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PARAMETRIC ESTIMATION AND ERROR STRUCTURE

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Abstract. In this paper, the basic regression approaches have been reviewed. The parametric estimation has been discussed in association with the error structure of the data series. Different regression models have been discussed. In particular, one common type of regression model: differential regression model has been discussed in detail and an example has been used to further the discussions. In the Physical Chemistry and Reaction Engineering literature, the integral methods and the differential methods have been "standardized" for solving the differential regression model problems. Discussions on these two "standard methods" are made with a real kinetic estimation problem. Finally, a viable approach to parametric estimation for the differential regression model problem is presented. The proposed method consists of a general numerical integrator and the utilization of the solver program in Excel®. With the proposed method, the trial-and-error nature and the tedious calculations of the traditional methods can be eliminated. Above all, the parameters estimated with the proposed method directly reflect the quality of the data series and thus can be trusted over those obtained from the traditional methods.
Keywords: Correlation, differential equation, parametric estimation, reaction rate data analysis, regression.

1. Introduction

In many engineering problems two or more variables are inherently related. Ideally, if one who is attempting to model the problem also knows the problem well, the relationship between the variables can be established using engineering, physical and/or chemical principles. To avoid complexity and/or uncertainties, engineers usually start with heuristic arguments based on engineering and/or physical principles to derive at a mathematical model to relate these variables qualitatively. Undetermined parameters or coefficients are left in the mathematical model / relationship to guard against any uncertainty and/or unaccounted complexity. Field (or experimental) data must be collected to estimate these unknown parameters before any actual use of this model. This leads to the classic problem of *parametric estimation*. While the model is known to be correct (if the parameters are determined accurately), the data contains error due to observation and instrumentation limitations. This situation is in contrary to functional approximation often encountered in applied mathematics where the data is error-free and the model is not exact. Parametric estimation is commonly encountered in