Fertility (and futures?) of 45 countries: Lexis surface data visualisations

Dr Jonathan Minton
University of Glasgow
Jonathan.Minton@Glasgow.ac.uk
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Introduction: Fertility in Europe

• Fertility has been declining
• There are differences between European regions
• ... And between Europe and other parts of the world
Introduction: Lexis Surfaces

• Share the challenge and techniques of map-makers
  • How to visually represent three dimensional relationships on a two dimensional surface

• Treating time like space
  • Spatial maps have latitude and longitude
  • Temporal maps (Lexis surfaces) have absolute time and relative time
    • Absolute time: year
    • Relative time: time since birth, time since first child, time since leaving education, etc
Demographic definitions of fertility

• Not about biological potential, but about ‘realisation of outcome’
• Age-specific fertility rates
  • Number of live births/woman of age x in period (year/birth year) y
  • (Various technical complications about defining age and period: squares, triangles or parallelograms)
• Schedule of fertility rate with age
• Total fertility rates as a period-based measure
Period measures and cohort measures

• Total fertility rates as a period-based measure:
  • Observations of schedule of age and fertility rate observed in a period
  • Effectively produces a ‘synthetic cohort’
  • (n.b. biological and demographic uses of the term ‘period’ are distinct)
Period measures and cohort measures

• Real cohorts are birth cohorts
  • Total fertility of 1920s cohorts: known
  • Total fertility of 1980s cohorts: unknown

• Important unknowns
  • Time to first birth
  • Interval between births (Tempo changes)
Methods: data

• Human Fertility Database: http://www.humanfertility.org/
• Human Fertility Collection: http://www.fertilitydata.org/
• Preferential ‘munging’ of the two:
  • 1) HFD;
  • 2) HFC:
    • i) STAT: Official statistical data: Data that come from statistical publications and official websites of national statistical offices
    • ii) ODE: European Demographic Observatory (L'Observatoire Démographique Européen)
• Reference: http://www.fertilitydata.org/cgi-bin/collections.php
• Additional ‘munging’ to impute ASMRs in more recent missing years
Methods: Software

• R with Github

• R packages:
  • *Lattice/LatticeExtra: main maps*
  • *R2stl: 3D printable STL files (HFD only)*
  • *Wickhamese packages – readr, tidyr, stringr, dplyr, purr – for general data management and automation*

• Github
  • [https://github.com/JonMinton/Statistical_Sculpture/](https://github.com/JonMinton/Statistical_Sculpture/)
Methods: Producing cumulative cohort fertility rates

• Given ASFRs, at what age do different birth cohorts ‘achieve’ a given number of children?

• CCFRs of 1.30, 1.50, 1.80, and 2.05 are highlighted as contours
  • 2.05 = ‘replacement fertility levels’
  • The 1.30 line always below 1.50 line, 1.50 below 1.80, 1.80 below 2.05
  • If a contour line is not visible for a particular birth cohort, that birth cohort did not achieve that cumulative fertility rate
  • If 2.05 line not visible: long term ageing and declining population

• For the final latticeplot – country tiles are coloured by region, and arranged by fertility rate in last year
Methods: Graphs produced

• Heatmaps/level plots of ASMRs given age and year
• Contour maps of ASMRs given age and year
• Heatmaps/level plots of ASMRs given age and birth year
• Cumulative cohort fertility maps
  • Contours giving CCFRs, colour/shade giving ASMRs
• CCFR latticeplot for all countries
Results
Discussion: Methodological Contributions

• Much data can be shown and made sense of at a time
  • Nearly 100 000 values represented in the latticeplot
• Complex data vis: A need to slow... down
  • Guiding through steps
• Intuitive sense of where different countries are heading
• Plotting of contours gives an approximate sense of trajectories:
  • Extrapolate iff age < 42? Vertical if age >= 42?
• Ordering in latticeplot is for last year but implied trendlines suggest which are stabilising and which are changing
Discussion: Substantive Contributions

• Most (‘developed’) countries do not achieve replacement fertility levels

• Countries that have include: Albania, Iceland, Ireland, New Zealand, USA, Norway?

• No strong overall relationship between countries’ CCFRs and regions
  • Southern and Central European countries tend have low fertility
  • Small countries with relatively high fertility

• Ordering in latticeplot is by fertility in last year, but lines show different trajectories
Discussions: Speculations

• Primary and secondary effects of migration
  • USA fertility recovery and Mexican immigration?
• Germany, Austria and openness to migration
• Differences between Scotland and England/Wales (‘Wangland’)
• Regional differences within countries
  • London and the rest
Discussion: Refugee Crises and European Demographic Trajectories

• Almost all European countries need migration to stabilise dependency ratios
  • Primary effects: More 25 year olds now
  • Secondary effects (perhaps): higher fertility rates so more 25 year olds in the next generation

• Within EU, countries with lower fertility appear more accepting of refugees
  • Austria, Germany, Italy?
Discussion: Brexit

• Brexit: Mass migration is the solution to long-term decline in Europe, not the problem
• As long as
  • short-term costs
  • regional variations in service demand
• - can be mitigated appropriately
• Conservatives: Austerity
• Labour (or a bit of it): Migration Relief Fund
• Scarcity: “Charity begins at home”
For further information

• NCRM podcast:
  • http://www.ncrm.ac.uk/resources/podcasts/view.php/Visualising-social-trends-in-3D

• Blogs:

• Papers:
  • http://www.ncbi.nlm.nih.gov/pubmed/24062300
  • http://jch.bmj.com/content/early/2016/03/01/jech-2014-205226.abstract
  • http://www.sciencedirect.com/science/article/pii/S1877584514000173

• Github repos (as before)

• Or... email Jonathan.Minton@Glasgow.ac.uk

• Thanks for listening!