Habilitation Thesis

Decision Making in Economics and Business
using
Stochastic Guesstimation and Analytic Hierarchy Processes

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Abstract
Romania’s abrupt change from the centralized economy system to the market one raised a set of unexpected econometrical problems in modeling and forecasting. In this context, the PhD thesis I developed, “Macroeconomic modeling using intelligent procedures” is a collection of particular applications for specific econometric problems. During two consecutive significant individual ACE-PHARE research fellowships as well as a modular doctoral support granted by OSI-HESP Hungary, all of these at Leicester University, England under the supervision of Professor Wojiłek Charemza, I focused my attention on a particular econometric algorithm, namely Repetitive Stochastic Guesstimation. After the completion of the PhD thesis (in 2003), this algorithm was assessed and assigned to the large field of evolutionary algorithms and I came up with specific derivations for some particular econometric problems.

Thus, the main results presenting a methodology for constructing confidence intervals for RSG’s estimators on a linear regression model, using a bootstrap approach were published (in 2009) in the paper “Confidence Intervals for the Guesstimation Algorithm: A Bootstrap Approach” , Economic Computation and Economic Cybernetics Studies and Research.

Yet, maybe the most important achievement after the PhD was completed was the mathematical proof for some sufficient conditions for the RSG’s algorithm introduced by W. Charemza to be convergent, on two particular models: a linear model and a GARCH(1,1) model. These achievements were completed by the publication of the main results in two journals: Communications in Statistics: Theory and Methods (“Convergence of the Guesstimation Algorithm”) and Romanian Journal of Forecasting (“Repetitive Stochastic Guesstimation for Estimating Parameters in a GARCH(1,1) Model”). Also, all the former applications done along my PhD doctoral stage, developed and completed with my new findings were published in a comprehensive monograph entitled “Computational Intelligent Techniques in Econometric Modelling-The case of Romania“ published in Germany with Lambert Academic Publishing.

Following the findings published so far, along the Senior Fulbright Research Grant I was granted in 2011, at California State University, East Bay I made some significant steps in determining a specific mathematical formulation for the newly considered algorithm, Stochastic Guesstimation (SG) ‘ estimators on an undersized linear model. The results achieved so far are presented in the thesis, at the end of section 1.2 and after these findings will be completed by some Monte Carlo estimations, in order to comparatively asses SG’s estimators with their Bayesian counterparts, will be gathered in a paper to be submitted to a specific international journal.
Therefore, section 1.2 present, in a flow, the main findings regarding sufficient convergence conditions of the former RSG algorithm—thus introducing the adapted Stochastic Guesstimation as well as the latest results regarding the specific formulation of the SG’s estimators on an undersized linear model.

On a different route, in the attempt to come with a general model able to quantify factors expressed in different measurement units, both tangible and intangible I came across with Analytical Hierarchy Processes (AHP) theory. While in section 1.3.1 it is presented a specific application of this technique regarding the inter-generational learning dynamics in universities (published in 2011 in the Electronic Journal of Knowledge Management) my interest focused on developing original methods for improving consistency in the decision matrices, expressed in various numerical scales. Preliminary findings regarding the determination of the best response in the context of the AHP survey design were presented in 2010 at the 5th International Conference on Business Excellence (“Numerical scales for decision Makers Preference Judgments in the Analytic Hierarchy Process”) and a more comprehensive version of these results was published in the year 2011 in the journal Management & Marketing Challenges for the Knowledge Society (“Survey Design using Individual Numerical scales in the framework of Analytic Hierarchy Process”). These results are described in the section 1.3.1 of this thesis. Starting from the observation that the literature on the determination of the individual numerical scales is flawed by some significant restrictions and anomalies, I focused my attention to the application of intelligent techniques, and especially Simulated Annealing algorithm in order to improve linguistic consistency. This research direction proved to be very intriguing and with a broad range of applications. The first findings in this direction were presented at the 6th International Conference on Business Excellence (“Determining the best response using Simulated Annealing for the AHP survey design” –Proceedings of the 6th International Conference on Business Excellence). This method is illustrated, along section 1.3.2 in this thesis. Expanding the findings already presented in section 1.3.2, my current research in the theory of AHP is addressing the point whether improving consistency in a certain decision matrix (DM) is conducting to a “better” priority vector. Increasing consistency for a given DM can be done by looking in two different directions. One direction would be the so called “linguistic consistency” where, in the attempt to increase consistency the search for a more consistent DM is performed among “close enough” linguistic variables to the initial DM. Another direction is the so-called “bold consistency, referring to the determination of the closest most consistent DM. All this line of research is part of my career plan, as further research directions and the main findings are mentioned in section 2.1.2.
The third mainstream of research emerged while I was benefiting of the Senior Fulbright Research Grant at the California State University, East Bay. In collaboration with Emeritus Professor Tony Lima, from the Department of Economics, some theoretical results were achieved in regard to the irregular behavior of average costs, no matter the production functions’ returns to scale. These theoretical results were published in the paper “Cost Minimization under Variable Input Prices” in 2013, in Romanian Journal of Forecasting and are described in section 1.4.1 of this thesis. The derivation of learning curves in the renewable energy sector grounded in the previous theoretical findings is described with full explanations in the section 1.4.2 in this thesis.

Using AHP for determining good priors as starting points in estimating undersized linear regression models is rendering one of my main research directions in the field of Nowcasting. Some main ideas are listed in the section 2.1.1 corresponding to the section 2 of this thesis, Career Development Plan. Further research, described in section 2.1.2 is concerning the study of linguistic versus bold consistency.