

Forecasting International Arrivals for Ecuador: A SARIMA Model Approach

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ABSTRACT: International tourism arrivals for Ecuador was forecasted in this paper, with monthly data from January 2000 to December 2019. The Box-Jenkins model was applied, specifically the technique called SARIMA, as the behavior of data indicated that a seasonal ARIMA was the best way to model a forecast. According to results, the best model was (1,1,0)(1,1,0), diagnostic checks were fulfilled, except normality test; forecasting and back forecasting values showed very good results

KEYWORDS: Box-Jenkins; SARIMA, Ecuador; Tourism Demand.

I. INTRODUCTION

Tourism has become an important part for political economics worldwide, it stimulates investments, and each country try to exploit its local nature to generate revenues. Ecuador has so much to offer, but it is restricted by its currency, any tourist from Latin America is cautious about how much to spend, as the Dollar is the most expensive currency in Latin America. Nevertheless, tourism has arranged itself to increase through years, due to government support, and be able to compete worldwide. Data from the World Economic Forum, show that Ecuador is below the average, Ecuador GDP tourism share is about 5% meanwhile the global is 9.5%. The worldwide indicator shows that 1 of 11 employees are related with tourism worldwide, but in Ecuador is 1 of 20. Revenues from tourism are still below what is expected. Colombia, Peru and United States represent about 70% of total tourist arrival, and the rest 30% it is from the rest of the world. In this study using the stationary multiplicative autoregressive moving average model, it was able to forecast arrivals to Ecuador for the period from January 2000 to December 2019.

II. LITERATURE SURVEY

The Shareef and McAleer (2007); Lim and McAleer, (2000) and Lin et al., (2011) have used foreign tourist arrival as a proxy for Tourism. Li et al., (2006); Sheldon. (1993); Syriopoulos. (1995) and Downward and Lumsdon. (2003), have used tourist expenses for proxy. The long run economic relationship of the tourism demand model for Ecuador was carried out in (Paladines and Amaiquema. 2017), using variables as the number of arrivals, the income of the origin country of the tourist, proxied by industrial or production index.

Long and short run relationships between tourism and some macroeconomic variables are also studied, but some of these variables cannot be measured and most studies use proxy variables (Lim. 2000; Song et al., 2003), in tourism model studies, income and prices are the most explanatory variables used. Leisure tourism is considered as a luxury good, though this variable would be difficult to measure. Most studies rely on the use of nominal or real GDP or GDP per capita, as more income people have, they are likely to travel more. More specifically, some researchers have applied the industrial output index for proxy GDP as this can be measured monthly (Gonzales and Moral. 1995; Seo et al., 2009), these studies have concluded the index has a positive relationship with tourist arrivals.

Others have used the relative hotel price index (Narayan, 2004) for proxy for expenditure or cost of living in the destination country has been included, but this kind of specific indices had not improved results from the relative price index (Martin and Witt,

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1987). Some studies proxied Tourism Price by relative prices (Habibi and Rahim, 2009; Narayan, 2004). More income, more leisure expenditure for tourism (Gonzales and Moral, 1995; Seo, et al., 2009; Halicioglu, 2010; Song et al., 2003).

Variable exchange rate used by (Halicioglu, 2010; Habibi and Rahim, 2009). Artus, (1972) expressed that tourists respond quickly to changes in exchange rate instead of relative inflation, other study argued that the exchange rate alone does not capture impacts on tourism, for this, many studies use real exchange rate (Martin and Witt, 1987).

Transport and tourist accommodation is also used (Louca, 2006). Transportation is not yet measured to calculate the cost of transportation of tourists, some tourists travel by car using gasoline; meanwhile others use airplanes (Narayan, 2004). I use the variable oil price instead of transportation (Crouch, 1994). But it could show the multicollinearity problem as oil price and income present similar changes. (Lim, 1999); these issues can be fixed by using dummy variables.

Tourism provides foreign currencies and its effect is a positive impact on any economy, as increase local imports and keeps constant the foreign currency reserve level (McKinnon, 1964) but in the case of Ecuador that uses dollars, local tourism should be affected negatively if currency devaluation in the origin tourist country takes place.

Other variables have jointly been studied to measure the impact on tourism, variable like domestic consumption (Jackman and Lorde, 2010), number of people under the poverty line (Croes and Vanegas, 2008), industrial good imports (Nowak et al., 2007); direct foreign investment (Tang et al., 2007); exports and imports (Khan et al., 2005), also political unrest and recessions would affect the demand of tourism (Loeb, 1982).

Geurts, Buchman and Ibrahim, (1976); Petrevska, (2015); Bigović, (2012); Saayman and Saayman; (2010); Haridev, (2013); Baldigara and Mamula (2015); Akuno, et al (2015); Song, H., Wong, K., & Chon, K. (2003) and Koutras et al (2016) used an ARIMA model to forecast the behavior of tourism in the short run.

All these studies have concluded there is a long run relationship, using Ordinary Least Squares (OLS) and advanced econometric methods like autoregressive lag models or Error Correction Models (ECM, ARDL, ARIMA), also they proved that tourism it is a relevant economic variable.

III.METHODOLOGY

After Arrivals were got from the Ministerio de Turismo del Ecuador webpage, monthly data of arrivals from January 2000 to December 2019, as it can be seen in Figure 1.

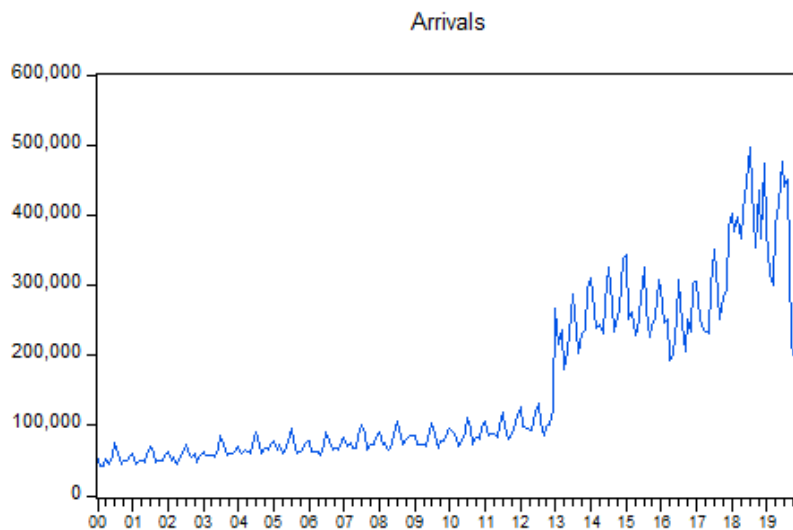


Figure 1 Arrivals to Ecuador from January 2000 to December 2019

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One thing to notice from a series, it is if that one is stationary, differencing at order one frequently removes trend, and a seasonal differenced removes any sign of seasonal peak, in this study a seasonal of 12 was applied.

A multiplicative seasonal ARIMA model was developed in this study, ARIMA(p,d,q) (P,D,Q)_s. the general algebraic form for this kind of model is:

$$\Phi_p(L^s)\phi_p(L)\Delta^d\Delta^D_s Y_t = \theta_q(L)\Theta_Q(L^s)a_t$$

For the regular component, we have $\Phi_P(L)$, and $\theta_q(L)$ represents the moving average polynomial, and d is the regular difference; $\phi_p(L)$ and $\phi_p(L)$, are polynomial for the stationary component, D is the order of integration.

This study tried at most not to overparameterize, as can cause estimators be inconsistent, so a parsimonious model was the guide to follow.

The use of dummy to correct seasonal peaks was avoid, as this can change the covariance of the series and a spurious regression can result.

As in concordance with other studies, the use of the ACF and PACF graphs were use, in order to determine the best SARIMA model possible, also, the use of AIC and the likelihood ratio statistics were observed, as guide to choose the best forecasting model to fit real data. Besides, no constant was used, as this regularly is found to be no significant.

In order to evaluation the forecast made by the proposed model, it was used the bias and covariance proportion, as well the Theil inequality coefficient. And finally, diagnostic check was applied for the final model, independence of the residuals, normality test, homoscedasticity test, and stability of the model by the inverse roots.

This study used in order to developed the seasonal ARIMA model, the Software Rstudio, that it is distributed under a GNU copyleft.

IV.SIMULATION AND RESULTS

In Data was analyzed as was shown on Figure 1, firstly, data was converted to natural logarithmic, then was differenced to remove any trend, and a seasonal difference of twelve was applied as well. After, unit root tests were applied and data passed tests.

No significant outliers were found, the best model based on AIC and diagnostic checks, was seasonal ARIMA(0,1,1)(0,1,1)₁₂. The final equation would be:

$$Y_t = \theta Y_{t-1} + \Theta Y_{t-12} + e_t = -0.2005t-1 - 0.5089_{t-12}$$

The constant term resulted to be no significant, the adjusted coefficient of determination was low, barely 34% explained, but the backward seasonal ARIMA forecasting (Figure 2), show very good fit, checking as well results of other test as shown at Table 1.

Table 1 Backward SARIMA forecast tests

Statistics	Value
Theil inequality coefficient	0.06
Covariance proportion explained	0.98
Mean test using Welch test (p-value)	0.54

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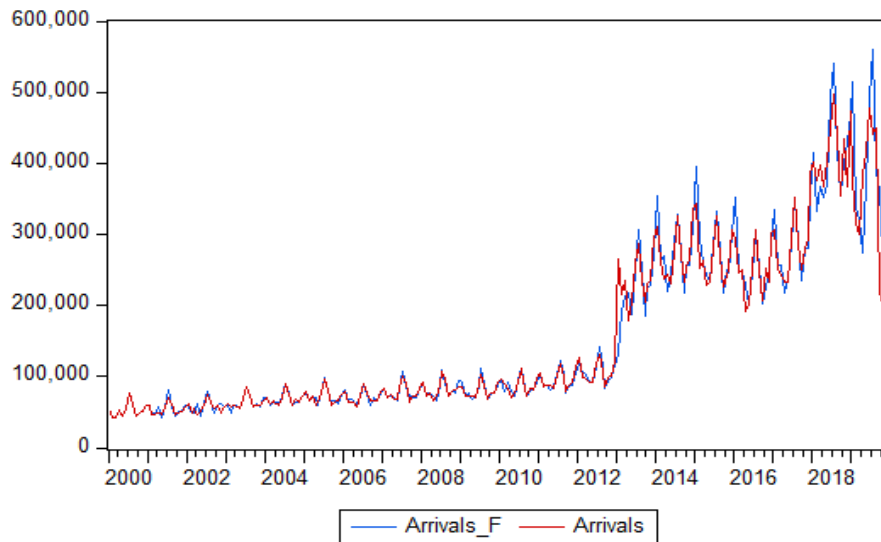


Figure 2 Arrivals backward SARIMA forecasting

Heteroskedasticity tests was applied, model passed those tests. Normality assumption was not passed, but citing Wooldridge (2010), normality can by bypass as data may be inferred to be normally distributed as it increases according to asymptotic theory.

According to the ACF and PACF correlograms, no residual correlation was observed, as well the squared of those correlograms, so, residuals may be considered white noise, and inverted roots are less than one.

Finally, Figure 3 shows the forecast of the SARIMA model, a small increase in arrivals may occur in the next 3 years, according to the model developed.

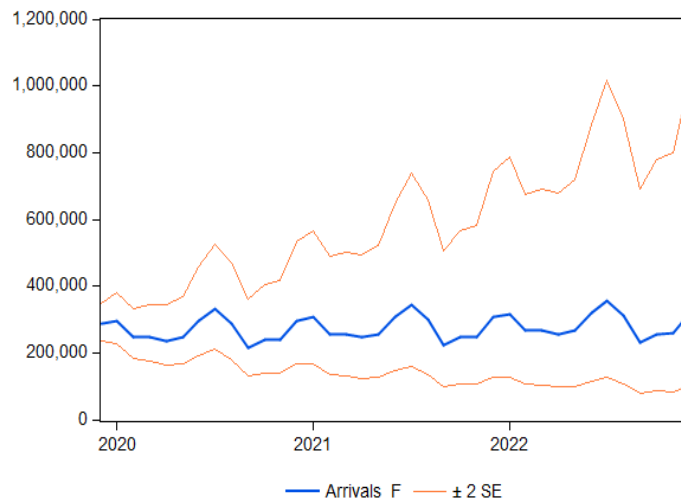


Figure 3 Arrivals forecast using the final SARIMA model

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VI.CONCLUSION

In this paper the model SARIMA was applied to the number of arrivals, in order to be able to do a short run or a long run forecast for tourism. The model chosen was a multiplicative seasonal ARIMA(0,1,1)(0,1,1)₁₂. The model developed showed itself statistically significant, good fit, good forecast, a low adjusted coefficient of determination, and passed diagnostic checks except the normality assumption. These results are better than (Paladines, J. and Amaquema, L. 2017), that showed a model no significant using an ARIMA model, this may be due the current model used more data and a multiplicative seasonal ARIMA model. Results for this model, reflects that Tourism will not generate more revenues in future if an important policy is applied in short run.

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