Rodrigues, Josemar; Cordeiro, Gauss M.; Cancho, Vicente G.; Balakrishnan, N.
Relaxed Poisson cure rate models. (English) Zbl 1381.62281
Biom. J. 58, No. 2, 397-415 (2016).

Summary: The purpose of this article is to make the standard promotion cure rate model [*A. Yu. Yakovlev* and *A. D. Tsodikov*, Stochastic models of tumor latency and their biostatistical applications. Singapore: World Scientific Publishing (1996; Zbl 0919.92024)] more flexible by assuming that the number of lesions or altered cells after a treatment follows a fractional Poisson distribution [*N. Laskin*, Commun. Nonlinear Sci. Numer. Simul. 8, No. 3–4, 201–213 (2003; Zbl 1025.35029)]. It is proved that the well-known Mittag-Leffler relaxation function [*M. N. Berberan-Santos*, J. Math. Chem. 38, No. 4, 629–635 (2005; Zbl 1101.33015)] is a simple way to obtain a new cure rate model that is a compromise between the promotion and geometric cure rate models allowing for superdispersion. So, the relaxed cure rate model developed here can be considered as a natural and less restrictive extension of the popular Poisson cure rate model at the cost of an additional parameter, but a competitor to negative-binomial cure rate models [the first author et al., J. Stat. Plann. Inference 139, No. 10, 3605–3611 (2009; Zbl 1173.62074)]. Some mathematical properties of a proper relaxed Poisson density are explored. A simulation study and an illustration of the proposed cure rate model from the Bayesian point of view are finally presented.

MSC:

62P10 Applications of statistics to biology and medical sciences; meta analysis
62F15 Bayesian inference

Cited in **2** Documents

Keywords:

Bayesian inference; fractional Poisson distribution; geometric cure rate model; Mittag-Leffler relaxation function; Poisson cure rate model; relaxed Poisson cure rate model

Full Text: DOI

References:

[1] Berberan-Santos, Properties of the Mittag-Leffler relaxation function, Journal of Mathematical Chemistry 38 pp 629– (2005) · Zbl 1101.33015 · doi:10.1007/s10910-005-6909-z

[2] Cahoy, Parameter estimation for fractional Poisson processes, Journal of Statistical Planning and Inference 140 pp 106– (2010) · Zbl 1205.62118 · doi:10.1016/j.jspi.2010.04.016

[3] Cancho, A flexible model for survival data with a cure rate: a Bayesian approach, Journal of Applied Statistics 38 pp 57– (2011)· doi:10.1080/02664760903254052

[4] Cooner, Flexible cure rate modeling under latent activation schemes, Journal of the American Statistical Association 102 pp 560– (2007) · Zbl 1172.62331 · doi:10.1198/016214507000000112

[5] Cowles, Markov chain Monte Carlo convergence diagnostics: a comparative review, Journal of the American Statistical Association 91 pp 883– (1996) · Zbl 0869.62066 · doi:10.1080/01621459.1996.10476956

[6] Gamerman, Markov Chain Monte Carlo: Stochastic Simulation for Bayesian Inference (2006)

[7] Geweke, Evaluating the Accuracy of Sampling-based Approaches to Calculating Posterior Moments (1992)

[8] Gorenflo, Computation of the Mittag-Leffler function E{\(\alpha\)},{\(\beta\)}(z) and its derivative, Fractional Calculus and Applied Analysis 5 pp 491– (2002) · Zbl 1027.33016

[9] Ibrahim, Bayesian Survival Analysis (2001) · Zbl 0978.62091 · doi:10.1007/978-1-4757-3447-8

[10] Jayakumar, The first-order autoregressive Mittag-Leffler process, Journal of Applied Probability 30 pp 462– (1993) · Zbl 0777.60063 · doi:10.2307/3214855

[11] Jose, A count model based on Mittag-Leffler interarrival times, Statistica 4 pp 501– (2011)

[12] Kirkwood, High- and low-dose interferon alfa-2b in high-risk melanoma: First analysis of intergroup trial E1690/S9111/C9190, Journal of Clinical Oncology 18 pp 2444– (2000)· doi:10.1200/JCO.2000.18.12.2444

[13] Kokonendji, Connections of the Poisson weight function to overdispersion and underdispersion, Journal of Statistical Planning and Inference 138 pp 1287– (2008) · Zbl 1133.62007 · doi:10.1016/j.jspi.2007.05.028

[14] Laskin, Fractional Poisson process, Communication in Non Linear Science and Numerical Simulation 8 pp 201– (2003) · Zbl 1025.35029 · doi:10.1016/S1007-5704(03)00037-6

[15] Mauro, Full characterization of the fractional Poisson process, Europhysics Letters 96 pp 20004– (2011)· doi:10.1209/0295-

5075/96/20004

[16] Mittag-Leffler, Une generalisation de lâintegrale de Laplace-Abel, Comptes Rendus de lAcadémie des Sciences, Series IIC 137 pp 537– (1903)

[17] Mudholkar, The exponentiated Weibull family: a reanalysis of the bus-motor failure data, Technometrics 37 pp 436– (1995) · Zbl 0900.62531 · doi:10.1080/00401706.1995.10484376

[18] Rodrigues, COM-Poisson cure rate survival models and an application to a cutaneous melanoma data, Journal of Statistical Planning and Inference 139 pp 3605– (2009a) · Zbl 1173.62074 · doi:10.1016/j.jspi.2009.04.014

[19] Rodrigues, On the unification of the long-term survival models, Statistics and Probability Letters 79 pp 753– (2009b) · Zbl 1349.62485 · doi:10.1016/j.spl.2008.10.029

[20] Tucker, How well is the probability of tumor cure after fractionated irradiation described by Poisson statistics, Radiation Research 24 pp 273– (1990)· doi:10.2307/3577839

[21] Yakovlev, Stochastic Models of Tumor Latency and Their Biostatistical Applications (1996) · Zbl 0919.92024 · doi:10.1142/2420

[22] Yin, Cure rate models: a unified approach, Canadian Journal of Statistics 33 pp 559– (2005) · Zbl 1098.62127 · doi:10.1002/cjs.5550330407