Annals of the Institute of Statistical Mathematics (2023) 75:1011–1038
https://doi.org/10.1007/s10463-023-00873-7

Goodness-of-fit tests for the Weibull distribution based on the Laplace transform and Stein's method

Bruno Ebner[1] · **Adrian Fischer**[2] · **Norbert Henze**[1] · **Celeste Mayer**[3]

Received: 15 August 2022 / Revised: 20 January 2023 / Accepted: 15 March 2023 /
Published online: 22 May 2023

Abstract
We propose novel goodness-of-fit tests for the Weibull distribution with unknown parameters. These tests are based on an alternative characterizing representation of the Laplace transform related to the density approach in the context of Stein's method. Asymptotic theory of the tests is derived, including the limit null distribution, the behaviour under contiguous alternatives, the validity of the parametric bootstrap procedure, and consistency of the tests against a large class of alternatives. A Monte Carlo simulation study shows the competitiveness of the new procedure. Finally, the procedure is applied to real data examples taken from the materials science.

Keywords Goodness-of-fit · Weibull distribution · Hilbert-space valued random elements · Contiguous alternatives

✉ Bruno Ebner
Bruno.Ebner@kit.edu

[1] Institute of Stochastics, Karlsruhe Institute of Technology (KIT), Englerstr. 2, 76133 Karlsruhe, Germany

[2] Université libre de Bruxelles (ULB), Campus de la Plaine - CP 210, Boulevard du Triomphe, ACC.2, 1050 Bruxelles, Belgium

[3] Landeskreditbank Baden-Württemberg – Förderbank (L-Bank), Schlossplatz 21, 76131 Karlsruhe, Germany