Methodological note
PIN Flash 11 – En route to safer mobility in EU capitals

Regression estimation of the average annual percentage change in road mortality rates over the past decade using centred 3-year moving averages

To estimate the average yearly percentage change in road death occurring over a given period, one should make use of the whole time series of counts, not just the counts in the first and the last year.

Since the road death counts are for certain jurisdictions small numbers subject to randomness, it is preferred to use central moving average numbers instead of single year values. The recorded number of deaths is replaced by the average of the counts registered this year, the previous year and the following year.

$Y_i^*=(Y_{i-1}+Y_i+Y_{i+1})/3$

The resulting estimate will be less sensitive to the randomness and likely more reliable.

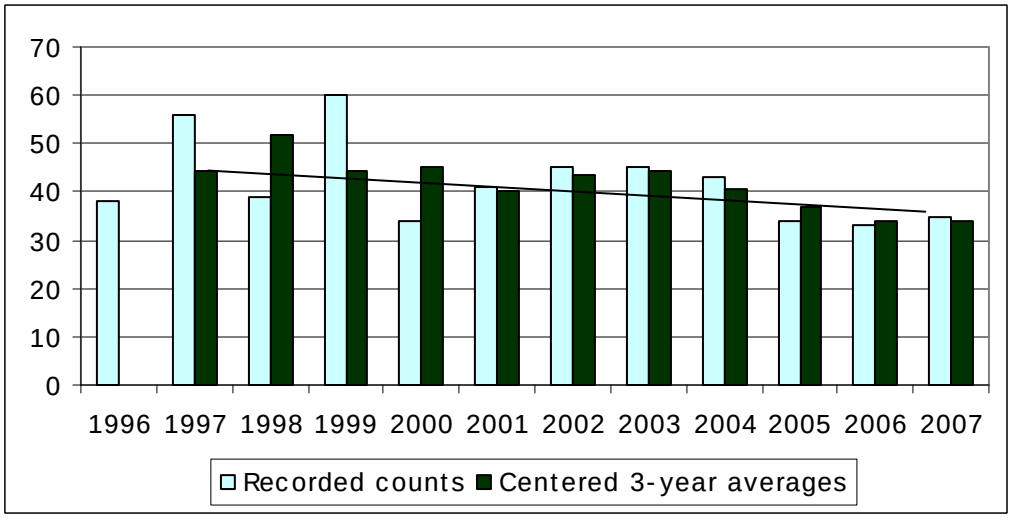

Fig.1: Death counts for Vienna together with 3-year averages.

The task is now to estimate the average annual change in road mortality in the period 1997-2007, while using three-year centred averages instead of single year values. For year 2007, the average of 2006 and 2007 is used.

We assume a priori a reduction in risk of mortality rate over time, so to fix the sign of a change; we will assume reduction, so that a minus sign indicates an increase. Let the average reduction per year as a percentage of the previous year be p. If λ_n is the risk of deaths in year n, then we wish to fit a model $\lambda_n = \lambda_0(1 - p/100)^n$, where in this case year 0 is 1997 and $n = 10$ in 2007.

This is equivalent to $\ln(\lambda_n/\lambda_0) = n.\ \ln(1-p/100)$ so if we fit $\ln(\lambda_n/\lambda_0) = an$ by linear regression, then a is the estimate of $\ln(1 - p/100)$ and p is estimated by $100(1 - e^a)$.

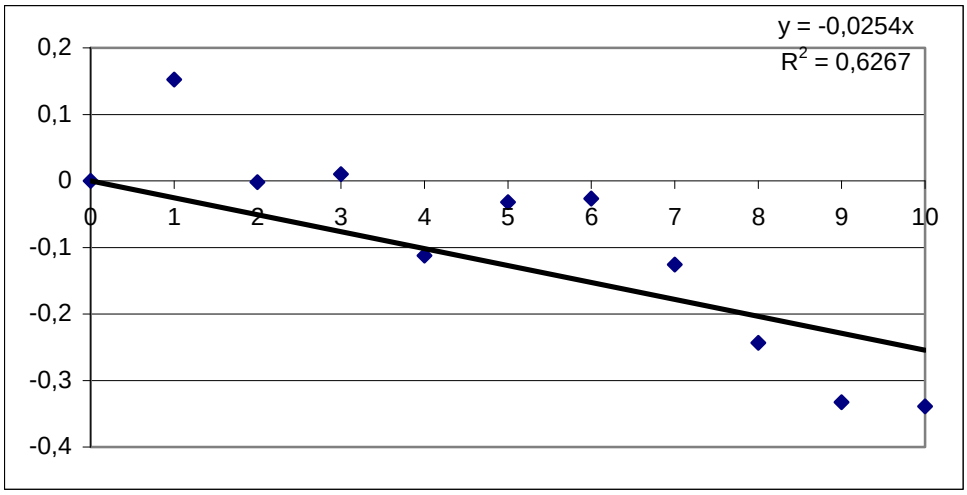

Fig.2: Linear regression function for logarithmically transformed changes in death counts since 2001 as baseline.

In this figure illustrating the use of the method and constructed for Vienna, the function $\ln(\lambda_n/\lambda_0) = an$ corresponds to the function $y=ax$, so the a is equal -0.0254. The p can now be estimated as $100(1 - e^a) = 100(1 - e^{-0.0254})= 2.51$. Average yearly reduction in road deaths is thus estimated as 2.5%.