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FORECASTING THE NUMBER OF PASSENGERS SERVICED AT THE BULGARIAN RIVER PORTS

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Abstract:

The river transport in Bulgaria is controlled and coordinated by Executive Agency for Exploration and Maintenance of the Danube River. This transport and its infrastructure are put under serious pressure in connection with its membership in the European Union. The problem of forecasting in the new strategic documents is crucial to the formation of proper innovation infrastructure policy for the future development of the tourism in the country. This paper is aimed at presenting the lack of real forecasting in many of the strategic documents and projects adopted for the development of the river transport in Bulgaria (i.e. Improving the navigation of the Bulgarian-Romanian section of the Danube River; Construction of a winter shelter for 39 vessels; CO-WANDA convention on waste management for inland navigation on the Danube; NEWADA duo Network of Danube Waterway Administrations – data & user orientation; InTraRegio /Towards an Intermodal Transport Network through innovative research-driven clusters in regions of organized and competitive knowledge and many directives and decisions concerning the river transport). There are also many International Bilateral River Cross-border Agreements. The paper provides a practical example for the use of triple exponential smoothing, also known as Method Holt-Winters in the presence of a linear trend and additive and multiplicative cyclicity on the number of tourism arrivals at Bulgarian river ports.

Key words: river transport, strategic documents and projects, additive and multiplicative cyclicity, triple exponential smoothing method, Holt-Winters method;

1. INTRODUCTION

The river transport in Bulgaria is controlled and coordinated by Executive Agency for Exploration and Maintenance of the Danube River. This transport and its infrastructure are put under serious pressure in connection with its membership in the European Union. The problem of forecasting in the new strategic documents is crucial to the formation of proper innovation infrastructure policy for the future development of the tourism in the country. This paper is aimed at presenting the lack of real forecasting in many of the strategic documents and projects adopted for the development of the river transport in Bulgaria A possible solution can be found in the group of the exponential forecasting methods and in particular in the face of the Halt-Winters method of exponential smoothing. This method is explicitly suitable for forecasting and planning of the of the river transport infrastructure, as it can provide considerably reliable forecast values on the number of passenger arrivals of some of the country's major river ports, such as the Ruse and Silistra ports which is under review in the present article. As it is seen from the statistical yearly records of the passengers flows on the Bulgarian river ports, the number of passengers is slowly decreasing within the period from 2000 to 2012 (Table 1). This decrease however is accompanied with linear trend with additive and multiplicative cyclicity (Chart 1). Forecast of the number of passengers served by Bulgarian river ports by river transport applying the methods described in this article is presented in chart 1 and table 1.

Table 1: Number of passengers served by Bulgarian river transport

Years	Number of passengers-thousand
1990	26
1991	13
1992	11
1993	11
1994	10
1995	10
1996	11
1997	60
1998	86
1999	121
2000	76,0
2001	67,0
2002	60,0
2003	73,0
2004	81,0
2005	80,0
2006	75,0
2007	232,0
2008	246,0
2009	237,0
2010	149,0
2011	162,0
2012	175,0

Source: Mirchova, S. (2014) from the NSI (National Statistical Institute)

As is clear from the presented graphically time series corresponds to the same forecast profile presence of a linear trend with the presence of the additive cycle that is forecast profile type (A, N model) corresponding methods of triple exponential smoothing, also known as Method Holt- Winters.

2. OBJECTIVES

As P. Dimitrov (2011, 2012) points out the task of creating an exponential smoothing forecast model for the long-run development of the tourism industry, and in a particular for the Bulgarian river ports, meets with solving of several major problems:

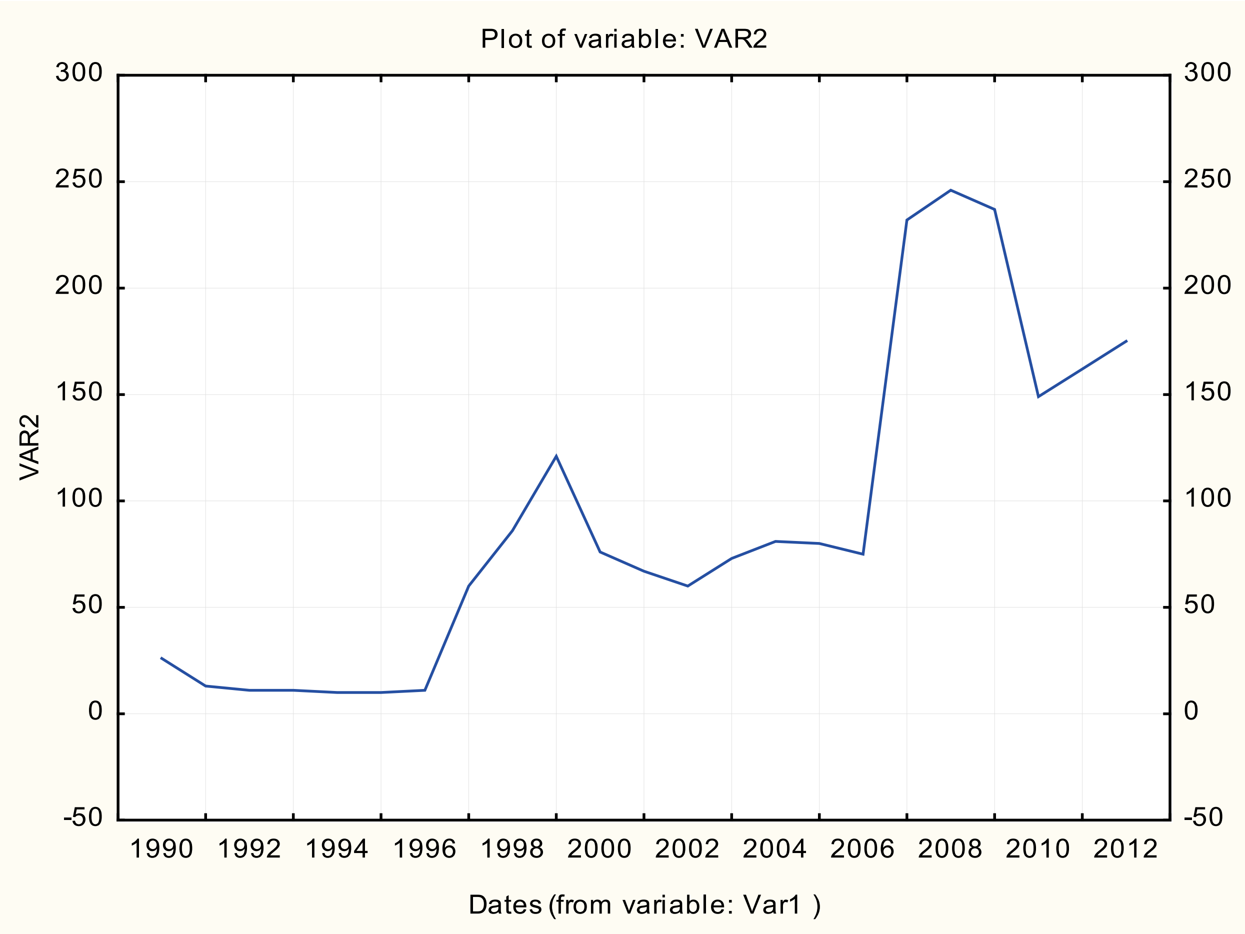
1. Finding of a suitable general indicator, on the basis of which to build the long-run forecasts (the forecast for periods longer than 5 years);
2. Determining the time series pattern, or the so-called “forecast profile” (Gardner, 1987:174-175) (Hyndman, Koehler, Ord and Snyder, 2008:11:23) and the quality of the data in the pattern, on the basis of which to select the suitable forecasting exponential smoothing model.
3. Selecting and using of suitable forecasting techniques;
4. Calculating of long-run forecasts for the value of the above-mentioned general indicator (up to the year 2025).

3. METHODOLOGY AND MAIN RESULTS

With regards to the first problem, i.e. the finding of a general suitable indicator, on the basis of which to make the forecast, it can be pointed out that the Bulgarian river ports have published their yearly statistical records of serviced passengers, already presented in point 1 of the present article.

The second problem of determining the times series pattern, or the so-called times series’ “forecast profile” is usually solved by comparing the times series in regard with a pre-set classification of exponential smoothing methods or the derived from them forecast profiles in terms of development curves. As Hyndman, Koehler, Ord and Snyder point out (Hyndman et al., 2008:11-12), this classification of smoothing methods originated with Pegles’ taxonomy (Pegles, 1969:311-315). This was later extended by Gardner (Gardner, 1985:1-28) and modified by Hyndman et al. (2002, 2008) and extended by Taylor (Taylor, 2003:715-725) giving a classification set of fifteen models. In the regarded time series, as it will become later clear, the Gardner’s much simplified classification can also be successfully used for finding the best fit forecasting method or forecast profile. The finding that the time series of the number of the passengers serviced at the Bulgarian river ports for the time period 2000 – 2012 correspond to the “linear trend, additive or multiplicative seasonality” profile and require the “A, M” variation of exponential forecasting methods makes the third problem, the one of selecting and using of a suitable forecasting exponential smoothing method much more predetermined and easier to solve. As both Gardner and Hyndman et al. point out this profile corresponds to the method of triple exponential smoothing in the presence of a linear trend and additive or multiplicative ciclicity, known as the Holt-Winters method.

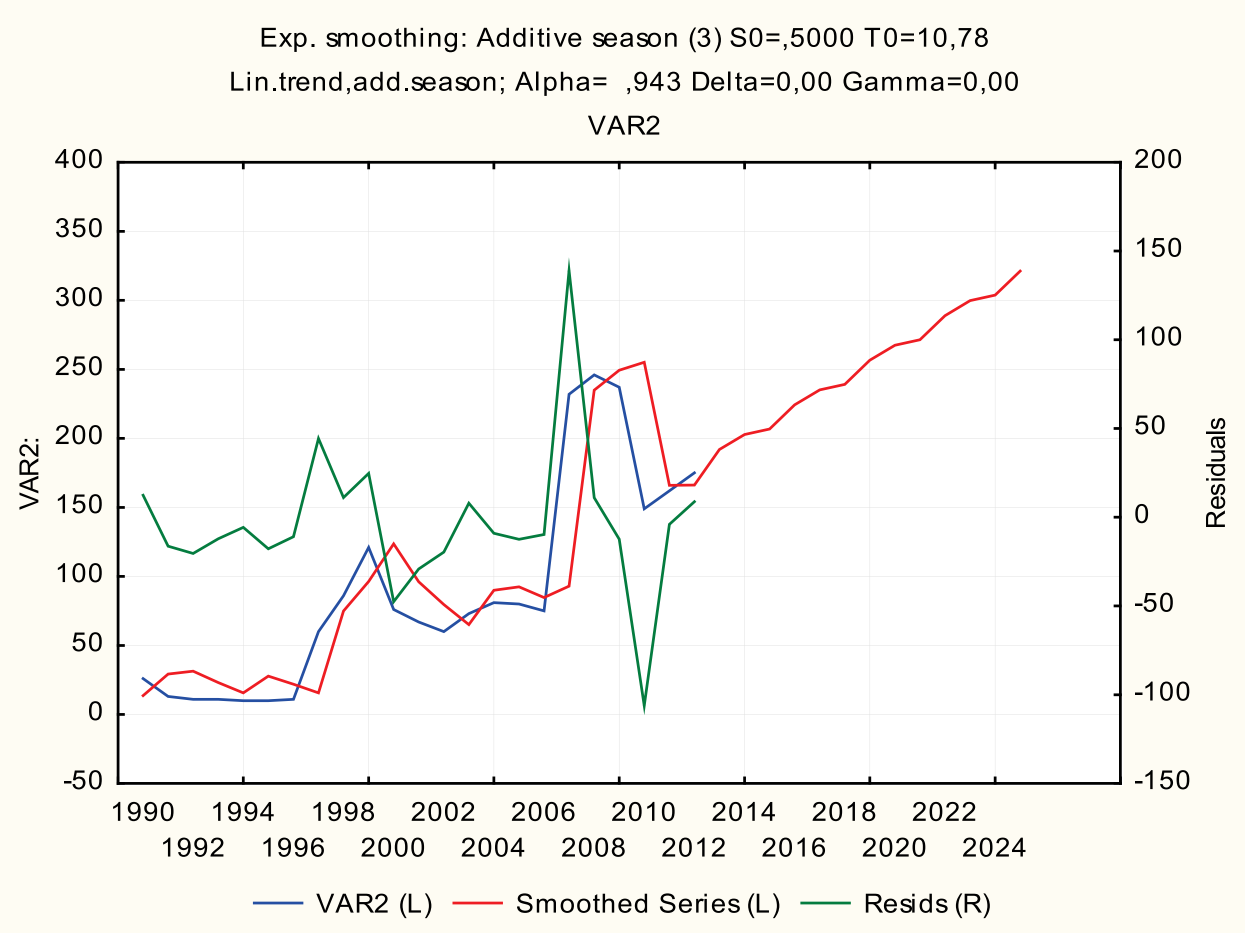
Chart 1: Graphical representations of time series for the total number of passengers served by river transport



Source: Mirchova, S. (2014) from the NSI (National Statistical Institute)

In applying the methodology for forecasting by triple exponential smoothing, the presence of a linear trend in the presence of additive cycle seems positive upward trend of the estimates. After 2015 they became positive. Since in this case it is a metric number of passengers served, it can arrive at the conclusion that if sustained so the available processes and factors affecting the development of the time series, it is possible to achieve an increase in the number of serviced passengers and actual growth of this sub-sector in the long run.

Chart 2: Graphical representations of time series for the total number of passengers served by river transport, projected results and the absolute amount of errors in forecasts



Source: Mirchova, S. (2014) from the NSI (National Statistical Institute)

Table 2: Description of the parameters of the prediction model used to calculate the estimates for the total number of passengers served by river transport method Holt-Winters calculated with software "STATISTICA" ®

Summary of error	Exp. smoothing: Additive season (3) S0=,5000 T0=10,78 (Spreadsheet1 RECHEN) Lin.trend,add.season; Alpha= ,943 Delta=0,00 Gamma=0,00 VAR2 Error
Mean error	-3,1997202698
Mean absolute error	25,7509346284
Sums of squares	38995,4919820955
Mean square	1695,4561731346
Mean percentage error	-33,7226810262
Mean abs. perc. error	54,1837318504

Source: Mirchova, S. (2014) from the NSI (National Statistical Institute)

Table 3: Estimated value and errors in estimates of the number of passengers served by river transport for the period 1990 - 2025, with software "STATISTICA" ®

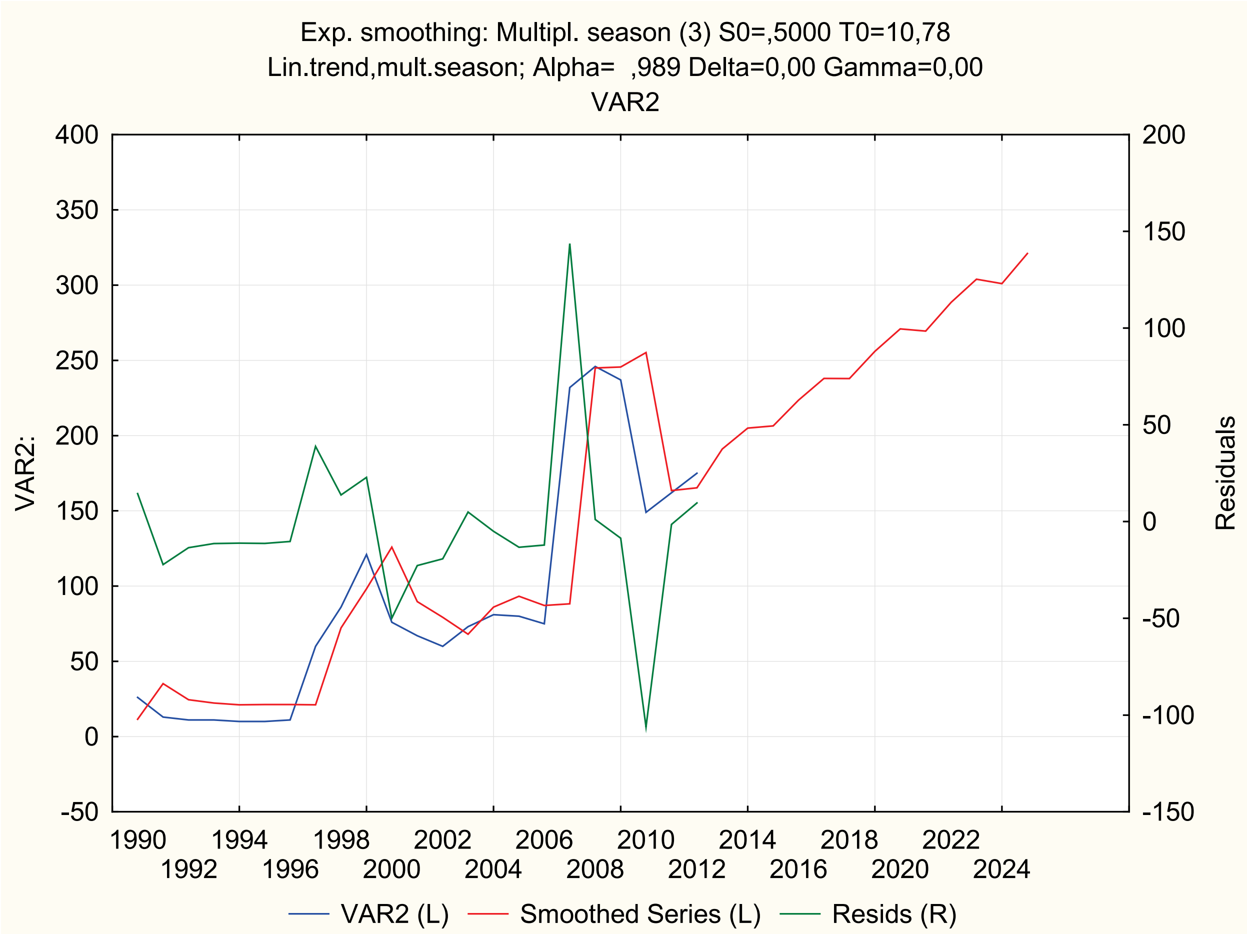
Var1 (Dates)	Exp. smoothing: Additive season (3) S0=,5000 T0=10,78 (Spreadsheet1 RECHEN Lin.trend,add.season; Alpha= ,943 Delta=0,00 Gamma=0,00 VAR2			
	VAR2	Smoothed Series	Resids	Seasonal Factors
1990	26,0000	13,5952	12,405	2,31746
1991	13,0000	29,2612	-16,261	-4,49206
1992	11,0000	31,3713	-20,371	2,17460
1993	11,0000	23,0818	-12,082	
1994	10,0000	15,6569	-5,657	
1995	10,0000	27,7669	-17,767	
1996	11,0000	21,9333	-10,933	
1997	60,0000	15,5915	44,409	
1998	86,0000	74,9132	11,087	
1999	121,0000	96,2887	24,711	
2000	76,0000	123,5597	-47,560	
2001	67,0000	96,1553	-29,155	
2002	60,0000	79,5825	-19,582	
2003	73,0000	65,0845	7,916	
2004	81,0000	89,9933	-8,993	
2005	80,0000	92,4333	-12,433	
2006	75,0000	84,6769	-9,677	
2007	232,0000	92,9960	139,004	
2008	246,0000	234,9974	11,003	
2009	237,0000	249,3411	-12,341	
2010	149,0000	255,1479	-106,148	
2011	162,0000	165,9711	-3,971	
2012	175,0000	166,1946	8,805	
2013		191,9425		
2014		202,8632		
2015		206,8314		
2016		224,2759		
2017		235,1965		
2018		239,1648		
2019		256,6092		
2020		267,5298		
2021		271,4981		
2022		288,9425		
2023		299,8632		
2024		303,8314		
2025		321,2759		

Source: Mirchova, S. (2014) from the NSI (National Statistical Institute)

It is clear also that the lowest estimate in the forecast model in 2015 is 206.8314 passengers served. And last realistic value for the previous 2014 shows that the number is 202.8632. Reported estimated value for 2025 is 321.2759.

As is clear from the presented graphically time series corresponds to the same forecast profile presence of a linear trend with the presence of multiplicative cycle that is forecast profile type (A, M model) corresponding methods triple exponential smoothing, also known as methods of Holt- Winters.

Chart 3: Graphical representation of time series for the total number of passengers served by river transport, projected results and the absolute amount of errors in forecasts



Source: Mirchova, S. (2014) from the NSI (National Statistical Institute)

Table 4: Description of the parameters of the prediction model used to calculate the estimates for the total number of passengers served by river transport method Holt-Winters calculated with software "STATISTICA" ®

Summary of error	Exp. smoothing: Multipl. season (3) S0=,5000 T0=10,78 (Spreadsheet1 RE Lin.trend,mult.season; Alpha= ,989 Delta=0,00 Gamma=0,00 VAR2 Error
Mean error	-2,9924046162
Mean absolute error	24,678555929
Sums of squares	39448,7981522481
Mean square	1715,1651370543
Mean percentage error	-31,7359672514

Source: Mirchova, S. (2014) from the NSI (National Statistical Institute)

Table 5: Description of the parameters of the prediction model used to calculate the estimates for the total number of passengers served by river transport method Holt-Winters calculated with software "STATISTICA" ®

Var1 (Dates)	Exp. smoothing: Multipl. season (3) S0=,5000 T0=10,78 (Spreadsheet1 RECHEN) Lin.trend,mult.season; Alpha= ,989 Delta=0,00 Gamma=0,00 VAR2			
	VAR2	Smoothed Series	Resids	Seasonal Factors
1990	26,0000	11,5053	14,495	102,0176
1991	13,0000	35,2040	-22,204	97,4983
1992	11,0000	24,4798	-13,480	100,4840
1993	11,0000	22,3137	-11,314	
1994	10,0000	21,1398	-11,140	
1995	10,0000	21,2625	-11,262	
1996	11,0000	21,2736	-10,274	
1997	60,0000	21,1289	38,871	
1998	86,0000	72,2267	13,773	
1999	121,0000	98,1539	22,846	
2000	76,0000	125,9078	-49,908	
2001	67,0000	89,7231	-22,723	
2002	60,0000	79,2715	-19,272	
2003	73,0000	68,0528	4,947	
2004	81,0000	86,0093	-5,009	
2005	80,0000	93,2874	-13,287	
2006	75,0000	87,1039	-12,104	
2007	232,0000	88,2639	143,736	
2008	246,0000	244,9307	1,069	
2009	237,0000	245,5994	-8,599	
2010	149,0000	255,1851	-106,185	
2011	162,0000	163,4551	-1,455	
2012	175,0000	165,3470	9,653	
2013		191,0795		
2014		204,9910		
2015		206,4183		
2016		223,5694		
2017		237,9767		
2018		237,9428		
2019		256,0592		
2020		270,9624		
2021		269,4672		
2022		288,5491		
2023		303,9481		
2024		300,9917		
2025		321,0389		

Source: Mirchova, S. (2014) from the NSI (National Statistical Institute)

4. CONCLUSIONS

The forecast results achieved through the Holt-Winters method for the annual data of the number of the passengers serviced at the Bulgarian river ports and the presence of a steady trend of annual decrease show out that there will be a constant decrease of the number of the passengers up to the end of the year 2025. Presented charts and tables also show that the lowest estimation in the forecast model in 2015 was 206.4183 passengers served. The last realistic value for the previous 2014 is 204.9910. The highest estimation to 2025 is 321.0389 passengers served by Bulgarian river ports. Based on the achieved forecast values in Table 5 and Chart 4, one can conclude that the variation in the number of the serviced passengers on the Bulgarian river ports will remain steadily decreasing. This strongly requires a change in the policy of infrastructure investment of the river authorities, if they would like to achieve a steadier trend of increase and overcoming this trend they should take really serious actions. In Bulgarian transport policy the river transport should be main priority to increase the number of passengers served by Bulgarian river ports. To achieve this goal there should be taken some actions:

1. Improving the infrastructure of existing river ports and completion of new ones.
2. Expanding the scope and capacity of ferry links on the Danube River with Romania, which are suitable for navigation on "Europe channel" canal Rhine-Main-Danube and to meet the environmental standards.
3. Upgrading the infrastructure of river ports that are used for tourist purposes - in Veleka, Kamchia, Ropotamo.
4. Increasing the number of passenger ships for international tourism, which is only 6 numbers and shipped mainly Western tourists.
5. Specialization of port terminals, according to regional characteristics.
6. Completing the River Information System.

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