Estimating a Social Accounting Matrix Course

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Course Description

This course is a specialist course in the estimation of Social Accounting Matrices (SAMs). The course is orientated to the estimation of SAMs designed to support computable General Equilibrium (CGE) models; SAMs so estimated can be used by other whole economy models. The techniques used derive early work in the 1940s and 1950s that focused on the estimation of national accounts and can be used for the estimation of data matrices in a wide range of contexts.

The course is designed for individuals who have a well-developed background in economics and single-country or global CGE modelling, and who have extensive experience using the General Algebraic Modelling System (GAMS) software. The GAMS programmes used in this course are arguably more complex than those used for CGE models, in part because the statistical theories applied are rarely taught in economics degree programmes. The course uses GAMS intensively and assumes the use of GAMS Studio. During the course participants will typically need to expand their knowledge and understanding of GAMS.

The course emphasises the development of an understanding of the properties and structure of SAMs, with a strong emphasis on understanding the price system embedded in a SAM and its role in whole economy models. The course follows the principles of national accounting developed by Richard Stone, and associates, in the 1940s, 1950s and 1960s, that are now cornerstones of the System of National Accounts.[1] The estimation of SAMs that are appropriate to support meaningful policy analyses depend critically upon the effort devoted to compiling a high-quality *PRIOR* (initial) SAM from national accounts data, and various surveys. The mathematical techniques, explored in this course, for converting the prior SAM

[1] "The fact that others have not had to reinvent the architecture of the national accounts in particular is perhaps the most telling measure of the importance of Richard Stone's contributions and their enduring significance." (Pyatt, 2005).

into a final SAM cannot be a substitute for the efforts devoted to compiling the prior SAM, but they are complements.

The main GAMS programme used in this course, to derive/estimate the final SAM, uses a maximum and cross entropy metric (developed by Sherman Robinson and associates) that is based on information theory. During the course the RAS method, developed by Stone and associates, is also used: it is demonstrated that the RAS method is good, given the computing constraints when it was developed, for its intended purposes. But RAS is deficient as a tool for SAM estimation; this is demonstrated by replication a study by Lynch to estimate a Input-Output Table (IOT) for 1968 using the 1963 IOT as a prior. Modified RAS methods are used to demonstrate how adding information can greatly improve the performance of the RAS method. The modified RAS method provides a basis upon which users can appreciate how adding information can greatly improve the performance of any mathematical SAM estimation technique. The entropy programme used in this course is designed to allow those estimating a SAM to add additional layers of information over and above the *prior* SAM. The entropy method has another major advantage: the estimation results provide information about the potential benefits of improved prior estimates of transaction values.

The course assumes that the participants have an in-depth knowledge of graduate level economics and a reasonable understanding of mathematics and statistics for economics. The methods used in this course require an understanding of Social Accounting Matrices (SAMs), while an understanding of the relationships between SAMs and whole economy/CGE models will be helpful.

The materials are organised in 6 modules. The first module reviews the theory of social accounting, covering, inter alia, single entry (matrix) accounts, the Law of One Price, the System of National Accounts (SNA) and definitions of the production boundary, Supply and Use Tables (SUT) and Input-output Tables (IOT). The second module explores the data requirements for a SAM and includes simple practical exercises that compile prior macro and micro-SAM stylised data. The third module begins the practical examination of mathematical methods used to reconcile national accounts data in SAM format: the RAS method is used to illustrate the importance of good quality prior estimates and the limitations of RAS. The

fourth and fifth modules the theory and application of SAM Estimation using the entropy metric. The fourth module focuses on the theory of maximum and cross entropy estimation and the practical application of the SAMEST programme, while the sixth module explores options in the SAMEST programme that can be used to tune the programme and improve estimation. The final module provides some SAM estimation exercises that allow participants to explore applications of SAMEST in different contexts.

The time commitment for this course is indeterminate because it depends heavily upon prior knowledge and experience of each participant: this is one reason why the course is self-directed and unsupported. Participants should plan a SAM estimation project of their own that will be undertaken immediately following completion of this course: experience indicates that embedding the skills explored in this course is important.

The course is delivered from the cgemod website (www.cgemod.org.uk). It is open source but unsupported. This means that participants must self-direct their learning and that there is NO tutor available to provide support. It is offered solely in the hope that it is useful to participants with no warranty that the SAMEST programme is appropriate for specific applications.

This course does NOT use a GUI, i.e., SAMEST is run in 'native' GAMS. The GAMS programmes used in this course were developed using GAMS Studio, and therefore should be portable across Windows, MacOS and Linux, and require that the participants work in 'native' GAMS using data that are accessed from Excel and GDX. Subsequently, when estimating a SAM using national surveys users may need to master other computer programmes, e.g., SPSS, SQL, etc., to extract the data; the requisite programmes will depend on the format in which the data have been stored. These programmes are not used in this course.

Participants need licences for GAMS with CONOPT, KNITRO and PATH solvers.

Course Aims and Objectives

Course Aims

To develop the SAM estimation skills of participants (using GAMS) so they

i) understand the structure and content of complete and consistent SAMs;
ii) understand the price system in a SAM;
iii) can organise the data required for *prior* SAMs and satellite accounts;
iv) understand the strengths and weaknesses of SAM estimation techniques; and
v) can critically evaluate the information content of a SAM.

Course Objectives

On completion of the course the participants will be able to:

i) evaluate critically the information content of a SAM;
ii) identify and understand the data requirements to create a *prior* SAM;
iii) use SAMEST, & RAS, programmes to estimate complete & consistent SAMs;
iv) interpret the results from the SAMEST programme to identify those cells of a prior SAM that might benefit from improved prior estimates; and
v) identify appropriate satellite accounts consistent with the estimated SAM.

Outline
Module M1: Theory of Social Accounting

	Topic	Tasks	Exercises
M1:1	Introduction	SAMs as accounting systems	Interpreting transaction values (TV)
M1:2	What is a SAM?	Understanding the single-entry accounting method	Deriving a simple SAM from macro T-accounts
M1:3	Properties of a SAM	The price system in a SAM and the Law of One Price (LOOP)	Deriving implicit prices from TVs
M1:4	SAMs and the SNA	Roles of Supply and Use Tables (SUT) and SAMs in the System of National Accounts (SAN)	Interpreting the data in satellite accounts
M1:5	Production boundaries	SNA and 'general' production boundaries	Interpreting aggregate measures of economic activity, e.g., GDP, & welfare
M1:6	SUT vv IOT	The relationship between SUT and Input-output tables	No exercise
M1:7	Interpreting Information in a SAM	Using coefficients to interpret the information in a SAM	A SAM interpretation exercise

Module M2: Data for Prior Macro and Micro SAMs

	Topic	Tasks	Exercises
M2:1	Introduction	Top down vv Bottom up	Collecting aggregate national accounts data
M2:2	Prior Macro SAM	Role of a macro SAM	Deriving a macro SAM from aggregate national accounts data
M2:3	Data Requirements for a SAM	Overview of data requirements	Reconciling income and expenditure data
M2:4	Organisation of data and code to generate priors	Organising data for a *prior* SAM	Use of Excel, GDX and GAMS
M2:5	Prior Micro SAM	Relationship between micro and macro SAMs	Using supplied data to derive a prior micro SAM
M2:6	Satellite accounts	Relationship between TVs and satellite account data	Using supplied data to derive a prior factor satellite account

Module M3: Mathematical Methods and Information

	Topic	Tasks	Exercises
M3:1	Introduction	Mathematical estimation tools; estimation vv balancing	No exercise
M3:2	RAS	The simple mechanics of RAS	RAS in Excel and GAMS; estimating a 1968 UK IOT from a 1963 IOT as the prior.
M3:3	Modified RAS	Modified RAS: estimation with additional information	Evaluating the benefits of additional information in RAS
M3:4	Estimating a small SAM	SAM estimation exercise	Using RAS with a prior SAM (from O28:7)

Module M4: Info-Metrics and SAM Estimation

	Topic	Tasks	Exercises
M4:1	Introduction	Information Theory and Estimation	No exercise
M4:2	Maximum & Cross Entropy	Estimation principles. Overview of the code; structure and controls	Using entropy estimation with a simple prior
M4:3	Introduction to SAMEST	Using the SAMEST programme	Estimating a macro SAM
M4:4	Estimating Probabilities	From probabilities to parameters	
M4:5	Micro SAM estimation	Using the SAMEST programme	Estimating a small micro SAM

Module M5: Refining SAM Estimation

	Topic	Tasks	Exercises
M5:1	Introduction	Tuning SAMEST	No exercise
M5:2	Errors and Error Specification	Using the SAMEST programme	Tuning an estimating small SAM
M5:3	Micro SAM estimation	Using the SAMEST programme	Estimating a medium micro SAM
M5:4	Other Entropy Applications	Global trade matrices; CGE model parameters	none
M5.5	Satellite account estimation	Using the SAMEST programme	Estimating a medium micro SAM with satellite accounts
M5:6	Micro SAM estimation	Using the SAMEST programme	Estimating a micro SAM from a Selection

Module M6: Applications SAM Estimation

	Topic	Tasks	Exercises
M6:1	Introduction	Tuning SAMEST	No exercise
M6:2	Micro SAM estimation	Using the SAMEST programme	Estimating a micro SAM from a Selection