Discipline Syllabus

«Methods of Decision Making»

1. Course Description

a. Title of a Course: «Methods of Decision Making»

b. Lecturer: Vitaly Molostvov

c. Pre-requisites: basic courses in Calculus, Linear Algebra, Theory of Probability

d. Course Type (compulsory, elective, optional): compulsory

e. Abstract

The course includes main notions and stages of decision making, relevant mathematical models and methods, namely, linear and nonlinear programming, multi-objective and dynamical optimization methods, game considerations and their use in applied problems.

2. Learning Objectives: To familiarize students with basic concepts, models and methods of decision making.

3. Learning Outcomes:

- Know principles of mathematical models construction in decision analysis;
- Be able to choose rational options in practical decision-making problems;
- Have skills in analysis of game-theoretic models.

4. Course Plan:

Topic 1. Introduction. Participants and stages of decision making (DM). Mathematical models and methods in DM.

Topic 2. Linear optimization models and Linear Programming (LP). Examples. Geometry and Algebra of LP problems. Simplex method. Duality in LP. Integer LP.

Topic 3. Nonlinear optimization models and Nonlinear Programming (NLP). Classical optimization. Nonlinear programming. Khun-Tucker conditions in convex programming problem. Idea of numerical methods.

Topic 4. Multicriterial Decision Making (MCDM). Vectorial criteria, decision and criterial spaces, multicriterial preferences. Pareto optimality. Linear convolution method, the method of main criterion, goal programming and other methods to choose specific efficient decision. DM in condition of uncertainty

Topic 5. Methods of dynamic system optimization (with discrete time). State and control variables. Bellman function and Bellman principle, method of dynamical programming.

Topic 6. Models of network planning.

Topic 7. Matrix games. Equilibrium solutions and their properties. Game as a model of conflict situations. Examples. Classification of games. Minimax and maximin strategies. Saddlle point. Nonzero sum games. Equilibrium points, their properties vs saddle points.

Topic 8. Methods to calculate equilibrium solutions in conflict situation with finite strategy sets of participants. Methods to solve ((2x2), (2xn) and (mx2) matrix games. Solution of arbitrary (mxn) matrix game by reducing to a corresponding LP problem. Method of the best response to solve nonantagonistic two-player games.

5. Reading List

a. Required

Aleskerov F., Bouyssou D., Monjardet B. Utility Maximization, Choice and Preference, Springer Verlag, Berlin, 2007

Intriligator M. Mathematical optimization and economic theory, Prentice-Hall, N.Y., 1971.

Fishburn P. Mathematics for Decision Theory, The Hague, Mouton, 1972.

Luce R.D., Raiffa H. Games and Decisions, New York, Wiley, 1957.

Yu P.L. Multiple criteria decision making: concepts, techniques, and extensions. – New York: Plenum Press, 1985.

b. Optional

Aizerman M., Aleskerov F. Theory of Choice, Elsevier, North--Holland, 1995.

Takayama A.. Analitical Methods in Economics. Ann Arbor, the University of Michigan Press, 1996.

Fletcher R. Practical methods of Optimization. Wiley, 2000

Rardin R.L. Optimization in Operations Research. Prentice Hall, 1997.

Walsey L.A. (1998) Integer Programming. Wiley.

Miettinen K. (1999) Nonlinear multi-objective optimization. Kluwer Academic Publishers.

Martin J. Osborne, An introduction to game theory, Oxford University Press, 2003

6. Grading System

10% work on seminar + 40% mid-term exam + 50% final exam.

7. Guidelines for Knowledge Assessment

8. Methods of Instruction

The discipline is delivered through lectures and seminars, including computer classes.

9. Special Equipment and Software Support (if required): Computer classes