PROPERTIES OF THE GENERALIZED NONLINEAR LEAST SQUARES METHOD APPLIED FOR FITTING DISTRIBUTION TO DATA

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Abstract

We introduce and analyze a class of estimators for distribution parameters based on the relationship between the distribution function and the empirical distribution function. This class includes the nonlinear least squares estimator and the weighted nonlinear least squares estimator which has been used in parameter estimation for lifetime data (see e.g. [6, 8]) as well as the generalized nonlinear least squares estimator proposed in [3]. Sufficient conditions for consistency and asymptotic normality are given. Capability and limitations are illustrated by simulations.

Keywords: generalized least squares, distribution fitting, generalized method of moments.

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References

[1] P.A. Al-Baidhani and C.D. Sinclair, *Comparison of methods of estimation of parameters of the Weibull distribution*, Communications in Statistics – Simulation and Computation **16** (1987) 373–384.

[2] T.W. Anderson and D.A. Darling, *Asymptotic theory of certain "goodness of fit" criteria based on stochastic processes*, Ann. Math. Statist. **23** (1952) 193–212.

[3] M. Benšić, *Fitting distribution to data by a generalized nonlinear least squares method*, Communications in Statistics – Simulation and Computation (2012), in press.

[4] P. Billingsly, Convergence of Probability Measures (John Wiley & Sons, New York, 1968).

[5] J. Castillo and J. Daoudi, *Estimation of the generalized Pareto distribution*, Statistics and Probability Letters **79** (2009) 684–688.

[6] D. Jukić, M. Benšić and R. Scitovski, *On the existence of the nonlinear weighted least squares estimate for a three-parameter Weibull distribution*, Computational Statistics & Data Analysis **52** (2008) 4502–4511.

[7] D. Harris and L. Matyas, *Introduction to the generalized method of moment estimation*, in: Matyas, L. (Ed.), Generalized method of moment estimation (Cambridge University Press, Cambridge, 1999) 3–30.

[8] D. Kundu and M.Z. Raqab, *Generalized Rayleigh distribution: different methods of estimations*, Computational Statistics & Data Analysis **49** (2005) 187–200.

[9] D. Kundu and M.Z. Raqab, *Burr Type X distribution: Revisited*, J. Prob. Stat. Sci. **4** (2006) 179–193.

[10] J.F. Lawless, Statistical Models and Methods for Lifetime Data (Wiley, New York, 1982).

[11] A. Luceño, *Fitting the generalized Pareto distribution to data using maximum goodness-of-fit estimator*, Comp. Stat. & Data Anal. **51** (2006) 904–917.

[12] D.N.P. Murthy, M. Bulmer and J.A. Eccleston, *Weibull model selection for reliability modelling*, Reliability Engineering and System Safety **86** (2004) 257–267.

[13] D. Pollard, *The minimum distance method of testing*, Metrika **27** (1980) 43–70.

[14] H. Rinne, The Weibull Distribution. A Handbook (Chapman & Hall/CRC, Boca Raton, 2009).

[15] G.A.F. Seber and C.J. Wild, Nonlinear Regression (John Wiley & Sons, New York, 1989).

[16] R.L. Smith and J.C. Naylor, *A comparison of maximum likelihood and Bayesian estimators for the three-parameter Weibull distribution*, Biometrika **73** (1987) 67–90.

[17] J.G. Surles and W.J. Padgett, *Inference for reliability and stress-strength for a scaled Burr Type X distribution*, Lifetime Data Analysis **7** (2001) 187–200.

[18] F.J. Torres, *Estimation of parameters of the shifted Gompertz distribution using least squares, maximum likelihood and moments methods*, J. Comp. and Appl. Math. **255** (2014) 867–877.

[19] J. Wolfowitz, *Estimation by minimum distance method*, Ann. Inst. Statisti. Math. **5** (1953) 9–23.

[20] J. Wolfowitz, *The minimum distance method*, Ann. Math. Statist. **28** (1957) 75–88.