CHANGES IN THE QUANTITIES OF MUNICIPAL WASTE IN THE SZEGED REGION

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1. INTRODUCTION

A characteristic feature of advanced consumer societies is the increase in municipal waste production owing to higher amounts of packaging materials. As an additional tendency over recent years, we witness a dramatic growth in the volume of waste, along with an unfavourable change in their composition. Primary strategic objectives of advanced waste management include decreasing the amount and volume of the waste produced, reducing the proportion of components that are alien to, or harmful for, the environment, recycling of wastes, or utilization thereof to produce energy. In this paper, we have examined the quantity parameters of municipal waste generated in the Szeged region over the period between 2000 and 2005. Processing of the quantitative data pertaining to waste produced in a large city and its region that is viewed as average in terms of Hungarian waste management allows one to arrive at some general conclusions. Resource material was obtained from data made available by the Environmental Management Public Benefit Company of Szeged (Szeged, Városgazda sor 1). The data involves quantities of waste delivered to the regional waste disposal site of Szeged on Sándorfalva Road and eliminated there by way of orderly disposal or utilization. The premises of the disposal site are operated by the Environmental Management Public Benefit Company of Szeged upon commission by the Local Government of Szeged, a City of County Rank.
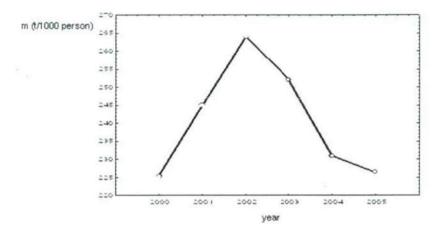
Research objectives: to identify, by way of a time series analysis, the changes in the quantity of municipal waste, to explore regular features in seasonal changes of quantity parameters, to define seasonal indices for each month by eliminating season-dependent indices of individual months, to specify overall trends for the period studied, as well as global trends of the period studied and the relevant mathematical relations that apply to these trends.

Methods applied: We have applied single-variable statistical methods, in particular, time series analysis and trend analysis throughout the research. Time series analysis was applied to determine changes in the quantity of municipal waste over time. Trend analysis was used to specify the trend component on the basis of a "season-free" time sequence using a 5-component moving average smoothing. To carry out the analyses, the STATISTICA software was applied.
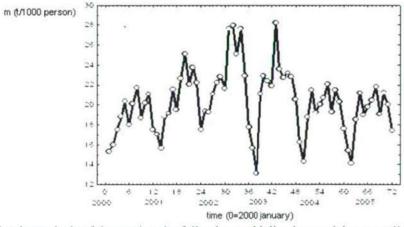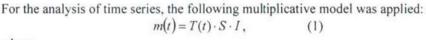
2. PROCEDURE OF THE ANALYSIS

Initial data is included in the diagram below. The analysis was based on data related to municipal waste produced from January 1, 2000 to December 31, 2005 by approximately 250,000 inhabitants of Szeged and its region. The analysis data was used to specify the seasonal variation in waste production and to determine long-term trends.

Changes in the annual amount of waste of 1000 persons during the period studied

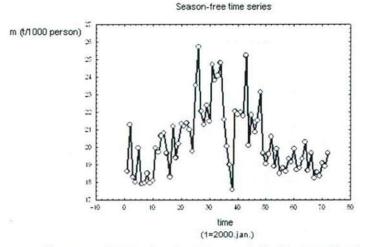Time series of monthly amounts of waste of 1000 persons

For the analysis of time series, the following multiplicative model was applied:

$$m(t) = T(t) \cdot S \cdot I, \qquad (1)$$

where

$T(t)$ t is the trend value defined in months.

S is the seasonal index of the last month,

I is the irregularity component used to account for random fluctuations.
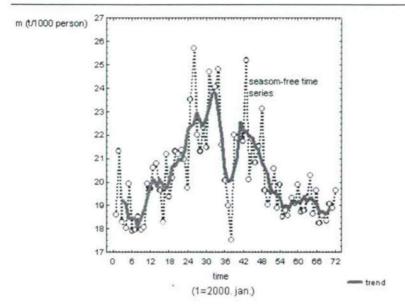
Seasonal indexes of the months

The season-free time series obtained after elimination of the seasonal effects contains only the trend-related and the random fluctuations.
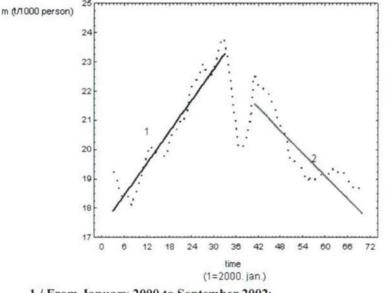
Season-free time series

time
(1=2000.jan.)

The season-free trend component was defined using a 5-point moving average smoothing, as follows:

m (t/1000 person)

time
(1=2000. jan.)

trend

The two sections of the trend obtained is suitably specified by a linear function:

m (t/1000 person)

time
(1=2000. jan.)

1./ From January 2000 to September 2002:
$$T(t) = 17,36 + 0,18 \cdot t \quad (R = 0,96, \quad R^2 = 0,92). \tag{2}$$
The above period can be globally characterized as one showing a monthly increase in the quantity of waste produced by 1000 persons by a rate of 0.18 tons.

2./ From January 2003 to December 2005:
$$T(t) = 26,90 - 0,13 \cdot t \quad (R = 0,88, \quad R^2 = 0,78), \tag{3}$$
which, however, indicates an 0.13 tons monthly decrease.

3. SUMMARY OF THE FINDINGS

The time series analysis appears to clearly confirm the observation that changes in municipal waste production show a cyclic character. Determination of seasonal relations demonstrates that the lowest specific quantity indicator (relative to the amount of waste per 1000 persons) is noted in the winter period, with peaks attained in summer months (the highest level recorded in August). Sharp increases in the amounts of waste transported in April and October are related to spring clean-up and gardening activities, and garden wastes and fallen leaves, respectively.

Aside from the cyclic changes due to seasons, the analysis has also revealed that the annual amount of waste per capita showed a steady increase up to 2002 (0.18 tons/month), followed by a comparable, but slightly less steep decrease thereafter (0.13 tons/month). The trend analysis clearly demonstrates a sharp increase in municipal waste production in the period after the change of the political regime, owing the a significant change in consumer habits. According to data obtained for Szeged, the peak period of municipal waste produced was in the summer of 2002, followed by a considerable drop in winter 2002/2003, where a definitely opposite trend started to take place. Thereafter, a gradually decreasing rate of waste production was noted, with the amount recorded in December 2005 having more or less reached the level noted in the year 2002. For the time being, the underlying reasons are unknown and call for a more thorough exploration into the social and sociological reasons of the phenomenon concerned.

BIBLIOGRAPHY

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