FORECASTING THE TOURISM DEMAND USING TIME-SERIES – A CASE STUDY ON THE PREFECTURES OF WESTERN GREECE

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Abstract: The present work studies the well-timed issue of forecasting the tourism demand for the three prefectures of the Region of Western Greece: Achaia, Etoloakarnania and Ilia. The proposed approach consists in finding a proper model, for each prefecture, based mostly on the effectiveness and complexity of the proposed models. Utilizing the official statistical data for the tourist occupancy of all tourist accommodations (except camping sites) from the above three prefectures, for all months between 2005 and 2012, a trend and seasonality analysis has been realized in order to construct suitable models using the well-known ARIMA (Box-Jenkins) methodology. Then a series of statistical test have been employed to select the best fitted model to given data. The forecasting effectiveness of the chosen model is measured using the last twelve observations as a training set. Finally, a 12-period prediction for the three prefectures is proposed.

Keywords: Prefectures of Achaia, Ilia & Etoloakarnania, ARIMA, forecasting model, Western Greece tourism.

Introduction

It is a common truth that tourism is a perishable product which strongly depends on various factors as the current financial status, natural disasters, cultural events, social behaviors, marketing policies etc. In this work the issue of forecasting the tourism demand will be studied in the prefectures constitutes the Region of Western Greece.

Tourism industry in Greece is composed from very crucial economic activities and constitutes a valuable source of earnings; tourism employment, contribution in gross domestic product and multiplier effect investments. A key-factor of Greek tourism industry is its ability to host visitors in various places. Therefore, a desirable task is to forecast monthly and/or annually percentages of occupancy in Greece and in the various regions of this country. Potentially, this task leads to more effective use (allocation) of the available sources for the Greece visitors.

The current global and local financial crisis comes, also, to demonstrate the decisive role of tourism in Greek economy. In fact, Greek tourism managed to maintain its strength and prove to the state - but also the society -

that with an effective support, the sector can become a driving force for the creation of more income in the country and the improvement of the economy competitiveness.

The perspective of local communities to gain strong currency, with high travel receipts fast enough, charms the national government, local authorities and groups of owners of capital, who pursue and encourage tourism. Tourism is an important source of income for many Greek regions, and especially for those with less developed modern service/industrial based economies, such as the Region of Western Greece.

The possibility of forecasting tourism demand at regional and local level, and particularly at different scales of the Region of Western Greece, will give firstly a clear picture of the development of tourism in the study region and secondly the possibility of continuous updating of this picture, and also prediction of the type and intensity of tourism demand (and especially hotel demand), at various spatial scales. So that any attempt for policy making of tourism development, in public and private sector, be based on a reliable depiction of the trends and patterns (such as seasonality) of hotel demand at different spatio-temporal scales. The continuous quantitative and qualitative expansion of such data would allow the formation of a framework for monitoring the evolutionary progress of hotel demand and consumption, and thus will play a key role in creating an integrated system of planning tourism development at regional and local level.

Forecasting is about predicting the behavior of future events (Makridakis & Hibon, 1979; Frees, 1996; Franses, 2004) and plays a significant role in tourism planning. Tourism investments should be based on professional business planning and on achievement vision of the industry future. The tourism industry needs to reduce the risks of poor decisions. One prompt way to reduce this risk is by discerning future events or environments more clearly (Smith, 1995; Burger et al, 2001). Benefits derived from forecasting are imaginable. In the case of forecasts of demands turning out too high, accommodation firms will suffer; there might be, for instance empty rooms in hotels, unoccupied apartments, and so on. If, on the other hand, the case turned out to be that forecasts of demand are too low, then firms will lose opportunities; for example, there may be inadequate hotel accommodation etc. (Chu, 2004). In practice, time series forecasts are extrapolations in future times of the available time series values. A good projection should provide a forecaster with a sense of the reliability of the forecast. A convenient way to capture this sense is the prediction interval, which provides a measure of the reliability of the forecast (Psillakis, Panagopoulos, & Kanellopoulos, 2009). An exhaustive review on forecasting time series can be found in (Song, & Li, 2008).

In this paper, motivated mostly from absence of systematic research of the Region of Western Greece (Panagopoulos, & Panagopoulos, 2005), we used the well-known Box-Jenkins method (Box, & Jenkins, 1976; Box, Jenkins, & Reinsel, 1994) to model the hotel tourism occupancy (except camping sites) for the three prefectures of the Region of Western Greece, for the period 2005-2012. The choice of an ARIMA model consists mostly in its flexibility and generality as it can handle different types of data. Furthermore, despite of the hard programming implementation of Box-Jenkins method it can be easily found and applied in many computational and statistical packages (e.g. Minitab) and it can produce reliable predictions when the appropriate model is chosen.

The structure of the paper is as follows: In the next section we present a short profile of Western Greece and in section 3 we develop the forecasting models for each prefecture, as well as, we demonstrate the prediction results. Finally, in the last section we discuss some conclusions and remarks.

Short Profile of Western Greece

The Region of Western Greece occupies the northwest Peloponnese and the western tip of mainland Greece. It includes the prefectures of Etoloakarnania, Achaia and Ilia. For the most part the land is mountainous (45.3%) and half-mountainous (25.6%), while only 29.1% are lowlands. It has extensive coastline at all three prefectures, which are bounded by the Ionian Sea and the gulfs of Amvrakikos, Patras and Corinth. The main lines in the investment profile of Western Greece are described by the followings (Invest in Greece Agency, 2012; Research Institute for Tourism, 2014):

Main economic activities include agriculture and tourism services.

As in many other Regions of Greece, production of wine and olive oil is significant. Dairy products are also important to the local economy as well as fish farming, unique to the area and a traditional source of income.

Western Greece is quickly becoming one of the top tourism destinations in Greece. The emergence new hotel units and new investments in the area have strengthened the local economy and are currently changing the overall profile of economic activity.

The geomorphology of Western Greece has great diversity. It includes mountains with a very high altitude, large natural lakes and rivers.

The Region of Western Greece is privileged in terms of accommodating many, various and significantly sensitive ecosystems.

Significant tourism infrastructures (Western Greece is served by 2 airports and 6 ports)

In 2013 there were in Western Greece 292 Hotels with 11368 rooms and 21417 beds.

The tourism development of the Region's prefectures is dynamic but spatially restricted, since specific areas (as enclaves) are developing a complex superstructure, where tourist accommodation and services, for organized package tourist plays a prominent role, but as important is the development of holiday home enclaves, and camping units. It is mainly a Region for domestic tourism. Greek tourists present a stable consumption (in terms of hotel nights spent) all over the year, particularly in the prefectures of Achaia and Etoloakarnania. In contrast, the consumption of foreign tourists presents a relatively high seasonality, especially in the prefecture of Ilia (May to September).

The proposed models

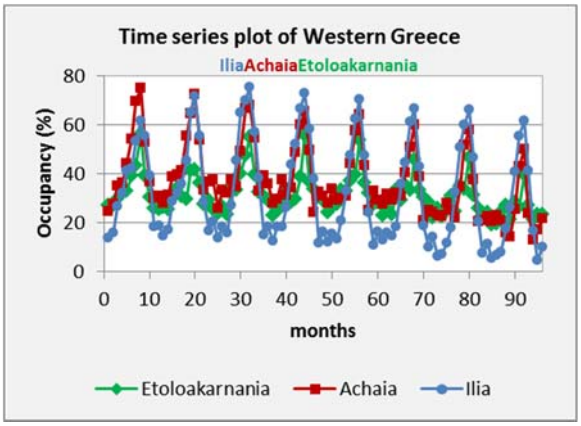
For each of the studied prefecture a forecasting is proposed based on ARIMA forecasting models. For the evaluation of the proposed models, we used the monthly occupancy of all tourist accommodations (except from camping sites) from the Prefectures of Etoloakarnania, Achaia and Hlia for January of 2005 till December 2012. The used data were obtained from the official records of the Hellenic Statistical Authority. It is underlined that Hellenic Statistical Authority has not released any similar data for the period 2013 until now. The development of proper models for each prefecture was made using the Minitab package.

For all three prefectures, the plotted data (Figure 1) reveal a strong seasonality with considerable variation in the rates of occupancy between summer and winter months. Maximum occupancy is observed in August in all three

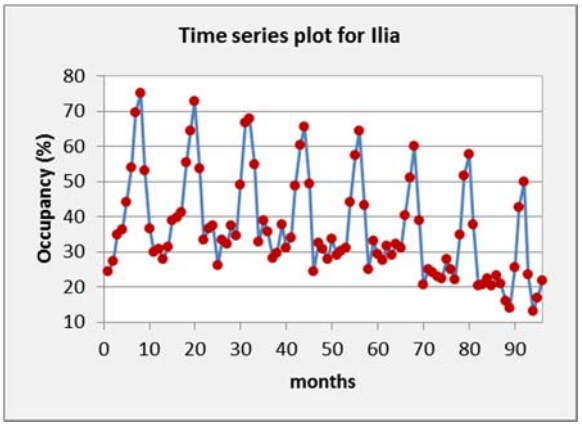
prefectures and for the three summer months a significantly increased occupancy is noticed, contrary to the winter months where the occupancy rates are very low. The greater volatility in occupancy occurs in Ilia which during the summer months the occupancy exceeds 70%, while during the winter months fall below 10%. On the other hand, the smallest fluctuation in occupancy between summer and winter months is observed in the prefecture of Etoloakarnania (19% - 57%).

It is of particular interest the underlying trend in the plotted datasets. The entire region of Western Greece (Figure 1a) discloses a clear decreasing trend over the last 3 years. In prefecture of Achaia (Figure 1c) is much more intense and occurs throughout the study period. On the other hand this downward trend is not as pronounced in Ilia (Figure 1b), and a fall is observed in Etoloakarnania (Figure 1d), especially during the summer months, where the maximum values of this time series occur.

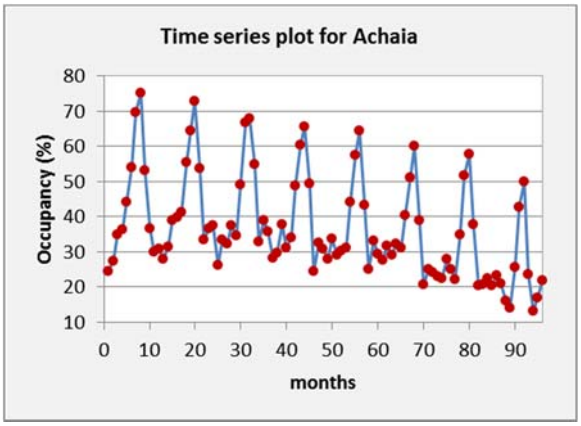
Figure 1. Time series plot for three prefectures and the Region of Western Greece for period 2005-2012



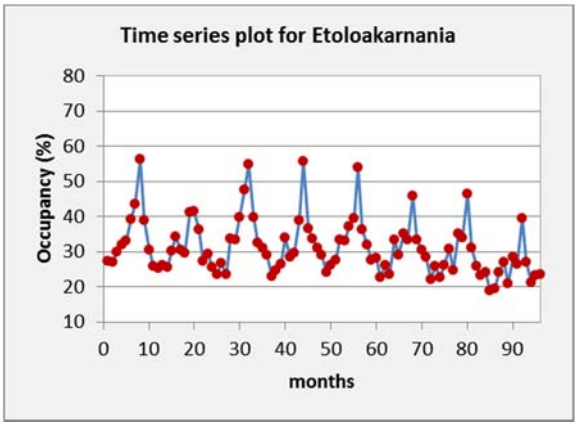
a. Region of Western Greece



b. Prefecture of Ilia



c. Prefecture of Achaia



d. Prefecture of Etoloakarnania

After a series of tests the best model (all coefficients are statistically significant and, moreover, they have the lowest MSE error) for each prefecture is given below. The created models are used to predict the occupancy for the corresponding prefectures of Western Greece.

Table 1. The ARIMA model for Etoloakarnania: $(1,1,0)(0,1,1)_{12}$

Type	Coef	StDev	T	P
AR 1	-0,5626	0,0925	-6,08	0
SMA 12	0,8519	0,0957	8,9	0
Differencing: 1 regular, 1 seasonal of order 12				
Number of observations: Original series 96, after differencing 83				
Residuals: SS = 761,418 (backforecasts excluded), MS = 9,400 DF = 81				

Table 2. The ARIMA model for Achaia: $(1,1,2)(2,1,1)_{12}$

Type	Coef	StDev	T	P
AR 1	-0,9114	0,1244	-7,33	0
SAR 12	-1,1376	0,1878	-6,06	0
SAR 24	-0,6417	0,1095	-5,86	0
MA 1	-0,4005	0,1536	-2,61	0,011
MA 2	0,5551	0,1075	5,16	0
SMA 12	-0,6213	0,232	-2,68	0,009
Differencing: 1 regular, 1 seasonal of order 12				
Number of observations: Original series 96, after differencing 83				
Residuals: SS = 885,282 (backforecasts excluded), MS = 11,497 DF = 77				

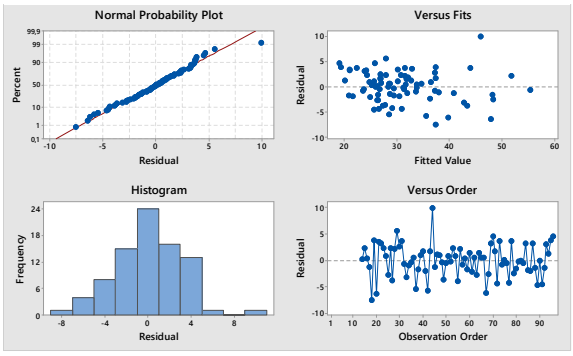
The next step in presented analysis is the verification of the proposed models for best fitting to the corresponding data. Thus, we have to check model parameters for being statistically significant and then to check the residuals for zero mean, for being normally distributed and being not correlated.

As it can be seen from the above tables all parameters of all the proposed models are statistically significant (P-Value < 0.05). According to the following figures the normality of residual distribution is accepted at any level of significance.

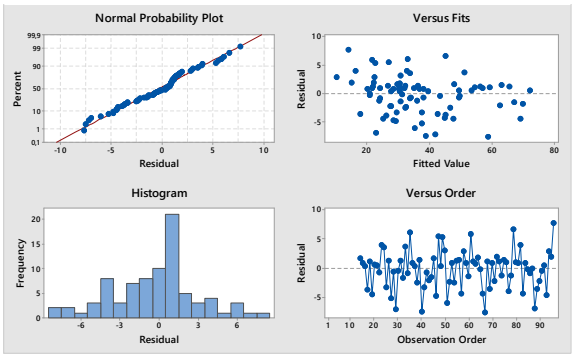
Table 3. The ARIMA model for Ilia: $(1,1,1)(0,1,1)_{12}$

Type	Coef	StDev	T	P
AR 1	0,4805	0,1119	4,29	0
MA 1	0,98	0,0482	20,34	0
SMA 12	0,8581	0,0855	10,04	0
Constant	-0,01851	0,003672	-5,04	0
Differencing: 1 regular, 1 seasonal of order 12				
Number of observations: Original series 96, after differencing 83				
Residuals: SS = 1008,24 (backforecasts excluded), MS = 12,76 DF = 79				

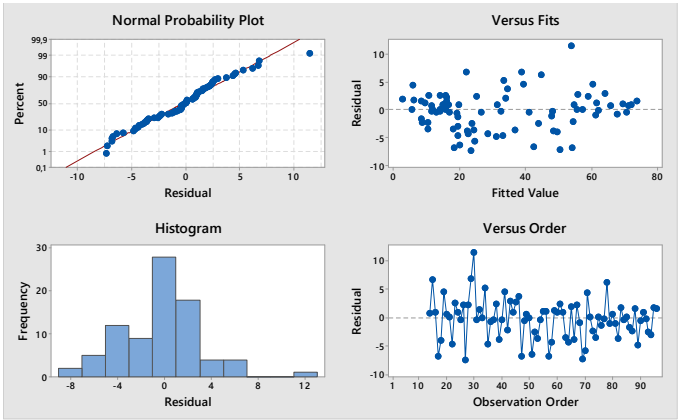
Figure 2. Normality of residual distribution for prefectures of Western Greece



a. Prefecture of Etoloakarnania



b. Prefecture of Achaia



c. Prefecture of Ilia

All the proposed models have the best fit to the corresponding data and we can use them to predict the percentages of occupancy of accommodation in the specific prefectures for the next 12 months.

It is well-known that a good fit of the model does not always imply a reliable prediction. Thus, the measurement of forecasting ability of the proposed models will be evaluated using real data, excluding the last 12 observations forecasting over this time interval (Xenakis, 1998). We estimated the model without these observations and take forecasts for this latter interval. Finally we compare these forecasts with the data that we kept separate of the above procedure.

Table 5. Comparison of forecasting and actual values for the year 2012 with confidence level of 95% for prediction intervals for Ilia.

Period	Forecast	Lower	Upper	Actual
85	5,4169	-1,5865	12,4204	5,5
86	8,2616	0,4301	16,0932	6,7
87	11,1608	3,1197	19,2018	8
88	17,5273	9,4223	25,6323	17,5
89	31,0422	22,9129	39,1716	26,2
90	43,6204	35,4791	51,7617	40,7
91	56,1052	47,9563	64,2542	55,5
92	62,4516	54,2969	70,6064	61,9
93	44,2532	36,0933	52,413	41,4
94	21,0722	12,9076	29,2368	16,6
95	5,0398	-3,1294	13,209	4,5
96	8,7675	0,5938	16,9412	9,9

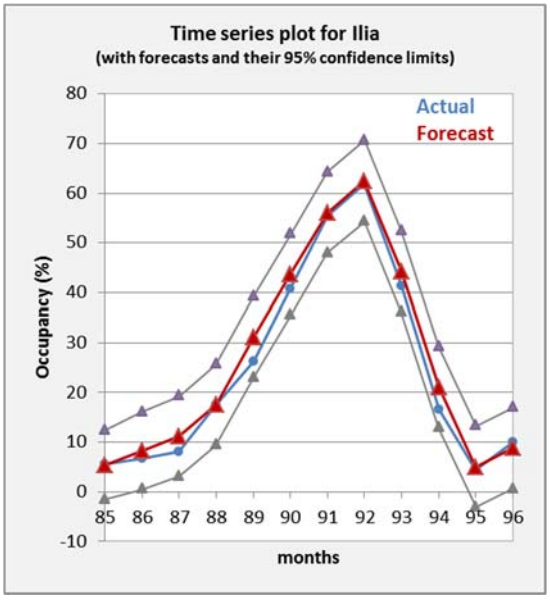


Table 5. Comparison of forecasting and actual values for the year 2012 with confidence level of 95% for prediction intervals for Achaia.

Period	Forecast	Lower	Upper	Actual
85	20,7528	14,1056	27,4	20,5
86	24,1567	16,757	31,5564	23,2
87	21,4766	13,6145	29,3387	20,9
88	23,4454	14,9576	31,9333	16
89	21,6915	12,7832	30,5998	14,1
90	32,8462	23,3958	42,2966	25,6
91	49,6473	39,8065	59,4881	42,8
92	55,6825	45,3594	66,0056	50
93	34,7389	24,0487	45,4291	23,7
94	18,5152	7,3878	29,6425	13,1
95	21,7641	10,2886	33,2395	16,9
96	20,2892	8,412	32,1664	21,8

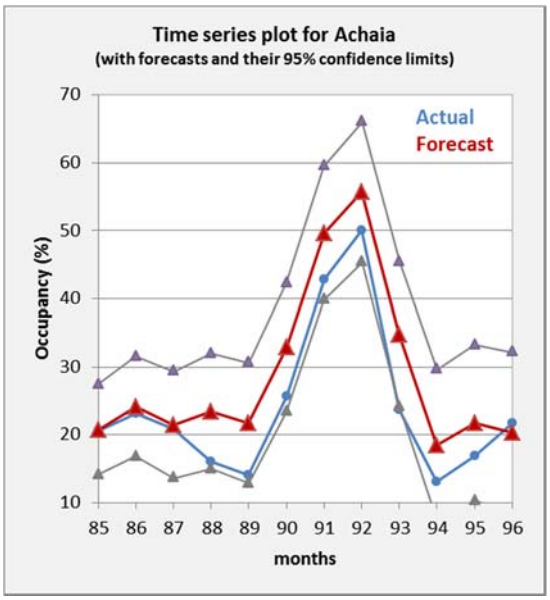
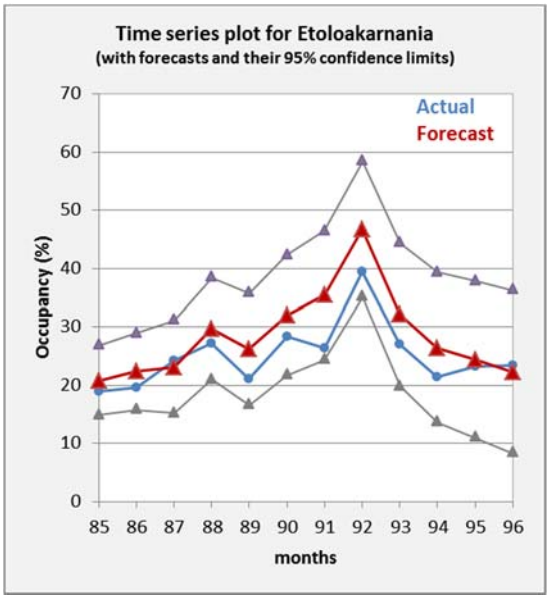


Table 6. Comparison of forecasting and actual values for the year 2012 with confidence level of 95% for prediction intervals for Etoloakarnania.

Period	Forecast	Lower	Upper	Actual
85	20,8384	14,8279	26,8489	19
86	22,3424	15,782	28,9029	19,6
87	23,1566	15,1833	31,1298	24,2
88	29,6899	20,9978	38,3821	27,2
89	26,2026	16,6076	35,7976	21,1
90	32,0312	21,7386	42,3238	28,4
91	35,4123	24,4002	46,4244	26,5
92	46,8002	35,1483	58,4521	39,5
93	32,0969	19,8197	44,3741	27
94	26,4594	13,5973	39,3215	21,4
95	24,4159	10,989	37,8428	23,2
96	22,3151	8,3491	36,281	23,5



For all models, the forecasts from the twelve months (period 85 till 96) are satisfactory because these values are close to real values and all of them are between the lower and upper limits. Finally, we predict the percentages of occupancy of accommodation in the specific prefectures for the next twelve months. The ex-ante forecasts from period 97 till 108 are presented in Figures 3-5.

Figure 5. Ex-ante forecasting for 12 months (2013) for Ilia

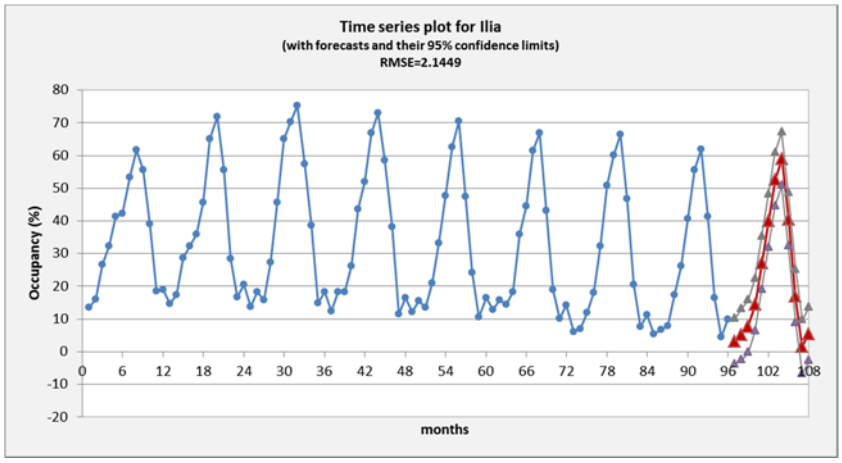


Figure 6. Ex-ante forecasting for 12 months (2013) for Achaia

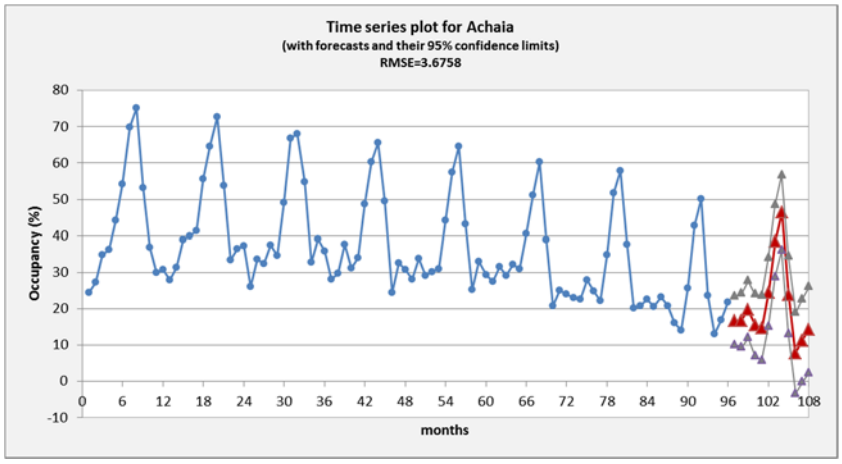
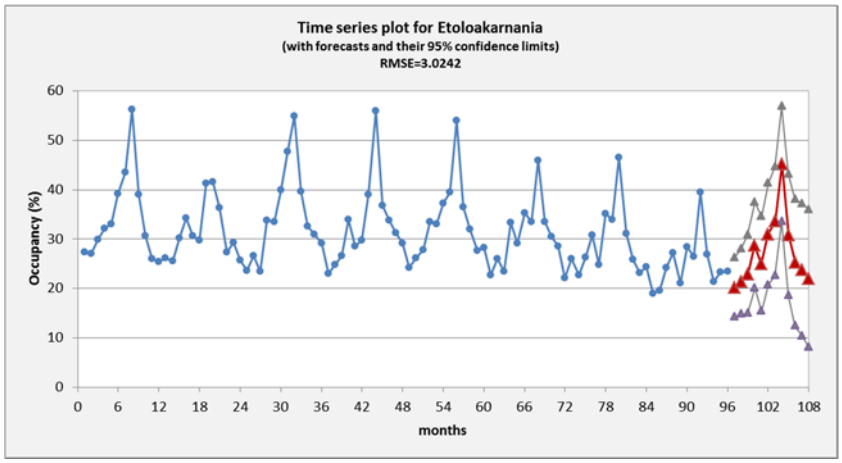


Figure 7. Ex-ante forecasting for 12 months (2013) for Etoloakarnania



Conclusion

In this paper we have proposed three new models to forecast tourism demand from observed time series. The proposed approach is lying on the well-known Box-Jenkins method for finding a proper model, for each prefecture, based mostly on the effectiveness and complexity of the proposed model. The models were testes on the occupancy of all tourist accommodation (except from camping sites) on all three prefectures in the Region of Western Greece from January of 2005 till December 2012. A series of statistical test have been employed to examine the best fitted model to given data. The forecasting effectiveness of the chosen model is measured using the last twelve observations as a training set and, finally, a 12-period prediction for the three prefectures is proposed.

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