

**NEW DOCTORAL DEGREES**  
**IN THE DEPARTMENT OF MATHEMATICS**  
**UNIVERSITY OF OSIJEK**

**Dr. Darija Marković** received her PhD in Mathematics from the Department of Mathematics of the University of Zagreb on 7 May 2009 with the dissertation entitled “PARAMETER ESTIMATION PROBLEM IN THE WEIBULL MODEL” (Mentors: Dr. D. Jukić and Dr. M. Marušić).

**Abstract**

In this dissertation we consider the problem of the existence of best parameters in the Weibull model, one of the most widely used statistical models in reliability theory and life data theory. Particular attention is given to a 3-parameter Weibull model. We have listed some of the many applications of this model.

We have described some of the classical methods for estimating parameters of the Weibull model, two graphical methods (Weibull probability plot and hazard plot), and two analytical methods (method of moments and the maximum likelihood method). We have highlighted some of the problems that occur when using these methods. For each of these methods illustrative numerical examples are given.

In addition to classical methods of estimating the unknown parameters, we have discussed the least squares method. By the least squares method one should distinguish two approaches: the ordinary least squares method and the total least squares method. We have elaborated in detail and illustrated with numerical examples the ordinary least squares method for a transformed Weibull distribution.

The main contributions of this dissertation are contained in the theorems about the existence of best parameters for the 3-parameter Weibull distribution function and the density function in terms of both ordinary least squares and total least squares. Thereby the data should satisfy natural conditions. Illustrative numerical examples are provided. All these theorems about the existence of best parameters are generalized in  $p$  norm ( $1 \leq p < \infty$ ) as well.

**Published papers**

- [1] **D. Marković**, D. Jukić, M. Benšić, *Nonlinear weighted least squares estimation of a three-parameter Weibull density with a nonparametric start*, J. Comput. Appl. Math. **228**(2009), 304-312.
- [2] **D. Marković**, D. Jukić, *On nonlinear weighted least squares fitting of the three-parameter inverse Weibull distribution*, Math. Commun., 2009, accepted for publication.
- [3] **D. Marković**, *QR dekompozicija velikih vrpčastih matrica i primjena na konstrukciju aproksimirajućeg spline-a*, PrimMath[2001], Mathematica u znanosti, tehnologiji i obrazovanju, Zagreb, September 27–28, 2001, pp. 215-227.

- [4] D. Jukić, **D. Marković**, M. Ribičić, A. Krajina, *On the choice of initial approximation of the least squares estimate in some growth models of exponential type*, Proceedings of the 9<sup>th</sup> International Conference on Operational Research, Trogir, October 2–4, 2002, pp. 47-55.
- [5] D. Dudaš, **D. Marković**, *Bèzier-ove krivulje i de Casteljau-ov algoritam*, Zbornik radova PrimMath[2003], Mathematica u znanosti, tehnologiji i obrazovanju, Zagreb, September 25–26, 2003, pp. 51-67.
- [6] **D. Marković**, D. Jukić, *A review of some existence results on parameter estimation problem in the three-parameter Weibull model*, Proceedings of the 12<sup>th</sup> International Conference on Operational Research, Pula, September 24–26, 2008.