New Zealand

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

COMPASS RESEARCH CENTRE

FACULTY OF ARTS
THE UNIVERSITY OF AUCKLAND
Whare Wānanga o Tāmaki Makaurau

Informing Health and Social Policy Colloquium

30 July 2010

COMPASS Research Centre
www.compass.auckland.ac.nz

FOUNDATION FOR RESEARCH SCIENCE & TECHNOLOGY
Tūāpapa Rangahau Pūtaiao

The University of Auckland

Project Leader – Peter Davis

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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.

MELC Advisory Group

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- 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

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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.

Scenario testing
Example: Housing and health

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- 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?*

MELC – Aims/Use

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ANY QUESTIONS?

Research Fellow: Roy Lay-Yee

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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

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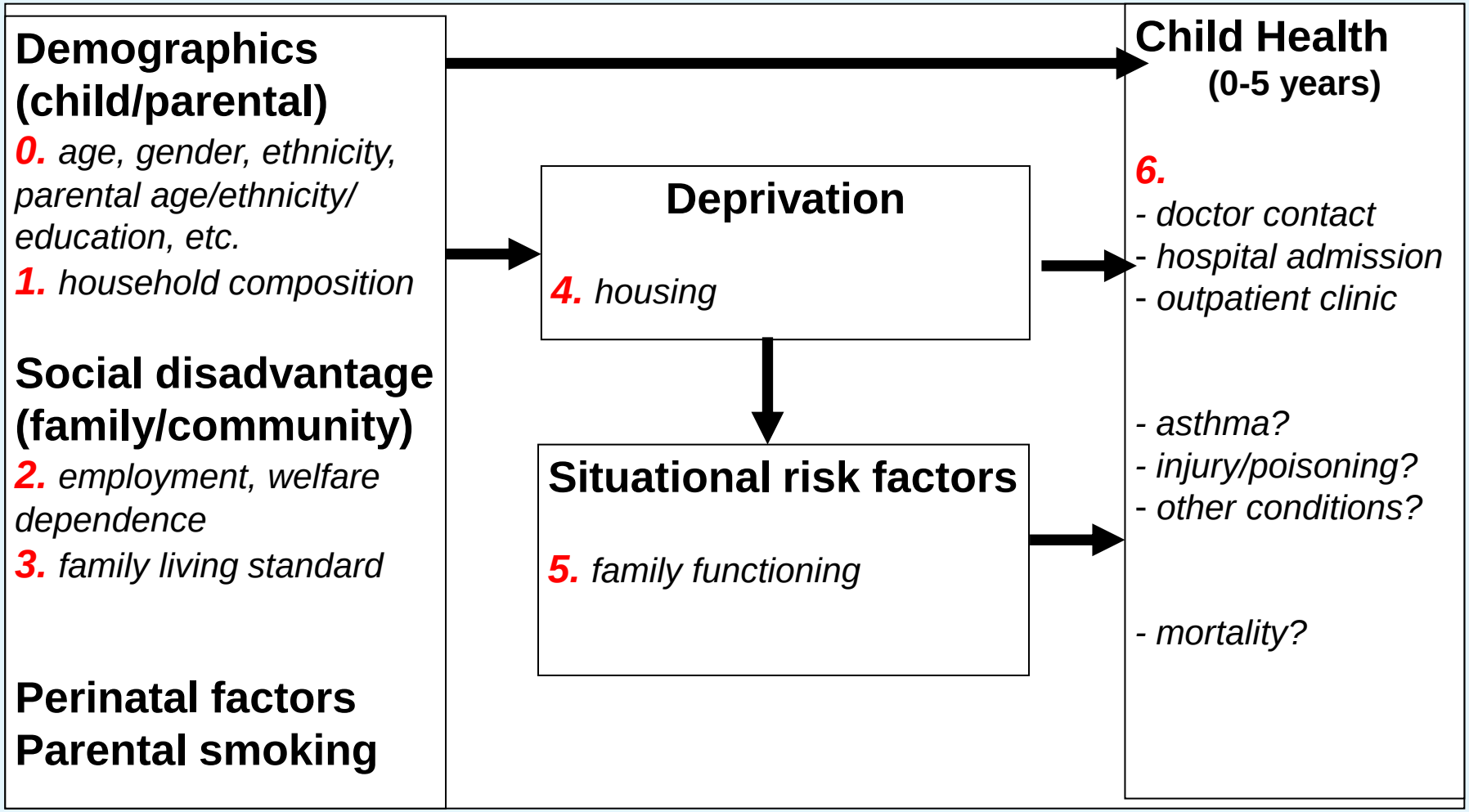

New Zealand

The University of Auckland

Microsimulation – how it works

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

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- 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

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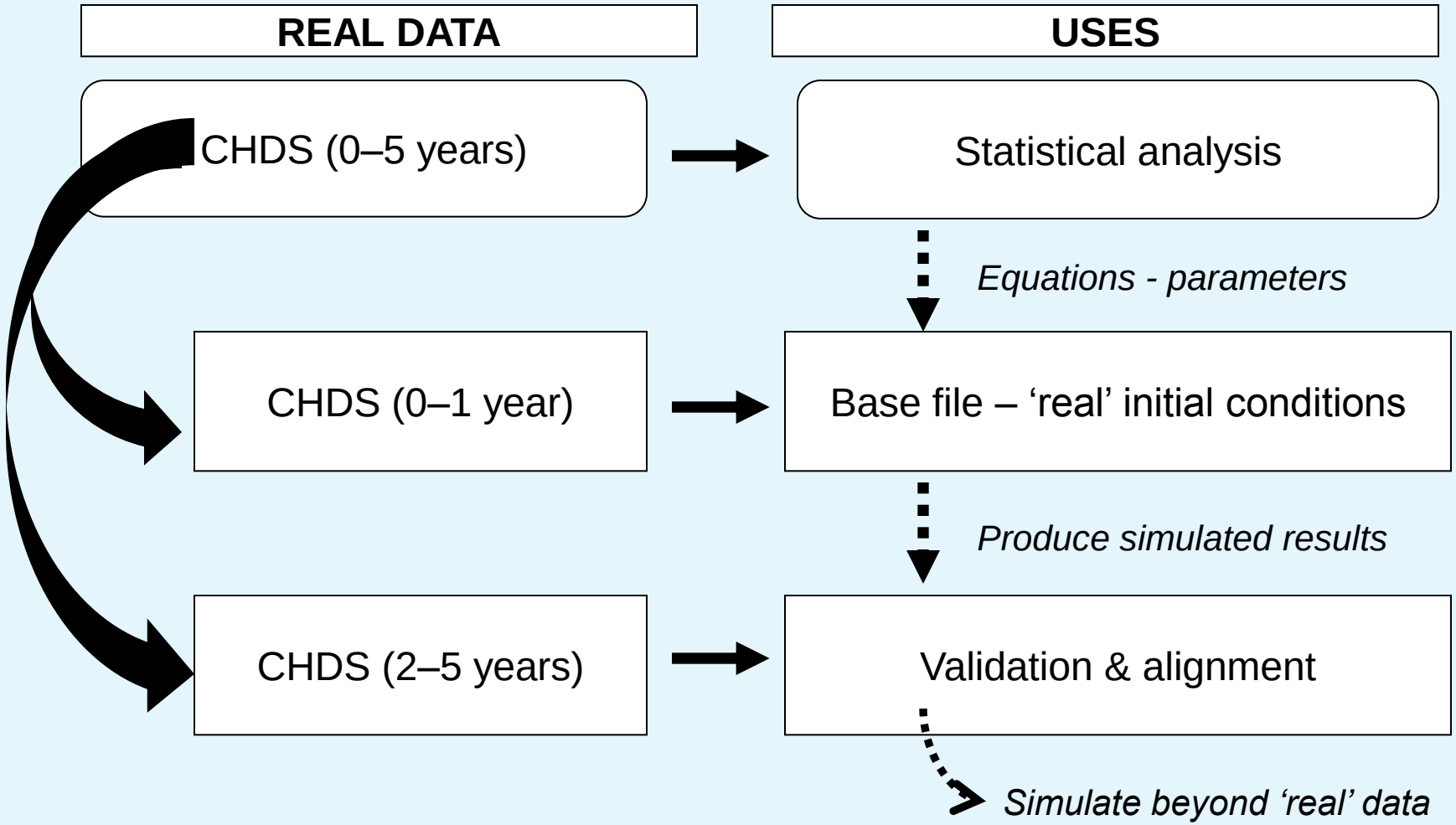
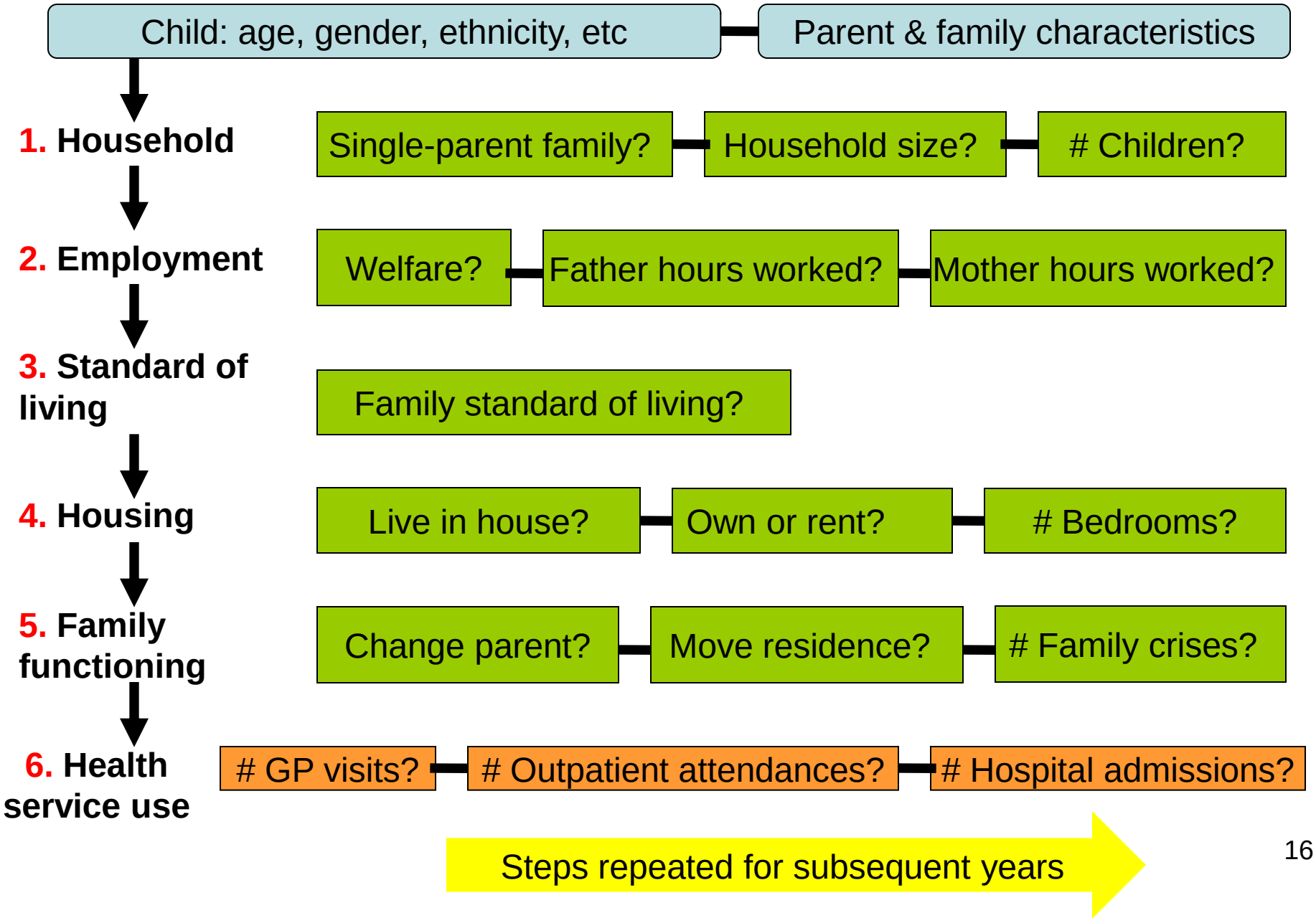


The simulation process *(colour-coded)*

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)	
Steps	**Simulation: Year 2**
1	**Household characteristics**: Single-or-2-parent, Household-size, Children-number
2	**Employment:** Welfare, Mother-hours-worked, Father-hours-worked
3	**Family-standard-of-living**
4	**Housing**: Accommodation-type, Owned-rented, Bedrooms-number
5	**Family functioning**: Change-of-parents, Change-of-residence, Adverse-family-events-number
6	**Health service use**: Number of (1) GP-visits, (2) Outpatient-attendances, (3) Hospital-admissions
	Simulation: Repeat for Years 3 to 5

An individual's life history unfolding …



How variables are simulated

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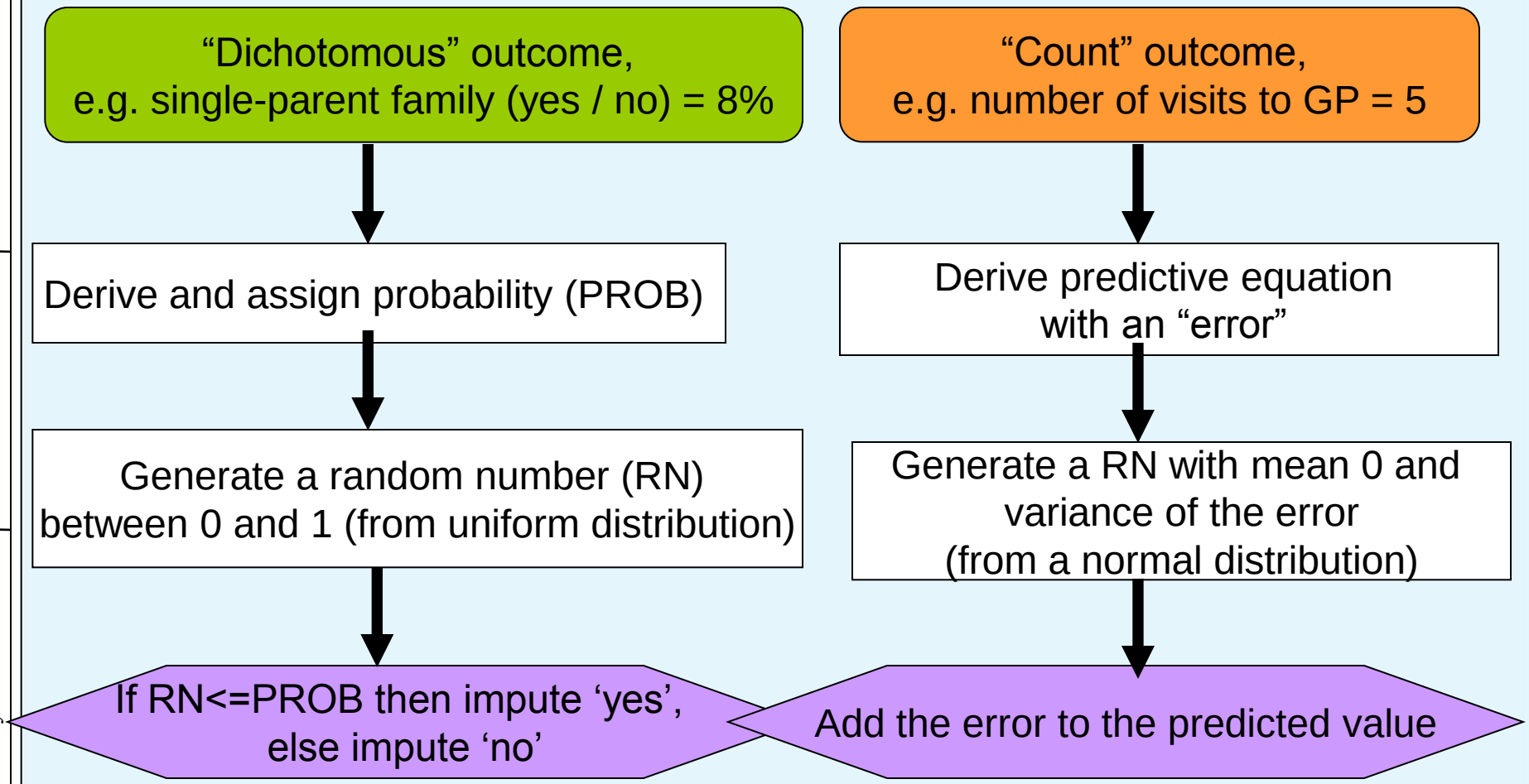
For each child (in **base file)**



Current state is based on previous year → dynamism!

Preliminary validation

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	Total number of GP visits (mean)	
Year	**CHDS real data**	**Simulation**
1	5.8	5.8
2	5.3	4.1
3	3.2	3.4
4	3.1	2.9
5	3.2	2.4

MELC Modelling Tool Construction

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ANY QUESTIONS?

MELC MODELLING TOOL APPLICATION

Scenario testing

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- 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

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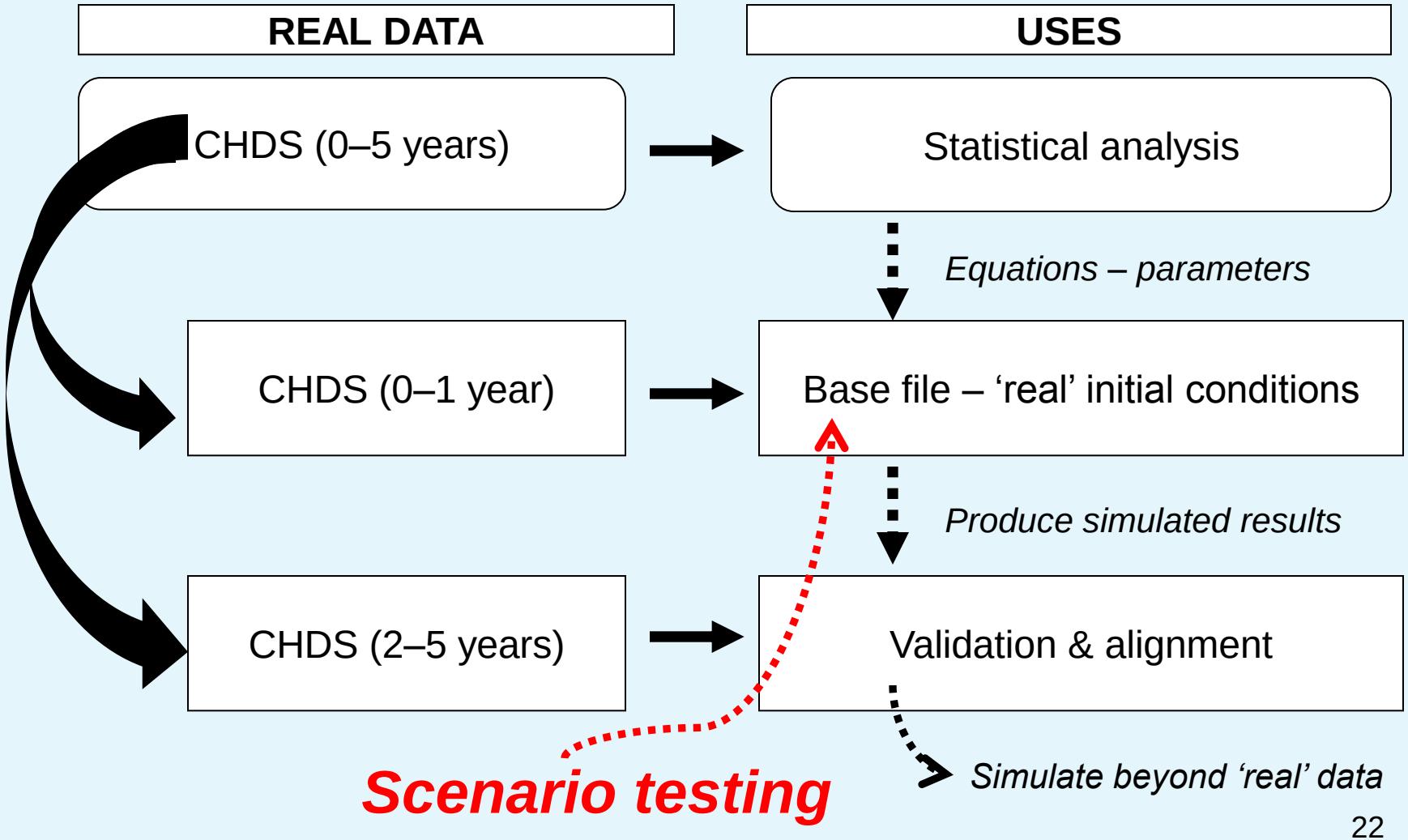

Scenario testing example:
Housing and health

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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.

Steps	Simulation: Year 2
1	**Household characteristics**: Single-or-2-parent, Household-size, Children-number
2	**Employment:** Welfare, Mother-hours-worked, Father-hours-worked
3	**Family-standard-of-living**
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	Simulation: Repeat for Years 3 to 5

MELC Modelling Tool Application

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Research Fellow: Wendy Wrapson

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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

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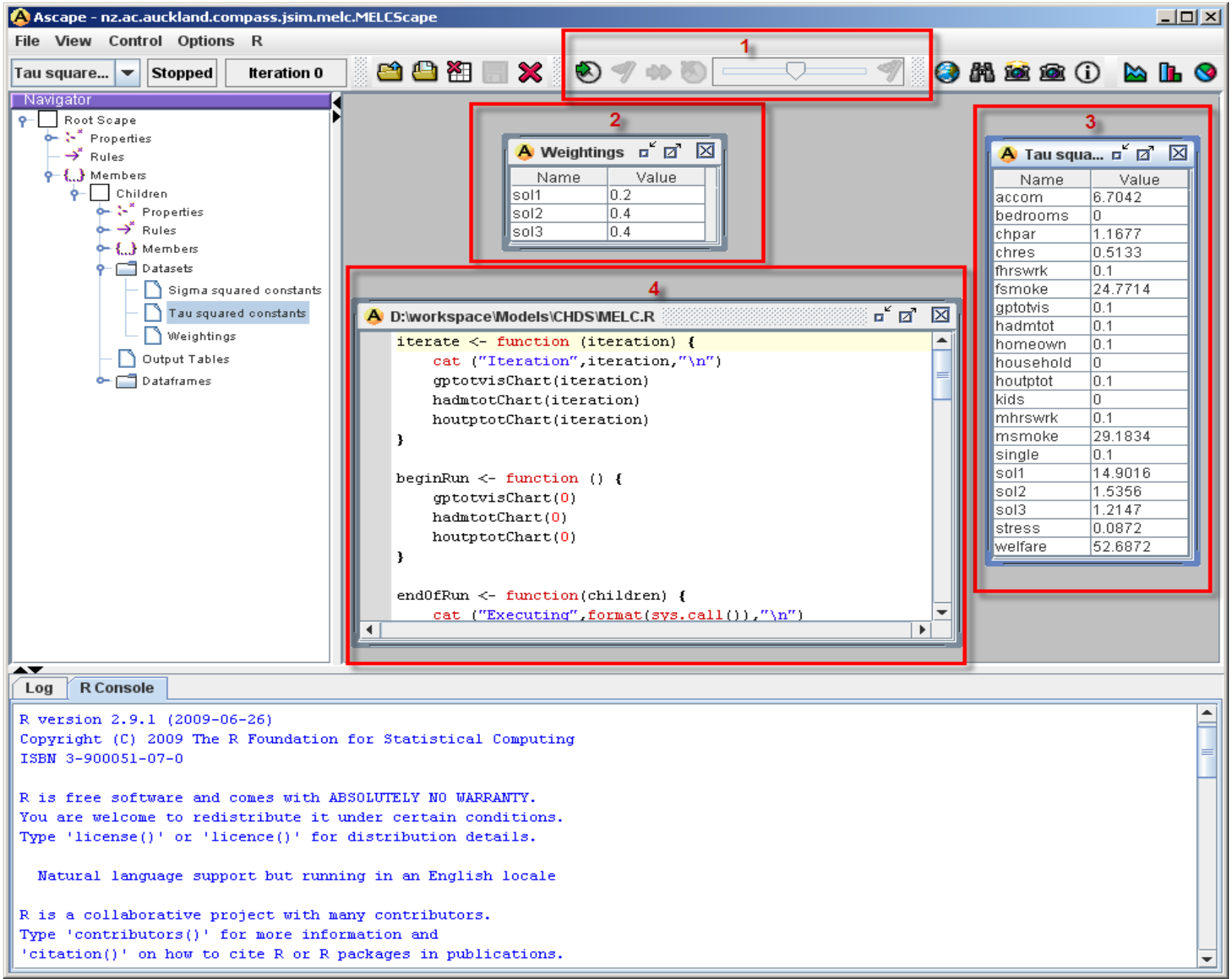
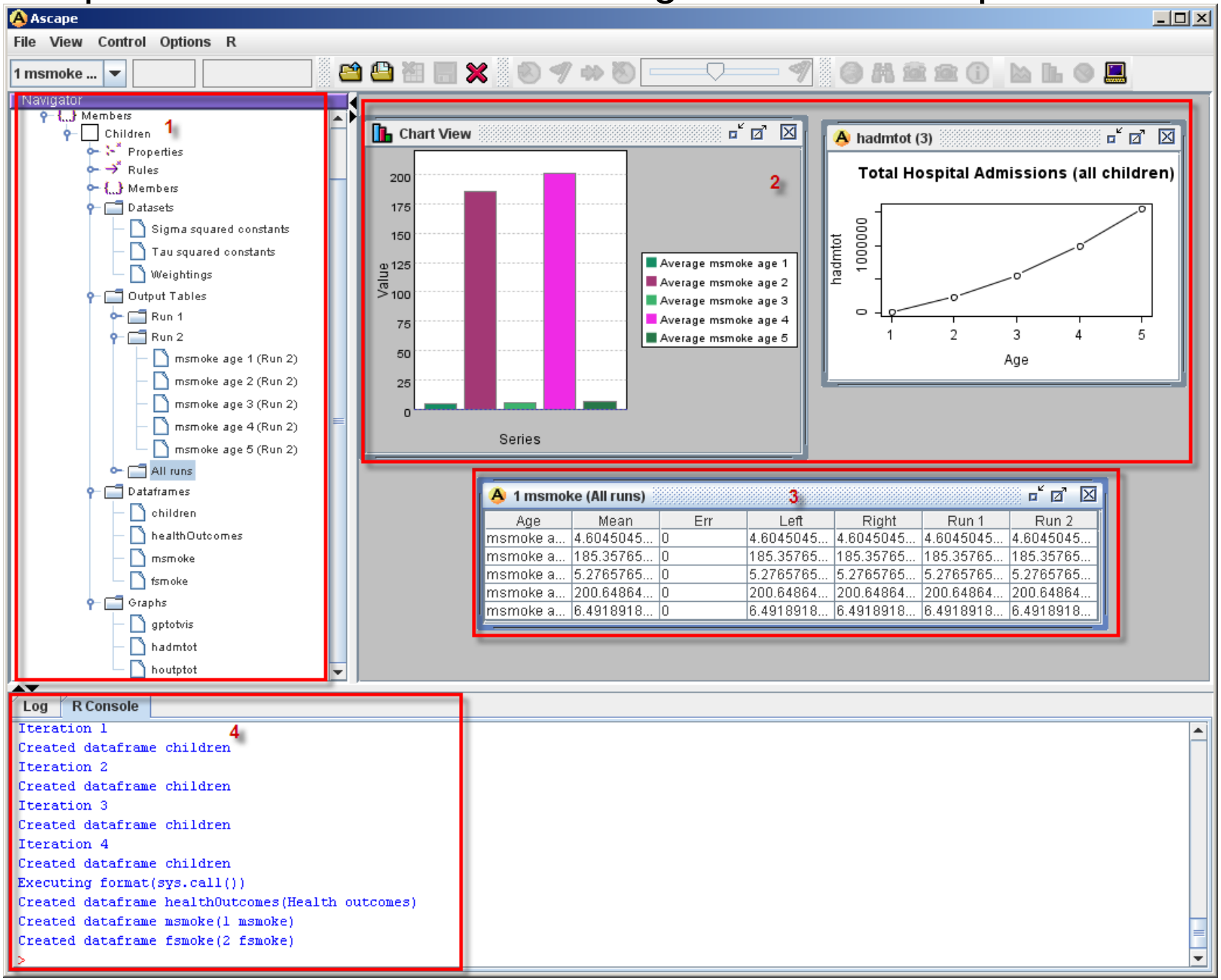
- Designed to be an end user tool for microsimulation models
  - Can be run on a desktop PC by non-technical users
- Developed in Java via an open source model in collaboration with international modelling software developers
- Provides basic in-built analysis functionality
  - Comprehensive analysis 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



Age	Mean	Err	Left	Right	Run 1	Run 2
msmoke a...	4.6045045...	0	4.6045045...	4.6045045...	4.6045045...	4.6045045...
msmoke a...	185.35765...	0	185.35765...	185.35765...	185.35765...	185.35765...
msmoke a...	5.2765765...	0	5.2765765...	5.2765765...	5.2765765...	5.2765765...
msmoke a...	200.64864...	0	200.64864...	200.64864...	200.64864...	200.64864...
msmoke a...	6.4918918...	0	6.4918918...	6.4918918...	6.4918918...	6.4918918...

MELC MODELLING TOOL DEMONSTRATION

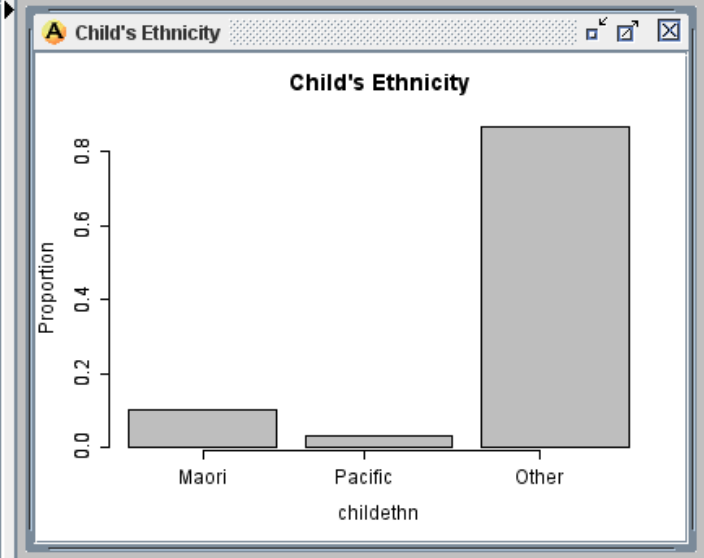
Ascape

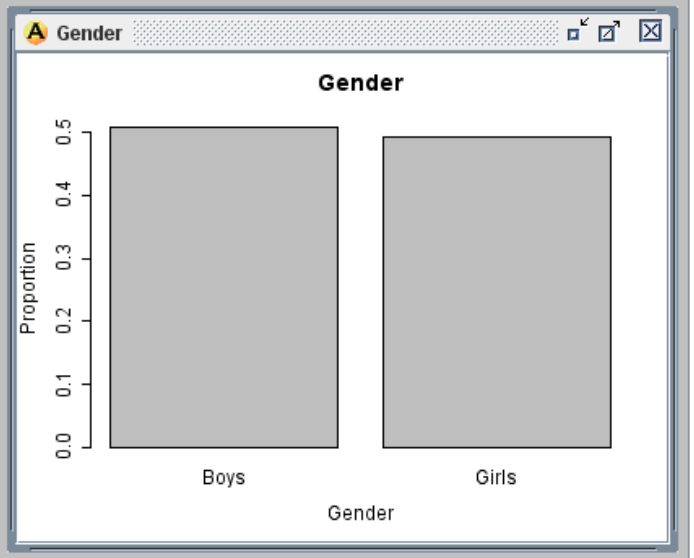
File View Control Options R

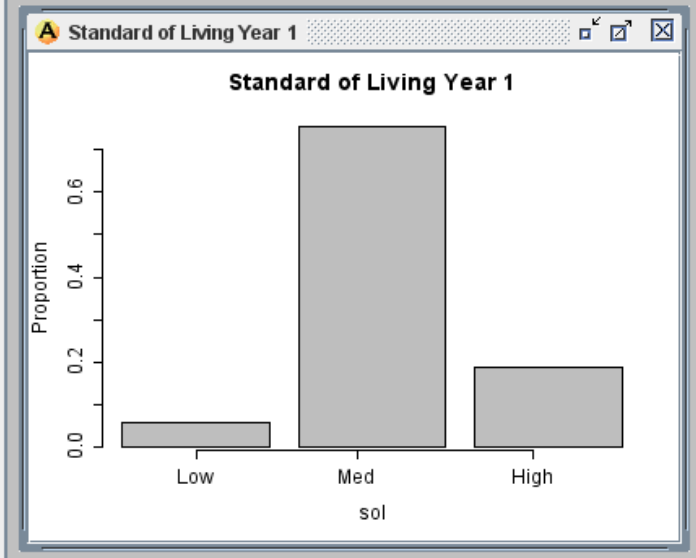
Home Own...

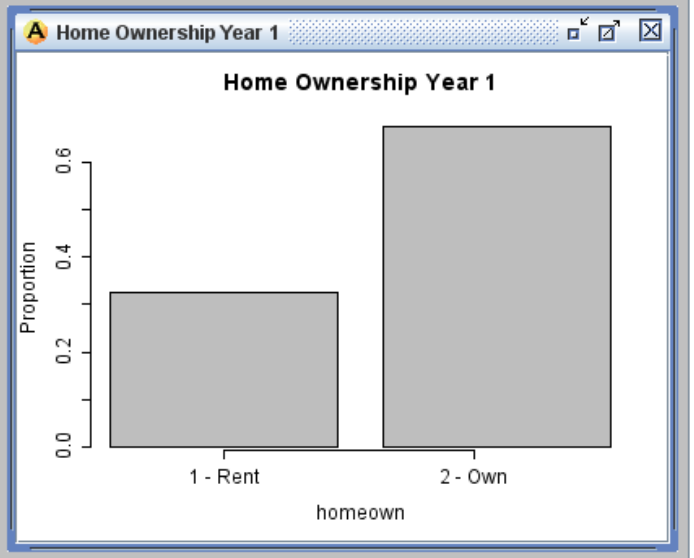
Navigator

- MELC
  - Properties
  - Rules
  - Members
  - Children
    - Properties
    - Rules
    - Members
    - Datasets
    - Output Tables
    - Dataframes
    - Parameter sets
    - Graphs
      - Home Ownership Year 1 Weighted
      - Home Ownership Year 1
      - Standard of Living Year 1 Weighted
      - Standard of Living Year 1
      - Gender
      - Child's Ethnicity
      - gptotvis
      - gptotvis weighted
      - hadmtot
      - hadmtot weighted
      - houtptot
      - houtptot weighted
      - msmoke
      - fsmoke
      - gptotvis pacific
      - gptotvis maori
      - gptotvis boys
      - gptotvis girls
      - gptotvis all
    - Basefile (children)









Ascape

File View Control Options R

Navigator

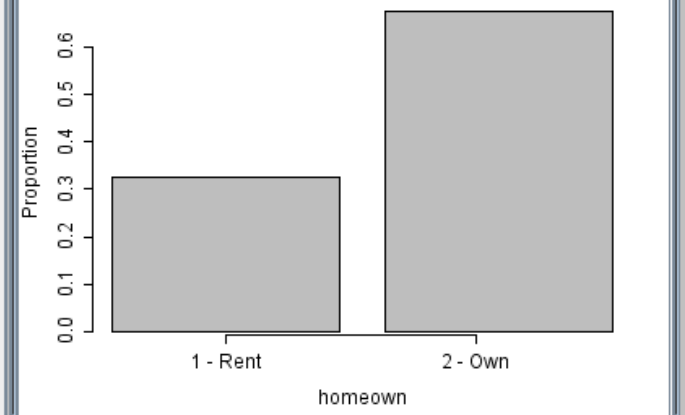
- MELC
  - Properties
  - Rules
  - Members
  - Children
    - Properties
    - Rules
    - Members
    - Datasets
    - Output Tables
    - Dataframes
    - Parameter sets
      - Weightings - Home Ownership
    - Graphs
    - Basefile (children)

Weightings - Home Ownership

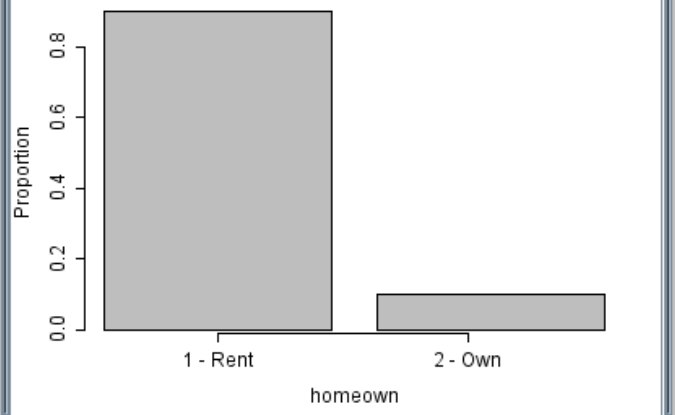
Name	Value
1	0.9
2	0.1

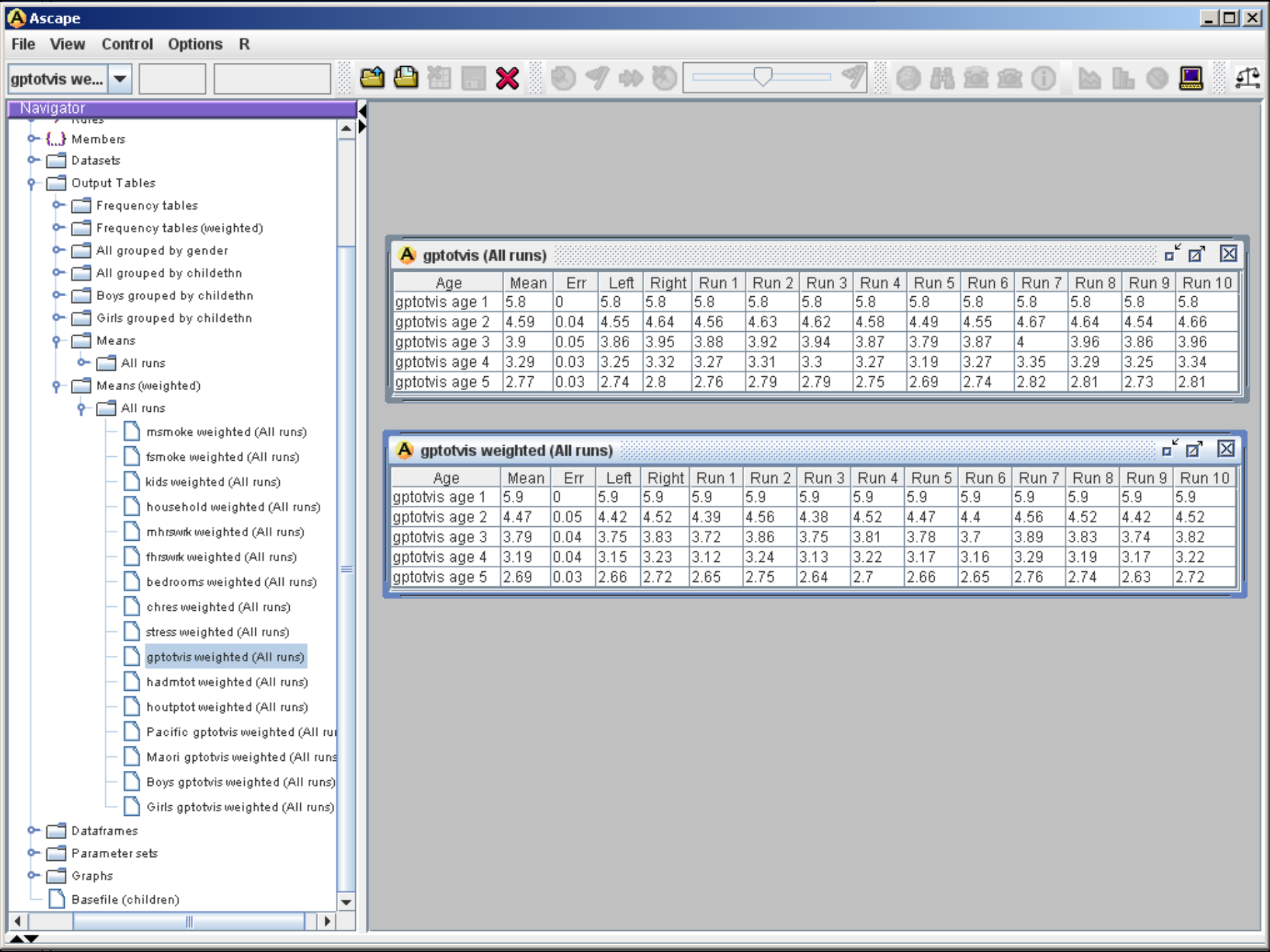
Update Defaults

Home Ownership Year 1



Home Ownership Year 1 Weighted



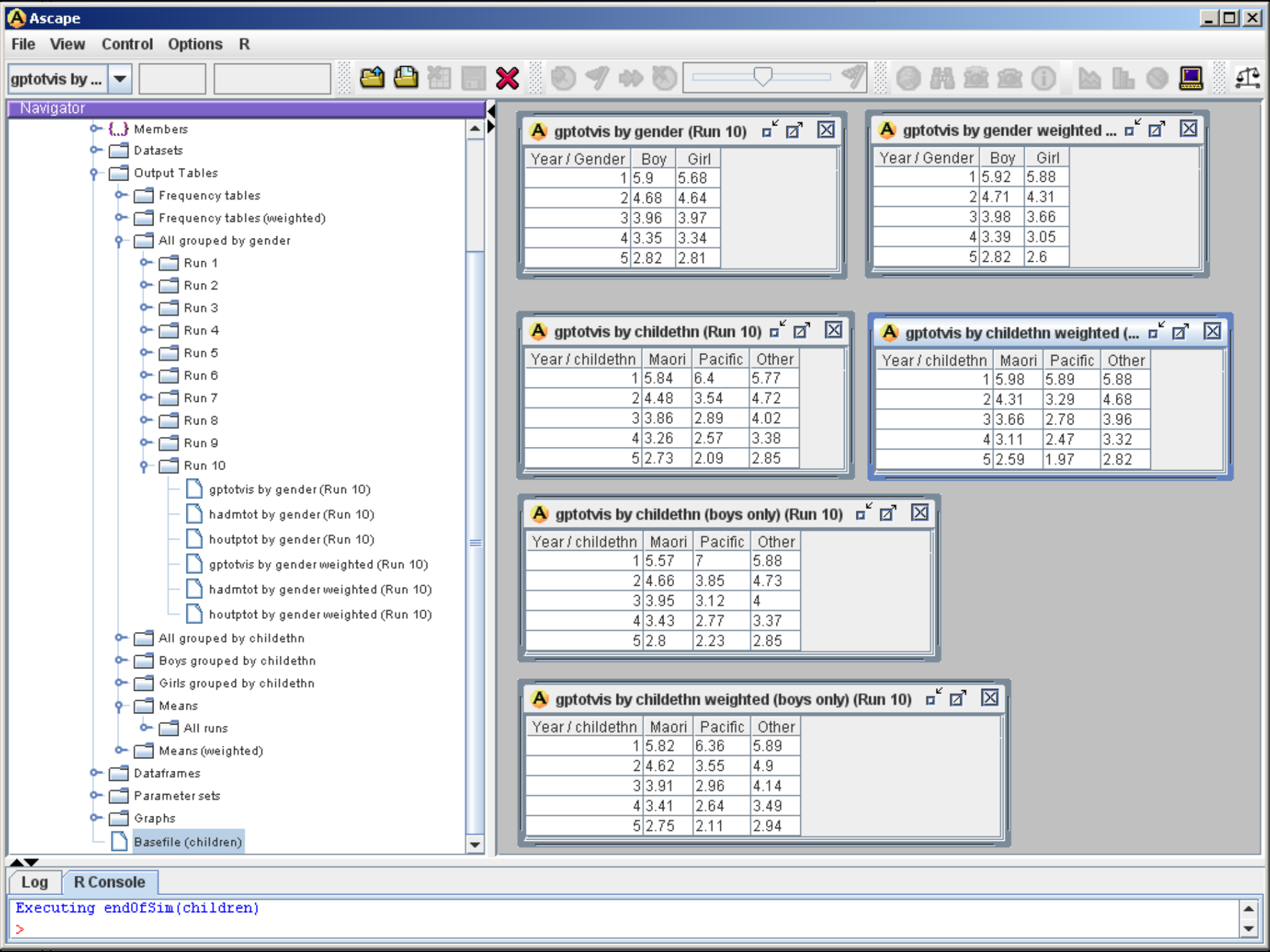


gptotvis (All runs)

Age	Mean	Err	Left	Right	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10
gptotvis age 1	5.8	0	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
gptotvis age 2	4.59	0.04	4.55	4.64	4.56	4.63	4.62	4.58	4.49	4.55	4.67	4.64	4.54	4.66
gptotvis age 3	3.9	0.05	3.86	3.95	3.88	3.92	3.94	3.87	3.79	3.87	4	3.96	3.86	3.96
gptotvis age 4	3.29	0.03	3.25	3.32	3.27	3.31	3.3	3.27	3.19	3.27	3.35	3.29	3.25	3.34
gptotvis age 5	2.77	0.03	2.74	2.8	2.76	2.79	2.79	2.75	2.69	2.74	2.82	2.81	2.73	2.81

gptotvis weighted (All runs)

Age	Mean	Err	Left	Right	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10
gptotvis age 1	5.9	0	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
gptotvis age 2	4.47	0.05	4.42	4.52	4.39	4.56	4.38	4.52	4.47	4.4	4.56	4.52	4.42	4.52
gptotvis age 3	3.79	0.04	3.75	3.83	3.72	3.86	3.75	3.81	3.78	3.7	3.89	3.83	3.74	3.82
gptotvis age 4	3.19	0.04	3.15	3.23	3.12	3.24	3.13	3.22	3.17	3.16	3.29	3.19	3.17	3.22
gptotvis age 5	2.69	0.03	2.66	2.72	2.65	2.75	2.64	2.7	2.66	2.65	2.76	2.74	2.63	2.72


Ascape
File View Control Options R
gptotvis by ...
Navigator
Members
Datasets
Output Tables
Frequency tables
Frequency tables (weighted)
All grouped by gender
Run 1
Run 2
Run 3
Run 4
Run 5
Run 6
Run 7
Run 8
Run 9
Run 10
gptotvis by gender (Run 10)
hadmtot by gender (Run 10)
houtptot by gender (Run 10)
gptotvis by gender weighted (Run 10)
hadmtot by gender weighted (Run 10)
houtptot by gender weighted (Run 10)
All grouped by childethn
Boys grouped by childethn
Girls grouped by childethn
Means
All runs
Means (weighted)
Dataframes
Parameter sets
Graphs
Basefile (children)
gptotvis by gender (Run 10)
Year / Gender Boy Girl
1 5.9 5.68
2 4.68 4.64
3 3.96 3.97
4 3.35 3.34
5 2.82 2.81
gptotvis by gender weighted ...
Year / Gender Boy Girl
1 5.92 5.88
2 4.71 4.31
3 3.98 3.66
4 3.39 3.05
5 2.82 2.6
gptotvis by childethn (Run 10)
Year / childethn Maori Pacific Other
1 5.84 6.4 5.77
2 4.48 3.54 4.72
3 3.86 2.89 4.02
4 3.26 2.57 3.38
5 2.73 2.09 2.85
gptotvis by childethn weighted (...
Year / childethn Maori Pacific Other
1 5.98 5.89 5.88
2 4.31 3.29 4.68
3 3.66 2.78 3.96
4 3.11 2.47 3.32
5 2.59 1.97 2.82
gptotvis by childethn (boys only) (Run 10)
Year / childethn Maori Pacific Other
1 5.57 7 5.88
2 4.66 3.85 4.73
3 3.95 3.12 4
4 3.43 2.77 3.37
5 2.8 2.23 2.85
gptotvis by childethn weighted (boys only) (Run 10)
Year / childethn Maori Pacific Other
1 5.82 6.36 5.89
2 4.62 3.55 4.9
3 3.91 2.96 4.14
4 3.41 2.64 3.49
5 2.75 2.11 2.94
Log
R Console
Executing endOfSim(children)
>

Ascape

File View Control Options R

gptotvis by ...

Navigator

houtptot by gen
gptotvis by gen
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houtptot by gen
All grouped by childethi
Boys grouped by childet
Girls grouped by childet
Means
All runs
Means (weighted)
Dataframes
Parameter sets
Graphs
Home Ownership Year 1
Home Ownership Year 1
Standard of Living Year
Standard of Living Year
Gender
Child's Ethnicity
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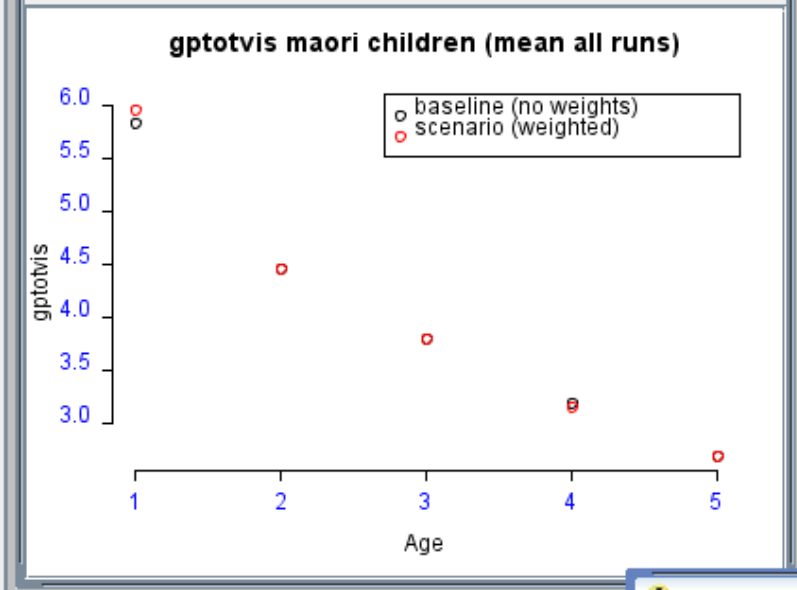
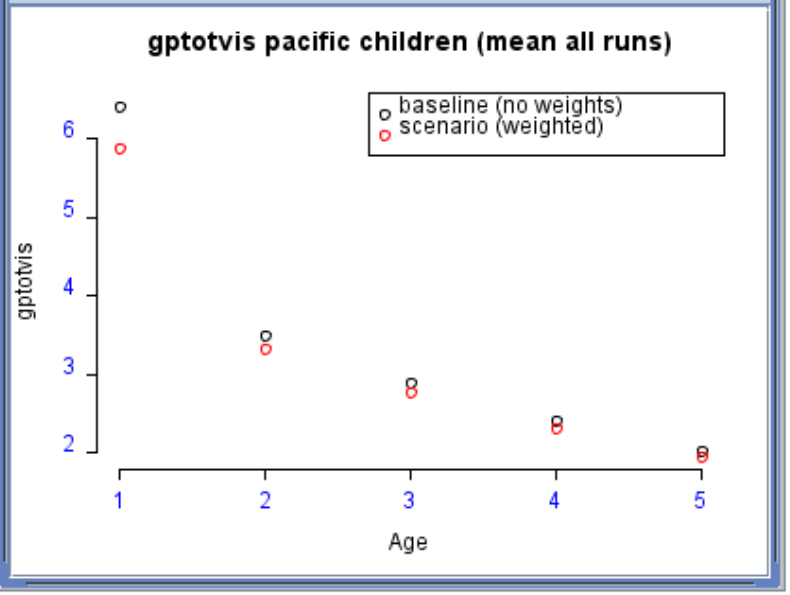
gptotvis weighted
hadmtot
hadmtot weighted
houtptot
houtptot weighted
msmoke
fsmoke
gptotvis pacific
gptotvis maori
gptotvis boys
gptotvis girls
gptotvis all
Basefile (children)

gptotvis maori



gptotvis pacific



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Basefile (c...

Navigator

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houptpot by
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All runs
Dataframes
Graphs
base sol1 weig
base sol1
base gender
base childethn
gptotvis
gptotvis weight
hadmtot
hadmtot weigh
houptpot
houptpot weigh
Basefile (children)

Basefile (children)

a0	GENDER	childethn	sol.1	sol.2	sol.3	sol.4	sol.5	gptotvis.1	gptotvis.2	gptotvis.3	gpto
1	1	3	2	3	2	3	3	6	4	3	
2	2	3	1	1	1	2	1	11	5	4	
3	1	3	3	3	3	3	3	7	4	3	
4	1	1	2	2	2	2	2	3	4	4	
5	1	3	2	2	2	2	2	6	4	4	
7	1	3	2	2	2	2	2	3	4	4	
8	2	3	2	2	2	2	2	5	4	3	
9	1	3	2	2	2	2	2	4	4	3	
10	1	3	2	2	2	2	2	6	4	4	
11	1	3	2	2	2	2	2	4	4	3	
13	1	1	2	2	2	2	2	4	3	3	
14	2	3	2	3	3	3	3	9	4	3	
15	2	3	2	2	2	2	2	6	5	4	
16	2	3	2	2	3	3	3	6	4	4	
18	2	3	3	3	2	2	2	5	4	4	
19	1	3	3	2	2	2	2	5	4	4	
20	1	2	2	2	1	2	2	3	3	2	
21	1	3	2	2	2	2	2	8	4	3	
22	1	1	2	2	2	2	2	6	2	2	
24	2	3	2	2	2	2	2	7	4	3	
25	2	3	2	2	2	2	2	4	4	4	
27	1	3	2	2	2	2	2	7	4	3	
28	1	1	2	2	2	2	2	5	3	3	
29	2	3	2	2	2	2	2	4	4	4	
30	1	3	3	3	2	2	2	2	4	3	
31	2	3	2	2	2	2	2	5	4	3	
32	1	3	3	2	2	2	2	4	4	3	
34	1	3	2	2	2	2	2	6	4	3	
35	1	3	2	2	2	2	2	12	5	4	
37	2	3	2	2	2	2	2	2	3	3	
38	1	3	2	2	2	2	2	3	4	4	
39	2	1	1	2	2	2	2	15	5	4	
41	2	3	2	2	2	2	2	7	4	3	

Log R Console

```
Created dataframe houtptot(houtptot weighted)
>
>
```

MELC – Software

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ANY QUESTIONS?

Where to from here?

The next 3 years ...

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- 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

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