ANSWERv6 for TIMES: Status Report

Ken Noble
Noble-Soft Systems, Australia

ETSAP Annex X Meeting
Oxford, England
15-18 November 2005

Overview

◆ Brief History of ANSWER-TIMES
◆ Special Acknowledgments
◆ Creating multi-region ANSWER-TIMES
◆ Status Report
◆ Benefits of ANSWERv6 for TIMES
◆ Loose ends
◆ Future Intentions
◆ Acknowledgments
Brief History of ANSWER-TIMES

- Late 1999: mathematics and GAMS code for TIMES already well developed
- But no user interface – anyone wishing to work with TIMES needed to maintain their data as text files (GAMS format)
- ANSWER (version 3) supported single-region MARKAL models
- 2000: with modest ETSAP support and a substantial in-kind contribution from (then) Australian ETSAP Partner ABARE, ANSWER version 3 adapted to support single-region TIMES
  - And made available to any ETSAP Partner who wished to experiment with it
- Oct. 2000: ETSAP Meeting Baden Switzerland decided not to provide further support to ABARE for development of ANSWER-TIMES
  - But some ETSAP Partners continued to use it

Brief History of ANSWER-TIMES (cont)

- 2001: ANSWER version 3 significantly enhanced to support multi-region MARKAL models, becoming ANSWER version 5
  - Even though TIMES User Constraint formulation from 2000 had changed, so User Constraint part of model would have needed to be kept as a text file
- Dec. 2003: Ken Noble retired from ABARE and became the owner/developer of the ANSWER software
- Nov. 2004: ETSAP Meeting Firenze still interest in ANSWER-TIMES
- July 2005: ETSAP provided funding assistance to Noble-Soft to complete single-region update and assess feasibility of creating multi-region ANSWER-TIMES
Special Acknowledgments

◆ Antti Lehtila, VTT Energy Finland for his extremely generous, knowledgeable and committed assistance in expertly fielding numerous questions related to the intricacies of TIMES
  - Antti’s expertise indispensable in progressing ANSWER-TIMES
  - TIMES Model Documentation is very good, but is sometimes ambiguous and occasionally misleading

Creating multi-region ANSWER-TIMES - 1

◆ Compare single-region ANSWER-MARKAL Visual Basic code with single-region ANSWER-TIMES Visual Basic code and see that no. of changes is not too frightening
  - Maybe feasible to change multi-region ANSWER-MARKAL VB code to accommodate multi-region ANSWER-TIMES?

◆ Remember back to 2001: what was involved in creating multi-region ANSWER-MARKAL from single-region ANSWER-MARKAL
  - Addition of Region field to many of the database tables
  - Particular issues related to bilateral trade
  - Most ANSWER Home Screen functions required minimal change
  - More substantial change required for Data/Results Screen functions

◆ Essential: single set of Visual Basic code supporting ANSWER and TIMES, hence ANSWERv6
Creating multi-region ANSWER-TIMES - 2

- Create multi-region ANSWER-TIMES database by adding Region field to appropriate tables of single-region ANSWER-TIMES database
- Copy AnswerV5 Visual Basic code to AnswerV6_Dev folder, try to open multi-region ANSWER-TIMES database
  - As bad things happen, fix AnswerV6_Dev Visual Basic code while retaining compatibility for multi-region ANSWER-MARKAL
- Fairly easy to get Home Screen up and running
- Rather more issues to address re Data/Results Screen
  - Particular issues related to trade in TIMES

Creating multi-region ANSWER-TIMES – 3

Home Screen
Creating multi-region ANSWER-TIMES – 4
Data Screen – Process Tab

Creating multi-region ANSWER-TIMES – 5
Process Set Memberships Tree
Creating multi-region ANSWER-TIMES – 6
Data Screen – Trade Tab

Feasible to import a single-region TIMES GAMS DD into multi-region ANSWER-TIMES database structure?
- Yes, including trade links to external regions
- This was how 3-region D3-FR3-IT3 model data was imported
- One bit of cheating because one of the commodities “breaks the rules”

Creating multi-region ANSWER-TIMES - 7

- Feasible to import a single-region TIMES GAMS DD into multi-region ANSWER-TIMES database structure?
  - Yes, including trade links to external regions
  - This was how 3-region D3-FR3-IT3 model data was imported
  - One bit of cheating because one of the commodities “breaks the rules”

- Feasible to carry out Run Model for a single-region from multi-region ANSWER-TIMES database structure?
  - Yes, already done so from (slightly modified) ANSWER Run Model VB code, generating everything except trade links to external regions
  - And verifying that resultant LP matrix was precisely what it should be
  - Modifications still required to ANSWER Run Model VB code to generate trade links to external regions
Creating multi-region ANSWER-TIMES - 8

- Feasible to import a multi-region TIMES GAMS DD into multi-region ANSWER-TIMES database structure?
  - Yes, some revamping of GAMS code that ANSWER-TIMES currently uses to import single-region TIMES GAMS DD required

- Feasible to carry out Run Model for multiple regions from multi-region ANSWER-TIMES database structure?
  - Yes, some revamping of GAMS code that ANSWER-TIMES uses to interface with ETSAP TIMES GAMS code required
  - Once modifications to generate trade links to external regions for single-region run are made, essentially a matter of generating single-region TIMES GAMS DD files for each region involved in multiple region run
  - Additional modifications to ANSWER Run Model VB code because trade in ANSWER-TIMES requires a different paradigm to that adopted for bilateral trade in ANSWER-MARKAL
  - Additional complications from cross-region constraints

Creating multi-region ANSWER-TIMES - 9

- Feasible to import results from single-region ANSWER-TIMES run into multi-region ANSWER-TIMES database structure?
  - Yes, already done so
  - Note: TIMES GAMS code that produces results ANT file for import into (single-region) ANSWER-TIMES has been static since October 2000
  - Expect VEDA-BE will be preferred for TIMES results analysis

- Feasible to import results from multi-region ANSWER-TIMES run into multi-region ANSWER-TIMES database structure?
  - Yes
  - Either modify TIMES GAMS code that produces results for import into ANSWER-TIMES to put out one ANT file for each region (then minimal changes to ANSWER VB code); or leave TIMES GAMS code as is, putting out a single ANT file (then more changes needed to ANSWER VB code)
  - Some modifications to ANSWER Import Results VB code may be needed in any case because trade in ANSWER-TIMES requires a different paradigm to that adopted for bilateral trade in ANSWER-MARKAL
ANSWER-TIMES Status Report

- Majority of standard TIMES Sets and Parameters in latest v1.5.0 TIMES GAMS code recognized
- Many Home Screen functions already working
- Many Data Screen functions already working
- “File, Import single-region TIMES GAMS DD” menu function is close to being fully operational
  - Strategy for import of multi-region TIMES GAMS DD is clear
- “Run Model” for single/multiple regions requires some work to be fully operational
- Import Results into ANSWER-TIMES already working for single-region run

Benefits of ANSWERv6 for TIMES

- For those familiar with ANSWER-MARKAL, easy to approach TIMES within the same interface paradigm
  - Can focus on TIMES aspects and not have to be concerned with interface aspects
- For new users, ANSWER has a gentle learning curve
  - Beneficial in promoting use of TIMES, perhaps especially within universities?
  - Particular interest in constructing ANSWER-TIMES training databases to demonstrate important TIMES features
- New ANSWER features will become available for both TIMES and MARKAL
- ANSWER-TIMES User Manual can be created based very substantially on existing ANSWER-MARKAL User Manual
Loose ends - 1

- Check to ensure all standard TIMES Sets and Parameters in latest v1.5.0 TIMES GAMS code are supported
- Some aspects of operation of Trade tab need to be refined
- User Constraints Set Memberships tree needs to be revised and made more user-friendly
- “Import TIMES GAMS DD” and “Run Model” need to be made fully operational
- More TIMES GAMS DDs are needed for integrity testing
  - ANSWER-TIMES “Import TIMES GAMS DD” – “Run Model” cycle should generate the same LP matrix as that from running TIMES GAMS DD directly against TIMES GAMS code in Command Prompt window
  - A fairly demanding test of integrity!

Loose ends - 2

- Representation inside ANSWER-TIMES of “internal” and “external” regions needs to be refined
- RES graphics mechanism needs to be adjusted to cater for trade links to external regions
- Role of special _GLOBAL region (introduced into ANSWER-MARKAL to handle cross-region constraints) needs to be examined/determined
- Improvements to better handle special needs of TIMES
  - e.g. New Process specification form incorporating I/O Commodities and facilitating definition of Process Commodity Group
- Allow >10 character Item names, etc, etc
- “Nothing is particularly hard if you divide it into small jobs”
  - Henry Ford
Future Intentions

◆ Operational ANSWERv6 multi-region ANSWER-TIMES prototype available for distribution to interested ETSAP Partners by end of 2005
◆ Improvements to better handle special needs of TIMES introduced in first quarter of 2006
◆ Very interested to collaborate with ETSAP TIMES experts to construct ANSWER-TIMES training databases
◆ Inform existing ANSWER-MARKAL clients that ANSWERv6 for TIMES is available for evaluation
◆ Enhancement to support new TIMES features, if there appears to be a demand

Acknowledgments

◆ Antti Lehtila, VTT Energy Finland (see Special Acknowledgements)
◆ Uwe Remme, IER Germany for his knowledgeable and expert assistance in Dec. 2004 and June 2005 with single-region ANSWER-TIMES
◆ GianCarlo Tosato, ETSAP Project Head, for providing funding assistance to Noble-Soft Systems to investigate feasibility of creating multi-region ANSWER-TIMES
◆ TIMES Model Documentation authors (Richard Loulou, Uwe Remme, Amit Kanudia, Antti Lehtila, Gary Goldstein) for doing such a good job
◆ The single-region ANSWER-TIMES users who encouraged me to pursue the further development of ANSWER-TIMES