Universidad Zaragoza

Academic Year/course: 2022/23

27027 - Stochastic Optimisation

Syllabus Information

Academic Year: 2022/23
Subject: 27027 - Stochastic Optimisation
Faculty / School: 100 - Facultad de Ciencias
Degree: 453 - Degree in Mathematics
ECTS: 6.0
Year: 4
Semester: First semester
Subject Type: Optional
Module:

1. General information

1.1. Aims of the course

Its aim is to provide future professionals with knowledge in the modeling of stochastic systems and in the techniques for solving the associated problems.

These approaches and objectives are aligned with the following Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/), in such a way that the acquisition of the learning outcomes of the module provides training and competence to contribute to some extent to their achievement: (4) Quality education, (5) Gender equality, (8) Decent work and economic growth, (9) Industry, innovation and infrastructure, (10) Reducing inequality, (17) Partnerships for the goals.

1.3. Recommendations to take this course

It is recommended that students attend all classes. Students are expected to prepare the topics throughout the course and to do regular homework assignments to become familiar with the different concepts, some with economic implications, which are the core of the course.

2. Learning goals

2.2. Learning goals

At the end of the course, the student will be able to:

- Model real systems that include randomness.
- Identify real systems that can be modeled by dynamic programming.
- Formulate and solve dynamic programming problems.
- Identify real systems that can be modeled by means of Markov Chains.
- Analyze the transient and stationary behavior of Markov Chains.
- Identify systems that can be modeled using queuing models and recognize their characteristics.
- Represent the transitions diagram of a queuing model and formulate and solve the equilibrium equations.
- Compute the main evaluation measures of the most common queuing models.
- Simulate simple real systems by computer.

3. Assessment (1st and 2nd call)

3.1. Assessment tasks (description of tasks, marking system and assessment criteria)

A written test related to the activities developed in the computer practices (15%).

A simulation work to be presented publicly in front of the class (15%).

A final written exam in the official call (70%).

It will be possible to opt for a continuous evaluation of the subject in which 70% of the score corresponding to the final exam can be obtained as the sum of the scores obtained in three written tests that will be carried out in person throughout the course, corresponding to the three learning blocks: dynamic programming (24%), Markov chains (22%) and queuing theory (24%). In order to be eligible for the continuous evaluation it is necessary to obtain at least 40% of the corresponding score in each of the blocks.

According to the University regulations, the students can refuse the aforementioned system and take only the exams in the official periods as a global test.

4. Methodology, learning tasks, syllabus and resources

4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as lectures, problem-solving sessions and laboratory sessions.

4.2. Learning tasks

This course is organized as follows:

- **Lectures.** They consist on the 30% of the sessions. Lecture slides and other important materials will be posted on Moodle; please check it regularly.
- **Problem-solving sessions.** They consist on the 50% of the sessions.
- **Laboratory sessions.** They consist on the 20% of the classes.

The teaching activities and assessment tasks will take place in a face-to-face mode, except in the case that, due to the health situation, the dispositions emitted by the competent authorities and by the University of Zaragoza compel to take them to a greater or lesser extent in a telematic form.

4.3. Syllabus

- **Topic 1:** Introduction.
- **Topic 2:** Dynamic programming.
- **Topic 3:** Markov chains.
- **Topic 4:** Queuing theory.
- **Topic 5:** Simulation.

4.4. Course planning and calendar

Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course will be provided on the first day of class, or please refer to the Faculty of Sciences website and Moodle.

4.5. Bibliography and recommended resources

- A. O. Allen. Probability, statistics, and queueing theory : with computer science applications. Academic Press, New York, 2nd edition, 1990.
- U. N. Bhat. Elements of Applied Stochastic Processes. John Wiley and Sons, New York, 2nd edition, 1984.
- D. Gross, J. F. Shortle, J. M. Thompson, C. M. Harris. Fundamentals of queueing theory. John Wiley and Sons, 4th edition, 2008.
- D. P. Heyman, M. J. Sobel. Stochastic Models in Operations Research, vol. I. Dover Publications, INC, Mineola, NY, 1982.
- F. S. Hillier, G. J. Lieberman. Introducción a la Investigación de Operaciones. McGrawHill, México, octava edition, 2006.
- L. Kleinrock. Queueing Systems, vol. 1: Theory. John Wiley and Sons, New York, 1975.
- L. Kleinrock. Queueing Systems, vol. 2: Computer Applications. John Wiley and Sons, New York, 1975.
- V. G. Kulkarni. Modeling, Analysis, Design and Control of Stochastic Systems. Springer, New York, 1999.
- A. M. Law, W. D. Kelton. Simulation Modeling and Analysis. McGrawHill, Boston, 3rd edition, 2000.
- A. Ravindran, D. T. Phillips, J. J. Solberg. Operations Research. Principles and Practice. John Wiley and Sons, New York, 2nd edition, 1987.
- K. S. Trivedi. Probability and Statistics with Reliability, Queuing and Computer Science Applications. John Wiley and Sons, 2nd edition, 2002.

- W. L. Winston. Operations Research. Thomsom Brooks/Cole, Belmont, CA, 4th edition, 2004.

http://psfunizar10.unizar.es/br13/egAsignaturas.php?codigo=27027