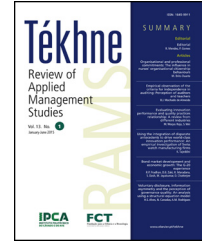




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ARTICLE

Tourism demand modelling and forecasting with artificial neural network models: The Mozambique case study

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Abstract This study is aimed to model and forecast the tourism demand for Mozambique for the period from January 2004 to December 2013 using artificial neural networks models. The number of overnight stays in Hotels was used as representative of the tourism demand. A set of independent variables were experimented in the input of the model, namely: Consumer Price Index, Gross Domestic Product and Exchange Rates, of the outbound tourism markets, South Africa, United State of America, Mozambique, Portugal and the United Kingdom. The best model achieved has 6.5% for Mean Absolute Percentage Error and 0.696 for Pearson correlation coefficient. A model like this with high accuracy of forecast is important for the economic agents to know the future growth of this activity sector, as it is important for stakeholders to provide products, services and infrastructures and for the hotels establishments to adequate its level of capacity to the tourism demand.

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1. Introduction

In many countries, whether developed or developing, tourism, due to its transversality, has gained more and more space in the economic outlook, boosting the development of other interrelated sectors such as agriculture, crafts, food, drinks, transportation, etc. (SPDTM, 2004). For Mozambique, the tourism sector is the major ally on the fight over poverty, through the enhancement of natural resources and the historical and cultural heritage areas that are contributing to the promotion of investment and employment as well as the generation of foreign exchange earnings (SPDTM, 2004).

Actually, the tourism industry has less contribution in the gross domestic product and employment market in Mozambique than in the world. According to WTTC (2014), the direct contribution to Gross Domestic Product (GDP) it estimated in 2.9% for 2014 and the contribution to employment market is 2.2%, in Mozambique. When compared with the tourism contribution in GDP of the world 3.1%, and in the employment 9.8% (WTTC, 2014).

Mozambique needs to make its tourist potentialities to be known in order to be competitive in the regional market (Southern region of Africa), just like South Africa that has (3% to GDP and, 5% to Employment) and Tanzania with (5.1% to GDP and; 4.3% to Employment).

So several actions have to be taken by private and public (actors/players) institutions to improve the situation. The starting point begins with the strategic plan, *i.e.*, where the accuracy of forecasting plays a crucial factor in the knowledge of the future.

According to the tourism studies, it is estimated that in 2025 there will be over 4 million tourists in Mozambique (SPDTM, 2004). It is expected that the rate of growth between 2004 and 2025 goes around 6, 1%, and we expect that this number of entries has considerable effects on the number of overnight stays, because the number of tourism internationally have greater impact on the number of overnight stays compared to domestic tourism.

So, concerned with that, this study has the aim to develop a model as well as forecasting the overnights number for the period of 2004–2013 on a monthly basis from a set of variables presumed to influence the number of overnight stays by 5 major tourist issuing countries for Mozambique, namely: Mozambique itself, South Africa, United States of America, Portugal and the United Kingdom. The selected variables are Harmonized Index of Consumer Prices, Gross Domestic Product per capita and Exchange Rate.

Therefore, the aim of this work is the modelling and forecasting tourism demand represented by total overnights for Mozambique, for the period, since January 2004 until December 2013 using artificial neural networks methodology. Additionally, in the study for accuracy was used Mean Absolute Percentage Error (MAPE) and Pearson correlation coefficient (r).

In order to achieve the objective of this study, the paper is organized in this structure: Section 1 presents the literature review; Section 2 presents the methodological approach; Section 3 presents the empirical results and analysis, while the final section summarizes the main conclusions.

2. Literature review

Due to the perishable nature of the tourism industry, the need to devise accurate forecasts has become crucial (*e.g.*, Gunter & Önder, 2015; Law, 2000; Law & Au, 1999; Witt & Witt, 1995). Most studies about modelling and forecasting have been published in the recent years (*e.g.*, Athanasopoulos & Hyndman, 2008; Dwyer, Forsyth, & Dwyer, 2010; Fernandes, Monte, & Teixeira, 2009; Fernandes, 2005; Li, Song, & Witt, 2005; Peng, Song, Crouch, & Witt, 2014; Rigall-I-Torrent & Fluvia, 2007, 2011; Santos & Fernandes, 2011; Song & Li, 2008; Song & Witt, 2012; Song, Witt, & Li, 2003; Tribe & Xiao, 2011). Some of these studies used neural networks for modelling and forecasting tourism demand (*e.g.*, Claveria & Torra, 2014; Fernandes & Teixeira, 2008; Fernandes, Teixeira, Ferreira, & Azevedo, 2008; Law, 2000; Law & Au, 1999; Teixeira & Fernandes, 2014). For example, Law and Au (1999) used a supervised feed-forward neural network model to forecast Japanese tourist arrivals in Hong Kong. Law and Au used Service Price, Average Hotel Rate, Foreign Exchange Rate, Population, Marketing Expenses, and Gross Domestic Expenditure as explanatory variable and estimated Japanese arrivals from Hong Kong was applied as dependent variable. Law and Au (1999) conclude that using the neural network model to forecast Japanese arrivals outperforms multiple regressions, naive, moving average, and exponent smoothing. Law (2000) applied Back propagation learning in improving the accuracy of neural network-based tourism demand forecasting and the empirical results indicate that using a back propagation algorithm to train neural network outperforms regression models and time-series models in terms of forecasting accuracy. Fernandes et al. (2008) applied artificial neural networks as alternative to ARIMA model to forecast 'nights spent in the hotel accommodation' recorded in the period from January 1987 until December 2006. Fernandes and Teixeira (2008) applied a neural networks to model and forecast tourism demand, represented by number of overnight stays in north of Portugal since January 1987 to December 2006. Claveria and Torra (2014) applied neural networks to forecasting tourism demand in Catalonia (Spain). Teixeira and Fernandes (2014) applied artificial neural networks to forecast time series namely: tourism revenue and overnights registered in the hotels of north of Portugal for the period between January 2006 and December 2011.

Most of the studies about modelling and forecasting used tourist arrivals as variable representative of the tourist demand (*e.g.*, Gunter & Önder, 2015; Law, 2000). According to them, the second most used variable was the variable income or tourist spending. Another variable no less used to model the tourist demand is the number of overnight stays registered/recorded in hotels and similar guest houses. According to Cunha and Abrantes (2013), the use of variable number of overnight stays is relevant when you want to capture the movement of foreign and domestic tourists simultaneously.

The variable number of overnight stays has been used in several studies related to modelling and forecasting of tourism demand using artificial neural networks (Fernandes et al., 2008; Teixeira & Fernandes, 2014). This study for modelling and forecasting used the number of overnight

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