

## **Stochastic Small Area Population Forecasting until 2015 for Hospital Planning in Rostock, East Germany**

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The paper is based on a project that is carried out in cooperation with the University Hospital of Rostock. Its aim is to perform alternative projections of the population for the catchment area of the hospital in order to establish new calculations for the allocation of clinical beds. The time span covered lasts until 2015.

The regional setting for the proposed paper is a small area in the Northeastern part of Germany. It is located in the part of East Germany that former belonged to the GDR. The province of Mecklenburg-Western Pomerania experienced and experiences a major decline in population. After reunification in 1990 the economic situation deteriorated followed by a restructuration of the industry in the region. Especially the former most important employer – the shipbuilding industry – went down. The lack of employment as well as other factors drove a lot of people out of Mecklenburg-Western Pomerania to find work somewhere else. Most of them emigrated towards the Western part of Germany.

Additionally, the province also faces the problems of an aging society due to increasing longevity and decreasing fertility rates. After reunification the fertility rates in Eastern Germany declined to an all-time low. In this sense Mecklenburg-Western Pomerania is a sort of negative model region facing the consequences of demographic aging plus a loss of population due to out-migration.

The focus of our analysis is the town of Rostock and its surrounding area. It is a town of the Hanseatic League and houses about 200,000 inhabitants.

The city of Rostock itself experiences a decline in population due to the lack of working opportunities. This also affects the population structure as out-migration is not equally distributed over the age groups.

The so called Rostock region includes the city of Rostock itself and its sur-

roundings (which are administratively two different units). People move out of Rostock to settle down in the countryside to build houses for their families. Therefore the surrounding area of Rostock (with around 120,000 inhabitants) benefits from this movement. The observed trend in population displays a stabilization of population and eventually even a slight increase. Even though the whole Rostock region still experiences a declining trend (see figure 1), in the forecasting period (2002-2015) it is not as pronounced as for the total area of the province of Mecklenburg-Western Pomerania . We therefore argue that for the Rostock region alternative projections have to be used in public planning than for Mecklenburg-Western Pomerania as a whole.

### **Data, method and results**

The data originates from the Regional Statistical Office of the province of Mecklenburg-Western Pomerania and consists of statistics on population counts, births, deaths, and migration numbers. There is a 20 year period of data available. The analysis and assumptions are mainly based on data from the period after reunification. This is because at that point in time the personal and economic situation of the people changed dramatically and affected the demographic factors. It induced a decrease in mortality rates (due to biomedical advances), a decline in fertility rates and particularly an increase in migration.

The paper uses the program PEP (program for error propagation) developed by Prof. Juha Alho from the University of Joensuu, Finland. It is a stochastic approach which uses simulations. It includes assumptions about the development of the input variables like mortality, fertility and migration rates as well as assumptions about the most likely area of errors in the forecasts. For a detailed description of the error model we refer to Alho and Spencer in [1].

The mortality rates are projected using the Lee-Carter method. After analyzing the data the fertility rates seem to stabilize and are therefore assumed

to be constant at the latest level. Forecasts for migration numbers turned out to be difficult to assess as the numbers fluctuate very much and there might be data registration problems involved. Therefore we kept to the most recent numbers and used them for the population projections.

The paper describes the development of the population of the Rostock region. It turns out that the population in the town itself will decline whereas the population of the surroundings stabilizes. For the whole Rostock region – the two regions combined – one may notice that the decrease in population is not as pronounced as for the city of Rostock alone (figure 2). In our projections the median of the number of inhabitants of the city of Rostock declines by more than 10% until 2015, whereas the median of the population of the surroundings increases by about 3 %. This results in a decrease of the median projection for the Rostock region of only 5%.

We compare our forecasting results with the projections made by official institutions which are used to design the allocation of clinical beds. The latter are based on a scenario approach with rather unrealistic assumptions while we use stochastic projections that provide 80% confidence intervals.

The final result of our paper is an estimation of the number of clinical beds needed in the University Hospital of Rostock.

## References

- [1] Alho, J. M. and B.D. Spencer *The practical specification of the expected error of population forecasts*. Journal of Official Statistics 13 (3), 203-225.

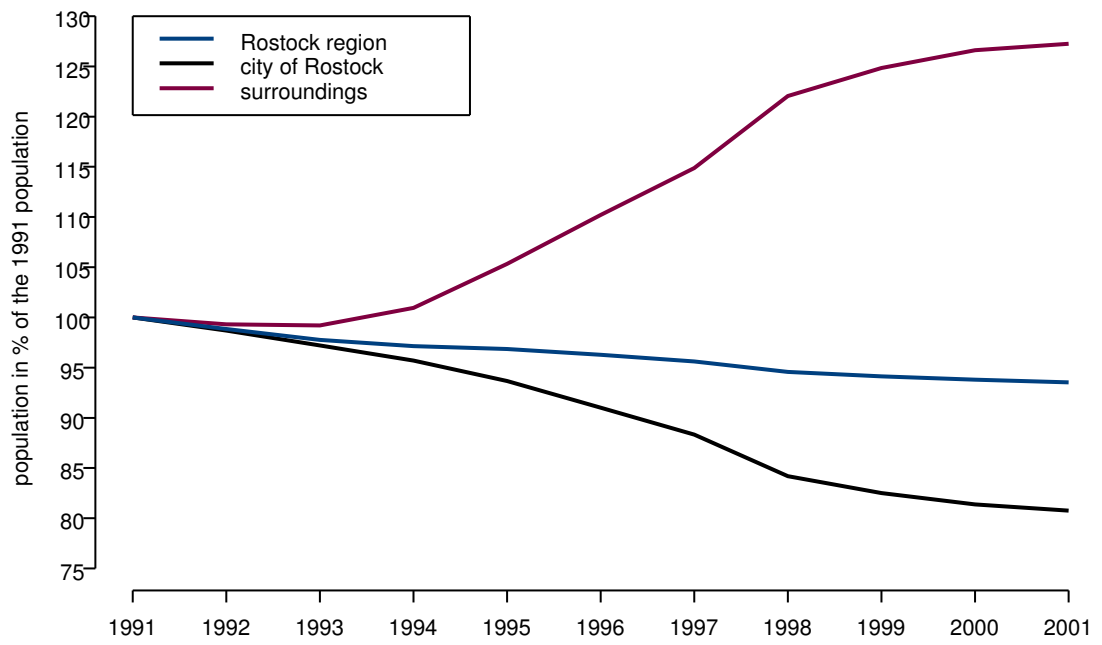


Figure 1: Population counts in the Rostock region between 1991 and 2001 in % of the 1991 population

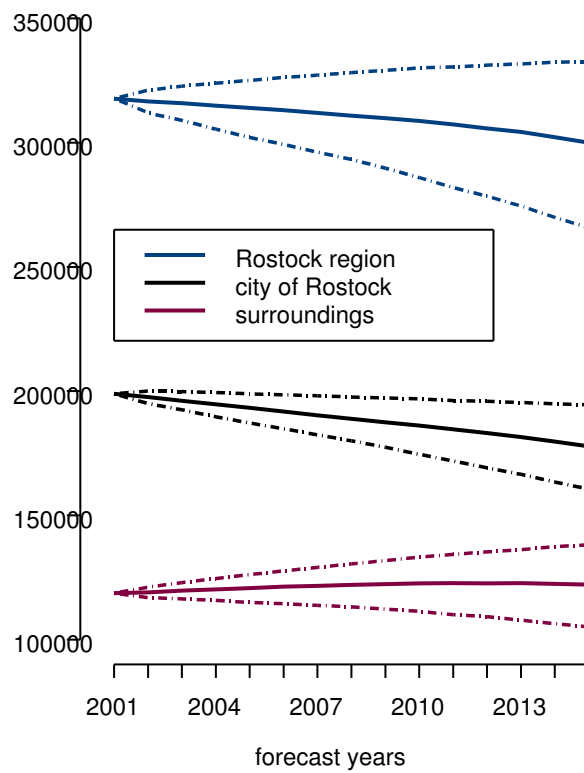


Figure 2: Population projections (number of inhabitants) for the years 2002-2015 for the Rostock region, the city of Rostock and the surroundings. Median, 10th and 90th percentile.