JOINT INTERNATIONAL CONFERENCES
10TH EDITION EUROPEAN INTEGRATION REALITIES AND PERSPECTIVES
5TH EDITION THE GLOBAL ADVANCEMENT OF UNIVERSITIES AND COLLEGES

Analysis and Trend Determination of the Evolution of Tourist Accommodation Establishments (Adjusted Data Based Seasonally) in the European Union (28) with Analytical Methods

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Abstract: This work presents the comparative analysis and trend determination of the evolution tourist accommodation establishments in the European Union (28), adjusted data based seasonally, in the period May 2014 - December 2014 used the Analytical Methods. The principal causes of the evolution tourist accommodation establishments were: the general economic evolution of industries and GDP per capita, the relatively low revenue or low development of the infrastructure. Trend determination of the evolution tourist accommodation establishments in the European Union (28) with analytical methods requires least squares method. On the base the results of the absolute deviations between empirical and theoretical values for the linear, curvilinear and modified exponential regression, will choose the best trend equation for the smallest variation. The best trend model for evolution tourist accommodation establishments in EU (28) is modelled using linear regression equation.

Keywords: accommodation establishments; least squares method; trend

1. Introduction

A Tourism Satellite Account (TSA) is an economic measure of the importance of tourism. This TSA integrates in a single format data about the supply and use of tourism-related goods and services, and it permits a comparison of tourism with other industries since the concepts and methods used are based on the System of National Accounts.

"The tourist accommodation establishments - monthly data adjusted series is a collection of monthly, quarterly and annual series."

On the base of the evolution of tourist accommodation establishments in the European Union (28) between May 2014 and December 2014, we will adjust the series by least squares method.

We will calculate the linear, curvilinear and exponential modified regression, with the method of least squares for determining the trend of evolution tourist accommodation establishments in the European Union (28).

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Then, on the base of the coefficients of variation we will analyze the smallest variation $\sum(y_i - y_t)^2$ or for $\sum|y_i - y_t|$ and after we can choose the best trend.

2. Statistical Data

According to the data provided by the www.eurostat.ec.europa.eu the evolution of tourist accommodation establishments in the European Union (28) between May 2014 and December 2014 with adjusted data based seasonally, synthesised in the following tables.

Table 1. Nights spent total (residents and non-residents) at tourist accommodation establishments - monthly data

Nights spent	European Union (28 countries)		
GEO/TIME	Total	Residents	Non-residents
2014M05	222.632.381	121.991.458	100.640.923
2014M06	284.605.699	146.855.872	137.749.827
2014M07	409.160.653	217.666.521	191.494.132
2014M08	473.674.603	265.780.360	207.894.243
2014M09	268.705.197	134.186.545	134.518.652
2014M10	191.419.123	102.482.252	88.936.871
2014M11	124.510.713	74.125.038	50.385.675
2014M12	127.854.926	72.958.103	54.896.823

Sources: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=tour_occ_nim&lang=en

2.1. Analyse of Statistical Data - Graphical Evolution

Analyse of statistical data for the evolution the evolution of tourist accommodation establishments in the European Union (28) between May 2014 and December 2014 with adjusted data based seasonally use the graphics, centralised as well as:

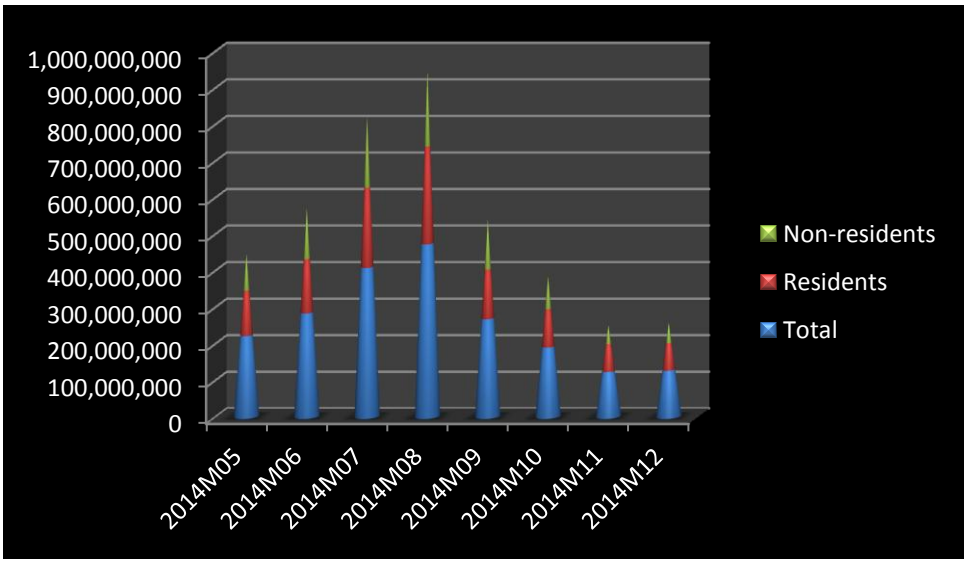

Figure 1. Evolution of tourist accommodation establishments in European Union (28)

Sources: own calculations

2.2. Determining the linear trend

Least squares method involves solving the following system of equations for a linear regression:

$$\begin{cases} \sum y_i = n * a + b\sum t_i \\ \sum t_i\, y_i = a\sum t_i + b * \sum t_i^2 \end{cases}$$

We will consider origin of the time variable the centre of the series such that $\sum t_i = 0$, because the terms of the series are consecutive numbers and the anterior system of equations becomes:

$$\begin{cases} \sum y_i = n * a \\ \sum t_i\, y_i = b * \sum t_i^2 \end{cases}$$

Table 2. Trend linear of evolution of tourist accommodation establishments in European Union (28)

Years	y_i	t_i	$t_i\, y_i$	t_i^2	$y_t = a + bt_i$	$\lvert y_i - y_t \rvert$
2014M05	222.632.381	- 4	-890.529.524	16	362810228,1	140177847,1
2014M06	284.605.699	-3	-853.817.097	9	337812774,1	53207075,08
2014M07	409.160.653	-2	-818.321.306	4	312815320	96345332,99
2014M08	473.674.603	-1	-473.674.603	1	287817865,9	185856737,1
2014M09	268.705.197	1	268.705.197	1	237822957,8	30882239,19
2014M10	191.419.123	2	382.838.246	4	212825503,7	21406380,74
2014M11	124.510.713	3	373.532.139	9	187828049,7	63317336,67
2014M12	127.854.926	4	511.419.704	16	162830595,6	34975669,61
Total	2.102.563.295	0	-1.499.847.244	60	2102563295	626168618,5

Sources: own calculations

So, on the data in Table no. 2 the system of equations becomes:

$$\begin{cases} 2.102.563.295 = 8a \\ -1.499.847.244 = 60b \end{cases} \qquad \begin{cases} a = 262.820.411,875 \\ b = -24.997.454,067 \end{cases}$$

We will obtain the linear regression equation:

$$y_t = a + bt_i = 262.820.411,875 - 24.997.454,067t_i$$

It can be observed that the linear regression equation for the evolution of tourist accommodation establishments in European Union (28) is $\boldsymbol{y_t} = 262.820.411,875 - 24.997.454,067t_i$ in the Table no. 2.

2.3. Determining the curvilinear regression equation

"For a curvilinear regression, least squares method involves solving the following system of equations:

$$\begin{cases} \sum y_i = n * a + b\sum t_i + c\sum t_i^2 \\ \sum t_i\, y_i = a\sum t_i + b * \sum t_i^2 + c * \sum t_i^3 \\ \sum t_i^2\, y_i = a\sum t_i^2 + b * \sum t_i^3 + c * \sum t_i^4 \end{cases}$$

" (Pripoaie, 2008).

We will consider origin of the time variable the centre of the series such that $\sum t_i = 0$, because the terms of the series are consecutive numbers and the system of equations becomes:

$$\begin{cases} \sum y_i = n * a + c\sum t_i^2 \\ \sum t_i\, y_i = b * \sum t_i^2 \\ \sum t_i^2\, y_i = a\sum t_i^2 + c * \sum t_i^4 \end{cases}$$

Table 3.Trend curvilinear of evolution of tourist accommodation establishments in European Union

Years	y_i	t_i	$t_i\, y_i$	t_i^2	t_i^3	t_i^4	$y_i\, t_i^2$	$y_t = a + bt_i + ct_i^2$	$\lvert y_i - y_t \rvert$
1	2	3	4	5	6	7	8	9	10
2014M05	222.632.381	-4	-890.529.524	16	-64	256	3562118096	361517716,1	138885335,1
2014M06	284.605.699	-3	-853.817.097	9	-27	81	2561451291	246044415,8	38561283,23
2014M07	409.160.653	-2	-818.321.306	4	-8	16	1636642612	156421357,3	252739295,7
2014M08	473.674.603	-1	-473.674.603	1	-1	1	473674603	92648540,52	381026062,5
2014M09	268.705.197	1	268.705.197	1	1	1	268705197	42653632,38	226051564,6
2014M10	191.419.123	2	382.838.246	4	8	16	765676492	56431540,99	134987582
2014M11	124.510.713	3	373.532.139	9	27	81	1120596417	96059691,37	28451021,63
2014M12	127.854.926	4	511.419.704	16	64	256	2045678816	161538083,5	33683157,53
Total	2.102.563.295	0	-1.499.847.244	60	0	708	12434543524	1213314978	1234385302

Sources: own calculations

So, on the data in the Table no. 4 the system of equations becomes:

$$\begin{cases} 2.102.563.295 = 8a + 60c \\ -1.499.847.244 = 60b \\ 12.434.543.524 = 60a + 708c \end{cases}$$

We will obtain:

$$\begin{cases} b = \dfrac{-1.499.847.244}{60} \\ 2.102.563.295 = 8a + 60c \\ 12.434.543.524 = 60a + 708c \end{cases}$$

$$\rightarrow \quad \begin{matrix} b = -24.997.454{,}067 \\ 2.102.563.295 * 15 = 8a * 15 + 15 * 60c \\ 12.434.543.524 * (-2) = 60a * (-2) + 708c * (-2) \end{matrix}$$

$$6.669.362.377 = 0 + 516c$$

$$c = \frac{6.669.362.377}{516} = 12.925.120{,}89$$

$$\begin{cases} b = -24.997.454{,}067 \\ c = 12.925.120{,}89 \\ 12.434.543.524 = 60a + 708 * 12.925.120{,}89 \end{cases} \rightarrow$$

$$\begin{cases} b = -24.997.454{,}067 \\ c = 12.925.120{,}89 \\ 3.283.557.933{,}88 = 60a \end{cases}$$

$$\rightarrow \begin{cases} b = -24.997.454{,}067 \\ c = 12.925.120{,}89 \\ a = 54.725.965{,}56 \end{cases}$$

The curvilinear regression equation is:

$y_t = a + bt_i + ct_i^2 = 54.725.965{,}56 - 24.997.454{,}067t_i + 12.925.120{,}89t_i^2$

It can be observed that the curvilinear regression equation is determined in column 9 of Table no. 3.

2.4. Determining the Regression Equation Type Modified Exponential $y_t = a * b^{ti}$

For a type modified exponential regression of the type $y_t = a * b^{ti}$, least squares method involves solving the following system of equations:

$$\begin{cases} \log a = \dfrac{\sum \log y_i}{n} \\ \log b = \dfrac{\sum t_i \log y_i}{\sum t_i^2} \end{cases}$$

We will consider origin of the time variable the centre of the series such that $\sum t_i = 0$, because the terms of the series are consecutive numbers.

Table 4. Trend exponential of evolution of tourist accommodation establishments in European Union

Years	y_i	t_i	$t_i y_i$	t_i^2	log y_i	t_i log y_i	**log y_t = log a + t_i log b**	**y_t=a*b^{ti}**	$\lvert y_i - y_t \rvert$
1	2	3	4	5	6	7	8	9	10
2014M05	222.632.381	-4	-890.529.524	16	8,35	-33,39	10,34	21627185237	21404552856
2014M06	284.605.699	-3	-853.817.097	9	8,45	-25,36	9,85	6998419960	6713814261
2014M07	409.160.653	-2	-818.321.306	4	8,61	-17,22	9,36	2264644308	1855483655
2014M08	473.674.603	-1	-473.674.603	1	8,68	-8,68	8,87	732824533,1	259149930,1
2014M09	268.705.197	1	268.705.197	1	8,43	8,43	7,89	76736148,94	191969048,1
2014M10	191.419.123	2	382.838.246	4	8,28	16,56	7,40	24831331,05	166587791,9
2014M11	124.510.713	3	373.532.139	9	8,10	24,29	6,91	8035261,222	116475451,8
2014M12	127.854.926	4	511.419.704	16	8,11	32,43	6,42	2600159,563	125254766,4
Total	2.102.563.295	0	-1.499.847.244	60	67,00	-2,95	67,00	31735276938,80	30833287760,25

Sources: own calculations

So, on the data in the Table no. 5 the system of equations becomes:

$$\begin{cases} \log a = \dfrac{\sum \log y_i}{n} = \dfrac{67}{8} = 8,375 \\ \log b = \dfrac{\sum t_i \log y_i}{\sum t_i^2} = \dfrac{-2,95}{60} = -0,49 \end{cases} \rightarrow \begin{cases} a = 237.137.370,6 \\ b = 0,32 \end{cases} \rightarrow$$

Results that the exponential trend equation is:

$\log y_t = \log a + t_i \log b = 8,375 - 0,49t_i$,

or $y_t = 237.137.370,6 * 0,32^{ti}$

Therefore, the modified exponential regression equation is calculated in column 9 of Table 4.

3. Conclusions

Therefore**,** the best trend with the method of least squares for the evolution of tourist accommodation establishments in European Union (28) is what leads to minimum value for $\sum(y_i - y_t)^2$ or for$\sum|y_i - y_t|$.

The data obtained in previous calculations we can summarize in the following table, no. 5 thus:

Table 5

Years	Linear regression equation		Curvilinear regression equation		Modified exponential regression equation	
	$y_t = a + bt_i$	$\|y_i - y_t\|$	$y_t = a + bt_i + ct_i^2$	$\|y_i - y_t\|$	$y_t = a*b^{ti}$	$\|y_i - y_t\|$
2014M05	362810228,1	140177847,1	361517716,1	138885335,1	21627185237	21404552856
2014M06	337812774,1	53207075,08	246044415,8	38561283,23	6998419960	6713814261
2014M07	312815320	96345332,99	156421357,3	252739295,7	2264644308	1855483655
2014M08	287817865,9	185856737,1	92648540,52	381026062,5	732824533,1	259149930,1
2014M09	237822957,8	30882239,19	42653632,38	226051564,6	76736148,94	191969048,1
2014M10	212825503,7	21406380,74	56431540,99	134987582	24831331,05	166587791,9
2014M11	187828049,7	63317336,67	96059691,37	28451021,63	8035261,222	116475451,8
2014M12	162830595,6	34975669,61	161538083,5	33683157,53	2600159,563	125254766,4
Total	2102563295	626.168.618,5	1213314978	1.234.385.302	31735276938,80	30.833.287.760,25

Based on the results synthesized in Table no. 5 the values for the linear equation regression are the lowest value and this is the best trend with the method of least squares for the evolution of tourist accommodation establishments in European Union (28) in the analyzed period.

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