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Forecasting accuracy evaluation of tourist arrivals ☆

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ABSTRACT

This paper evaluates the use of several parametric and nonparametric forecasting techniques for predicting tourism demand in selected European countries. We find that no single model can provide the best forecasts for any of the countries in the short-, medium- and long-run. The results, which are tested for statistical significance, enable forecasters to choose the most suitable model (from those evaluated here) based on the country and horizon for forecasting tourism demand. Should a single model be of interest, then, across all selected countries and horizons the Recurrent Singular Spectrum Analysis model is found to be the most efficient based on lowest overall forecasting error. Neural Networks and ARFIMA are found to be the worst performing models.

Introduction

Tourism in the 21st century has experienced continued expansion and diversification, becoming one of the largest and fastest-growing economic sectors in the world. Among the most favourite destinations, Europe is considered the most prominent one, receiving the highest amount of tourists arrivals (563 million), representing 52% of the global tourist arrivals and generating an income of more than €368 billions in 2013 (UNWTO, 2014). However, despite Europe being the region with the most arrivals, it is not the region that is growing at the fastest rate. According to UNWTO (2014), regions such as Asia and the Pacific, and Africa that have traditionally had a lower rate of arrivals are experiencing the highest growth in recent years. These developments might be due to the global financial crisis and the ongoing European debt crisis that Europe has suffered the most from (e.g., see Antonakakis, Dragouni, & Filis, 2015; Antonakakis, Dragouni, & Filis, 2015). Since the European Union has placed a lot of emphasis on the tourism sector as a source of economic prosperity for its member countries (Lee & Brahmasrene, 2013), the need of accurate forecasts of tourism demand is of paramount importance.

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The importance of accurate tourism demand forecasting has been already established in the literature since the 1980s, especially given the perishable nature of tourism (see, for example Uysal & O'Leary, 1986; Law & Au, 1999; Law, 2000). Indicatively, we maintain that destination countries require substantial investments in infrastructure and promotional activities, hence accurate tourist arrivals forecasts are necessary in the effort of safeguarding positive returns on investment (Chatziantoniou, Degiannakis, Eeckels, & Filis, 2016). Furthermore, accurate tourist arrival forecasts are important for policy makers as they can serve as a tool for policy decisions, which aim at boosting economic development, wellbeing and employment, particularly for tourism destination countries (Palmer, Monta, & Sesé, 2006; Song & Witt, 2006; Gounopoulos, Petmezas, & Santamaria, 2012). In addition, accurate forecasts are also important at industrial level (e.g. airlines, tour operators, hotels, etc.), as for example, they allow firms to produce more accurate budgets.

Moreover, various time horizons are relevant to decision making in the tourism sector. For example, short-term forecasts are required for scheduling and staffing, while medium-term forecasts for planning tour operator brochures and long-term forecasts for investment in aircraft, hotels and infrastructure. To that end, the purpose of this study is to evaluate both the short-, medium- and long-run forecasting accuracy of tourism demand based on several parametric and nonparametric forecasting techniques in selected European countries, namely, Austria, Cyprus, Germany, Greece, Netherlands, Portugal, Spain, Sweden and the United Kingdom.

In contrast to previous studies, that compare different classes of the same model or a few different classes of models, this study employs nine alternative parametric and non-parametric techniques, thereby complementing all previous studies in an attempt to uncover the best forecasting method of tourist arrivals in Europe. In particular, the models employed include the Autoregressive Moving Average (ARIMA), Exponential Smoothing (ETS), Neural Networks (NN), Trigonometric Box-Cox ARMA Trend Seasonal (TBATS), Fractionalized ARIMA (ARFIMA) and both Singular Spectrum Analysis algorithms, i.e. recurrent SSA (SSA-R) and vector SSA (SSA-V). In addition, we also consider the efficacy of simpler forecasting techniques such as Moving Average (MA) and Weighted Moving Average (WMA) in relation to the advanced econometric techniques.

Given that there exists a wide variety of forecasting techniques in addition to those considered here, it is pertinent to present justification for our choices. Firstly, the use of simple models such as MA and WMA are useful alongside the broad range of econometric techniques to determine exactly how better off the complex techniques can be at forecasting tourist arrivals in Europe. Secondly, with the exception of SSA, MA and WMA models, all other models are provided via the forecast package in R as automatic forecasting techniques (Hydman & Khandakar, 2008). As such, the results of this paper can shed light on the appropriateness of these popular automated forecasting techniques at predicting European tourist arrivals. In addition, ARIMA is universally accepted as a mandatory benchmark in forecasting studies especially where new alternatives are introduced as viable options for predicting a given variable. Whilst ETS, NN, and ARFIMA are already widely used and popular, the same cannot be said of TBATS which was introduced by De Livera, Hyndman, and Snyder (2011) before being incorporated in the forecast package. In brief, the TBATS technique uses a new method that greatly reduces the computational burden in the maximum likelihood estimation when forecasting complex seasonal time series such as those with multiple seasonal periods, high-frequency seasonality, non-integer seasonality, and dual-calendar effects (De Livera et al., 2011). TBATS has been used to forecast energy consumption (Silva & Rajapaksa, 2014), the price of gold (Hassani, Silva, Gupta, & Segnon, 2015) and housing downturns (Zietz & Traian, 2014) in previous studies. Thirdly, all the aforementioned techniques are classical methods, and SSA is able to provide a completely different modelling approach as SSA is a filtering technique. In brief, the use of SSA enables us to identify the impact of signal extraction and denoising in comparison to the classical forecasting approach with regard to predicting European tourist arrivals. Fourthly, this study marks the introductory and successful application of both TBATS and SSA-R for tourism demand forecasting. Finally, the models considered in this study represent both parametric and nonparametric approaches. The parametric models rely on assumptions such as normality and stationarity which are both likely to be violated in 9/10 European tourist arrivals series considered here (see, Tables 1 and 2). In the event of such violations, it is interesting to note how parametric forecasts which could require data transformations compare with nonparametric forecasts from SSA which requires no prior assumptions about the data generating process.

Put differently, this study provides the most comprehensive forecasting comparison among several parametric and nonparametric techniques of international tourist arrivals in Europe. Note that, in this paper, as discussed, we follow an univariate approach to forecasting tourist arrivals. There are two reasons for this: First, as indicated by Antonakakis et al. (2015); Antonakakis et al. (2015), on average tourism is a leading indicator for the economies under consideration. In light of this, it is only rational that we try and develop univariate forecasting models for tourist arrivals, which allows us to forecast the same independent of other macroeconomic variables that possibly affects tourist arrivals. Second, the tourism-growth literature (see, for example and references cited therein for detailed literature reviews Arslanturk, Balcilar, & Ozdemir (2011);Balcilar, van Eyden, Inglesi-Lotz, & Gupta (2014)) indicates that there are possibly large number of variables that can affect both tourism and growth simultaneously. Given this, at this stage, we avoided possible selection bias in choosing such variables for these countries. However, we leave this as a possible venue of future research, which we discuss further in the conclusion.

Our findings reveal that no single model can provide the best forecasts for any of the countries considered here in the short-, medium- and long-run. Moreover, forecasts from NN, ETS, ARFIMA, MA and WMA models provide the least accurate predictions for European tourist arrivals, yet interestingly ARFIMA forecasts are better than the powerful NN model and in certain cases the MA and WMA forecasts succeed in outperforming both ARFIMA and NN forecasts. SSA-R, SSA-V, ARIMA and TBATS are found to be viable options for modelling European tourist arrivals based on the most number of times a given model outperforms the competing models in the above order. The paper also computes information on the ability of the forecasts to predict the correct direction of change in the data which adds value to the overall results. Thus, the nature in which