

Introduction

Projecting educational investment and educational composition of a population is generally regarded as having far-reaching consequences on a nation's educational and economic development (Hussar & Thomas, 2009; Lurz & Goujon, 2001; Lutz & Samir, 2011). A sizable literature, therefore, has attempted to estimate and project educational demographics in terms of school enrollment, educational attainment, educational expenditure, teacher-student ratio and illiteracy rates, which subsequently would bring a wide array of implications to strategic policy planning for educational development and reform of a nation (Holz, 2008; Hussar & Thomas, 2009; Landau, 1983; Lurz & Goujon, 2001). While there is a substantial amount of literature on educational forecasts, far more of the research studies tended to concentrate on extrapolating the future for policy planning and decision making than on comparatively detecting the predictive power of models adopted for different categories of data sources in the educational arena. Within the past decade, a growing number of studies have devoted to judgments of forecasting performance on educational data extrapolated by a variety of extrapolative (time series) methods, ranging from single exponential smoothing, double exponential smoothing, autoregressive integrated moving average (ARIMA), Markov model, neural network algorithms to fuzzy time series model (Baker & Richards, 1999; Boes & Pflaumer, 2006; Chen, 2002; Chen, 2008; Song & Chissom, 1993, 1994; Sullivan & Woodall, 1994).

In forecasting, precision is the major concern since better forecasts could translate into better strategic policy planning and decision making. It has been generally assumed that immigration, birth rate, mortality rate, economic and policy changes are exogenous variables which might alter the historical trend into an uncertain direction and affect the precision of projecting the future of educational demographics (Hussar & Thomas, 2009). Motivated by the high probability of forecasting uncertainty, Tang and Yin (2012) put GM (1, 1) and GM (1, 1) rolling models derived from the grey system theory in comparison with simple linear extrapolation techniques employed by the National Center for Educational Statistics (NCES) of the United States on plotting two categories of school expenditure and nine categories of school enrollment in the United States.

Experimental results indicated that the forecasting efficiency of grey prediction was as competitive as simple linear extrapolation technique adopted by the NCES (Tang & Yin, 2012).

Following the same research line on justifying grey prediction models' mathematical power to flexibly deal with volatile situations, the present study aims to undertake an out-of-sample forecasting competition to compare the forecasting efficiency between grey prediction and weighted average cohort survival ratio (CSR) adopted by Prescott (2008) in a large-scale projection study published by Western Interstate Commission for Higher Education (WICHE). Adhering to the assumption that life-phase changes would influence population change, weighted average CSR operates by estimating the difference between the enrollments in a given grade in a given year and the enrollments in the next grade level in the year to come. The purpose was to take into account possible impacts on prediction accuracy brought about by evident demographic shifts in the population (Prescott, 2008; Western Interstate Commission for Higher Education, 2012).

To determine the relative accuracy of two grey prediction models and weighted average CSR for projecting high school graduates, the analysis of the present study involves two stages. First, the two grey prediction techniques, named GM (1, 1) and GM (1, 1) rolling models, are used to generate individual forecasts. Second, comparative accuracy tests are assessed across the above two grey forecasting models and weighted average CSR employed by Prescott in WICHE's 2008 projection study with regard to predictive power in high school graduates in the United States.

Literature Review

The Application of Uncertainty System Theory to Educational Forecasts

Most studies in the literature on educational projections have been conducted based on conventional extrapolative or regression time series analysis to perform short-term forecasts. A commonly used forecasting technique is the straightforward extrapolation of past trends (Baker & Richards, 1999; Holz, 2008; Hussar & Thomas, 2009; Song &