



Course guide

200617 - PE - Stochastic Programming

Last modified: 01/06/2023

Unit in charge: School of Mathematics and Statistics
Teaching unit: 715 - EIO - Department of Statistics and Operations Research.
Degree: MASTER'S DEGREE IN STATISTICS AND OPERATIONS RESEARCH (Syllabus 2013). (Optional subject).
Academic year: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: JORDI CASTRO PÉREZ
Others: Segon quadrimestre:
JORDI CASTRO PÉREZ - A
JESSICA RODRÍGUEZ PEREIRA - A

PRIOR SKILLS

Basic knowledge of Operations Research / Optimization / Mathematical Programming and Modelling .

REQUIREMENTS

Introductory course to Operations Research.
Or chapters 1-3 of "F.S. Hillier, G.J. Lieberman, Introduction to Operations Research, McGraw-Hill" (or first chapters of a similar book).

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

3. CE-2. Ability to master the proper terminology in a field that is necessary to apply statistical or operations research models and methods to solve real problems.
4. CE-3. Ability to formulate, analyze and validate models applicable to practical problems. Ability to select the method and / or statistical or operations research technique more appropriate to apply this model to the situation or problem.
5. CE-5. Ability to formulate and solve real problems of decision-making in different application areas being able to choose the statistical method and the optimization algorithm more suitable in every occasion.
Translate to english
6. CE-6. Ability to use appropriate software to perform the necessary calculations in solving a problem.
7. CE-9. Ability to implement statistical and operations research algorithms.

Transversal:

1. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
2. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

TEACHING METHODOLOGY

Theory:

The contents of the course will be presented and discussed by combining theory lectures, and problems and lab sessions.

Problems:

Problems will be interspersed with the theory along with case studies, which will be presented and solved.

Lab sessions:

Laboratory sessions in which the use of software will be demonstrated for solving stochastic programming problems.

Language:

The course can be imparted in either English, Catalan or Spanish.

LEARNING OBJECTIVES OF THE SUBJECT

The goal of this course is to introduce the student to the problems of system modeling in the presence of uncertainty, and familiarization with techniques and algorithms for dealing with them. The course deals with the case of stochastic programming, i.e. the optimization of problems with random variables. Stochastic modelling and programming bases are provided and it is hoped that upon completion of the course the student will be able to identify, model, formulate and solve decision-making problems with both deterministic and as random variables.

Abilities to Be Acquired:

- * Identifying when a problem is suitable to be modeled and solved as a stochastic optimization problem.
- * Formulation of stochastic optimization problems, determining decisions in the first, second and next stages.
- * Knowledge of the basic properties of stochastic optimization problems.
- * Knowledge of specialized solution methods for stochastic problems.
- * Knowledge and use of software for the solution of stochastic problems.

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	24.00
Hours small group	15,0	12.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

Introduction.

Description:

Presentation. Stochastic Programming in OR. Relation to other stochastic methods.

Full-or-part-time: 60h

Theory classes: 38h

Practical classes: 10h

Laboratory classes: 12h

Stochastic modelling.

Description:

Introduction to Stochastic Programming. Examples of models: two-stage, multi-stage, chance constraints, non-linear models. Modeling with uncertainty. Formulation of stochastic problems, risk aversion, chance constraints..



Basic Properties.

Description:

Basic Properties of Stochastic Programming Problems and Theory. Feasible Sets, Recourse Function.

Solution methods.

Description:

(Two-stage Recourse Problems. Decomposition Methods: Primal Problem Solutions (L-shaped method, multicut version); Dual approaches (Dantzig-Wolfe method). Matrix Factorization Methods with exploitation of structure. Interior Point Methods for Stochastic Problems.

GRADING SYSTEM

Exam and completion of classwork. The final mark is 65% of exam and 35% classwork.

BIBLIOGRAPHY

Basic:

- Birge, J.R.; Louveaux, F. Introduction to stochastic programming [on line]. Springer, 1997 [Consultation: 07/07/2023]. Available on: <https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/b97617>. ISBN 1280010053.
- Kall, P.; Wallace, S.W. Stochastic programming. Wiley, 1994. ISBN 0471951587.
- Prékopa, András. Stochastic programming. Kluwer Academic Publishers, 1995. ISBN 0792334825.