

George Mason University

Department of SEOR and Mathematical Sciences Department.

Spring 2011

Professor Roman A. Polyak

**OR 649/Math 493/Econ 496/SYST 465: Pricing in Optimization and Game Theory
Tuesday 4:30-7:10 pm. Robinson Hall A107**

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Text: Wayne Winston, M.Venkataramanan “*Introduction to Mathematical Programming*”, *Fourth Edition Book/Cole Thomson Learning Inc. 2003.*

Course Summary: Finding the adequate mechanism for pricing limited recourses, goods and services is one of the main goals of theoretical analysis complex systems. On the other hand pricing is one of the main ideas for developing numerical methods to find optimal solutions and economic equilibrium. This reflects the fundamental role of the Classical Lagrangian and the Lagrange multipliers in constrained optimization.

In the first part of the course we will cover the basic ideas and methods in Linear Programming (LP) and Matrix Games (MG) and show the intimate relation between solving the dual pair of LP and finding equilibrium in MG. The fundamental role of pricing in LP will be particularly emphasized: duality, sensitivity analysis and LP decomposition.

In the second part we will introduce some basic facts of the Nonlinear Optimization (NLP). We will use these facts for establishing existence of equilibrium in a Linear Exchange (LE) model and for developing the pricing mechanism for finding the equilibrium.

We conclude by introducing the Nonlinear Equilibrium (NE) and consider methods for finding NE.

There will be homework assignment and a project.

Grading: 15% homework; 35% midterm exam; 10% project; 40 % final exam.

Course Schedule

1. Real life applications that led to LP and NLP formulation.
2. Simplex method
3. Shadow prices, sensitivity analysis (review)
4. Duality in LP: basic duality theorems and their economic interpretation
5. Pricing mechanism in LP. Dantzig-Wolf decomposition
6. Two person MG. Pure and mixed strategies. The basic John Von Newman theorem for MG
7. MG and duality in LP. Solving MG using LP methods

Midterm

8. Braun-Robinson iterative method for solving MG. Pricing Mechanism for LP based on BR method
9. Basics in NLP: KKT conditions and duality in NLP.
10. Existence of equilibrium in LE market model
11. Finding Equilibrium in LE model.
12. Nonlinear Equilibrium and pricing mechanism for finding NE.

Final Exam: May 17, 2011.