DEVELOPING A SIMULATION TOOL FOR POLICYMAKERS. THE MODELLING THE EARLY LIFE COURSE PROJECT (MEL-C)

Informing Health and Social Policy Colloquium
30 July 2010

COMPASS Research Centre
www.compass.auckland.ac.nz
Peter is Director of the Centre of Methods and Policy Application in the Social Sciences (COMPASS), and Professor of Sociology in Health and Wellbeing. His interests are in advanced methods and applied social science. Most of his work has been in health services research and policy, but he is also interested in questions of social policy and the application of sociological analysis to real-world problems.
International Advisory Group – comprises 5 members of high international standing in the area of microsimulation:

- **Prof Laurie Brown**, National Centre for Social and Economic Modelling (NATSEM), University of Canberra, Australia
- **Prof Nigel Gilbert**, Department of Sociology, University of Surrey, Guildford, UK
- **A/Prof. Flaminio Squazzoni**, University of Brescia, Italy
- **Dr Rick Morrison**, Senior Methodologist, DYNACAN team, Canada
- **Dr Dimitris Ballas**, Senior Lecturer, Department of Geography, University of Sheffield, UK
MELC presentation overview

- What is MELC?
- The MELC Modelling Tool
  - Construction
  - Application
  - Software development
  - Demonstration
- Where to from here?
What is MELC?
MELC: Aims of the project

1. Goals … what are we trying to do?
   - Construct a simulation model as a decision-support tool for policy-making.

2. Rationale … why are we doing it?
   - To improve policymakers’ ability to respond to issues concerning children and young people in a changing world.

3. Means … how are we doing it?
   - By building a model with data from existing longitudinal studies to quantify the underlying determinants of progress in the early life course.

A good start to life
Scenario testing
Example: Housing and health

If the affordability of home ownership (i.e. the proportion of families that live in their own homes) falls

What impact does this have on the utilisation of health services (i.e. GP visits) for the children in those families?
ANY QUESTIONS?
Roy is a Research Fellow and Senior Analyst with COMPASS. He is a co-author on numerous publications and plays a key role in managing and analysing complex data sets in the dissemination of research results.
MELC MODELLING TOOL CONSTRUCTION
Prototype Conceptual Model: Early life course, family & health

Demographics (child/parental)
0. age, gender, ethnicity, parental age/ethnicity/education, etc.
1. household composition

Social disadvantage (family/community)
2. employment, welfare dependence
3. family living standard

Perinatal factors
Parental smoking

Deprivation
4. housing

Situational risk factors
5. family functioning

Child Health (0-5 years)
6. - doctor contact
- hospital admission
- outpatient clinic
- asthma?
- injury/poisoning?
- other conditions?
- mortality?
How microsimulation works

- Operates at the level of individual units.
  - In our case, we start with a sample of children from the Christchurch Health and Development Study (CHDS)

- Each person has a unique identifier and a set of associated attributes.
  - These are the ‘initial’ attributes such as gender, ethnicity

- A set of rules – say derived from statistical models - is applied to these persons to mimic changes in state and behaviour.
  - For example, how is visiting the GP affected by housing (adjusting for other factors)

- This produces estimates of outcomes including both aggregate and distributional effects.
  - For example, the average number of GP visits – possibly at each age, broken down by gender and ethnicity
Data source and uses: Christchurch Health & Development Study

- **Longitudinal data – cohort born 1977**
  - approx 1,100 observations per year, 6 waves (0–5 years)
  - will be weighted to NZ Census 2006 to be current and representative

- **Uses of CHDS – provides real data**
  1. for statistical analysis
  2. as initial conditions for simulation
  3. as benchmarks for simulated results
Uses of CHDS: provides real data

REAL DATA

- CHDS (0–5 years)
- CHDS (0–1 year)
- CHDS (2–5 years)

USES

- Statistical analysis
- Equations - parameters
- Base file – ‘real’ initial conditions
- Produce simulated results
- Validation & alignment
- Simulate beyond ‘real’ data

Uses of CHDS:
provides real data
The simulation process *(colour-coded)*

**Base file + simulated + simulated final outcome**

**Base file (contains initial conditions)**
- Child and parent characteristics at BIRTH: Age, gender, ethnicity, parental age / ethnicity / education, SES at birth, Single-or-2-parent-birth, Birth-order, Breast-feeding, Twin, Birth-weight, Gestational-age, Neonatal-intensive-care, Mother-cigs-per-day, Mother-alcohol-drinks-per-day
- **Given YEAR 1 characteristics as below** (plus Parental smoking: Maternal-smoking, Paternal-smoking)

<table>
<thead>
<tr>
<th>Steps</th>
<th>Simulation: Year 2</th>
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<tbody>
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<td>1</td>
<td>Household characteristics: Single-or-2-parent, Household-size, Children-number</td>
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<td>Employment: Welfare, Mother-hours-worked, Father-hours-worked</td>
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<td>Housing: Accommodation-type, Owned-rented, Bedrooms-number</td>
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<td>Family functioning: Change-of-parents, Change-of-residence, Adverse-family-events-number</td>
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<td>Health service use: Number of (1) GP-visits, (2) Outpatient-attendances, (3) Hospital-admissions</td>
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Simulation: Repeat for Years 3 to 5
An individual’s life history unfolding …

1. Household
   - Single-parent family?
   - Household size?
   - # Children?

2. Employment
   - Welfare?
   - Father hours worked?
   - Mother hours worked?

3. Standard of living
   - Family standard of living?

4. Housing
   - Live in house?
   - Own or rent?
   - # Bedrooms?

5. Family functioning
   - Change parent?
   - Move residence?
   - # Family crises?

6. Health service use
   - # GP visits?
   - # Outpatient attendances?
   - # Hospital admissions?

Steps repeated for subsequent years
How variables are simulated

For each child (in base file)

“Dichotomous” outcome, e.g. single-parent family (yes / no) = 8%

Derive and assign probability (PROB)

Generate a random number (RN) between 0 and 1 (from uniform distribution)

If RN<=PROB then impute ‘yes’, else impute ‘no’

“Count” outcome, e.g. number of visits to GP = 5

Derive predictive equation with an “error”

Generate a RN with mean 0 and variance of the error (from a normal distribution)

Add the error to the predicted value

Current state is based on previous year → dynamism!
Preliminary validation

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MELC Modelling Tool Construction

ANY QUESTIONS?
MELC MODELLING TOOL APPLICATION
Scenario testing

Test “what if” scenarios – projection and “counterfactuals”
- Project into the future – look at social trends
- Counterfactuals – alternative settings – different to reality

Example: Housing and health
- If the affordability of home ownership (i.e. the proportion of families that live in their own homes) falls …

What impact does this have on the utilisation of health services (i.e. GP visits) for children in those families?
Uses of CHDS: provides real data

REAL DATA

- CHDS (0–5 years)
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- CHDS (2–5 years)

USES

- Statistical analysis
- Equations – parameters
- Base file – ‘real’ initial conditions
- Validation & alignment
- Produce simulated results
- Scenario testing
- Simulate beyond ‘real’ data
Scenario testing example: Housing and health

Change initial condition

Base file (contains initial conditions)

- Child and parent characteristics at BIRTH: Age, gender, ethnicity, parental age / ethnicity / education, SES at birth, Single-or-2-parent-birth, Birth-order, Breast-feeding, Twin, Birth-weight, Gestational-age, Neonatal-intensive-care, Mother-cigs-per-day, Mother-alcohol-drinks-per-day
- YEAR 1 characteristics: Parental smoking, Household characteristics, Employment, Family-standard-of-living, Housing, Family functioning, Health service use.

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Simulation: Repeat for Years 3 to 5
ANY QUESTIONS?
Wendy is a Research Fellow with COMPASS. She has a background in health/social psychology and prior to joining COMPASS worked as a Research Fellow in the UK and Australia.
MELC MODELLING TOOL
SOFTWARE DEVELOPMENT
Software development: Overview

- Designed to be an end user tool for microsimulation models
  - Can be run on a desktop PC by non-technical users
- Developed in Java via an open source model in collaboration with international modelling software developers
- Provides basic in-built analysis functionality
  - Comprehensive analysis provided via R
  - Results can be exported for analysis in external packages (SAS, SPSS, etc.)
Graphical user interface showing simulation input features.
Graphical user interface showing simulation output features
MELC MODELLING TOOL DEMONSTRATION
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ANY QUESTIONS?
Where to from here?
The next 3 years ...

If we are awarded additional funding by FRST, it will allow us to:

- Incorporate additional longitudinal data sets
  - Ensure better representation, and robustness and validity of the model
  - We particularly need Māori and Pacific data to ensure the model represents contemporary New Zealand society
  - Enable scenario testing involving
    - other areas besides health (e.g. education, development, behaviour)
    - older age groups

- Work with potential end-users to develop the full model

- Develop and test a fully integrated model to allow more sophisticated scenario testing
Further information

For further information, please contact:
Dr Wendy Wrapson
Research Fellow
w.wrapson@auckland.ac.nz