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DEVELOPMENT TRENDS IN THE NUMBER OF POSTAL PARCELS IN THE REPUBLIC OF CROATIA

Summary: In the last couple of years, the Republic of Croatia has witnessed a growth in the number of postal parcels. In this paper, by applying quantitative methods, we perform the decomposition of a time series, where the development of the number of parcels is decomposed into the part which refers to the influence of the season and the part which refers to the irregular component, i.e. the unexplained part. We also perform an estimate of the developments of the number of parcels until 2025 by using the exponential trend, where the developments of the parcel number variable are estimated without the influence of the season. The research has established the influence of the season, where highest parcel traffic is achieved in the fourth quarters. By applying the exponential trend model, it has been established that in every following period, a growth in the number of parcels by 2.75% is to be expected.

1. INTRODUCTION

According to the Croatian Bureau of Statistics, in the last 10 years, a growth in the total number of postal and courier service parcels has been recorded, in comparison with items of correspondence and other kinds of consignments [1]. In order to determine the future capacity needs for means of transport, it is necessary to predict the amount of postal consignments – in this case, the number of parcels. Therefore, in this paper, we have examined the development trend of postal parcels with the aim of elaborating a prognostic model. The prognostic model can be used for the planning of future transport capacities and the choice of optimum means of transport. The knowledge of future capacities of means of transport can directly influence transport effectiveness. On the basis of the data, an estimate of the developments in the number of parcels until 2025 is carried out by applying quantitative methods, while the decomposition of a time series and the regression method are used to elaborate the exponential trend of a model by means of which the development of the variable of the number of parcels is estimated without influences of the season. The applied analysis of time series is used for various types of research, in fields such as economy and engineering, where the decomposition of a time series enables a better understanding of general data-related patterns. Time series of data are divided into the trend-related, the seasonal and the irregular component, where each component contributes to the creation of the value. [2,3]. The statistical significance of the exponential trend model is tested by means of the ANOVA test.

2. POSTAL SYSTEM OF THE REPUBLIC OF CROATIA

In the Republic of Croatia, there are one national and 21 other postal service providers [4]. The postal system is a specific transport system, as it includes the transport system used for the transfer of consignments and the communication system used for the transfer of information [5]. From the point of view of transport system, different means of transport are used for the transport of postal consignments. Postal consignments, letters and parcels are transported between the entities that form a postal network, which include post offices and post centres, and consignments are delivered to end users in the Republic of Croatia via road transport. The Croatian Bureau of Statistics has carried out an analysis of the postal and courier services market of the Republic of Croatia [6]. On the basis of the data obtained, Chart 1 displays the share of postal parcels in the total number of postal and courier services, where it can be observed that postal parcels record a growth in comparison to items of correspondence and other consignments. A postal parcel is a consignment of appropriate dimensions that contains goods and objects [7].
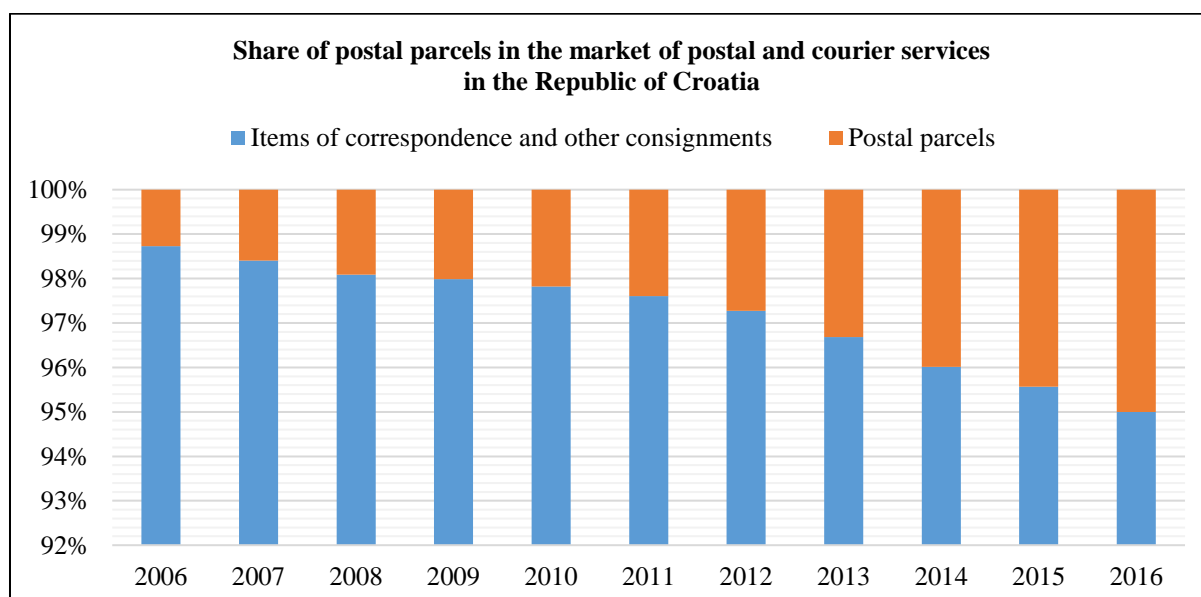

Chart 1. Share of postal parcels in the market of postal and courier services in the Republic of Croatia.

3. DECOMPOSITION OF THE DEVELOPMENT TREND IN THE NUMBER OF PARCELS WITHIN THE OBSERVED PERIOD

In this section of the paper, a decomposition of a time series is carried out by using quantitative methods from economics and engineering, where the trend in the number of parcels is decomposed to the influence of the season and the irregular component, i.e. the unexplained part. In the next step, an estimate of the trends in the number of parcels until 2025 is carried out by applying the exponential trend, where the trend in the variable of the number of parcels is estimated without influences of the season. Methods of decomposition of a time series are applied, where, after smoothing the variable from influences of the season and irregular influences, a smoothed variable is obtained and further used by applying the exponential regression model. The statistical significance of the exponential trend model is tested by means of the ANOVA test. The variable trend contributes, to a large extent, to the change in the number of consignments, while the representativeness of a model thus created will be tested by using the coefficient of determination. [8,9,10]

Table 1. Achieved number of parcels and decomposition per quarter.

Time	Number of parcels (ths)	Seasonal factors	Irreg. compon.	Smoothed trend c.
2006Q1	1150	95.37	104.47	1154.18
2006Q2	1172	100.00	98.25	1192.88
2006Q3	1195	99.51	94.53	1270.27
2006Q4	1435	105.11	99.43	1372.96
2007Q1	1478	95.37	104.67	1480.55
2007Q2	1588	100.00	101.29	1567.85
2007Q3	1561	99.51	96.21	1630.47
2007Q4	1834	105.11	102.90	1695.65
2008Q1	1672	95.37	99.43	1763.12
2008Q2	1795	100.00	96.97	1851.07
2008Q3	1951	99.51	101.81	1925.63
2008Q4	2210	105.11	106.76	1969.39
2009Q1	1813	95.37	98.08	1938.11
2009Q2	1899	100.00	100.78	1884.38
2009Q3	1768	99.51	95.98	1850.98
2009Q4	1897	105.11	97.24	1855.93
2010Q1	1927	95.37	107.19	1884.99
2010Q2	1796	100.00	94.89	1892.75
2010Q3	1916	99.51	99.99	1925.62
2010Q4	2050	105.11	100.07	1948.83
2011Q1	1947	95.37	102.90	1983.88
2011Q2	1959	100.00	98.20	1994.85
2011Q3	1977	99.51	98.97	2007.28
2011Q4	2176	105.11	101.37	2042.27
2012Q1	1913	95.37	95.16	2107.88
2012Q2	2226	100.00	101.09	2201.98
2012Q3	2363	99.51	103.86	2286.26
2012Q4	2427	105.11	98.12	2353.21
2013Q1	2267	95.37	98.11	2422.68
2013Q2	2523	100.00	99.84	2527.03
2013Q3	2622	99.51	98.11	2685.55
2013Q4	2987	105.11	98.23	2892.78
2014Q1	3013	95.37	100.79	3134.48
2014Q2	3399	100.00	101.89	3335.97
2014Q3	3599	99.51	104.35	3465.85
2014Q4	3609	105.11	97.88	3507.68
2015Q1	3356	95.37	98.71	3564.62
2015Q2	3599	100.00	98.96	3636.83
2015Q3	3825	99.51	103.43	3716.39
2015Q4	3969	105.11	99.87	3780.75

2016Q1	3479	95.37	93.82	3888.04
2016Q2	4117	100.00	101.38	4060.82
2016Q3	4398	99.51	103.40	4274.13
2016Q4	4505	105.11	97.83	4380.79

It can be established from Table 1, that due to the influence of the quarter, the number of parcels in the first quarter is lower by 4.63% than it is in the second quarter (I=95,37). In the third quarter, due to the influence of the season, the number of parcels is lower by 0.49% than in the second quarter, whereas in the fourth quarter, due to the influence of the quarter, the number of parcels is higher by 5.11%. To estimate the trends in the number of parcels in the future period, "smoothed" data are used, i.e. data from which the seasonal oscillations have been removed. The estimated model interprets 93.87% of the sums of the squares of the deviations of the number of parcels from the arithmetic mean of the period. The model in question is a reliable estimate model (R^2 higher than 80%).

Table 2. Estimate of the trend model.

Regression Summary for Dependent Variable: Parcels (Smoothed trend analysis) R2= 0.9387				
	beta	Std. err. - of b	T (42)	p-value
Intercept	3.1017	0.01	267.23	<0.001
Time	0.0118	0.00	25.36	<0.001

Therefore, the estimated model is as follows: log (parcels) = 3,10 + 0,0118*time (1)
where, after the transformation into the original form, a model with the following form is obtained:
Parcels = $1.258,93*1,0275^{X}$ (2)

Therefore, in the initial year, according to the model, 1,258.93 thousand parcels can be expected, while an average growth in the number of parcels by 2.75% can be expected in every following period (quarter). By using the estimated parameters, an estimate of the trends in the number of parcels for the period until 2025 is carried out. The estimated model is representative, because it interprets 93.87% of the sums of the squares of the deviations of the number of parcels from the arithmetic mean, and it is appropriate for prognostic purposes.

Table 3. Predicted number of postal parcels by quarter until 2025

Time	Predicted number of parcels	Time	Predicted number of parcels
2017Q1	4153.38	2021Q3	6768.23
2017Q2	4267.60	2021Q4	6954.36
2017Q3	4384.96	2022Q1	7145.60
2017Q4	4505.55	2022Q2	7342.10
2018Q1	4629.45	2022Q3	7544.01
2018Q2	4756.76	2022Q4	7751.47
2018Q3	4887.57	2023Q1	7964.64
2018Q4	5021.98	2023Q2	8183.67
2019Q1	5160.08	2023Q3	8408.72
2019Q2	5301.99	2023Q4	8639.96
2019Q3	5447.79	2024Q1	8877.56
2019Q4	5597.61	2024Q2	9121.69

2020Q1	5751.54	2024Q3	9372.53
2020Q2	5909.71	2024Q4	9630.28
2020Q3	6072.22	2025Q1	9895.11
2020Q4	6239.21	2025Q2	10167.23
2021Q1	6410.79	2025Q3	10446.83
2021Q2	6587.08	2025Q4	10734.11

It may be observed from Table 3 that it is to be expected that, in comparison with the number of parcels achieved in the first quarter of 2017, the number of parcels will double in the third quarter of 2025.
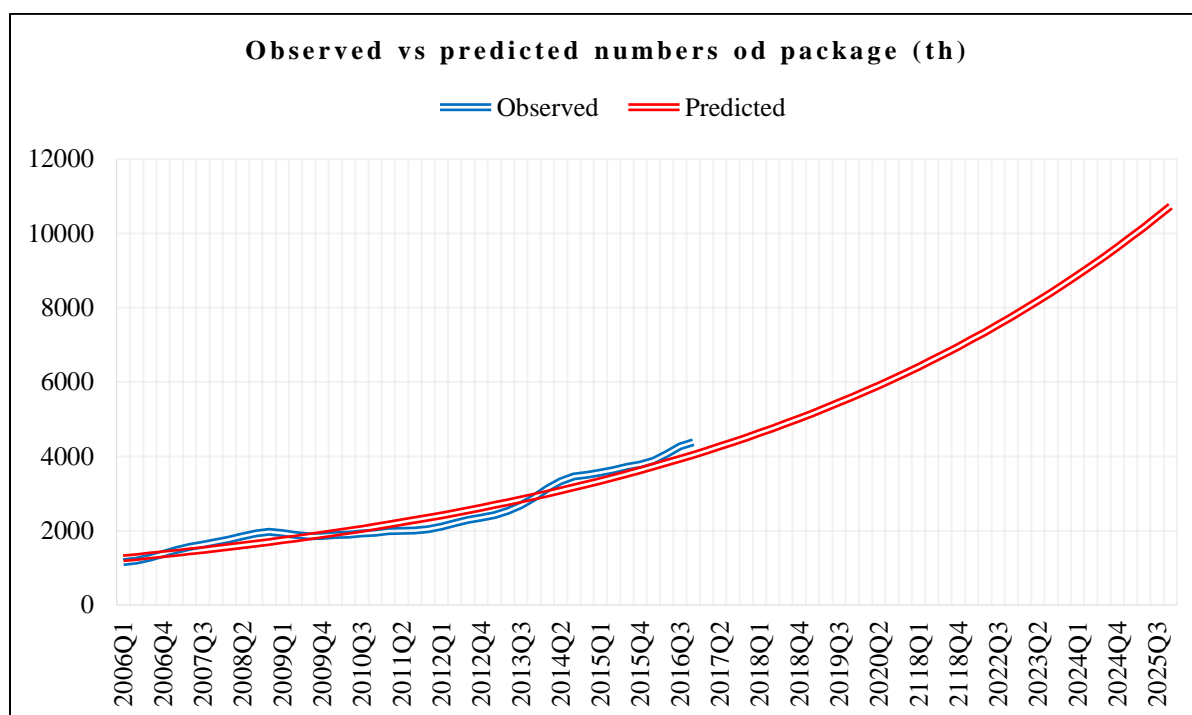

Chart 2. Observed and predicted number of postal parcels.

It can be observed from the chart that the trends in the real number of parcels closely follow the trends in the number of parcels estimated by means of the exponential trend model. The statistical significance of the model as a whole is tested by means of the ANOVA test.

Table 4. Statistical significance of the model.

Analysis of deviations; DV: Number of parcels (ths)				
	Sums of - squares	df	Mean - squares	F	p-value
Regress.	31502008.00	1	31502008.00	276.99	<0.001
Residual	4776592.00	42	113728.00		
Total	36278600.00				

The statistical significance of the model as a whole is tested by means of the ANOVA test where it has been established, on the basis of the empirical F with the value of 276.99, that the model as a whole is of statistical significance (empirical p value < 0.001).

4. CONCLUSION

After an analysis was performed, the existence of seasonal cycles of trends in the number of parcels within a calendar year has been established, where the highest number of parcels is expected in the fourth quarter, when, due to the influence of holiday mood, there is increased traffic of postal parcels. The lowest parcel traffic is expected in the first quarter. By using the exponential trend and the decomposition method of a time series, trends in the number of parcels within the observed period have been noted and estimates of the development in the number of parcels until 2025 have been carried out. By means of the applied model, it was established that in every following quarter, a growth in the parcel business by 2.75%, in comparison with the previous quarter, can be expected, i.e. in the fourth quarter of 2025, 10.73 thousand parcels can be expected. The estimated model interprets 93.87% of deviations, and the model in question is representative and statistically significant (empirical F value = 276.99; $p<0.001$).

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