Risk and Decision Making (Part II - Game Theory) Syllabus
MIT/Portugal 2 pages
Professor João Soares October 8th, 2007

Topic

The purpose of this part of course is to teach students to formulate problems as mathematical games and provide the basic tools to solve them. We will cover:

- Two-person zero sum games. We will start with the Strategic Form of a Game, analyse the so-called Matrix Games. We will talk about players, payoffs, strategies, etc. and the actual solving of Finite Games. We will also discuss the Extensive Form of a Game.
- Two-person general sum games. Noncooperative and Cooperative theory. The main concept in noncooperative theory is the strategic (or Nash) equilibrium. The cooperative theory is itself broken down into two branches: Transferable Utility models, in which side payments are allowed; and Non-Transferable Utility models, in which we assume that the payoffs of each player have distinct monetary units. In the latter case, the main concept is the Nash bargaining model.
- Games in coalitional form. Here we consider Many-Person Transferable Utility (Cooperative) Games. We will discuss ways to reach an agreement on a fair division. The central concepts are those of Imputations, the Core and The Nucleolus. We will also talk about the Shapley Value and, in particular, the Shapley-Shubik Power Index.

Textbooks

The main textbooks are Part II and Part III of

> Game Theory (lecture notes), Thomas S. Ferguson, Math Department, UCLA.

electronically available at `http://www.math.ucla.edu/~tom/Game_Theory/Contents.html`; Chapter 4 of

> An Introduction to Game-Theoretic Modelling, Michael Mesterton-Gibbons, AMS, 2nd ed, 2000.

and Chapters 1-10 of

Strategies and Games - Theory and Practice, Prajit K. Dutta, The MIT Press, 1999.

The latter can be replaced by any book with an emphasis on the application side of game theory.

Homework Assignments

There will be two homework assignments

- Problem exercises on two-person games.
- Model real situation in game theoretic terms.

Detailed Program

In units of one hour we will cover the program as follows.

Class, Date	Content	References
01, Oct 08	Introduction. The strategic form of a game.	[TF,2.1]
02, Oct 08	The minimax theorem. The principle of indifference.	[TF,2.2+3]
03, Oct 08	Solving finite games. The extensive form of a game.	[TF,2.4+5]
04, Oct 08	Review and sketch proof of selected exercises.	[TF,2]
05, Oct 09	Bimatrix games. Safety levels.	[TF,3.1]
06, Oct 09	Noncooperative games (Nash equilibria)	[TF,3.2]
07, Oct 09	Models of duopoly (Cournot)	[TF,3.3]
08, Oct 09	Cooperative Games (with TU and with Non TU)	[TF,3.4]
09, Oct 15	Review and sketch proof of selected exercises.	[TF,3]
10, Oct 15	Games in coalitional Form. Characteristic functions.	[MM,4.1]
11, Oct 15	Imputations and the Core.	[MM,4.2,3]
12, Oct 15	Coreless games	[MM,4.4]
13, Oct 16	The Nucleolus	[MM,4.5]
14, Oct 16	Improper games	[MM,4.6]
15, Oct 16	The Shapley value functions. The Shapley-Shubik power index.	[MM,4.7+8]
16, Oct 16	Review and sketch proof of selected exercises	[MM,4]

Thus, we will cover most of what is covered in the first two references. Copies of the MM reference will be made available.