I; Klüppelberg, C, The first passage event for sums of dependent Lévy processes with applications to insurance risk, Ann Appl Probab, 19, 2047-207, (2009) · Zbl 1209.60029

[17] Garrido, J; Morales, M, On the expected discounted penalty function for Lévy risk processes, North American Actuar J, 10, 196-218, (2006)

[18] Gerber, H U; Shiu, E S W, On the time value of ruin, North American Actuar J, 2, 48-78, (1998) · Zbl 1081.60550

[19] Hubalek, F; Kyprianou, A; Dalang, R (ed.); Dozzi, M (ed.); Russo, F (ed.), Old and new examples of scale functions for spectrally negative Lévy processes, 119-146, (2010), Boston

[20] Huzak, M M; Perman, M; Šikić, H; Vondraček, Z, Ruin probabilities and decompositions for general perturbed risk processes, Ann Appl Probab, 14, 1378-1397, (2006) · Zbl 1061.60075

[21] Kadankov, V F; Kadankova, T V, On the distribution of duration of stay in an interval of the semi-continuous process with independent increments, Random Oper Stoch Equ, 12, 361-384, (2004) · Zbl 1119.60034

[22] Klüppelberg, C; Kyprianou, A E, On extreme ruinous behaviour of Lévy insurance risk processes, J Appl Probab, 43, 594-598, (2006) · Zbl 1118.60071

[23] Klüppelberg, C; Kyprianou, A E; Maller, R A, Ruin probabilities and overshoots for general Lévy insurance risk processes, Ann Appl Probab, 14, 1766-1801, (2004) · Zbl 1066.60049

[24] Kyprianou A E. Introductory Lecture Notes on Fluctuations of Lévy Processes with Applications. Berlin: Springer-Verlag, 2006

[25] Kyprianou, A E; Palmowski, Z, A martingale review of some fluctuation theory for spectrally negative Lévy processes, No. 1857, 16-29, (2005), Berlin · Zbl 1063.60071

[26] Kyprianou, A E; Palmowski, Z, Distributional study of de Finetti's dividend problem for a general Lévy insurance risk process, J Appl Probab, 44, 428-443, (2007) · Zbl 1137.60047

[27] Kyprianou, A E; Pardo, J C; Rivero, V, Exact and asymptotic n-tuple laws at first and last passage, Ann Appl Probab, 20, 522-564, (2010) · Zbl 1200.60038

[28] Kyprianou, A E; Rivero, V; Song, R, Convexity and smoothness of scale functions and de Finetti's control problem, J Theor Probab, 23, 547-564, (2010) · Zbl 1188.93115

[29] Landriault, D; Renaud, J; Zhou, X W, Occupation times of spectrally negative Lévy processes with applications, Stochastic Process Appl, 121, 2629-2641, (2011) · Zbl 1227.60061

[30] Loeffen, R, On optimality of the barrier strategy in de Finetti's dividend problem for spectrally negative Lévy processes, Ann Appl Probab, 18, 1669-1680, (2009) · Zbl 1152.60344

[31] Morales, M, On the expected discounted penalty function for a perturbed risk process driven by a subordinator, Insurance Math Econom, 40, 293-301, (2007) · Zbl 1130.91032

[32] Pistorius, M R, A potential-theoretical review of some exit problems of spectrally negative Lévy processes, No. 1857, 30-41, (2005), Berlin · Zbl 1065.60047

[33] Renaud, J F; Zhou, X, Distribution of the present value of dividend payments in a Lévy risk model, J Appl Probab, 44, 420-427, (2007) · Zbl 1132.60041

[34] Rolski T, Schmidli H, Schmidt V, Teugels J. Stochastic Processes for Insurance and Finance. Chichester: Wiley, 1999 · Zbl 0940.60005

[35] Yang, H L; Zhang, L Z, Spectrally negative Lévy processes with applications in risk theory, Adv Appl Probab, 33, 281-291, (2001) · Zbl 0978.60104

[36] Zhou, X W, Some fluctuation identities for Lévy processes with jumps of the same sign, J Appl Probab, 41, 1191-1198, (2004) · Zbl 1064.60102

[37] Zhou, X W, On a classical risk model with a constant dividend barrier, North American Actuar J, 9, 95-108, (2005) · Zbl 1215.60051

[38] Zhang, C S; Wang, G J, The joint density function of three characteristics on jump-diffusion risk process, Insurance Math Econom, 32, 445-455, (2003) · Zbl 1066.91063

[39] Zhang, C S; Wu, R, Total duration of negative surplus for the compound Poisson process that is perturbed by diffusion, J Appl Probab, 39, 517-532, (2002) · Zbl 1046.91076