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PREDICTIVE ANALYSIS OF TRENDS IN THE TOURISM INDUSTRY IN TERMS OF EU COUNTRIES

Vitaliia Koibichuk, PhD, As. Prof.
Sumy State University, Ukraine

Serhii Drozd, postgraduate student
Sumy State University, Ukraine

A critical and urgent problem today is the study of the effects of Covid-19 on the development of the international economy. The paper predicts the impact of Covid-19 on the development of tourism industries in the popular European Union countries, exactly in Germany, Italy, Bulgaria, and France [1, 2]. Forecasting was made by the following stages: descriptive statics, time-series smoothing, seasonal decomposition, development of the forecast. Primary statistical information was taken from the Eurostat database [3].

The sample is the data from January 2014 to April 2020. Basic stages of forecasting making were made by the next algorithm: implementations of tools of the descriptive statistics, time-series smoothing, seasonal decomposition and development of the forecast [4]. The calculations were made in the applied computer program Statgraphics Centurion.

To find the results for the descriptive statistics, it was applied to the procedure Describe/Time Series/Descriptive Methods. For all the countries studied, the results of the descriptive statistics are as follows: the series are not stationary; they are not random in nature. An example represents Bulgaria by figures 1, 2, and table 1. So there are models that we can identify and use as predictive.

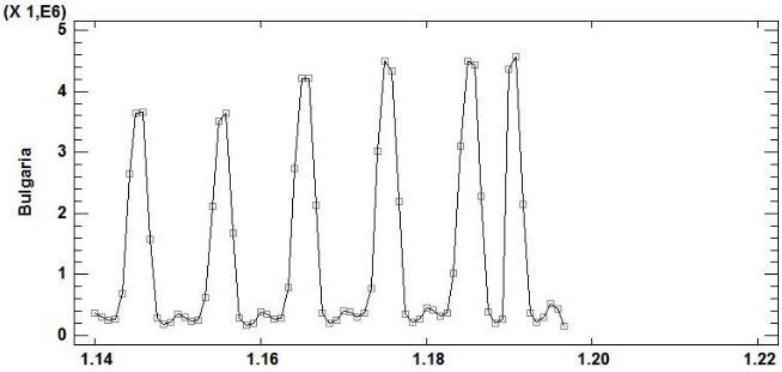

Figure 1. Time series plot for Bulgaria

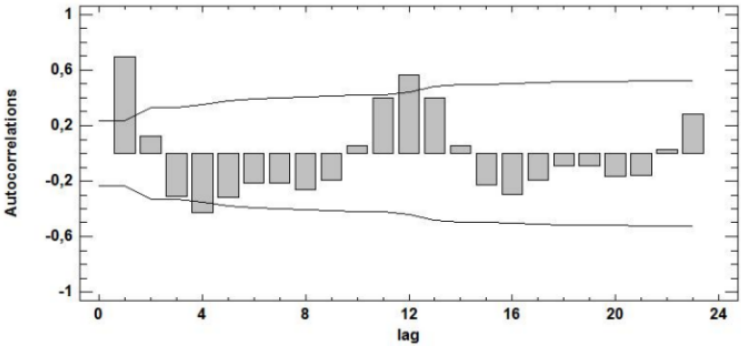

Figure 2. Estimated Autocorrelations for Bulgaria

Table 1. Estimated Autocorrelations for Bulgaria

			Lower 95,0%	*Upper 95,0%*
Lag	*Autocorrelation*	*Stnd. Error*	*Prob. Limit*	*Prob. Limit*
1	**0,696861**	0,120386	-0,235952	0,235952
2	0,126972	0,169022	-0,331278	0,331278
3	-0,308684	0,170399	-0,333977	0,333977
4	**-0,424144**	0,178319	-0,3495	0,3495
5	-0,320457	0,192385	-0,377069	0,377069
6	-0,214909	0,199972	-0,391939	0,391939
7	-0,212241	0,203292	-0,398445	0,398445
8	-0,260271	0,206478	-0,40469	0,40469
9	-0,194352	0,211179	-0,413905	0,413905
10	0,0575637	0,213756	-0,418955	0,418955
11	0,401559	0,21398	-0,419395	0,419395
12	**0,5678**	0,224636	-0,44028	0,44028
13	0,401663	0,244553	-0,479317	0,479317
14	0,0550923	0,253934	-0,497703	0,497703
15	-0,230575	0,254108	-0,498043	0,498043
16	-0,295466	0,257122	-0,503951	0,503951
17	-0,192016	0,261996	-0,513504	0,513504
18	-0,0898833	0,264028	-0,517486	0,517486
19	-0,0889616	0,264471	-0,518355	0,518355
20	-0,166751	0,264904	-0,519204	0,519204
21	-0,158696	0,266421	-0,522177	0,522177
22	0,025884	0,267788	-0,524856	0,524856
23	0,28347	0,267824	-0,524927	0,524927

Note: Compiled by authors based on works [5-8]

Table 1 shows the estimated autocorrelations between values of Bulgaria at various lags. The lag *k* autocorrelation coefficient measures the correlation between values of Bulgaria at time t and time t-k. Also shown are 95,0% probability limits around 0. If the probability limits at a particular lag do not contain the estimated coefficient, there is a statistically significant correlation at that lag at the 95,0% confidence level. In this case, 3 of the 24 autocorrelation coefficients are statistically significant at the 95,0% confidence level, implying that the time series may not be

completely random. Periodograms were used to determine the characteristics of cyclic fluctuations. On a periodogram graph, we can determine the number of cyclic fluctuations. If there are sharp spikes on the chart, this means that the series behaves cyclically (fir. 3).

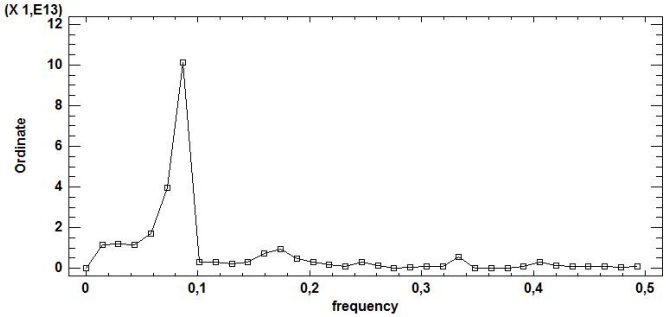

Figure 3. Periodogram For Germany

The quantitative indicator of cyclicality for Germany is six months. We define it from the Periodogram's table. For Italy indicator of cyclicality is two months, and no cyclicality for Bulgaria and France.

The next stage of analysis is time series smoothing. Smoothing allows you to get rid of a series of sharp outliers and demonstrate the main trend. The appropriated procedure in Statgraphics Centurion is Describe/Time Series/Smoozing with Simple Moving Average method, length of Moving Average is 12. As a result of smoothing, we get a visual representation based on which an assumption can be made about the future forecast model, which can be used with the input data [9-11].

The next stage is Describe/Time Series/Seasonal Decomposition. There are two models of seasonal decomposition. It is additive and multiplicative. The multiplicative model represents the seasonality indices in percent, the additive model in absolute values [12-14]. Seasonality indices show seasonal deviations from the annual average [15-17]. The analysis results for Germany are as follows: 2 months of increased demand, these are January and February. The lowest demand is in the month of May (table 2). The table 2 in bold indicates the numbers that correspond to the maximum and minimum values of the seasonality indices. As we can see, in January the demand exceeds the average annual value by 923819 tourists, and in May it is less than the average annual value by 791883 tourists.

Table 2. Seasonal Indices for Germany (Seasonal decomposition method: Additive)

Season	*Index*
1	828239,
2	**923819**,
3	-242613,

4	-242181,
5	**-791883**,
6	-475382,

The direct development of a forecast for the countries under study was carried out using the Forecast/User-Specified Model procedure. The main issue in the development of predictive models is their adequacy. The first thing to look out for is the autocorrelation of the residuals. The residuals should be random. If this is not the case, then the values of the autocorrelation function will go beyond the confidence intervals. Next, it's needed to build an adequate model based on the values of the model errors (the smaller the error, the better the model) and the results of passing the model of various tests. For Germany, this information represents in table 3 and table 4.

Table 3. Estimation Period

Model	*RMSE*	*MAE*	*MAPE*	*ME*	*MPE*
(A)	1,3142E6	1,01137E6	17,5114	-2,87614E-10	-2,78132
(B)	1,93868E6	1,51087E6	26,1343	-1910,87	-9,24693
(C)	1,68303E6	1,44964E6	24,2087	-22557,4	-5,78103
(D)	1,24469E6	957839,	16,3156	-19413,7	-3,2365
(E)	2,03597E6	1,74447E6	28,3785	-79689,3	-9,01905

Note: Compiled by authors based on works [3, 5, 19, 20]

Table 4. Tests for models validity

Model	*RMSE*	*RUNS*	*RUNM*	*AUTO*	*MEAN*	*VAR*
(A)	1,3142E6	OK	OK	OK	OK	OK
(B)	1,93868E6	***	***	***	OK	OK
(C)	1,68303E6	**	***	***	OK	OK
(D)	1,24469E6	*	OK	***	OK	OK
(E)	2,03597E6	***	***	***	OK	OK

Note: Compiled by authors based on works [3, 5, 21, 22]

Table 4 describes the type of models and test results: (A) Random walk with drift = – 13773,2 (Seasonal adjustment: Additive); (B) Constant mean = 6,73882E6 (Seasonal adjustment: multiplicative); (C) Simple moving average of 3 terms (Seasonal adjustment: Multiplicative); (D) Simple exponential smoothing with alpha = 0,9999 (Seasonal adjustment: Multiplicative); (E) Brown's quadratic exp. smoothing with alpha = 0,1036; OK – the model passed the test; * – worse; ** – even worse; *** – practically failed the test. That is, the best model is the model A, Random walk with drift. The forecast values are presented in table 5.

Table 5. Forecast Table for Germany for the next 2 years (Model: Random walk with drift = -13773,2; Seasonal adjustment: Additive)

		Lower 95,0%	*Upper 95,0%*
Period	*Forecast*	*Limit*	*Limit*
70,0	1,94145E6	-581933,	4,46483E6
71,0	1,37797E6	-2,19063E6	4,94657E6
72,0	1,6807E6	-2,68992E6	6,05132E6
73,0	2,97055E6	-2,07621E6	8,0173E6
74,0	3,05235E6	-2,59009E6	8,6948E6
75,0	1,87215E6	-4,30884E6	8,05314E6
76,0	1,85881E6	-4,81743E6	8,53504E6
77,0	1,29533E6	-5,84186E6	8,43253E6
78,0	1,59806E6	-5,97208E6	9,1682E6
79,0	2,88791E6	-5,09172E6	1,08675E7
80,0	2,96971E6	-5,39939E6	1,13388E7
81,0	1,78951E6	-6,95173E6	1,05308E7
82,0	1,77617E6	-7,322E6	1,08743E7
83,0	1,21269E6	-8,22893E6	1,06543E7
84,0	1,51542E6	-8,25758E6	1,12884E7
85,0	2,80527E6	-7,28825E6	1,28988E7
86,0	2,88707E6	-7,51708E6	1,32912E7
87,0	1,70687E6	-8,99892E6	1,24127E7
88,0	1,69353E6	-9,30563E6	1,26927E7
89,0	1,13005E6	-1,01548E7	1,24149E7
90,0	1,43278E6	-1,01308E7	1,29964E7
91,0	2,72263E6	-9,11307E6	1,45583E7
92,0	2,80444E6	-9,29727E6	1,49061E7
93,0	1,62423E6	-1,07378E7	1,39862E7

Thus, we can conclude that over the next two years in Germany there will be a significant reduction in tourists. Similar models were built for Bulgaria, France, Italy. For all countries, there is a negative trend in the development of the tourism industry

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