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FORECASTING THE NUMBER OF PASSENGERS SERVICED AT THE BULGARIAN BUS TERMINALS

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Abstract:
The bus transport in Bulgaria is controlled and coordinated by Executive Agency "Automobile Administration". 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 bus transport in Bulgaria. A strategy to increase competitiveness by increasing the number of passengers is also in line with the European Union policy to promote a balanced development in the transport sector in Bulgaria. Bulgaria's participation in the TINA project is an important element of the development of transport infrastructure. For Bulgaria, the network is specified on the sections of the five Trans-European Transport Corridors passing through the territory of the country.
The paper provides a practical example for the use of double exponential smoothing, also known as Holt Method in the presence of a linear trend and a lack of cyclicity on the number of tourism arrivals at Bulgarian bus terminals.

Key words: bus transport, bus terminals, cyclicity, double exponential smoothing method, Holt method;

1. INTRODUCTION

As a part of the Strategy, a National Transport Model is prepared. The model covers freight and passenger traffic as well as all modes of transport. The Model is applicable to internal, international and transit transport. The Integrated Transport Strategy for the period until 2030 represents a comprehensive plan for sustainable development of the transport system of the Republic of Bulgaria and a framework for investments in transport. With the development of the Integrated Transport Strategy for the period until 2030 the following specific objectives have been achieved:

- A database required for the analysis of the transport sector for forecast of the development of the transport system and for the development of a national transport model;
- A detailed analysis of the needs of the transport sector was performed, including road transport, railway transport, inland waterways transport, maritime transport, air and intermodal transport;
- A national multi- modal transport model was developed;
- National strategic objectives and strategic priorities have been defined;
- Appropriate measures to achieve the objectives have been formulated;
- A list of realistic projects was proposed, planned for financing from CF and ERDF (with the relevant timetable, budget and funding sources);
- Based on the analyses performed are measures were proposed to develop the administrative capacity of the beneficiaries to prepare and implement the planned projects

The strategic objectives of the transport policy for the period until 2030 are:

- Increasing the effectiveness and competitiveness of the transport sector
- Improvement of the transport connectivity and access (internal and external)
- Limiting the negative effects of the transport sector development.

The strategic priorities of the transport sector are as follows:

- Effective maintenance, modernization and development of transport infrastructure
- Improvement of the management of the transport system
- Development of intermodal transport
- Improvement of the conditions for implementation of the principles for liberalization of the transport market
- Reduction of the consumption of fuel and increasing the energy efficiency of transport
- Improvement of the connectivity of the Bulgarian transport system with the Single European transport space
- Ensuring quality and easily accessible transport in all regions of the country
- Limiting the negative effects of transport on environment and people's health
- Increasing security and safety of the transport system.

For this purpose we need to forecast the number of serviced passengers in the Bulgarian bus stations and the number of passengers with personal road transport. The forecast of the number of serviced passengers at the Bulgarian bus terminals using the methods described are presented in Figure 1 and Table 1.

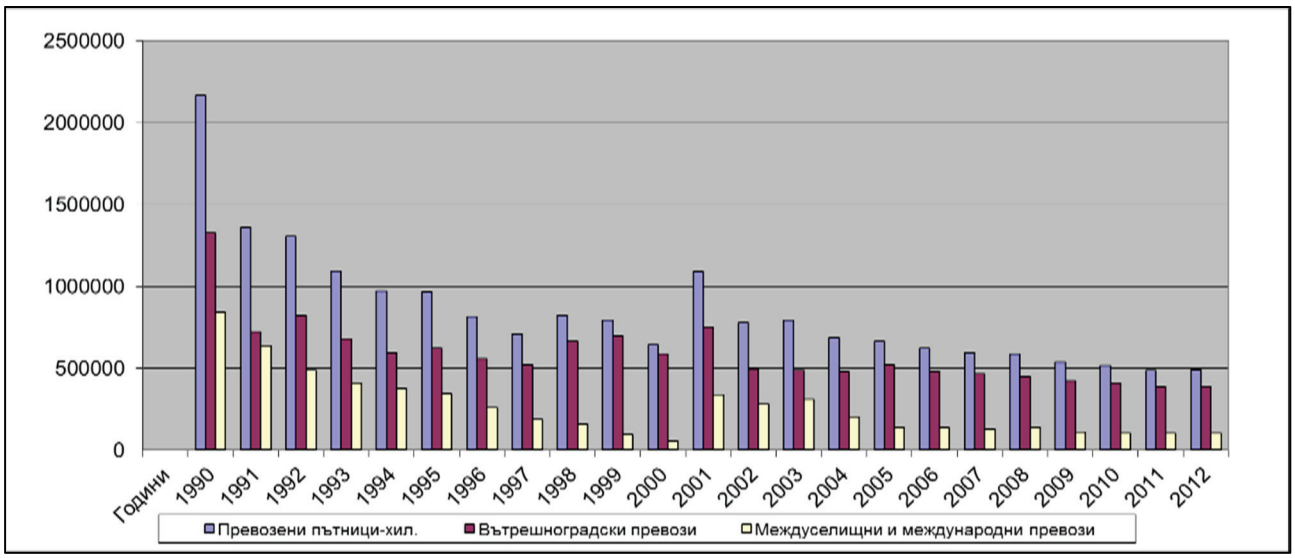
Table 1. Number of serviced passengers in the Bulgarian bus stations

Years	Serviced passangers	Intra-urban transport	Long-distance and international transport
1990	2167090	1325570	841520
1991	1359310	722350	636960
1992	1306667	819515	487152
1993	1096158	683086	413072
1994	973 652	597013	376639
1995	967343	624049	343294
1996	816570	556844	259726
1997	709439	521614	187825
1998	824649	665458	159191
1999	793502	698656	94846
2000	643995,0	587981,0	56014,0
2001	1088688,0	750807,0	337881,0

2002	777153,0	495028,0	282125,0
2003	795067,0	486849,0	308218,0
2004	685233,0	479269,0	205965,0
2005	664266,0	522204,0	142061,0
2006	623249,0	484783,0	138466,0
2007	594879,0	465510,0	129369,0
2008	589786,0	448530,0	141256,0
2009	536448,0	424134,0	112314,0
2010	516434,0	412447,0	103987,0
2011	487946,0	383839,0	104107,0
2012	491625,0	390235,0	101390,0

Source: Mirchova, S. (2014) according to NSI data

Fig. 1. Total number of passengers served by intra-city and long-distance and international transport



Source: Mirchova, S. (2014) according to NSI data

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 bus terminals, meets with solving of several major problems:

(i) 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);

(ii) 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.

(iii) Selecting and using of suitable forecasting techniques;

(iv) Calculating of long-run forecasts for the value of the above-mentioned general indicator (up to the year 2022).

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 there are monthly statistical records of the serviced passengers on the bus terminals by the National statistics institute.

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 form 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 (Table 2). 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 on the bus terminals for the time period 1990 – 2012 correspond to the prediction profile with a linear trend (decrease) and cyclic absence, the so called predicted profile of the type (A, N model), also known as the Holt method, a 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 double exponential smoothing in the presence of a linear trend and a lack seasonality, known as the Holt method.

Table 2. Classification of forecasting methods

Trend component	**Seasonal component**		
	N (None)	**A** (Additive)	**M** (Multiplicative)
N (None)	**N,N**	**N,A**	**N,M**
A (Additive)	**A,N**	**A,A**	**A,M**
$\mathbf{A_d}$ (Additive damped)	$\mathbf{A_d}$**,N**	$\mathbf{A_d}$**,A**	$\mathbf{A_d}$**,M**
M (Multiplicative)	**M,N**	**M,A**	**M,M**
$\mathbf{M_d}$ (Multiplicative damped)	$\mathbf{M_d}$**,N**	$\mathbf{M_d}$**,A**	$\mathbf{M_d}$**,M**

Source: Hyndman et al. (2008), p.12, cited by Dimitrov, P. (2012, pp.104-114)

Figure 2. Forecast profiles from Exponential Smoothing Models by Gardner (1987), cited by Dimitrov (2012, pp.104-114)

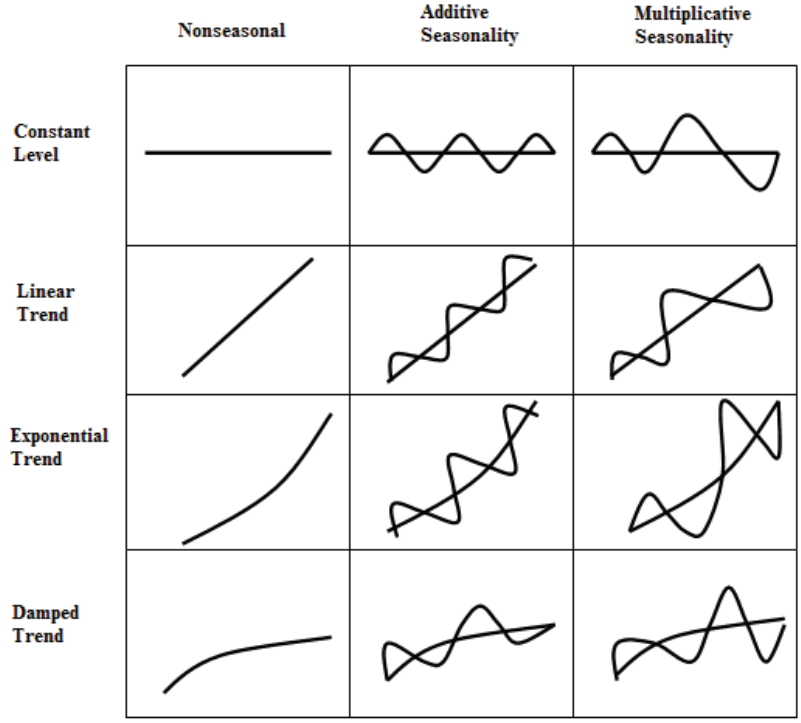
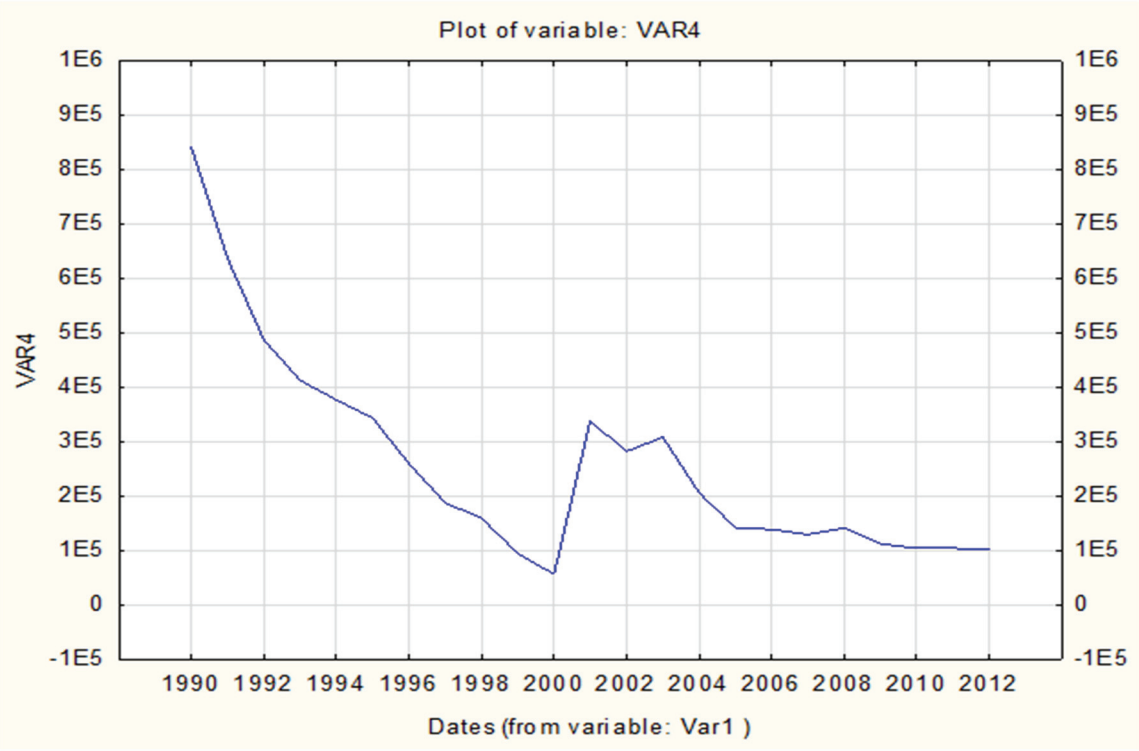


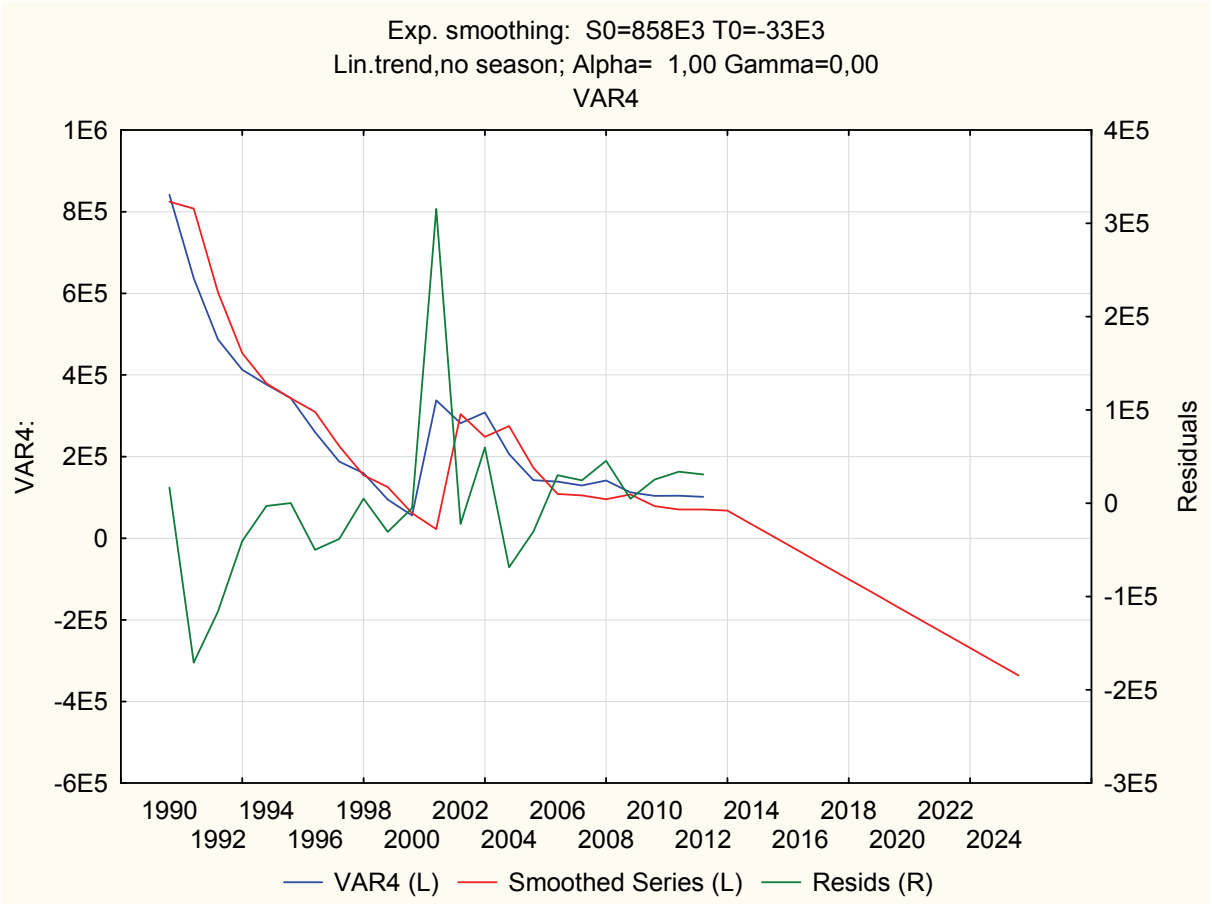
Figure 3. Graphic representation of the time series for the total number of passengers served by bus transport



Source: Mirchova, S. (2014) according to NSI data

When applying the prediction method by double exponential smoothing in the presence of a linear trend and the absence of cyclicity, a strong negative tendency to decrease the forecast values is outlined. As after 2015, they become negative. Since this is the number of serviced passengers that cannot accept negative values, it can be concluded that if the processes and factors that affect the development of the time line are kept, it is possible a drastic reduction in the number of passengers served and a substantial collapse of this subsector in the long run.

Figure 4. Graphic representation of the time line for the total number of bus passengers served, the forecast results and the absolute magnitude of the errors in the forecasts



Source: Mirchova, S. (2014) according to NSI data

Table 3. Description of the forecast model parameters used to calculate the estimated total number of bus passengers served by the Holt method, calculated with the software product "STATISTICA" ®

	Exp. smoothing: S0=858E3 T0=-33E3 (Spreadsheet1Avt Lin.trend,no season; Alpha= 1,00 Gamma=0,00 VAR4
Summary of error	Error
Mean error	7,313538E+02
Mean absolute error	5,076396E+04
Sums of squares	1,651484E+11
Mean square	7,180367E+09
Mean percentage error	3,368160E+00

Source: Mirchova, S. (2014) according to NSI data

Table 4. Estimates and errors in forecasts of the number of bus passengers served for the period 1990 to 2025 with the software product "STATISTICA" ®

Var1 (Dates)	Exp. smoothing: S0=858E3 T0=-33E3 (Spreadsheet1Avtobusen) Lin.trend,no season; Alpha= 1,00 Gamma=0,00 VAR4		
	VAR4	Smoothed Series	Resids
1990	841520,0	824699	16821
1991	636960,0	807878	-170918
1992	487152,0	603318	-116166
1993	413072,0	453510	-40438
1994	376639,0	379430	-2791
1995	343294,0	342997	297
1996	259726,0	309652	-49926
1997	187825,0	226084	-38259
1998	159191,0	154183	5008
1999	94846,0	125549	-30703
2000	56014,0	61204	-5190
2001	337881,0	22372	315509
2002	282125,0	304239	-22114
2003	308218,0	248483	59735
2004	205965,0	274576	-68611
2005	142061,0	172323	-30262
2006	138466,0	108419	30047
2007	129369,0	104824	24545
2008	141256,0	95727	45529
2009	112314,0	107614	4700
2010	103987,0	78672	25315
2011	104107,0	70345	33762
2012	101390,0	70465	30925
2013		67748	
2014		34105	
2015		463	
2016		-33179	
2017		-66821	
2018		-100464	
2019		-134106	
2020		-167748	
2021		-201390	
2022		-235033	
2023		-268675	
2024		-302317	
2025		-335960	

Source: Mirchova, S. (2014) according to NSI data

It is also seen that the lowest projected positive value in the forecast model in 2015 is only 463 serviced passengers. And the latest realistic value for the previous 2014 shows that the number of serviced passengers is 34 105. The estimated value to 2025 is negative and it is -335960 number of serviced passengers at the Bulgarian bus stations. The reported estimate is negative, ie we tend to decrease.

4. CONCLUSIONS

The expected main results of the implementation of the transport strategy are increasing the number of serviced passengers from different types of infrastructure in Bulgaria, such as developing the local economy, improving and facilitating the access of local residents to transport services and attracting new passengers passing through the territory of Bulgaria and using the transport infrastructure of our country.

The First Basic Strategic Sub-Action is Bus Transport Increasing the number of serviced passengers at the Bulgarian bus stations:
Action 1. Improvement of the infrastructure of the Bulgarian bus stations by building new ones and modernizing the existing ones.
Step 1 Drawing up a list of bus stations that need to be repaired;
Step 2 Finding appropriate sources of funding from the euro funds;
Step 3 Preparation of technical design assignments, public procurement for design, public procurement for the selection of construction and assembly works and public procurement for civil engineer;
Action 2. Increasing the qualification of the employees and the administrative staff of the Bulgarian bus stations by conducting computer literacy and foreign language courses.
Step 1 Organization of courses and the inclusion of the administrative staff in them through the Labor Offices
Action 3 Improving the quality of the services offered at the Bulgarian bus terminals by expanding and supplementing the range of additional services.
Step 1 Introducing on-line ticket purchase;
Step 2 Reduce prices for transport services by bus.
The second main strategic sub-objective Road transport increasing the number of passengers benefiting from road transport.
Action 1 Construction of highways - roads designed for road traffic to which access is made only by intersections at different levels or by controlled crossings at one level and for which:
- it is forbidden to stop and park its traffic lanes;
- does not intersect on one level with rail and pedestrian ways;
Step 1 Develop northwest highways and highways in order to overcome the shortcomings of the existing road network, oriented mainly east-west on major motorways and highways.
• The Rila Motorway, in its construction, should connect Dupnitsa to Trakia Motorway and Hemus Motorway.
Action 2 Improving the condition of first-class and lower-class roads, which is directly related to increasing the economic efficiency of road transport.
Step 1 Improving the quality of the pavement;
Step 2 Build road roads, it is necessary in areas where the density of the road network is insufficient, lower than the average for the country (and there is a lower density of the railway network).
Transport is fundamental to our economy and society. Mobility is vital for the internal market and for the quality of life of citizens as they enjoy their freedom to travel. Transport enables economic growth and job creation: it must be sustainable in the light of the new challenges we face.Transport is global, so effective action requires strong international cooperation. The future prosperity of our continent will depend on the ability of all of its regions to remain fully and competitively integrated in the world economy. Efficient transport is vital in making this happen.

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