





3. Simple syntax, introduction to the solvers

NLP (non-linear programming, used in constrained optimization)

MCP (mixed complementarity programming - for  $n \times n$  systems of equations and inequalities in  $n$  bounded (e.g., non-negative) unknowns)

direct solution as an NLP (non-linear programming) problem

solution using first-order condition as an MCP (mixed complementarity problem)

derivation of the cost function and alternative MCP solution.

4. Theory light: the Karush-Kuhn-Tucker theorem

fundamental result for optimization. Tells us we can convert a non-linear constrained optimization problem into a set of equations and inequalities in matched variables.

5. Introduction to complementarity

example of supply and demand: three types of solutions to two inequalities and unknowns with non-negative price and quantity

correspondence between equations and unknowns

use and interpretation of marginals (aka slack variables)

6. Maximizing utility subject to a budget constraint

formulated as an nlp

formulated as an mcp using the KKT (first-order) conditions

interpreting marginals as shadow values and Lagrangean multipliers

deriving Marshallian demand functions

deriving Hicksian demand functions, expenditure function

**Preliminary and incomplete - January 12, 2015**

7. Brief presentation of the Newton method for solving  $n \times n$  problems
8. Introduction to general equilibrium modeled as a complementarity problem  
Intro2.pdf, Part B  
conditions for equilibrium: zero profits, market clearing, income balance  
micro consistency
9. A basic two-good, two-factor general-equilibrium model  
model M21.gms  
assessing and interpreting counter-factuals
10. Variations on the basic model  
specific factors of production, income distribution  
slack activities; e.g., solar and wind power unprofitable at market prices  
labor-leisure choice  
two households with different preferences, income distribution
11. Taxes, distortions, public goods and bads  
benchmarking with taxes  
labor supply and distortionary income taxes  
equal-yield tax reform with endogenous labor-leisure choice  
modeling a public good or bad (pollution)  
endogenous, optimal provision of the public good
12. Open (trading) economy models  
modeling a small open economy  
tariffs versus real trade costs  
small economy with a benchmark tariff  
quantitative restriction such as a quota  
modeled as an endogenous tax equivalent  
modeled as a license: an artificial commodity  
benchmark trade imbalance  
large open economies and the optimal tariff argument
13. Increasing returns to scale and imperfect competition  
simple monopoly, markup formulae  
oligopoly with free entry and exit  
monopolistic competition
14. Added topics  
games with continuous strategies as a complementarity problem  
sets and conditionals  
games with discrete strategies  
balancing a matrix to achieve micro-consistency  
comparative steady-state analysis

## Policies, Etiquette

**E-mail policy:** you may email me with small questions, but I tend not to answer questions that have been answered twice in class. *You are responsible for what is presented in class, including revisions to the syllabus and changes in mid-term dates.*

**Class attendance policy:** Since there is no textbook and we are making things up as we go along, class attendance is mandatory.

**Athletics, clubs events, religion, weddings, etc. policy:** all these things are known well ahead of time. If you have a conflict with an exam, tell me this week or forever hold your peace.

If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, and [www.Colorado.EDU/disabilityservices](http://www.Colorado.EDU/disabilityservices) Disability Services' letters for students with disabilities indicate legally mandated reasonable accommodations. The syllabus statements and answers to Frequently Asked Questions can be found at [www.colorado.edu/disabilityservices](http://www.colorado.edu/disabilityservices)

Campus policy regarding religious observances requires

who are found to be in violation of the academic inte