TRANSPORT VOLUME IN REGIONS OF THE CZECH REPUBLIC IN RELATION TO THE PRODUCTION OF WASTE

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The article deals with the transport volume in regions of the Czech Republic in relation to the production of waste. On the basis of waste statistics and transport statistics is researched the greatness of the relation between the transport volume and the production of waste in regions of the Czech Republic. The relation is illustrated graphically too. We have many kinds of waste which we can monitor. The most important kinds of waste are municipal waste, industrial waste, construction and demolition waste, waste from energy prod. (excl. radioactive), mining and quarrying waste, waste from water treatment and distribution, agriculture and forestry waste, waste from sanitation and similar activities and other waste.

Key words: transport, waste, relation, region

1 Introduction

The **correlation** deals with interaction between variables, in the example variables are the transport volume and the production of waste in regions of the Czech Republic. Data are obtained from the Czech statistical office for years 2006 and 2007.

Sample correlation coefficient:

$$r_{12} = \frac{n\sum x_{1i}x_{2i} - \sum x_{1i}\sum x_{2i}}{\sqrt{\left[n\sum x_{1i}^2 - \left(\sum x_{1i}\right)^2\right]\cdot\left[n\sum x_{2i}^2 - \left(\sum x_{2i}\right)^2\right]}} \quad (1)$$

The sample correlation coefficient represents the dependence between two variables and takes the values < -1; 1 >. The closer to 1 (the absolute value), the stronger correlation is between variables. Pair correlation coefficients are possible to note like correlation matrix.

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Tab. 1 Correlation matrix of transport volume and the production of waste in regions in 2006

	Road transport			*Railway transport*			
	A Export of goods to other regions	*B Import of goods from other regions*	*C Transport of goods within region*	*D Export of goods to other regions*	*E Import of goods from other regions*	*F Transport of goods within region*	*waste*
A	1,00						
B	0,96	1,00					
C	0,66	0,68	1,00				
D	0,04	-0,04	0,34	1,00			
E	0,34	0,26	0,42	0,40	1,00		
F	-0,04	-0,01	0,55	0,77	0,36	1,00	
waste	0,41	0,51	**0,79**	0,31	0,26	**0,70**	1,00

Source: Czech statistical office

Results are possible to test, when null hypothesis is that we suppose independence between monitored variables.

Significance test of correlation coefficient

H_0: $\rho=0$

H_1: $\rho\neq0$

$$t = \frac{r}{\sqrt{1-r^2}}\sqrt{n-2} \qquad (2)$$

It was corroborated on 5% confidence level that there is statistical significant interdependence between the production of waste and the road and railway transport within region.

Regression analysis

We can model relations between transport and wastes by the help of a multiply regression analysis. The multiply regression analysis describes character of interdependence between variables.

It was used data from the Czech statistical office for year 2007 for these models.

2 Relation between industrial waste (tons) and transport of goods within the region by the road and railway transport.

General model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 \tag{3}$$

y… industrial waste (thous. t)
x_1 … transport of goods by road within region (thous. t)
x_2 … transport of goods by railway within region (thous. t)
β_0.. level constant
β_1, β_2… parameters

Parameters were estimated by the method of least squares:

$$y = -83{,}47 + 0{,}017\, x_1 + 0{,}0729\, x_2$$

It appears from this that increasing transport of goods within region increases industrial waste. The railway transport induces the greater growth of wastes because if transport of goods by railway increases by 1 t then industrial waste increase by 0,729 t while the same growth by road causes growth of waste just by 0,017 t.

Verification of model

Determination index

$$I^2 = \frac{S_T}{S_y} \tag{4}$$

Determination index indicates what part of total variability of observed values this model explains.

Determination index is 0,85 for this model which is very good.

Individual *t*-tests (check no zero parameters) corroborated on 5% confidence level as well as total *F*-test. It appears from this that the model is efficient for the description of relations between transport and waste from statistical point of view.

3 Relation between transport of goods by road within the region and industrial and municipal waste

General model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 \quad (5)$$

y … transport of goods by road within region (thous. t)
x_1 .. industrial waste (thous. t)
x_2 .. municipal waste (thous. t)
β_0.. level constant
β_1, β_2… parameters

Model with estimated parameters

$$y = 1770 + 74{,}086\, x_1 + 14{,}296\, x_2$$

From the model follows that increasing wastes increases transport within region. If industrial waste increases by 1 t in region, transport volume increases by 74,086 t. If municipal waste increases, transport volume increases by 14,296 t.

Verification of model

Determination index is 0,88, *t*-tests 17,9 and 4,72, *F*-test is 41,35. All these values confirm quality of model.

4 Relation between municipal waste and transport within the region

General model

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 \quad (6)$$

y… municipal waste (thous. t)
x_1 … transport of goods by road within region (thous. t)
x_2 … transport of goods by railway within region (thous. t)
β_0.. level constant
β_1, β_2… parameters

Model with estimated parameters

$$y = 85{,}989 + 0{,}0019\,x_1 + 0{,}00817\,x_2$$

From the model follows that increasing transport of goods within the region increases municipal waste. The railway transport induces the greater growth of wastes (by 8 kilograms) than the road transport (1,9 kilogram).

Verification of model

Determination index is only 0,6, *t*-tests 1,4 and 2,6, *F*-test is 8,4. These values are not too high so this model isn't appropriate next to use.

5 Conclusion

The hypothesis was that direct dependence exists between the transport volume and the production of waste in regions of the Czech Republic. This hypothesis was confirmed. The model, denotes relation between municipal waste and transport within the region, didn't comply with statistic tests but other models complied. Models proved that the strong dependence exists between hauling performance on road and industrial wastes.

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Reference literature

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