## 3. Simple syntax, introduction to the solvers

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

MCP (mixed complementarity programming - for nxn 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 functon

Preliminary and incomplete - January 12, 2015

- 7. Brief presentation of the Newton method for solving nxn 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

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**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.

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http://www.colorado.edu/policies/classbehavior.html and at

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