Commuting patterns: a modified radiation model and supporting data

Levente Varga*[1], Géza Tóth[2], Zoltán Néda[1]

[1]Babeş-Bolyai University, Faculty of Physics, Cluj-Napoca, Romania
[2]Hungarian Central Statistical Office, Budapest, Hungary

*vargal@cs.ubbcluj.ro

Several empirical models aimed at describing human mobility patterns have been proposed in the past. Most of them are based on an unjustified analogy, with concepts and models borrowed from physics: gravity and vector or scalar fields. Recently however, statistical physicists introduced a new category of models motivated by simple and reasonable socioeconomic assumptions.

The Radiation Model (RM) [1] and the Radiation Model with Selection (RMwS) [2] are two of such successful approaches. In these models, the salary a job pays and the commuting distance to it is the most important variables. In RM, the main hypothesis is that a worker will commute to the closest distance where he/she can improve his/her current income. If we assume now that the jobseekers are selective in their choices and they are willing to accept better offers only with a probability smaller than one, we get the RMwS model. Alternatively, the assumption behind this generalization can be interpreted as a fact that the jobseekers are aware only of a fraction of the available job offers.

Recently the two novel variations of the RM model were proposed by us, where one takes into account also the distance dependent travel costs and preference for choosing closer jobs. The first model, the Travel Cost Optimized Radiation Model (TCORM) [3] was tested for commuting patterns in Hungary. The second model, the Radiation Model with Distant Dependent Selection (RMwDDS) is presented here briefly and tested for commuting data. We use commuter and population census datasets from Hungary, Italy and USA and critically compare the performance of the RM, RMwS, TCORM and RMwDDS approximations. We find that the RMwDDS describes in the best manner the commuting fluxes versus distance dependence in all three commuting database.

References

[1] Simini, F., González, M.C., Maritan, A., Barabási, A.L. A universal model for mobility and migration patterns. Nature **484**, 96 (2012).

[2] Simini, F. Maritan, A. Néda, Z. Human Mobility in a Continuum Approach. PLoS ONE **8(3)**, e60069 (2013).

[3] Varga, L., Tóth, G., Néda, Z. An improved radiation model and its applicability for understanding commuting patterns in Hungary. Regional Statistics **6(2)**, 2738 (2016).