A Population Projection Model
For Ethnic Groups
Specification for a Multi-Country, Multi-Zone and
Multi-Group Model for the United Kingdom
http://www.geog.leeds.ac.uk/projects/migrants/Presentations.html
http://www.geog.leeds.ac.uk/projects/migrants/Publications.html

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International Conference of Effects of Migrations on Population
Structures in Europe, Vienna
1. December 2008

ESRC Research Award RES-165-25-0032, 01.10.2007- 30.09.2009
What happens when international migrants settle? Ethnic group population trends and
projections for UK local areas
Aims

• To project the ethnic populations of local areas (authorities) in the UK over the next 50 years (project)
• To explain the model design being developed (presentation)
• To describe one of the important inputs to the projection model – our ethnic mortality estimates

Part One (Phil Rees)

The projection model

• State space of model
• Accounting framework
• Model structure
• Internal migration model

Part Two (Pia Wohland)

Ethnic mortality estimation

• The relationship between illness and age
• All group illness and mortality
• Ethnic group illness
• The estimates of ethnic group mortality
Review of models

Population projection models:
- Single region models (POPGROUP)
- Multi-region models (SPA, ABM, LIPRO, UKPOP)
- ONS sub-national model (SNPP)
- GLA London Boroughs model
- Nested multi-region models (MULTIPOLES)

Ethnic population models
- Single region models (Rees & Parsons 2006: UK regions, Coleman and Scherbov: UK, Coleman 2006 on European models)
- Mixture models (Statistics New Zealand)
- Biregional models (Wilson: NT Australia)
## Projection model ingredients

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>PROCESSES</th>
<th>IMMIGRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base year/interval parameters</td>
<td>Start populations</td>
<td>End populations</td>
</tr>
<tr>
<td>Projection model parameters</td>
<td>Survival/mortality</td>
<td>Fertility</td>
</tr>
<tr>
<td>Projection output parameters</td>
<td>Emigration</td>
<td>Infant components</td>
</tr>
<tr>
<td></td>
<td>Internal migration</td>
<td>Derived components</td>
</tr>
</tbody>
</table>

### INPUT DATA
- Base Populations
- Survivorship/non-survivorship probabilities
- Emigration probabilities
- Internal migration probabilities
- Immigration flows
- Fertility rates
- Ethnic conversion probabilities

### PROJECTION ASSUMPTIONS
- Survival/mortality
- Emigration
- Internal migration
- Immigration
- Fertility

### PROJECTION RESULTS
- Population
- Survival/mortality
- Emigration
- Internal migration
- Immigration
- Fertility
- Derived components

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1. Introduction: background
2. A multilevel, multistate projection model for ethnic groups
3. Inputs to the projection model (ethnic mortality)
4. Concluding remarks
State space

1. Introduction: background

2. A multilevel, multistate projection model for ethnic groups

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Source: Dunnell (2007)

Zones (432) (O origins, D destinations)
- England 352LAs (City of London with Westminster; Isles of Scilly with Penwith)
- Wales 22 UAs
- Scotland 32 CAs
- Northern Ireland 26 DCs

Ages (102 period-cohorts) (A)
- Bto0, 0to1, 1to2, …, 99to100, 100+to101+ (102)

Sexes (2) (S)
- Males, Females

Ethnic Groups (16) (E)
- 16 Groups from the 2001 Census

Time intervals (flexible) (T)

Source: Dunnell (2007)
### Accounting framework for projection model

1. **Introduction:** background

2. **A multilevel, multistate projection model for ethnic groups**

3. **Inputs to the projection model (ethnic mortality)**

4. **Concluding remarks**

<table>
<thead>
<tr>
<th>DESTINATIONS</th>
<th>England</th>
<th>Wales</th>
<th>Scotland</th>
<th>Northern Ireland</th>
<th>Rest of world</th>
<th>Deaths</th>
<th>Totals</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>City of London and Westminster</td>
<td>City of London and Westminster</td>
<td>Isle of Anglesey/Ynys Môn</td>
<td>Aberdeen City</td>
<td>West Lothian</td>
<td>Derry City</td>
<td>Belfast</td>
</tr>
<tr>
<td>ORIGINS Zone names</td>
<td>Zones</td>
<td>Zones</td>
<td>Zones</td>
<td>Zones</td>
<td>Zones</td>
<td>Zones</td>
<td>Zones</td>
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<tr>
<td>England</td>
<td>City of London and Westminster</td>
<td>Isles <em>/ N(1)</em></td>
<td>Isle of Wight</td>
<td>Isle of Wight</td>
<td>Isle of Wight</td>
<td>Isle of Wight</td>
<td>Isle of Wight</td>
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<tr>
<td>Isle of Wight</td>
<td>Island <em>/ N(2)</em></td>
<td>Island <em>/ N(2)</em></td>
<td>Island <em>/ N(2)</em></td>
<td>Island <em>/ N(2)</em></td>
<td>Island <em>/ N(2)</em></td>
<td>Island <em>/ N(2)</em></td>
<td>Island <em>/ N(2)</em></td>
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<tr>
<td>Scotland</td>
<td>Aberdeen City</td>
<td>Aberdeen City</td>
<td>Aberdeen City</td>
<td>Aberdeen City</td>
<td>Aberdeen City</td>
<td>Aberdeen City</td>
<td>Aberdeen City</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>Derry City</td>
<td>Derry City</td>
<td>Derry City</td>
<td>Derry City</td>
<td>Derry City</td>
<td>Derry City</td>
<td>Derry City</td>
</tr>
<tr>
<td>Rest of world</td>
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<td>Immigrants</td>
<td>Immigrants</td>
<td>Immigrants</td>
<td>Immigrants</td>
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<tr>
<td>Totals</td>
<td>Populations</td>
<td>Populations</td>
<td>Populations</td>
<td>Populations</td>
<td>Populations</td>
<td>Populations</td>
<td>Populations</td>
</tr>
</tbody>
</table>

**Notes:**
- ORIGINS Zone names: *Zone names abbreviated as follows: 1(1), 1(2), 1(3), 1(4), N(1), N(2), N(3), N(4), R, D, D.E.
- Inputs to the projection model (ethnic mortality)
- Concluding remarks
Ethnic specific features

Ethnic groups are treated as **independent** populations

Except:
There should be **mixed births** (parents of different ethnicity) [Barrack Obama, Sebastian Coe, Ryan Giggs] because it is the future

There should be an opportunity for **re-identification**. This is more difficult to estimate but we need to introduce it when migrants cross from one “home country” to another
Internal migration model

Because there are a huge number of variables involved in internal migration, we will need to simplify things. We cannot estimate the saturated model:

\[ O_{432} D_{432} E_{16} S_2 A_{102} \]

We will start with an independence model to get the projections underway:

\[ O_{434} + D_{434} + E_{18} + S_2 + A_{102} \]

We will then adopt a compromise drawing on other work (van Imhoff et al. 1997, Raymer et al. 2008, Hussain and Stillwell 2008) such as:

\[ A_{102} S_2 + O_{432} D_{432} E_7 + E_{16} \]

age-sex + origin-age, origin-destination-broad ethnicity + detailed ethnicity
International immigration estimates

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Ethnic mortality
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**United Kingdom:**

ethnic groups used in estimation or projection models but no ethnic mortality differences recognised

**United States:**

Mortality statistics collected by race

- 2003 life expectancies
  - White men: 75.3
  - Black men: 68.9.
  - White women 80.4
  - Black women 75.9

(US Bureau of the Census)

Mortality data by ethnic groups for the UK?
Self reported illness in Census 2001

<table>
<thead>
<tr>
<th>Do you have any long-term illness, health problem or disability which limits your daily activities or the work you can do?</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Include problems which are due to old age.</td>
</tr>
</tbody>
</table>
ALL PERSON DEATHS DATA
2001 Vital statistics
Countries & Local Authorities

POPULATION DATA
2001 Mid year Estimates
Countries & Local Authorities

ALL PERSON RESIDENTS DATA
2001 Census Tables S16,S65
Countries & Local Authorities

ALL PERSON LIMITING LONG TERM ILLNESS DATA
2001 Census Tables S16,S65
Countries & Local Authorities

STANDARDISED MORTALITY RATIOS (SMR)
2001, UK Standard
Countries & Local Authorities

STANDARDISED ILLNESS RATIOS (SIR)
2001, UK Standard
Countries & Local Authorities

LIFE TABLES & SURVIVORSHIP PROBABILITIES BY ETHNICITY
2001 (Calendar Year)
Countries & Local Authorities

STANDARDISED MORTALITY RATIOS BY ETHNICITY
2001, UK Standard
Countries & Local Authorities

STANDARDISED ILLNESS RATIOS BY ETHNICITY
2001, UK Standard
Countries & Local Authorities

LIMITING LONG TERM ILLNESS BY ETHNICITY
2001 Census Tables ST 101, 107, 207, 318
Countries & Local Authorities

RESIDENTS DATA BY ETHNICITY
2001 Census Tables ST 101, 107, 207, 318
Countries & Local Authorities

REGRESSION ANALYSIS
SMR = f(SIR)
All group SMR as a function of SIR
Differences between home countries?

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<table>
<thead>
<tr>
<th>Nation</th>
<th>Gender</th>
<th>$r^2$</th>
<th>Intercept</th>
<th>Slope</th>
</tr>
</thead>
<tbody>
<tr>
<td>England</td>
<td>Females</td>
<td>0.51</td>
<td>52.1</td>
<td>0.48</td>
</tr>
<tr>
<td>Wales</td>
<td>Females</td>
<td>0.78</td>
<td>43.9</td>
<td>0.37</td>
</tr>
<tr>
<td>Scotland</td>
<td>Females</td>
<td>0.69</td>
<td>60.5</td>
<td>0.64</td>
</tr>
<tr>
<td>Northern Ireland</td>
<td>Females</td>
<td>0.16</td>
<td>71.2</td>
<td>0.26</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td>0.63</td>
<td>47.3</td>
<td>0.52</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td>0.56</td>
<td>54.9</td>
<td>0.39</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td>0.75</td>
<td>28.3</td>
<td>0.82</td>
</tr>
<tr>
<td>Males</td>
<td></td>
<td>0.40</td>
<td>59.9</td>
<td>0.36</td>
</tr>
</tbody>
</table>
England all group SMR as a function of SIR: High ethnic minority versus low ethnic minority LAs

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- Ethnic minority > 8.2%
- Ethnic minority <= 8.2%
- Fit line for Total
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Spatial distribution of female life expectancies at birth

Chinese

≥ 81.2 to < 85.9
≥ 78.9 to < 81.2
≥ 73.8 to < 78.9

Black African

White and Black African

Pakistani
Concluding remarks

We have outlined the structure of a new model to project ethnic group populations within a **multi-country, multi-zone and multi-group** framework.

This is a **work in construction** with many missing pieces which will be added as the model is converted into operational software.

We have also reported on some progress made in estimating the inputs needed for the projection model, focussing on one of the needed inputs, **ethnic-specific mortality**.

We have taken on a **very challenging task**. You may comment we are being over-ambitious.

We argue this is an important challenge because we need to know important things about the future society that **our children**, **grandchildren** and yet to be born **great grandchildren** will live in.