

## Faculty of Biological, Agronomic and Environmental Engineering

### BRTI2101 Decision aids and operational research

[37.5h+15h exercises] 4 credits

**Teacher(s):** Frédéric Gaspart, Michel Herman  
**Language:** French  
**Level:** Second cycle

#### Aims

The course is divided in two parts.

##### Part 1

1. Understanding decision processes and the various methods of decision making most commonly relied upon in agronomics, environmental sciences, economics and management
2. Taking into account risk and multi-criteria objectives
3. Formulating decision problems as they occur in agronomics and in natural resources management ; picking adequate methods

##### Part 2

4. Being able to use modelling, optimization and calibration techniques commonly used in operations research
5. Formulating and solving decision problems with mathematical programming softwares
6. Mastering these concepts and techniques so that they can be used in subsequent courses.

#### Main themes

##### Part 1

After an introductory list of typical decision problems for the bio-engineer, the course outlines, explains and compares various methods and decision making tools available in natural and social sciences. It distinguishes (and shows the complementarities of) statistics, natural sciences, environmental sciences and economics. Multi-criteria decisions and decisions under uncertainty are illustrated with examples taken in the fields of agricultural and agro-food production, natural resources management and land use.

##### Part 2

This part focuses on the basic concepts of operations research and their applications, especially the allocation of resources, location choices, transportation, inventories, Poisson processes, diet design, risk analysis and post-optimal analysis. Supervised exercises are explicitly proposed to apply and illustrate the concepts and the tools studied in the course in the specialized fields of interests of the students.

#### Content and teaching methods

##### Part 1

1. Individual choice under risk and uncertainty, VNM utility, risk aversion
2. Elements of Game Theory : games in normal form and extensive form
3. Non-cooperative bargaining, credibility, verifiability
4. Cooperative bargaining
5. Introduction to economic contract theory (moral hazard, screening, signalling)

Three times, students will receive problems to solve within ten days.

##### Part 2

1. Linear programming : algorithm, shadow price, binary variables
2. Network theory and PERT
3. Poisson processes
4. Simulations

Supervised exercises will be run by the teaching assistant in charge of the course.

**Other information (prerequisite, evaluation (assessment methods), course materials recommended readings,**

...)

Pre-requisite: knowledge and know-how in the basic courses of the bio-engineer's program, namely mathematics, system analysis, micro-economics (BIR1342 or 1343)

Related courses: Integrated exercises, Interdisciplinary project in agronomics, Integrated project, Land use seminar, M.A. thesis

Logistic support: reference manuals, articles, software

### Programmes in which this activity is taught

<b>BIR2</b>	Bio-ingénieur
<b>ECRU3DS</b>	Diplôme d'études spécialisées en économie rurale

### Other credits in programs

<b>BIR22/0A</b>	Deuxième année du programme conduisant au grade de bio-ingénieur: Sciences agronomiques (Technologies et gestion de l'information)	(4 credits)	Mandatory
<b>BIR22/0E</b>	Deuxième année du programme conduisant au grade de bio-ingénieur: Sciences et technologies de l'environnement (Technologies et gestion de l'information)	(4 credits)	Mandatory
<b>BIR22/5E</b>	Deuxième année du programme conduisant au grade de bio-ingénieur : Sciences et technologie de l'environnement (Aménagement du territoire)	(4 credits)	Mandatory
<b>BIR23/0C</b>	Troisième année du programme conduisant au grade de bio-ingénieur: chimie et bio-industries (Technologies et gestion de l'information)	(4 credits)	Mandatory
<b>ECRU3DS</b>	Diplôme d'études spécialisées en économie rurale	(4 credits)	Mandatory