

TOC

- A quick overview of NATSEM models
- Recent development
- Collaboration
- Future

- Established in 1993
- Focus on applied policy analysis
- Extensive use of microsimulation models

- Tax and Transfer Policy
- Public Health
- Spatial Economics
- Demography

Tax and Transfer Policy

STINMOD+ is a microsimulation model that can assess the impact of changes in tax and transfer system.

- Designed to answer common federal tax/transfer policy questions
- Longitudinal analysis capacity
- Built-in behavioural response in take up
- Extensible framework with spatial, behavioural integrations
- Intuitive interface

Public Health

- Cost of Illness Models
 - Covers diabetes, dementia, MC etc.
 - Designed to estimate short to long term cost of illness
 - Linked to STINMOD+ for productivity and tax/welfare estimates
- Spatial healthcare demand model
- Health workforce model

Spatial Model

An increasing number of analytical output at NATSEM can be presented spatially at the small area level

Table 1: An Example of Data Source

Data Type	Dataset A	Dataset B	Dataset C	Base Dataset
Subject Matter I, e.g. Income	High	Low	Low	High
Subject Matter II, e.g. Health	Low	High	Low	High
Attribute I (e.g. Spatial)	Low	None	Low	High

Spatial Model

- Derive rich distributional information at small area level through a statistical approach
- Used for presenting demographic profiles at regional level
- Detailed Income / Tax / Welfare claims

Population Projection Model

The population projection model underpins a number of longer term projection models at NATSEM

- Provides demographic forecast (30~50 years forward) at the small area level (LGA/SA4) by age, gender, and sometimes immigration status
- High out-of-sample predictive capacity. Using 2011 census data, the model output is very close to the actual 2016 Census
 - For 10-year age group and SA4 – correlation 0.997
 - For 1-digit COB and SA4 - correlation 0.999
- Refined fertility, mortality and migration pattern estimates

STINMOD+ serves as one of the core elements in NATSEM's new model development

- Redesigned architecture allowing easy extension
- Easy creation of user interface
- Continuous validation
- Accessible via multiple software

STINMOD+ serves as one of the core elements in NATSEM's new model development
Integration of multiple models following the STINMOD+ core

- Spatial model
- Dynamic Income Model
- Disease model
- Behavioural Models, e.g. labour supply
- Demographic Model
- Others

Model development integrations

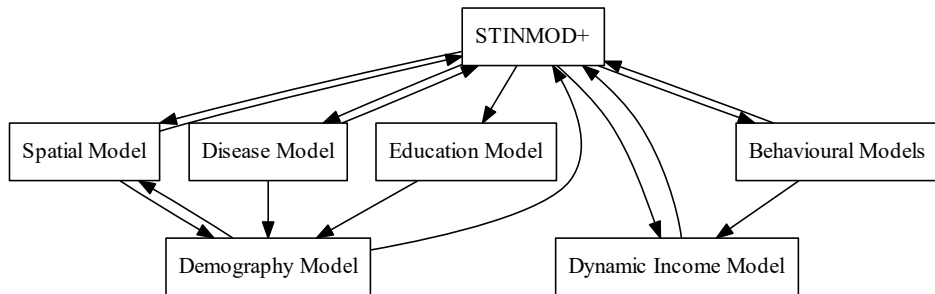


Figure 1: Model Integrations

Integration (Spatial Model)

Capital Cities

Adelaide

Brisbane

Darwin

Hobart

Melbourne

Perth

Sydney

Greater Melbourne

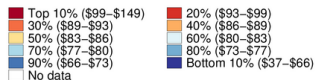
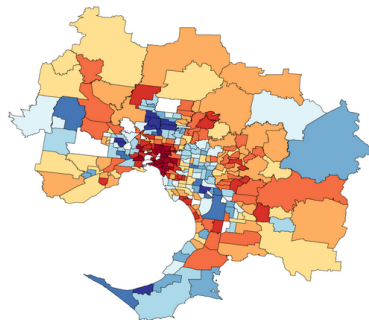


Figure 2: Screenshot from STINMOD+ online

Access

NATSEM has moved to cloud computing with its latest models



- A collection of models online **<https://stinmod.canberra.edu.au>**
- Accessible anywhere (you can run a policy proposal on your phone)
- Rapid response (a customized report returned in minutes)
- Always updated (we make 50+ updates a week on average)
- Accessible from any tools (Stata, R, SAS etc.)
- Thousands of external users

Access

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STINMOD+ Online Population Impact Model (Beta)

STINMOD+ online estimates the income redistribution impact of the federal tax and transfer policies across the entire Australian population.



Population and policies



Population ⓘ

2018 ▾

Baseline policy (financial year) ⓘ

2018-19 without 2018 budget ▾

Alternative policy (financial year) ⓘ

2018-19 ▾



Add policy reform



Tax and Tax Offset



Medicare



Family Tax Benefit



Child Care Subsidy



Pension



Allowance



Analysis options

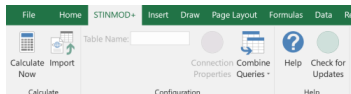


Figure 3: <https://stinmod.canberra.edu.au/>

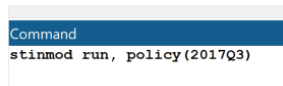
Access

- Can be used in Stata, SAS, SPSS, R, Python, Excel, Web etc.

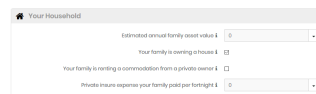
Example in Excel



Example in Stata



Example on Webapp



Quality

Quality in the architectural design of the model development

- Quality of the model architecture
- Quality of the input parameters
 - Policy
 - Population
- Errors
 - Parameter errors
 - Policy errors
 - Integration errors
 - Basic logic errors

Quality (Architecture)

- Industry average: about 15 - 50 errors per 1000 lines of delivered code (McConnell, 2004)
- Code length affects quality, maintenance and readability

Quality (Architecture)

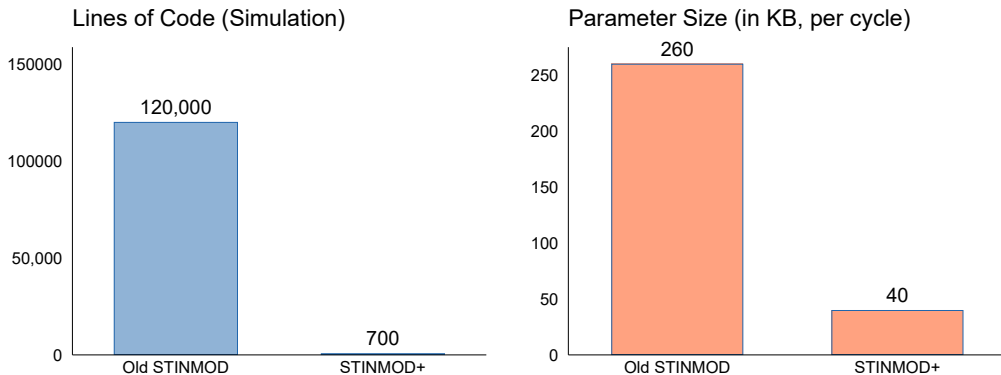


Figure 4: Less code, less error, less maintenance

Quality (Validation)

STINMOD+ new development are now subject to continuous validation, with dedicated servers running 24x7 looking for possible mistakes

What's being validated

- Parameter errors
- Policy errors
- Integration errors
- Basic logic errors

Provides summary report and real-time warnings when error occurs

Quality (Parameters)

Parameter Check

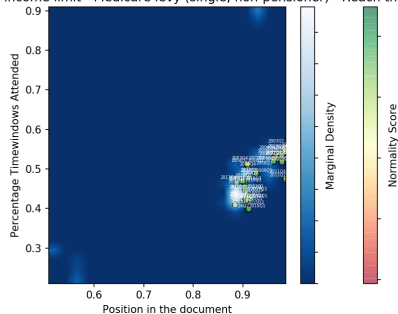
- Two common errors in tax transfer models
 - Inaccurate policy coding
 - Inaccurate policy parameters
- STINMOD+ uses an algorithm to detect possible errors by cross-checking with legislation documents.

Quality (Parameters)

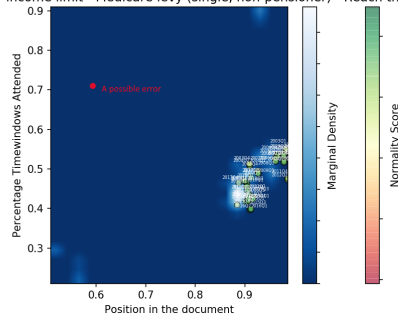
- The algorithm considers the value, context and other attributes of the parameter and estimates its likelihood of error.
- Behind the scene
 - We extract the texts in the legislation documents and derive a high dimensional vectors based on how policies appear in the documents
 - A mistake is likely to cause a deviation of the usual cluster of values and texts given the known patterns

Quality (Parameters)

Detection (medicare_levy_single_nonpension_income_limit_1)
income limit - Medicare levy (single, non-pensioner) - Reach the taxable



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Quality (Parameters)

We put the legislation documents sourced from official government and parliament websites into a shared network drive and this is what continuous validation does:

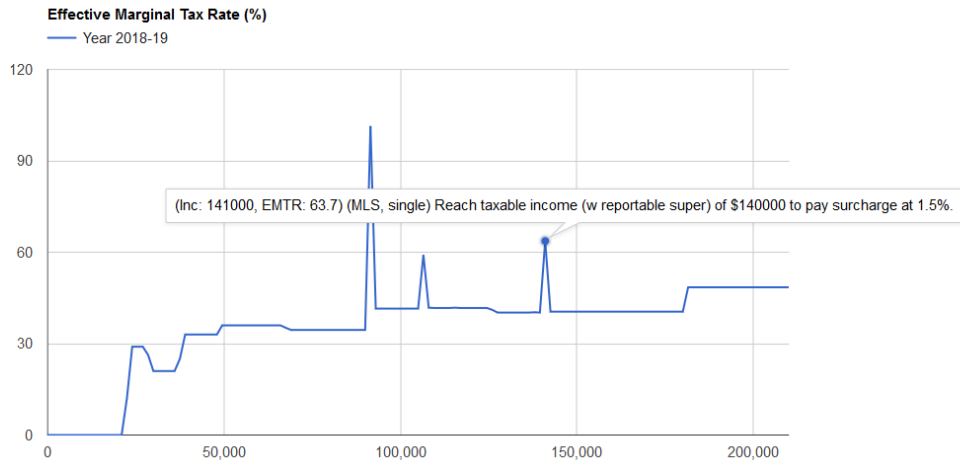
Table 3: An example of the STINMOD+ automated parametrisation validation report

Period	Found	Checked	Total	Coverage	Accuracy	Vetted Ratio
2009Q1	299	304	313	97.1%	98.4%	95.5%
2009Q2	301	304	313	97.1%	99.0%	96.2%
2009Q3	302	304	313	97.1%	99.3%	96.5%
2009Q4	298	302	311	97.1%	98.7%	95.8%

Quality (Policy)

- Policy errors
 - Run continuous on population data and monitor whether the model estimates matches expectation
 - Automated EMTR analyses to detect unexplained kink points for possible errors

Quality (Policy)



Quality (Policy)

- Reported vs simulated in HILDA

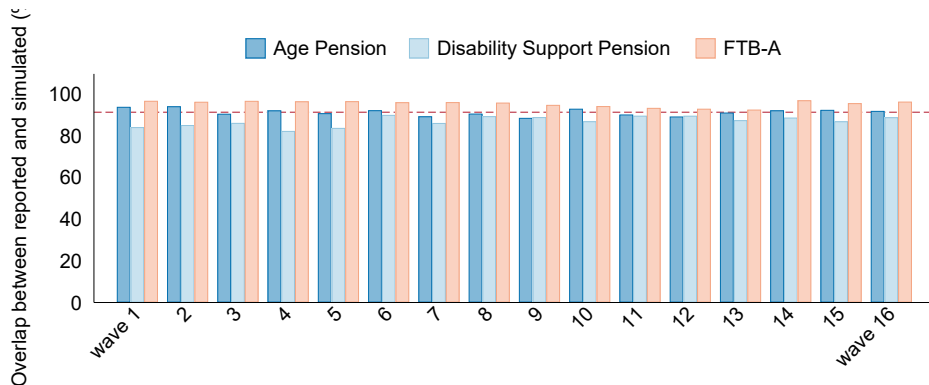


Figure 5: STINMOD+ benefit replication in HILDA

Quality (Policy)

- Reported vs simulated in HILDA

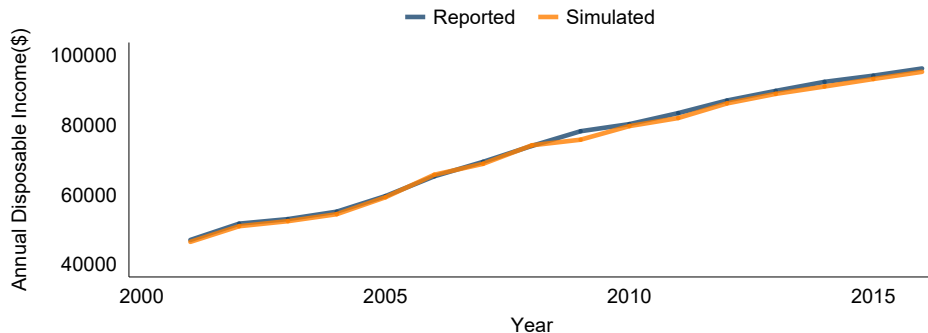


Figure 6: Simulated and reported average disposable income

Quality (Integration and Logic)

- Integration errors checks for possible incompatibilities with existing analyses
- Automatically examine the changes to all major components that are connected with STINMOD+
 - Different dataset integration (e.g. SIH / HILDA)
 - Different access method, e.g. website vs statistical package
 - Different key models, e.g. spatial models

Quality (Report)

A visual clue to know where things might have gone wrong

Average elapsed time:
(Average 300 run times = 30sec)

	Checkout SINRGDP	Prepare CSV files	Documentation Validation	2025 creation	Model Status Test	Test (Test PELGA SINRGDP Integration)	Create Report	Save Test Outputs	Publish S
	10s	2s	8min 14s	22s	1h 14min	23min 15s	7s	7s	10s
Aug 15 10:30 No Change	10s	2s	8min 7s	22s	9min 37s	32min 39s	7s	7s	10s
Aug 15 9:18 No Change	14s	2s	8min 7s	22s	9min 37s	29min 53s	7s	5s	10s
Aug 15 10:30 No Change	21s	2s	8min 22s	22s	11h 52min Failed	31min 54s	7s	7s	10s
Aug 15 11:05 No Change	20s	2s	8min 7s	22s	10min 38s	32min 9s	7s	5s	10s
Aug 15 10:30 No Change	14s	2s	8min 22s	22s	11min 23s	32min 39s	7s	7s	20s
Aug 15 10:45 No Change	10s	2s	8min 7s	22s	11min 8s	32min 39s	7s	5s	10s
Aug 15 10:30 No Change	21s	2s	8min 7s	22s	10min 37s	32min 9s	7s	5s	10s

Quality

- Parameter errors
- Policy errors
- Integration errors
- Basic logic errors

Research

- Growing use of simulating models for academic paper
 - Australian federal budget reform analysis (NATSEM, 2016; NATSEM, 2017)
 - Decomposition of income inequality over the past decades (Li & Hai, 2017)
 - Spatial impact of mortgage policy (Tanton et al., 2017)
- Visitor fellow program for external members
- PhD working on the STINMOD+ results

Research (Recent)

Market Volatility, Ageing and Policies - What is shaping the income distribution in Australia between 2002 and 2016

- Use STINMOD+ to simulate counterfactual income distribution in Australia over the past 15 years
- Decompose the drivers of changes in inequality

Research (Recent)

Decomposition Framework

- We decompose changes in the inequality measures (I) into four components:
 - Changes in the tax and welfare policies (p)
 - Changes in the demographic structure of the population (d)
 - Changes in the market income distribution (y)
 - Changes in other factors (a)

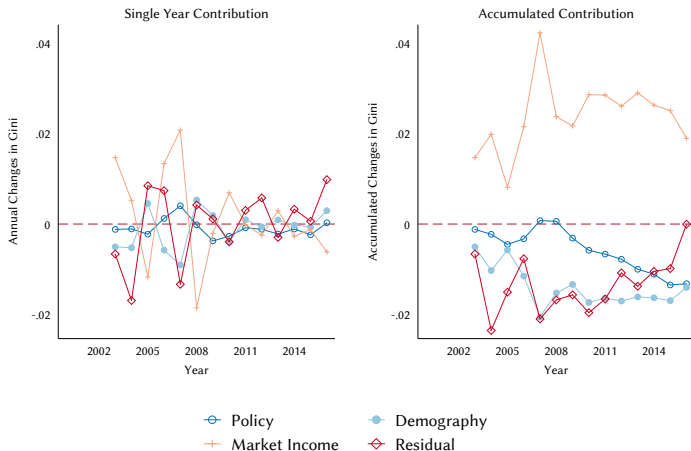
Research (Recent)

Summary

- Among the four factors we decomposed (Demography, Market income, Policy, and Others), market income fluctuation is the largest source of inequality
- Demographic change reduced inequality during the period
- Policy reforms lowered overall inequality but its effect is heterogeneous across the income spectrum
- Policy reforms increased income inequality for the rich but reduced income inequality for the poor post-GFC

Research (Recent)

Contribution to Income Inequality (Gini)



- Quick analysis
- Cross-validation for policy proposals
- Model integrations
 - Multiple party models
 - API access
- Research collaboration
- Share the scalable modelling infrastructure
 - UI framework sharing
 - Computation architecture
- Peer review / Feedback

Future

- Quality / UI / Integration
- User feedback based improvement
- Extension for research and use-case
- Research

Contact

STINMOD+

<https://stinmod.canberra.edu.au/>

NATSEM

<https://natsem.canberra.edu.au/>