TUGlab Users Guide

Miguel Ángel Mirás Calvo Departamento de Matemáticas Universidad de Vigo

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Introduction

The package TUGlab (Transferable Utility Games laboratory) is a Matlab program that could serve as a helpful complement to the books and other materials used in introductory courses on cooperative game theory. Its main goal is to emphasize the geometrical aspects of cooperative game theory. TUGlab offers to both the instructor and the student a tool to compute and visualize basic concepts for any given 3 or 4 persons TU games. It allows the user to experiment at will with games without worrying about the mathematical complexity of the computations. That is the power of this platform: its direct and flexible way of going to the heart of the concepts overcoming the mathematical complexity.

The TUGlab platform works on any implementation of the later releases of the Matlab product: Matlab 6 and Matlab 7 on Unix, PC or Macintosh. It is a collection of 53 files including:

- 1. The main scripts (28 files) defining the procedures concerning game theory concepts.
- 2. Auxiliary scripts (23 files) necessary for the computations but not directly related to game theory.
- 3. Data files (2 files with extension .mat).

Both the main scripts and the auxiliary scripts can be run directly from the Matlab Command Window.

The main scripts are:

- 1. additivegame Checks if a TU game is additive.
- 2. admissiblegame Checks if a TU game is compromise admissible.
- 3. balancedgame Checks if a TU game is balanced.
- 4. belongtocore Checks if a given point belongs to the core of a TU game.
- 5. convexgame Checks if a TU game is convex.
- 6. corecenter Computes the corecenter of a TU game.
- 7. corecoverset Draws the core-cover of a 4-person compromise admissible TU game.

- 8. **corecoververtices** Computes the vertices of the core-cover of a 4-person compromise admissible TU game.
- 9. coreset Draws the core of a balanced TU game.
- 10. corevertices Computes the vertices of the core of a TU game.
- 11. **dualgame** Returns the dual game of a TU game.
- 12. essentialgame Checks if a TU game is essential.
- 13. harsanyidividends Computes the Harsanyi dividends of a TU game.
- 14. harsanyiset Draws the Harsanyi set of a TU game.
- 15. imputationset Draws the imputation set of an essential non-degenerate TU game.
- 16. imputationvertices Computes the vertices of the imputation set of a TU game.
- 17. MLExtension Returns the multi-linear extension of a TU game.
- 18. monotonicgame Checks if a TU game is monotonic.
- 19. normalizedgame Provides both the 0 and 0-1 normalizations of a TU game.
- 20. nucleolus Returns the nucleolus of a TU game.
- 21. Shapley Computes the Shapley value and the marginal worth vectors of a TU game.
- 22. superadditivegame Checks if a TU game is superadditive.
- 23. tauvalue Computes the tau-value of a TU game.
- 24. totalbalancedgame Checks if a TU game is totally balanced.
- 25. utopiapayoffs Returns the utopia payoffs of a TU game.
- 26. weberset Draws the Weber set of an essential non-degenerate TU game.
- 27. webervertices Computes the vertices of the Weber set.
- 28. zeromonotonicgame Checks if a TU game is 0-monotonic.

The characteristic function of the game must be introduce as a vector A=[v(1) v(2) v(3) v(12) v(13) v(23) v(123)], for 3 persons games, or A=[v(1) v(2) v(3) v(4) v(12) v(13) v(14) v(23) v(24) v(34) v(123) v(124) v(134) v(234) v(1234)], for 4 persons games. So, for example, the next commands

A=[0 0 0 100 200 300 400];[control,info]=convexgame(A)

produce the outcome

control = 0 info = $v{123}-v{23}<v{13}-v{3}$

which tells us the the game given by A is not convex because the inequality v(123) - v(23) < v(13) - v(3) holds.

To draw, for example, the core of a game A it is optimal to plot the imputation set first and then superimpose the core. The following commands

```
A=[0,0,0,0,10,40,30,60,10,20,90,90,120,130,160];
clf
imputationset(A)
hold on,axis(axis)
coreset(A)
```

produce the picture



The 23 auxiliary scripts are:

CCimputation3.m	centroidgame3.m	checkbounds.m
checksegment.m	convexhullextremes.m	corecoverinfo.m
coreinfo.m	efficiency.m	facetsorder.m
gramschmidt.m	harsanyisetinfo.m	heronformula.m
hiperplane.m	imputation3plot.m	imputationset3white.m
linprog.m	lipsol.m	poligonorder.m
repeatedrows.m	weber4aux.m	weberinfo.m
weberinfoExtra.m	weberverticesExtra.m	

Finally, there are two data files: intersecciones.mat and interseccionesCC.mat. Please, report any bugs or suggestions about TUGlab to:

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mmiras@uvigo.es or esanchez@uvigo.es
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All comments would be welcome.