Stochastic Small Area Population Forecasting until 2015

Used for Hospital Planning in Rostock, Germany

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MOTIVATION AND REGIONAL SETTING

Description

The allocation of hospital beds is a challenge especially in countries with high variability in population density, as observed in the federal state of Mecklenburg- Western Pomerania (MWP), which has 1.7 Mio inhabitants.

The Rostock Region is located in the center of MWP. It includes the city of Rostock and its surroundings (county of Bad Doberan), housing a total of around 315,000 persons.

Our aim is the calculation of the future number of hospital beds in the University Hospital of Rostock. The calculation is based on a stochastic population projection for the Rostock Region.
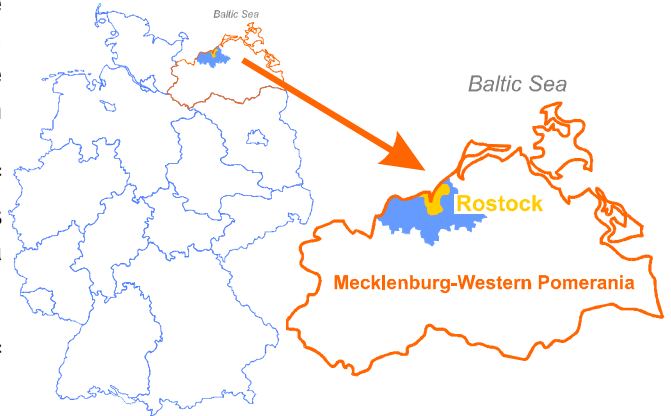
DATA AND METHOD

Population Projection

Data and Assumptions

- provided by the regional statistical office: population counts, births, deaths, and migration numbers (1982-2001)

- Assumptions are based on data from the period immediately following unification (1990-2001)

  - jump-off population as of December 31, 2001 (each sex separately, single years of age from 0 to age 89 and 90 years and above)
  - mortality rates are projected using the Lee-Carter method
  - total fertility rates varied substantially during the period of available data
  - migration numbers are constant on the last known level
  - we assume an uncertainty of ±30% in the point forecasts of the vital rates

Method

PEP (program for error propagation)
by Prof. Juha Alho, University of Joensuu, Finland

- stochastic propagation of errors using simulations
- jump-off population, assumptions on future rates and magnitude of errors have to be fixed by the user

- – reading in the point forecast
- – generating random variables to be used during the calculations
- – calculating future sample paths of the demographic rates
- – calculating the future population

- 3000 simulations for Rostock and surroundings separately, combination of the results
- 80% confidence interval of the results
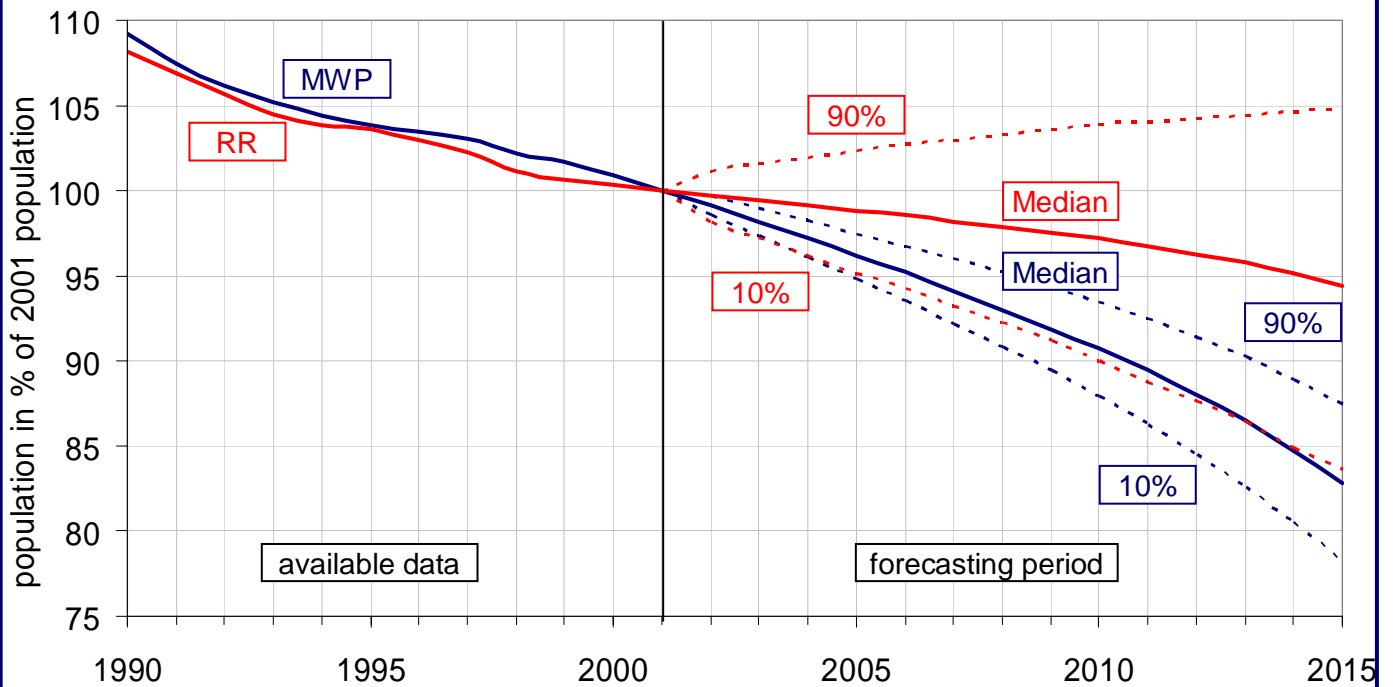
Allocation of Hospital Beds

Data on frequency of hospitalization and length of stay according to sex, age group and different medical departments (1994-2001)

Hill Burton Formula

$$\text{planned number of beds} = \frac{\text{population} \times \text{frequency of hospitalization} \times \text{length of stay}}{10{,}000 \times 365 \times TL}$$

TL = target level for bed occupation in % of capacity

POPULATION PROJECTION

Compared to MWP, the Rostock Region shows a different behavior in future population development suggesting to do an alternative calculation of number of hospital beds for the Rostock Region.
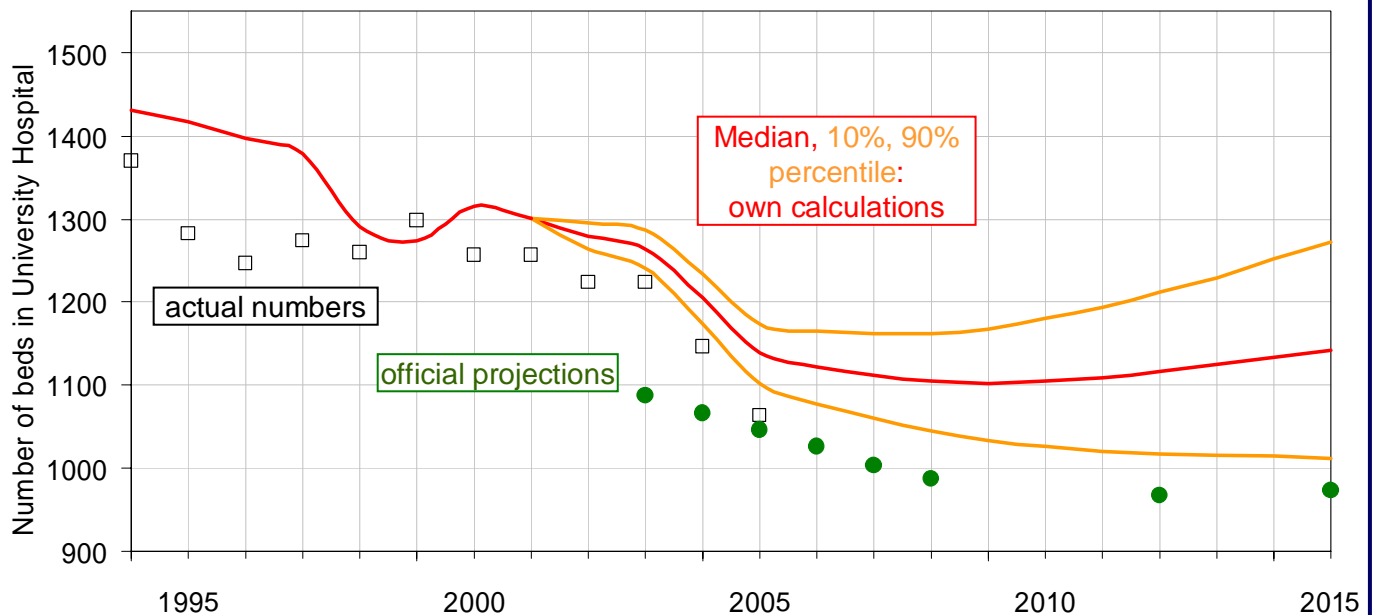
ROSTOCK REGION

Population pyramid, Rostock Region
as of December 31, 2001

Median projection 2015

Men

Women
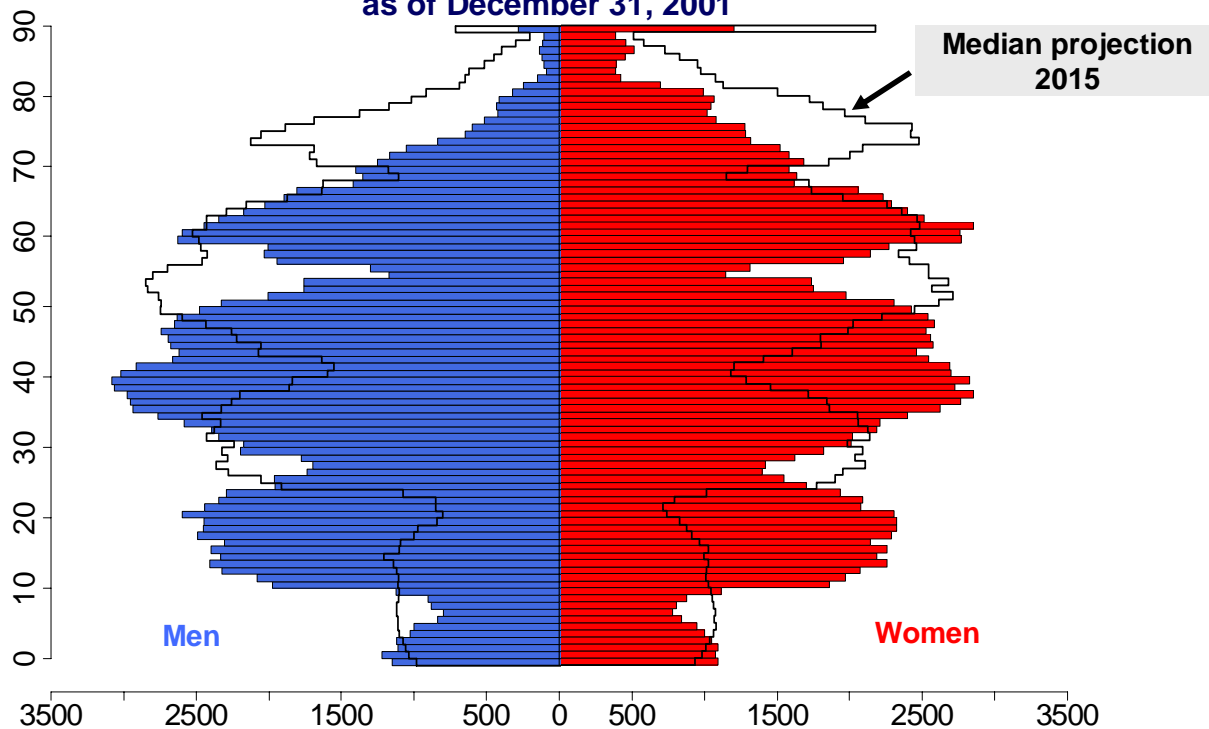
RESULTS AND DISCUSSION

- The Rostock Region is not experiencing the pronounced decline in population projected for MWP.
  - → official hospital plans may not capture these dynamics and may reduce the capacity of hospitals in the Rostock Region disproportionately
  - → the real numbers and official projections do not coincide with our projected number of beds for the University hospital

- For the further interpretation of our results, consider that the catchment area of the University Hospital of Rostock is much larger than the Rostock Region. About 25% of in-patients are coming for special treatment and therapies from more distant locations in MWP.

FUTURE RESEARCH

Future work involves

- the inclusion of changes in the age structure and the resulting hospital utilization of these age groups;

- the observation of the recent introduction's impact of a capitation system (DRG) on frequency of hospitalizations and length of stays.

Since downsizing in acute inpatient beds may lead to a loss of efficiency in the provision of health care, it needs to be counterbalanced by an increase in nursing homes and rehabilitation facilities.

Dunnigan/Pollock, BMJ 2003