University of California, Santa Barbara (UCSB)

Bren School of Environmental Science and Management

Intensive course

Sustainable Management of Natural Resources: A Viability Perspective

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Key Words. Natural resources management, Economics, Ecology, Sustainability, Viability, Multicriteria approach, Modeling, Simulation, Uncertainty.

Language. English.

Location. Bren School of Environmental Science and Management

Website. http://cermics.enpc.fr/~delara/ENSEIGNEMENT/UCSB2011/UCSB2011.html
Evaluation. Presence and participation. Computer practical works notation.

Short description.
This course introduces the viability approach, a dynamic and multicriteria framework to deal with sustainability issues. This approach allows researchers of different disciplines (e.g., economics, biology, sociology) to develop a common dynamic model to describe the system under study, and define the sustainability objectives with constraints that have to be satisfied at all times (e.g., economic, ecological and social constraints). This provides powerful tools for sustainable decision-making. During the whole course, the viability approach will be compared to usual economic and ecological approaches. This approach will be applied to natural resources management (nonrenewable and renewable resources). Deterministic and uncertainty cases will be studied. Both theoretical and practical methods will be presented. Practical exercises in computer lab will allow the student to apply what has been learnt to real world case studies (fisheries management, epidemics control).

Skills acquired.
Knowing and using concepts, models, mathematical and numerical methods of viability theory allowing to formalize and to treat issues concerning sustainability and precaution in the management of natural resources and of the environment, more specifically:

- *mathematical concepts*: state control dynamical models in discrete time, equilibrium and stability, viability and invariance, intertemporal optimality, stochastic and robust control,
- *methods:* linearization, maximum principle, dynamic programming,
- *simulation tools:* algorithms, Scilab programming.

We focus on examples related to the exploitation of renewable or exhaustible resources and to greenhouse gases mitigation. We propose a common framework of sequential decision allowing to take into account uncertainties, ecological and economic requirements, intergenerational equity.

Teaching courses and practical work with software Scilab alternate to make intuitive the more abstract and formal parts of the course.

1 Program

Introduction: Sustainability and Viability

2011 Monday November 14, 4:30–7pm. Classroom BH 1510.

slides

Introduction to the economics of sustainability, Sustainability criteria, Conservation issues, Consequences for natural resources management.

Introduction to the theory of viability: principle, interpretation in the context of sustainability theory, application to nonrenewable resources economics (the climate change issue), application to renewable resources economics (the fishery).

(Heal, 1998) (Martinet, 2007) (Martinet and Doyen, 2007) (Martinet, 2011) (Martinet, 2012) (Neumayer, 2010)

Viabilty for the Management of Natural Resources

2011 Tuesday November 15, 5–7:30pm. Classroom BH 1510.

Viability : examples, theory and methods. *slides*

Examples of natural resource management models and of environmental economics models: exhaustible resource, forest management, fishing management, CO_2 emissions mitigation, etc. Introduction to state control dynamical models in discrete time. Constraints, strategies.

(Béné, Doyen, and Gabay, 2001; Béné and Doyen, 2000, 2003; Martinet and Doyen, 2007; Rapaport, Terreaux, and Doyen, 2006; Martinet, Doyen, and Thébaud, 2007; Martinet, Thébaud, and Rapaport, 2010) (De Lara and Doyen, 2008)

Viable and Guaranteed Harvesting Management

2011 Wednesday November 16, 6–8:30pm. Computer laboratory BH 3035.

Computer laboratory: practical work with software Scilab.

Introduction to Scilab.

Viable harvesting of a renewable resource.

Viability and Uncertainty

2011 Friday November 18, 9–11:30am. Classroom BH 1510.

Control dynamical systems with uncertainty. *slides*

Introduction to stochastic viability. Comparison with expected discounted utility. *slides*

Illustration with the case of fisheries management. *slides*

(Doyen, De Lara, Ferraris, and Pelletier, 2007; De Lara and Martinet, 2009; Doyen and De Lara, 2010)

Sustainable Management of Fish Stock

2011 Friday November 18, 1–3:30pm. Computer laboratory BH 3035.

Computer laboratory: practical work with software Scilab.
Sustainable management of fish stock based on spawning stock biomass indicator.
(De Lara, Doyen, Guilbaud, and Rochet, 2007a,b)

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