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EDITORS

M. Ivete Gomes

Dinis Pestana

Pedro Silva

Xiaoning Ni

Beijing International Studies University, E-mail: nixiaoning@bisu.edu.cn

Abstract: The paper discusses the definition of Congestion based on DEA, its model and its application to China macro economy. The first part of this paper compares the different definitions and evaluation models of congestion, and points out the difference of viewpoints comes from whether it is congestion when all the inputs increase while the outputs keep constant. The different answers result in the different definitions and models. Combining the definitions and models with the real economic problems, the second part uses the models to evaluate the macro investment efficiency in China. The conclusions show that only a few provinces in the eastern China possess extra investments and there is less bad influence on them if the central government gives more help to the western or middle provinces.

Key words and phrases: Nonparametric Statistics, Congestion, Macro Investment Efficiency, DEA, Production frontier.

An Analysis of Tax Revenue Rorecast Errors

Peter Thomson

Statistics Research Associates Ltd

E-mail: peter@statsresearch.co.nz

Martin Keene

New Zealand Treasury

E-mail: martin.keene@treasury.govt.nz

Abstract: This paper presents an analysis of the New Zealand Treasury's tax revenue forecast errors, both in aggregate and disaggregated by individual tax type. The analysis focuses primarily on the annual one-year-ahead Budget forecasts that are typically based on rating up past tax revenues by growth rates in related macroeconomic variables such as GDP. The objective of the analysis is to better determine the major sources of tax revenue forecast error and to identify the potential for methodological improvements. A review of the Treasury's tax forecasting methods is given and a general class of models proposed that encompasses these methods. Adopting one of the simplest of these as a benchmark, the individual tax revenue forecast errors are first disaggregated into component errors due to forecasting the macroeconomic drivers used as a proxy for the tax base, and a component due to forecasting the tax ratio, or ratio of tax revenue to proxy tax base. The tax ratio is further disaggregated into a component error due to forecasting the tax ratio trend and non-systematic random error. The latter provides a measure of the best accuracy that can be achieved using the benchmark models adopted. Among other findings, it is shown that the main source of tax revenue underforecasting is the underforecasting of the macroeconomic variables used as tax-base proxies. The tax ratio forecasts were generally unbiased, but less precisely determined than the macroeconomic forecasts. This and other evidence indicate that better tax ratio forecasts are likely to be achieved, even with the simple benchmark model used here. The benchmark models have merit as competing models that could be investigated further alongside other simple structural time series models in a systematic evaluation using historical data.

Key words and phrases: Tax revenue forecasting; forecast error decompositions; disaggregation; benchmark models.

CPM 129 : Statistics and Insurance

The Value of a Random Life: Modelling Survival Probabilities in a Stochastic Environment

Jorge Miguel Bravo

University of Évora

Department of Economics

E-mail: jbravo@uevora.pt

Carlos A. Braumann

University of Évora

CIMA (Centro de Investigação em Matemática e Aplicações)

E-mail: braumann@uevora.pt

Abstract: In this paper we propose new solutions for modelling the evolution of the stochastic force of mortality of an individual aged x . The model is based on the well know affine term structure framework and uses doubly stochastic processes (also known as Cox processes) in a manner that is common in the credit risk literature. We investigate the applicability of these processes in describing the individual mortality, and provide a first calibration to the population of Portuguese life insured. The implications of considering stochastic mortality in pricing and reserving for life insurance products and in the immunization of pension and life annuities are analysed.

Key words and phrases: Mortality; affine models; life insurance; hedging.

Estimating Variance and Covariance Parameters by Generalized Estimating Equations for Credibility Models

Wing Kam Fung

Department of Statistics and Actuarial Sci

E-mail: wingfung@hku.hk

Huang Danwei

Department of statistics and actuarial science, HKU

E-mail: h0299983@hkusua.hku.hk

Abstract: A regression credibility model with a correlated error structure is proposed as an extension of the one proposed by Hachemeister [Hachemeister, C.A., 1975. *Credibility for regression models with application to trend*. In: Kahn, P.M. (Ed.), *Credibility: Theory and Applications*. Academic Press, New York, pp. 129-163]. It can be shown that this proposed regression credibility model is a general model that covers the Buhlmann and the Buhlmann-Straub frameworks. Generalized estimating equations (GEE) are developed to estimate the variance and covariance parameters. GEE approach can relax the distributional assumption imposed on the data and after some modification it may handle the data with high skewness and kurtosis. Simulation studies are conducted to investigate the performances of GEE approach when it is dealing with normal and non-normal data with different assumptions on error structure, including moving average, autoregressive and exchangeable. GEE estimators are also compared with other alternative estimators, such as Buhlmann, Buhlmann-Straub and Cossette and Luong's least square estimators [Cossette, H., Luong, A., 2003. *Generalised least squares estimators for credibility regression models with moving average errors*. *Insurance Math. Econom.* 32, 281-293]. This paper aims to provide a comprehensive study of the feasibility and robustness of GEE approach's application within credibility context.

Key words and phrases: Regression credibility model; Generalized estimating equations; Credibility theory; Correlated errors; Non-normality.

Analysis of the Moments of the Profit on an Income Protection Policy

Pedro Manuel Alves Barroso Magalhães

Departamento de Matemática

Universidade de Trás-os-Montes e Alto Douro

E-mail: pbarroso@utad.pt

Isabel Maria Ferraz Cordeiro

Escola de Economia e Gestão

Universidade do Minho and CEMAPRE/ISEG

E-mail: icordeiro@eeg.uminho.pt

Abstract: Income Protection (IP) is a class of long-term sickness insurance which provides cover against the risk of loss of income due to disability. Continuous Mortality Investigation Committee (1991) has presented a multiple state model for the analysis of IP data and has obtained graduations of the transition intensities defined for this model using a set of IP data from UK insurance companies. Based on this model, Waters (1990) has derived numerical algorithms which can be used to calculate recursively the moments of the present value of the profit on an IP policy. The main purpose of this paper is to carry out a sensitivity analysis where we analyse the effects on the mean of the profit and two risk measures of changing the values of the transition intensities. The mean of the profit and the risk measures (which measure the degree of risk of a policy and are based on the second and third moments of the profit) are calculated using the numerical algorithms and the graduations