**Introduction**

Lexis surfaces are a way of representing data that vary by both absolute time (year) and relative time (age). Usually, the horizontal axis is year and the vertical axis is age.

Lexis surfaces for different groups, but over the same ranges of age and year can be compared, to identify where and how the groups differ over the Lexis surface.

Scotland has a reputation as the ‘sick man of Europe’. Lexis surfaces are used here to identify firstly whether this reputation is justified, and secondly in which years and over which ages the burden of excess mortality is greatest.

**Method**

Data from the Human Mortality Database were used to crude death rates for Europe as a whole from 1950 to 2010, and for each age from 0 to 80 years. The Lexis surface for Scotland was calculated, and the differences in log(mortality), for each age-year configuration, were calculated.

The Lexis surface for Europe as a whole was visualised as a shaded contour plot (top figure), in which both shading and contour lines are used to represent values across the surface. The Lexis surface comparing Scotland with the rest of the Europe was visualised as a level plot (lower figure). Red shading indicates higher age-year specific mortality rates , and blue shading indicates lower mortality rates. The intensity of the shading indicates the extent of the deviation from the European average.

For comparison, Lexis surfaces of differences are also presented for England & Wales, France, and Norway, over the same age-year range.

The R script file used to generate the Lexis surfaces is available from:

<https://github.com/JonMinton/ASPHER_Poster>

**Results**

The shaded contour map for Europe as a whole, showing log(mortality), shows a number of patterns, including:

* A cohort effect associated with being born in the wake of The Great War;
* Comparatively high, but historically low, rates of mortality in infancy
* A growing protective childhood effect
* Broad tendencies towards reduced mortality risks at all ages in adulthood

The level plot for Scotland, showing deviation in log(mortality), suggests:

* The reputation for poor health compared with the European average is largely justified.
* The excess mortality risk affects historically affected both males and females only in middle age (approximately 40 years onwards).
* However, since the late 1990s/early 2000s, it has also started to affect adults of all ages.

The level plots for England & Wales, France, and Norway indicate:

* England & Wales used to have substantially better health than Europe as a whole, with a hint of a broad protective cohort effect associated with male ‘baby boomers’. However in recent years the advantage has been lost.
* France has always tended to be close to the European average.
* Norway has a ‘noisier’ level plot, presumably due to a smaller population size. However, overall Norway has tended towards lower mortality risk at all ages. In recent years there is a suggestion that the mortality advantage for younger adults has been lost. However, this may be an artefact. (See discussion)

**Discussion**

Shaded contour maps have been used to show some very strong, and generally positive, long-term trends in age-specific mortality rates within Europe. Level plots of differences show how Scotland and other nations differ from the European average. As expected, Scotland has generally poorer health than Europe as a whole, and in recent years this disadvantage seems to have affected adults of all ages rather than just middle age.

Some of the apparent disadvantage affecting younger adults in all four nations could be an artefact of population count estimates in these groups becoming more unreliable due to increased migration within Europe. This artefact is the focus of a paper I have written that is currently under review.

**Further Reading**

* Minton, Vanderbloemen, Dorling (2013), “Visualising Europe’s Demographic Scars with coplots and contour plots”, *International Journal of Epidemiology*. DOI: 10.1093/ije/dyt115
* Minton (2014), “Real geographies and virtual landscapes: Exploring the influence of place and space on mortality Lexis surfaces using shaded contour maps”, *Spatial and Spatio-temporal Epidemiology.* DOI: 0.1016/j.sste.2014.04.003
* Minton (Accepted), “If Europe were a country...”, *Environment & Planning A.*
* Minton, Zalonzik, Dorling (Under Review), “Hunting demographic ghosts: Do we need a census of Europe?”, *Environment & Planning A.*