



Computational
tools for
economics and
management

Paolo
Pellizzari

Instructor
Research

Contents

Course and
exam

One more
thing

Today

Computational tools for economics and management

2010/2011

Paolo Pellizzari

March 23, 2011



Computational tools

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Today

- Instructor
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- Contents
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- Miscellanea



CompTools: instructor

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Today

- Paolo Pellizzari: paolop@unive.it
<http://virgo.unive.it/paolop>

- Student time

	Day	Time
VE (S. Giobbe C/106)	Friday	10.00 - 11.30
TV (S. Paolo)	Monday	12.00 - 13.30

- All changes to the schedule are published. Check the page for updates

- Lectures

Wednesday | 14.00-15.30, S. Giobbe 10B

Thursday | 14.00-15.30, S. Giobbe 10B

Friday | 14.00-15.30, S. Giobbe 10B

- **NO lecture on Thu 24 March - TOMORROW!**
NO lecture on Wed 13 April



My research

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- Monte Carlo simulation
 - Derivative assets and option pricing
 - Artificial markets
 - Agent-based models in economics and finance



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Today

Topics

- Introduction to Computational Economics
- Ramsey growth model: OpenOffice (Excel)
- Neural networks: OpenOffice (Excel)
- The transportation model: GAMS
- Financial planning: GAMS
- General equilibrium models: GAMS



CompTools: course

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- Online material on the web page of the course
<http://virgo.unive.it/paolop/comptools.html>
- Textbook: Kendrick D., Mercado, R., Amman H.,
"Computational Economics", Princeton University Press,
2006
- The first two chapters (included in the program) can be
downloaded at
<http://press.princeton.edu/titles/8173.html>
Download the first chapter asap!
- The authors' website is at
<http://www.laits.utexas.edu/compeco/>
- Links to download software will be provided: OpenOffice
and GAMS
- Handwritten notes and computer practice. . .



CompTools: examination

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- Written test with:
 - 1 Multiple choices
 - 2 Open questions on models
 - 3 Computer outputs to be commented, solved or described
- (Probably) oral discussion of a written project to get 25+.
- This course will be an *agony* and *you'll get poor results* if you do not practice on a computer. Start now!



CompTools: software

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- Mac, Windows, Unix and Linux are ok...
- You need OpenOffice
 - ➊ Go to <http://www.openoffice.org/> and download your version
 - ➋ Get the Non-Linear solver at <http://extensions.services.openoffice.org/project/NLPSolver>
 - ➌ Install the NLPSolver extension in your OO.
 - ➍ Alternatively, Excel with the solver can be used (but OO is preferred).
- You need GAMS.
 - ➊ Read the instruction on the link provided on the web page.
 - ➋ Further info and assistance in week 3.



CompTools: misc

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- Università, *Universitas*. . . Studio, *Studium*. . .
- “I’m interested in the future because I plan to stay here for the next few years”
- Faculty dean (email pres.economia@unive.it), Economics and Management (email acomac@unive.it), Pellizzari (email paolop@unive.it)
- Difensore degli studenti, students’ defender: difenso@unive.it
- Teaching evaluation forms



Today: computational economics at large

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Today

- Numerical analysis applied to economic problems (say, linear and non-linear programming, optimization)
- Non standard computational tools for economic problems: simulation, data-mining, neural networks, genetic algorithms
- Analysis of “new” models that are almost intractable without computers. Often the description of the model is itself an algorithm or a fragment of code.

Features

- 1 Lots of agents
- 2 Massive interaction
- 3 Feedback effects, non-linearities and emergent behaviour



What's optimization?

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Today

(inspired to <http://www.solver.com/tutorial.htm>)

- We look for the best way to allocate scarce resources
 - ① Resources: time, capital, raw material in limited supply
 - ② Best: we want to maximize, say, profits and quality or minimize cost and risk.
- Examples: portfolio optimization, blending, routing.
- To have a model, you must
 - ① know the variables (what you decide)
 - ② specify the constraints
 - ③ have an objective
- Not far from real life...



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What's optimization? II

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Today

- Decision variables measure amounts of things to be allocated: money, hours, lorries. . . In a way they are your “actions”
- The objective is a function of the variables
- Constraints reflect real-world limits on your decisions. Some actions just cannot be taken
- In a spreadsheet
 - ① Decision variables are stored in a set of cells. They contain numbers.
 - ② The objective is a formula in a cell. It produces a single result as a function of the decision variables (other cells)
 - ③ Constraints involves two cells: “cell A \leq cell B” or similar. Cells A and B have formulas, that involves the decision variables



What's optimization? III

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Today

- Constraints can be
 - ① General: $\sum_i x_i = 1$
 - ② Bounds: $hours \leq 8$
 - ③ Policy-related: $f_{employee} \geq 20\%$
 - ④ Physical: money (often) and time cannot be negative
- Some decision variables can be integral (e.g., employees)
- Some decision variables are *binary*: 1 or 0, often meaning that something *is* or *is not* done
- *Feasible solution*: a set of values for all the variables such that no constraint is violated
- *Optimal solution*: a feasible solution for which the objective is best (maximized or minimized)



What's optimization? IV

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- *Globally optimal solution*: there are no other better feasible solutions whatsoever.
- *Locally optimal solution*: no better feasible solutions “in a neighborhood” .
- Humans would like global optimality but often computers only find good solution (improving the current situation) and local optimizers
- Optimization can be extremely hard when
 - ① There are many variables [size]
 - ② The objective function is mathematically nasty [smoothness, convexity]
 - ③ Constraints are integral
- Let's try with the famous Ramsey growth model. . .



Ramsey growth model

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Today

- Consumption and investment (same as consumption and saving)
- Production function: capital is used to produce output
- Capital accumulation relationship and consumption
- Utility function

Intertemporal consumption

- More consumption in a period means more utility...
- ... but also less investment and, hence, less consumption in the future