

# **Single Country and Global Recursive Dynamic Computable General Equilibrium (CGE) Modelling: Online Course**

## **Course Description**

This is a course on recursive dynamic (RDYN) single-country or global computable general equilibrium (CGE) modelling using the General Algebraic Modelling System (GAMS) software. The course is designed for individuals who have a well-developed background in economics and single-country or global CGE modelling, who wish to develop the technical skills needed to implement recursive dynamic single-country or global CGE models. The course emphasises the development of the skills required to develop systematic policy experiments and the interpretation of the results from those experiments. The course also develops the participants understanding of the calibration of RDYN CGE models, the behavioural relationships that control the updating of the model parameters, while enhancing GAMS coding skills. The course uses a mix of video presentations (lectures and ‘how to’ videos), practical computer exercises and policy analyses exercises.

The course is offered with two pathways variants. The first is a single-country course that builds on the ‘Single Country CGE modelling course’ and uses the STAGE\_t model. The second a global course that builds on the ‘Global CGE modelling course’ and uses the ANARRES\_t model.

The materials are organised in 4 modules that are available, via Moodle, for 13 weeks. The course is unsupported, i.e., no tutorial support is available. The first module uses the STAGE\_t model (used in the Practical Single Country CGE course) to introduce the basic concepts underpinning RDYN CGE models; it has 7 components that introduce the key concepts of RDYN models: time, reference scenario, capital accumulation and closure settings. This module is common to both pathways. The second module has 8 components that address issues relating to factor quality and opportunity costs; while the principles

covered by both pathways are common there are differences in detail reflecting the different possibilities available. The third modules have focus on selected topics that differ by pathway. Both pathways have two components that are concerned with savings and time lags and accelerated depreciation of physical capital. The single country pathway then focuses on demographics and the evolution of populations over time, while the global pathway examines issues of relating international capital mobility and labour migration. The final module for both pathways is a project for which it is assumed participants will use their own models and integrate the RDYN components explored in the previous three modules. Guidance is provided about one way that such integration might be achieved.

Participants on this course are required to have well developed CGE and GAMS skills. A minimum requirements is the completion of the ‘Single Country Computable General Equilibrium (CGE) Modelling course’ (see [www.cgemod.org.uk/single\\_cge.html](http://www.cgemod.org.uk/single_cge.html) for details) or the ‘Global Computable General Equilibrium (CGE) Modelling course’ (see [www.cgemod.org.uk/global\\_cge.html](http://www.cgemod.org.uk/global_cge.html) for details). We do not accept participants who have not completed at least one of these courses.

The course is delivered via an electronic learning environment – Moodle. Moodle provides an environment that allows the delivery of learning materials in a structured and organised manner, and an asynchronous forum in which participants can engage with other participants.

This course does NOT use a GUI (Graphical User Interface) to access GAMS. Experience has demonstrated, to our satisfaction, that the use of GUI’s by participants on training programmes typically limits the development of the skills needed to be a good CGE modeller or user of CGE models, while encouraging the belief that CGE models are ‘black boxes’. All course materials were developed using GAMS Studio, which is platform independent for Windows, MacOS and Linux. We work in Windows, so we cannot guarantee that all the techniques are available with Mac OS or LINUX. We do not use LINUX and have not tested the materials using LINUX, but some testing has been done for MacOS.

A full licence for GAMS with PATH and CONOPT solvers is required

## Course Aims and Objectives

### Course Aims

To develop the CGE modelling skills of participants (using GAMS) so they

- i) understand the behavioural relationships used in RDYN CGE models;
- ii) understand the impact of different behavioural relationships used to update model parameters in RDYN CGE models;
- iii) understand the calibration of the model parameters in RDYN CGE models;
- iv) can formulate appropriate RDYN CGE policy experiments; and
- v) can interpret the results generated by RDYN CGE models.

### Course Objectives

On completion of the course the participants will be able:

- i) formulate and code appropriate policy experiments;
- ii) identify and understand the strengths and limitations of RDYN CGE models;
- iii) modify behavioural relationships that control the updating of model parameters;
- iv) interpret the results from RDYN CGE models; and
- v) identify, and present, the policy implications of simulations using RDYN CGE models.

## STAGE & ANARRES Models

This course uses the STAGE\_t or ANARRES\_t CGE models, which are developments of the open source STAGE\_1 model ([www.cgemod.org.uk/stage.html](http://www.cgemod.org.uk/stage.html)) and the ANARRES\_1 model ([www.cgemod.org.uk/globe.html](http://www.cgemod.org.uk/globe.html)). STAGE\_t and ANARRES\_t models are state-of-the-art CGE models designed for the analyses of a wide range of real-world policy issues and advanced bases for the further (academic) model development.

Participants on this course will have access to the STAGE\_3 and ANARRES\_3 models from the Practical Single Country and/or Global CGE courses: these models are only available to participants of the Single Country and/or Global CGE courses offered by CGEMOD.

## **Timetable**

The course is run in two cycles – Sept/Dec, and Jan/April.

The timetables for courses are available at [www.cgemod.org.uk/ttable.html](http://www.cgemod.org.uk/ttable.html)

## **Course Fees**

The course fees is £250 or £200. For details see [www.cgemod.org.uk/fees.html](http://www.cgemod.org.uk/fees.html)

## **Registration**

Registration is online at [www.cgemod.org.uk/regist.html](http://www.cgemod.org.uk/regist.html)

## **Further Information and registration**

For further information please contact Scott McDonald

Email: [scott@cgemod.org.uk](mailto:scott@cgemod.org.uk)

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**Module O15S: The Basics of a Recursive Dynamic: STAGE\_t Model**

	Topic	Tasks	Exercises
O15:1	Introduction to Recursive Dynamics	Nested directory structure; \$SETGLOBAL	Ex 15.1: Load, run and test the comparative static stg_t model
O15:2	RDYN as experiments	Time & RDYN; REFERENCE scenario	Ex 15.2: Coding the time sets
O15:3	RDYN and the 'Residual'	Economics of Total Factor Productivity and the 'Residual'	Ex 15.3: Estimating TFP and the 'Residual'
O15:4	Simple accumulation of capital	Saving rates; Gross & Net Investment; Depreciation	Ex 15.4: Coding the physical accumulation of capital
O15:5	Reference Scenarios	The meaning of reference scenarios; Defining a baseline	Ex 15.5: Calibrating and running a reference scenario
O15:6	Closure settings in RDYN 1	Macroeconomic closure and market clearing conditions	Ex 15.6: Setting and changing model closure conditions
O15:7	A first RDYN experiment	Trade tax reform	Ex 15.7: Tariff reform in a RDYN model

**Module O16S: Factor Quality and Opportunity Costs: STAGE\_t Model**

	Topic	Tasks	Exercises
O16:1	Factor quality	Factor specific productivity growth	Ex 16.1: Factor productivity in stg_t
O16:2	Labour accumulation	Quantities of labour	Ex 16.2: labour force 'exit' and 'entry'
O16:3	Labour quality	'Quality' of labour: education;	Ex 16.3: Education and quality of labour services
O16:4	Capital accumulation	Putty-Putty vv Putty-Clay	Ex 16.4: Growth of different 'types' of capital
O16:5	R&D and capital 'quality'	Investment in R&D and the quality of capital	Ex 16.5: R&D and the quality of capital
O16:6	Closure settings in RDYN 2	Macroeconomic closure and market clearing conditions	Ex 16.6: Setting and changing model closure conditions
O16:8	A second RDYN experiment	Factor taxes	Ex 16.7: Factor taxes in RDYN model

**Module O17S: Topics in Recursive Dynamics: STAGE\_t Model**

	<b>Topic</b>	<b>Tasks</b>	<b>Exercises</b>
O17:1	Savings & Steady state	Savings rates and steady-state growth paths	Ex 17.1: Changing the savings rates
O17:2	Physical capital	Investment lags and premature retirement	Ex 17.2: Investment lags and depreciation rates
O17:3	Demographics	Demographic profiles	
O17:4	Labour force growth	Birth and Death rates; the labour force	Ex 17.4: Labour force perpetual inventory
O17:5	Health and Education	Endogenous changes in the quality of labour	Ex 17.5: Heath, education and the quality of labour
O17:6	Closure settings in RDYN 3	Macroeconomic closure and market clearing conditions	Ex 17.6: Setting and changing model closure conditions
O17:8	A third RDYN experiment	Education/health and demographics	Ex 17.7: Labour & demographics in RDYN model

**Module O18S: Course Project**

The objectives of the project are to develop your ability to (i) set up and implement policy experiments in a RDYN CGE model. There are five elements to the project: calibration, dynamics, policy experiments and interpretation, sensitivity analyses and project report.

It is assumed you will use the course materials with your own model as part of preplanned research project. Thus, the materials for this module are designed to help you develop your own vision of a recursive dynamic model. Hence, the policy simulations, closure assumptions and sensitivity analysis conducted are not prescribed.

	<b>Topic</b>	<b>Tasks</b>	<b>Exercises</b>
O18:1	**** RDYN project	<p>The project aims are</p> <ol style="list-style-type: none"> <li>1. set up and implement policy experiments in the CGE model;</li> <li>2. interpret the results of your policy experiments</li> </ol>	<p>There are five elements to the project;</p> <ol style="list-style-type: none"> <li>1. model recalibration and testing;</li> <li>2. dynamics programming;</li> <li>3. policy experiments and interpretation;</li> <li>4. sensitivity analyses; and</li> <li>5. project paper/reportt</li> </ol>

**Module O15G: The Basics of a Recursive Dynamic: stg\_t Model**

	Topic	Tasks	Exercises
O15:1	Introduction to Recursive Dynamics	Nested directory structure; \$SETGLOBAL	Ex 15.1: Load, run and test the comparative static stg_t model
O15:2	RDYN as experiments	Time & RDYN; REFERENCE scenario	Ex 15.2: Coding the time sets
O15:3	RDYN and the 'Residual'	Economics of Total Factor Productivity and the 'Residual'	Ex 15.3: Estimating TFP and the 'Residual'
O15:4	Simple accumulation of capital	Saving rates; Gross & Net Investment; Depreciation	Ex 15.4: Coding the physical accumulation of capital
O15:5	Reference Scenarios	The meaning of reference scenarios; Defining a baseline	Ex 15.5: Calibrating and running a reference scenario
O15:6	Closure settings in RDYN 1	Macroeconomic closure and market clearing conditions	Ex 15.6: Setting and changing model closure conditions
O15:7	A first RDYN experiment	Trade tax reform	Ex 15.7: Tariff reform in a RDYN model

**Module O16G: Factor Quality and Opportunity Costs: ANARRES\_t Model**

	Topic	Tasks	Exercises
O16:1	Factor quality	Factor specific productivity growth	Ex 16.1: Factor productivity in anar_t
O16:2	Labour accumulation	Quantities of labour	Ex 16.2: labour force 'exit' and 'entry'
O16:3	Labour quality	Education and training	Ex 16.3: Education and quality of labour services
O16:4	Capital accumulation	Putty-Putty vv Putty-Clay	Ex 16.4: Growth of different 'types' of capital
O16:5	R&D and capital 'quality'	Investment in R&D and the quality of capital	Ex 16.5: R&D and the quality of capital
O16:6	Closure settings in RDYN 2	Macroeconomic closure and market clearing conditions	Ex 16.6: Setting and changing model closure conditions
O16:8	A second RDYN experiment	Factor taxes	Ex 16.7: Factor taxes in RDYN model

**Module O17G: Topics in Recursive Dynamics: ANARRES\_t Model**

	Topic	Tasks	Exercises
O17:1	Savings & Steady state	Savings rates and steady-state growth paths	Ex 17.1: Changing the savings rates
O17:2	Physical capital	Investment lags and premature retirement	Ex 17.2: Investment lags and depreciation rates
O17:3	Migration	Labour migration	Ex 17.3: Migration
O17:4	Capital mobility	Transnational capital ownership	Ex 17.4: Capital mobility
O17:5	Closure settings in RDYN 3	Macroeconomic closure and market clearing conditions	Ex 17.6: Setting and changing model closure conditions
O17:6	A third RDYN experiment	Education/health and demographics	Ex 17.7: Labour & demographics in RDYN model

**Module O18G: Course Project**

The objectives of the project are to develop your ability to (i) set up and implement policy experiments in a RDYN CGE model. There are five elements to the project: calibration, dynamics, policy experiments and interpretation, sensitivity analyses and project report.

It is assumed you will use the course materials with your own model as part of preplanned research project. Thus, the materials for this module are designed to help you develop your own vision of a recursive dynamic model. Hence, the policy simulations, closure assumptions and sensitivity analysis conducted are not prescribed.

	Topic	Tasks	Exercises
O18:1	**** RDYN project	The project aims are 1. set up and implement policy experiments in the CGE model; 2. interpret the results of your policy experiments	There are five elements to the project; 1. model recalibration and testing; 2. dynamics programming; 3. policy experiments and interpretation; 4. sensitivity analyses; and 5. project paper/report