

## Corrigendum

JÜRGEN GUDDAT, LUKA NERALIĆ AND OLIVER STEIN, *Sensitivity analysis of the proportionate change of a subset of outputs or/and inputs in DEA*

[Mathematical Communications 11(2006), 187-201.]

The beginning of subsection 2.1 on page 188 should read:

**2.1.** Let us suppose that there are  $n$  Decision Making Units (DMUs) with  $m$  inputs and  $s$  outputs. Let  $x_{ij}$  be the observed amount of  $i$ th type of input of the  $j$ th DMU ( $x_{ij} > 0$ ,  $i = 1, 2, \dots, m$ ,  $j = 1, 2, \dots, n$ ) and let  $y_{rj}$  be the observed amount of output of the  $r$ th type for the  $j$ th DMU ( $y_{rj} > 0$ ,  $r = 1, 2, \dots, s$ ,  $j = 1, 2, \dots, n$ ). Let  $Y_j$ ,  $X_j$  be the observed vectors of outputs and inputs of the DMU $_j$ , respectively,  $j = 1, 2, \dots, n$ . Let  $e$  be the column vector of ones and let  $T$  as a superscript denote the transpose. In order to see if the DMU $_{j_0} = \text{DMU}_0$  is efficient according to the CCR ratio model the following linear programming problem should be solved:

$$\min 0\lambda_1 + \dots + 0\lambda_0 + \dots + 0\lambda_n - \varepsilon e^T s^+ - \varepsilon e^T s^- + \theta$$

subject to

$$\begin{array}{rccccccc} Y_1\lambda_1 + \dots + Y_0\lambda_0 + \dots + Y_n\lambda_n & - & s^+ & & = & Y_0 & \\ -X_1\lambda_1 - \dots - X_0\lambda_0 - \dots - X_n\lambda_n & - & s^- & + & X_0\theta & = & 0 \\ & & \lambda_1, & \dots, & \lambda_n, & s^+, & s^- & \geq & 0, \end{array} \quad (1)$$

with  $Y_0 = Y_{j_0}$ ,  $X_0 = X_{j_0}$ ,  $\lambda_0 = \lambda_{j_0}$  and  $\theta$  unconstrained.



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**Dr. Kristian Sabo** received his PhD in Mathematics from the Department of Mathematics of the University of Zagreb on 20 April 2007 with the dissertation entitled "PARAMETER ESTIMATION PROBLEM IN SOME CHEMICAL KINETICS MODELS". (Advisors: Dr. R. Scitovski, Dr. D. Jukić and Dr. M. Marušić )

**Abstract**

In this dissertation we consider the existence problem of kinetics parameters in some special mathematical models of enzyme kinetics. On the basis of the law of mass action the system of ordinary differential equations is derived by means of which the Michaelis-Menten's model is described. The Michaelis-Menten's model represents one of the most fundamental models of chemical kinetics used for explanation of kinetical properties of many enzymes. In addition to some additional conditions, by applying a quasi-steady-state hypothesis, from the system of differential equations we obtain different functional connections between quantities that can be measured. Functional connections mentioned are crucial for kinetic parameter estimation.

With respect to that, we give the results of kinetics parameters existence (Michaelis-Menten constant and maximal velocity of a chemical reaction). Ordinary least squares and total least square are considered as well as ordinary and total  $l_p$ , ( $1 < p < \infty$ ) approaches.

Moreover, the problem of kinetics parameters existence is solved in the sense of an ordinary least square on the basis of a closed functional connection between time and concentration of a substrate in an enzymatic reaction.

Particularly, one mathematical model used for parameter estimation of initial velocity of an enzymatic reaction is analyzed, as well as the parameter estimation problem in substrate inhibition models.

Finally, for each of the aforementioned models we propose a good initial approximation. A good initial approximation is necessary for a numerical procedure by which the related nonlinear functional is minimized. Moreover, illustrative numerical examples are provided.

**Published papers**

- [1] M. Benšić, **K. Sabo**, *Estimation of a border for a two-dimensional uniform distribution if data are measured with additive error*, Statistics, A Journal of Theoretical and Applied Statistics, accepted for publication, 2007.
- [2] K. P. Hadeler, D. Jukić, **K. Sabo**, *Least squares problems for Michaelis Menten kinetics*, Mathematical Methods in the Applied Sciences, accepted for publication, 2007.

- [3] M. Benšić, **K. Sabo**, *Estimating the width of a uniform distribution when data are measured with additive normal errors with known variance*, Computational Statistics and Data Analysis, accepted for publication, 2007.
- [4] D. Jukić, **K. Sabo**, R. Scitovski, *A review of existence criteria for parameter estimation of the Michaelis-Menten regression model*, Annali dell'Universita' di Ferrara, accepted for publication, 2007.
- [5] D. Jukić, **K. Sabo**, R. Scitovski, *Total least squares fitting Michaelis-Menten enzyme kinetic model function*, Journal of Computational and Applied Mathematics, 201(2007), 230-246.
- [6] R. Scitovski, G. Kralik, **K. Sabo**, T. Jelen, *A mathematical model of controlling the growth of tissue in pigs*, Appl. Math. Comput., 181(2006), 1126-1138.
- [7] **K. Sabo**, A. Baumgartner, *One method for searching the best least squares approximation*, Mathematical Communications - Supplement 1(2001), 63-68.
- [8] D. Jukić, R. Scitovski, **K. Sabo**, *Total least squares problem for the Hubbert function*, Proceedings of the Conference on Appl. Mathematics and Scientific Computing, Springer, 2005, pp. 217-233.
- [9] D. Jukić, R. Scitovski, A. Baumgartner, **K. Sabo**, *Localization of the least squares estimate*, Proceedings of the 10th International Conference on Operational Research, Trogir, September 22-24, 2004, pp. 165-174.
- [10] D. Jukić, **K. Sabo**, G. Bokun, *Least squares problem for the Hubbert function*, Proceedings of the 9th International Conference on Operational Research, Trogir, October 2-4, 2002, pp. 132-145.
- [11] R. Scitovski, R. Šalić, K. Petrić, **K. Sabo**, *Optimal allocation of nodes for surface generating*, Proceedings of 19th Int. Conf. Information Tehnology Interfaces, Pula, 1997, pp. 383-408.

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- *Papers in a bound collection:*
  - [3] G. A. WATSON, *The total approximation problem*, in: *Approximation Theory IV*, (C. K. Chui, L. L. Schumaker and J. D. Ward, Eds.), Academic Press, 1983, 723–728.

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In 2001 the Department of Mathematics and the Osijek Mathematical Society started to publish a professional and methodological journal *Osječki matematički list (Osijek Mathematical Gazette)* intended for high-school pupils and teachers, as well as Bachelor and Master level students.

Today, in accordance with the new Bologna process, Department of Mathematics carries out a five-year Master of Science programme in mathematics and computer education, a three-year first cycle study programme (Bachelor level) in mathematics and a two-year second cycle study programme (Master level) in mathematics with one of the following branches: financial and business mathematics, mathematics and computer science, mathematical economy and statistics, and industrial and applied mathematics.

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