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

Rodica Pripoaie¹

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).

¹ Associate Professor, PhD, “Danubius” University of Galati, Romania, Address: 3 Galati Boulevard, 800654 Galati, Romania, Tel.: +40.372.361.102, fax: +40.372.361.290, Corresponding author: rodicapripoaie@yahoo.com.
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>
<thead>
<tr>
<th>Nights spent</th>
<th>European Union (28 countries)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
</tr>
<tr>
<td>GEO/TIME</td>
<td></td>
</tr>
<tr>
<td>2014M05</td>
<td>222,632,381</td>
</tr>
<tr>
<td>2014M06</td>
<td>284,605,699</td>
</tr>
<tr>
<td>2014M08</td>
<td>473,674,603</td>
</tr>
<tr>
<td>2014M09</td>
<td>268,705,197</td>
</tr>
<tr>
<td>2014M10</td>
<td>191,419,123</td>
</tr>
<tr>
<td>2014M11</td>
<td>124,510,713</td>
</tr>
<tr>
<td>2014M12</td>
<td>127,854,926</td>
</tr>
</tbody>
</table>


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:

![Graph showing tourist accommodation establishments in European Union (28)](image)

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:

\[
\begin{align*}
\sum y_i &= n \cdot a + b \sum t_i \\
\sum t_i y_i &= a \sum t_i^2 + b \sum t_i^3
\end{align*}
\]

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:

\[
\begin{align*}
\sum y_i &= n \cdot a \\
\sum t_i y_i &= b \cdot \sum t_i^2
\end{align*}
\]

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

| Years       | \( y_i \)  | \( t_i \) | \( t_i y_i \) | \( t_i^2 \) | \( y_t = a + bt_i \) | \( |y_t - y_i| \) |
|-------------|------------|-----------|---------------|-------------|-------------------|----------------|
| 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    |
| 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:

\[
\begin{align*}
2.102.563.295 &= 8a \\
-1.499.847.244 &= 60b
\end{align*}
\]

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 \( y_t = 262.820.411.875 - 24.997.454.067t_i \) 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:

\[
\begin{align*}
\sum y_i &= n \cdot a + b \sum t_i + c \sum t_i^2 \\
\sum t_i y_i &= a \sum t_i^2 + b \cdot \sum t_i^3 + c \cdot \sum t_i^4
\end{align*}
\]

(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:
\[
\begin{align*}
\sum y_i &= n \cdot a + c \sum t_i^2 \\
\sum t_iy_i &= b \cdot \sum t_i^3 \\
\sum t_i^2 y_i &= a \sum t_i^3 + c \cdot \sum t_i^4
\end{align*}
\]

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

<table>
<thead>
<tr>
<th>Years</th>
<th>(y_i)</th>
<th>(t_i)</th>
<th>(t_iy_i)</th>
<th>(t_i^2)</th>
<th>(t_i^3)</th>
<th>(t_i^4)</th>
<th>(y_t = a + bt_i + ct_i^2)</th>
<th>(y_i - y_t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014M05</td>
<td>222,632,381</td>
<td>4</td>
<td>-890,529,524</td>
<td>16</td>
<td>-64</td>
<td>256</td>
<td>3562118096</td>
<td>361517716,1</td>
</tr>
<tr>
<td>2014M06</td>
<td>284,605,699</td>
<td>-3</td>
<td>-853,817,097</td>
<td>9</td>
<td>-27</td>
<td>81</td>
<td>2561451291</td>
<td>246044415,8</td>
</tr>
<tr>
<td>2014M07</td>
<td>409,160,653</td>
<td>-2</td>
<td>-818,321,306</td>
<td>4</td>
<td>-8</td>
<td>16</td>
<td>1636646212</td>
<td>156421357,3</td>
</tr>
<tr>
<td>2014M08</td>
<td>473,674,603</td>
<td>-1</td>
<td>-473,674,603</td>
<td>1</td>
<td>-1</td>
<td>1</td>
<td>473674603</td>
<td>92648540,52</td>
</tr>
<tr>
<td>2014M09</td>
<td>268,705,197</td>
<td>1</td>
<td>268,705,197</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>268705197</td>
<td>42653632,38</td>
</tr>
<tr>
<td>2014M10</td>
<td>191,419,123</td>
<td>2</td>
<td>382,838,246</td>
<td>4</td>
<td>8</td>
<td>16</td>
<td>765676492</td>
<td>56431540,99</td>
</tr>
<tr>
<td>2014M11</td>
<td>124,510,713</td>
<td>3</td>
<td>373,532,139</td>
<td>9</td>
<td>27</td>
<td>81</td>
<td>1120596417</td>
<td>96059691,37</td>
</tr>
<tr>
<td>2014M12</td>
<td>127,854,926</td>
<td>4</td>
<td>511,419,704</td>
<td>16</td>
<td>64</td>
<td>256</td>
<td>2045678816</td>
<td>161538083,5</td>
</tr>
<tr>
<td>Total</td>
<td>2,102,563,295</td>
<td>0</td>
<td>-1,499,847,244</td>
<td>60</td>
<td>0</td>
<td>708</td>
<td>12434543524</td>
<td>1213314978</td>
</tr>
</tbody>
</table>

Sources: own calculations

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

\[
\begin{align*}
2.102.563.295 &= 8a + 60c \\
-1.499.847.244 &= 60b \\
12.434.543.524 &= 60a + 708c
\end{align*}
\]

We will obtain:

\[
\begin{align*}
b &= -\frac{1,499,847,244}{60} \\
2.102.563.295 &= 8a + 60c \\
12.434.543.524 &= 60a + 708c
\end{align*}
\]

\[
\rightarrow \frac{2.102.563.295}{15} = 8a + 15 + 15 \cdot 60c \\
12.434.543.524 \cdot (-2) = 60a \cdot (-2) + 708c \cdot (-2)
\]

\[
\begin{align*}
6.669,362,377 &= 0 + 516c \\
c &= \frac{6.669,362,377}{516} = 12,925,120,89
\end{align*}
\]

\[
\begin{align*}
b &= -24,997,454,067 \\
c &= 12,925,120,89 \\
12.434.543.524 &= 60a + 708 \cdot 12,925.120,89
\end{align*}
\]

\[
\begin{align*}
b &= -24,997,454,067 \\
c &= 12,925,120,89 \\
3.283,557,933,88 &= 60a
\end{align*}
\]

\[
\begin{align*}
b &= -24,997,454,067 \\
c &= 12,925,120,89 \\
a &= 54,725,965,56
\end{align*}
\]

The curvilinear regression equation is:
Performance and Risks in the European Economy

\[ y_t = a + bt_i + ct_i^2 = 54.725.965,56 - 24.997.454,067t_i + 12.925.120,89t_i^2 \]

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 \( y_t = a \ast b^{t_i} \)

For a type modified exponential regression of the type \( y_t = a \ast b^{t_i} \), least squares method involves solving the following system of equations:

\[
\begin{align*}
\log a &= \frac{\sum \log y_i}{n} \\
\log b &= \frac{\sum t_i \log y_i}{\sum t_i^2}
\end{align*}
\]

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 | \( y_i \) | \( t_i \) | \( t_i y_i \) | \( t_i^2 \) | \( \log y_i \) | \( t_i \log y_i \) | \( \log y_i = \log a + t_i \log b \) | \( y_i = a \ast b^{t_i} \) | \( |y_i - y_t| \) |
|-------|---------|---------|-------------|---------|-------------|-----------------|-----------------|-----------------|-----------------|
| 1     | 2       | 3       | 4           | 5       | 6           | 7               | 8               | 9               | 10              |
| 2014M05 | 222.632.381 | -4 | -380.529.524  | 16      | 8.35       | 33.39           | 10.34           | 21627185237     | 21404552856     |
| 2014M06 | 284.605.699 | -3  | -385.817.097  | 9       | 8.45       | 25.36           | 9.85            | 6998419960      | 6713814261      |
| 2014M07 | 409.160.653 | -2  | -381.312.306  | 4       | 8.61       | 17.22           | 9.36            | 2264644308      | 1855483655      |
| 2014M08 | 473.673.603 | -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     | 166587971,9     |
| 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     | 125245766,4     |
| 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:

\[
\begin{align*}
\log a &= \frac{\sum \log y_i}{n} = \frac{67}{8} = 8.375 \\
\log b &= \frac{\sum t_i \log y_i}{\sum t_i^2} = \frac{-2.95}{60} = -0.049 \rightarrow \{a = 237.137.370,6, b = 0,32\}
\end{align*}
\]

Results that the exponential trend equation is:

\[ \log y_t = \log a + t_i \log b = 8.375 - 0,49t_i \]

or \[ y_t = 237.137.370,6 \ast 0,32^{t_i} \]

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>
<thead>
<tr>
<th>Years</th>
<th>Linear regression equation</th>
<th>Curvilinear regression equation</th>
<th>Modified exponential regression equation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$y_i = a + bt_i$</td>
<td>$y_i = a + bt_i + c t_i^2$</td>
<td>$y_i = a^b t^c$</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>y_i - y_t</td>
<td>$</td>
</tr>
<tr>
<td>2014M05</td>
<td>362810228,1</td>
<td>140177847,1</td>
<td>21627185237</td>
</tr>
<tr>
<td>2014M06</td>
<td>337812774,1</td>
<td>53207075,08</td>
<td>6998419960</td>
</tr>
<tr>
<td>2014M07</td>
<td>361517716,1</td>
<td>8561283,23</td>
<td>138885335,1</td>
</tr>
<tr>
<td>2014M08</td>
<td>28717865,9</td>
<td>1855483655</td>
<td>6173814261</td>
</tr>
<tr>
<td>2014M09</td>
<td>30882239,1</td>
<td>216051564,6</td>
<td>191969048,1</td>
</tr>
<tr>
<td>2014M10</td>
<td>321815320</td>
<td>156421357,3</td>
<td>1855483655</td>
</tr>
<tr>
<td>2014M11</td>
<td>28717865,9</td>
<td>92648540,52</td>
<td>259149930,1</td>
</tr>
<tr>
<td>2014M12</td>
<td>212825503,7</td>
<td>42553632,38</td>
<td>76736148,94</td>
</tr>
<tr>
<td>Total</td>
<td>2102563295</td>
<td>11283287760,25</td>
<td>30833287760,25</td>
</tr>
</tbody>
</table>

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.

References


http://ec.europa.eu/eurostat/data/database