

ScotBen

A Microsimulation Tax Benefit Model for Scotland

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<https://virtual-worlds.scot/ima2021/>

What?

Scotben is an open source microsimulation model tax-benefit of Scotland. Brand new - only brought to a useable state in the last fortnight. This is its first outing.

Why?

- Scottish Independence: the debate is about all sorts of things, but inevitably it's also about money: what would the budget of an independent Scotland look like?
- Scotland already has a measure of fiscal autonomy (most income tax, a few benefits, some environmental taxes). What can be done with the powers we already have?
- The standard of debate in Scotland (on all sides) is not high! This is my modest attempt to help;
- Scotland is sufficiently different from the rest of the UK (rUK) for a specialised model;
 - weight data specifically to Scottish demographics and uprate to Scotland-specific forecasts;
 - model the Scotland-specific taxes and benefits carefully.
- I was bored! This was my lockdown distraction. I'd been thinking about building this for several years, though;
- I know something about this: I worked for many years on the Institute for Fiscal Studies' TAXBEN, which was a good model in its day, and since then I've built **many different microsimulations** for clients all over the world.

How?

- Conventional Tax Benefit Model - similar in outline to e.g. IFS Taxben and its descendants such as the, IPPR model;
- Highly modular design: it's made up of components that can easily be bolted together to make e.g. forecasting models, social care simulations, etc.

- Static model - no non-takeup, labour supply etc. But get the structure right and these things are much easier;
- **Test first development** principle - write 'unit tests' describing how each tax and benefit should be calculated, and then just enough model code to make the tests pass - the **model test suite** is almost as big as the model itself.

Julia

- **Julia** bridges the gap between statistics packages and high-level programming languages;
- you can do detailed, accurate programming with good support for **rich types** (vital in a tax benefit model);
- but also use it for **data science/econometrics** (all the model regressions and graphics are native julia);
- *very fast* - **outpacing C/Fortran in some cases**;
- **Julia has a huge collection of contributed packages** - including standard econometrics routines, data handling, graphics, differential equations and much else;
- This presentation is itself a Julia program, written using **Pluto**. The model and its data are actually loaded directly in to this presentation and we'll interact with them very briefly in a minute.

Open Source

- all the program code is available on **GitHub** under a **permissive licence**
- I can't hide! Much harder to fudge things this way.

Structure

Divided into **packages** and **modules**. A package is a high level generic chunk of code that can be downloaded and used independently. A module is a namespace - a small chunk of package code in which you can hide messy details from the rest of the program.

High Level generic packages:

These can be used directly in any model written in Julia. (And are fairly easy to port to **other languages**).

- **Budget Constraints**;
- **Data Weighting**;
- **Poverty & Inequality**.

The Model

The Model is itself a package. Internally, it's broken down into a collection of semi-independent modules, for example:

- **a household**;
- **the fiscal system parameters**;
- **means-tested benefits**;
- **income tax**

.. **and so on**

Some of the modules (e.g. **Equivalence Scales**) may eventually be moved out into generic packages.

Data

- uses pooled (2015-2018) Scottish Households from Family Resources Survey from the UK Data Service;
- Data from the Scottish Household Survey is matched in. This allows much more accurate modelling of local taxes and (in the future) health, housing conditions;
- Since we have a Calmar-like weighting system built-in, we can weight to Scottish Population, Employment Levels, and so on very accurately and easily.

```

• begin
•   hhs = CSV.File( "$(settings.data_dir)/model_households_scotland.tab" )|>DataFrame
•   people = CSV.File( "$(settings.data_dir)/model_people_scotland.tab" )|>DataFrame
• end

```

The Model In Action

No point if people can't use it. I've no plans to build a full web UI. Been there, done that, boring and rarely used.

Instead, simple single-page UIs illustrating one point of interest. So far:

- Budget Constraints - the weird, kinky world of the UK Tax Benefit System
- A Simple Budget For Scotland

These visualisations use Dash.

For full detailed interactions, this Pluto notebook system and 'lab assistant' programs such as Dr Watson.

Known Problems

This is a very new model and full results are just emerging over the last 2 weeks. The test suite gives me confidence that the low-level calculations are accurate. However:

- Modelled **Inequality is too low** compared to official figures - possibly related to 100% takeup
- Revenue estimates for Income Tax ~£1bn too high compared to **official forecasts**:
 - possibly employers pension contributions;
 - or something to do with the pandemic.

Next Steps

Scotben's clean interfaces and modular structure makes adding features easy. Julia also working as a statistics package makes adding behavioural features much easier.

- **Benefit non-takeup corrections** - this seems important for e.g. inequality estimates;
- long term projections (e.g. the **Scottish Growth Commission**- long term projection is technically quite easy with the components we have. **An earlier exercise is available**;
- consumption and spending data - either using estimated Engel Curves or matching in **Living Costs and Food Survey** (LCF) data.

And much else.

To Find Out More

- **Tax Benefit Models: A short introduction to microsimulation and tax benefit models.**
Originally written for the Open University, it covers all the essential ideas. | I've also written **the most boring blog ever about the Model**;
- **Poverty and Inequality: My Notes | World Bank Handbook | Official Figures for Scotland**;

- Scotland's Finances: [Scottish Fiscal Commission](#) | [Scottish Government Budget Documents](#).

I'd very much welcome contributions and suggestions. If you spot anything odd or if you have any ideas for how this can be improved, you can:

- [Open an issue on GitHub](#); or
- [email me](#).

finally, you can download this presentation from <https://virtual-worlds.scot/ima2021/pres.zip>