

## INITIAL COURSE PROPOSAL (Ph.D. IN MATHEMATICAL ENGINEERING, STATISTICS AND OPERATIONS RESEARCH)

**Title:** GAME THEORY AND APPLICATIONS

**Contents:**

1. Game Theory. A general introduction.
  - a. Non cooperative games: Nash equilibrium.
  - b. Cooperative games. TU games. Solution concepts: The Shapley value and the Core.
  - c. Cooperative TU games with restrictions in the communication. The Myerson value and the Position value. (2 hours).
2. Some Extensions on the solution concepts for Cooperative TU games.
  - a. Shapley value characterizations.
  - b. Sample computation of the Shapley and Myerson values.
  - c. Pyramidal values.
  - d. Group values (5 hours)
3. Game Theory approaches to the analysis of centrality, cohesiveness and clustering in social networks.
  - a. Game theoretical measures for centrality of individuals in social networks, directed social networks and weighted social networks.
  - b. Cohesiveness measure for subgroups in social networks. Clustering in social networks. (6 hours).
4. Bayesian Nash Equilibrium. Auctions. (2 hours).

**Summary:** The aim of this course is to provide students of knowledge in one of the disciplines of Operational Research that has obtained more relevance in recent years not only in the mathematical environ but also in the economic one. We are talking about Game Theory. After giving some general overview, the course focus in the applications of Game Theory to which the instructors have developed some contributions: solution concepts and its characterizations for cooperative TU games, auctions, centrality, cohesiveness and clustering measures in social networks.

**Responsible for the activity:** Juan Tejada ([jtejada@mat.ucm.es](mailto:jtejada@mat.ucm.es))

**Involved instructors:** Estrella Alonso, Javier Castro, Daniel Gómez, Enrique González-Arangüena, Conrado Manuel, Juan Tejada.

**Total number of hours:** 15

**Location:** Dpt. of Statistics and Operational Research I. Fac. Mathematical Sciences. UCM

**Dates:** December 11, 12, 13, 14, 15, 18 and 19, afternoon-evening.

**Comments:** The course is programmed as a self-containing one. So the students only need the prerequisites of the general program.

**Would you accept that the course could be given by videoconference restricted to some doctoral students who could not attend in person?** Yes