

OCW 2020

PROPERTIES OF ONE- DIMENSIONAL RANDOM VARIABLES: THEORY AND PRACTICE



COURSE SYLLABUS

Department of Applied Mathematics

Lecturers: Xabier Erdocia Iriarte

Itsaso Leceta Lasa



1. INTRODUCTION

Statistical techniques are used in all areas of science. Statistics is an essential tool in engineering, since it allows us to predict, control and manage the changing phenomena effectively.

The management of mass data in the current society is urgent, especially considering that the data to be treated as a consequence of industry 4.0 will be more and more numerous. Knowing how to draw conclusions from these data is essential.

2. WHO IS IT FOR AND PREREQUISITES

This course is aimed at all students who want to deepen in random unidimensional variables in the statistical field.

To carry out this course it is recommended that students have internalized basic mathematical concepts.

3. OBJECTIVES

The objectives of the course are the following:

- Deepening in one-dimensional random variables
- Knowledge and application of basic distributions
- Know how to solve exercises on random variables using free R software

4. COMPETENCES

With the theoretical and practical material presented in this course, the aim is to assimilate the matter progressively. The competences to develop in the course are:

- G1.** Identify the characteristics that describe the one-dimensional random variable.
- G2.** Recognise and differentiate the main probability distributions.

- G3.** Solve problems using the corresponding statistical method and interpret the results obtained.
- G4.** Be able to solve problems using the computer free R software.
- G5.** Encourage individual learning to adapt to changing environments.

5. COURSE DESCRIPTION

This course introduces the student into the basics of the one-dimensional random variable. The nature of the course is theoretical-practical, where the theory has to be applied in different exercises. The use of free R software is also described as a tool for solving exercises.

The eight weeks course duration is 55 hours. The timeframe defined in the chronogram is designed depending on the necessity of each topic. However, each student can organize their time according to their needs with the aim of acquiring the learning skills.

Firstly, one-dimensional random variable is defined and its moments are described. Then, the functions of one-dimensional random variable are presented. Once the main aspects of one-dimensional variable have been addressed, the most important discrete and continuous distributions will be introduced. Finally, the use of free R software to solve exercises will be explained.

The lecturers that have prepared this course are as follows:

NAME: Xabier Erdocia Iriarte

CATEGORY: Assistant Professor

FACULTY/DEPARTMENT: Faculty of Engineering of Bilbao – Applied Mathematics

KNOWLEDGE AREA: Applied Mathematics

NAME: Itsaso Leceta Lasa

CATEGORY: Assistant Professor

FACULTY/DEPARTMENT: Faculty of Engineering of Gipuzkoa – Applied Mathematics

KNOWLEDGE AREA: Applied Mathematics

6. LIST OF TOPICS

1. LESSON: Moments of the one-dimensional random variable

- 1.1. Concept of one-dimensional random variable.
- 1.2. Mean value.
- 1.3. Moments of the random variable.
- 1.4. Measures of position. Dispersion measures. Fisher coefficients.
- 1.5. Tchebychev's inequality.

In this lesson, the one-dimensional random variable is defined and its moments are described.

2. LESSON: Functions of one-dimensional random variable

- 2.1. Probability function.
- 2.2. Density function.
- 2.3. Distribution function.
- 2.4. Characteristic function.
- 2.5. Generating function.

In this lesson the functions of one-dimensional random variable are defined.

3. LESSON: Discrete distributions of random variables

- 3.1. Binary distribution.
- 3.2. Binomial distribution.
- 3.3. Geometric distribution.
- 3.4. Negative binomial distribution.
- 3.5. Hypergeometric distribution.
- 3.6. Distribution of Poisson.

Once the aspects related to the one-dimensional random variable have been addressed, in this lesson the most important discrete distributions will be shown.

4. LESSON: Continuous distributions of random variables

- 4.1. Uniform distribution.
- 4.2. Exponential distribution.
- 4.3. Normal distribution.

After working with discrete distributions, in the following lesson the continuous distributions are shown.

5. LESSON: Free R software

- 5.1. Installation of R.
- 5.2. First steps with R.
- 5.3. Discrete distributions with R.
- 5.4. Continuous distributions with R.

In this lesson, the use of free software R will be explained for the resolution of exercises on random variables.

7. METHODOLOGY

In order to take the full advantage of this course, the suggested educational method is the following:

- ✓ The student should read the theory of each topic including the most important concepts. If there is any doubt, the bibliography could be checked for clarification.
- ✓ The student should understand the examples that have been already solved by the lecturers, so that by internalising them, students acquire the skills to solve by their own the proposed exercises.
- ✓ After understanding the examples, students should solve the suggested exercises and check that the results obtained are correct.
- ✓ Finally, the self-evaluation test must be performed.

8. TIMELINE

The following schedule details the recommended time for each topic. Within each topic, theory and practice have been differentiated so that the student knows the recommended time to dedicate to each part.

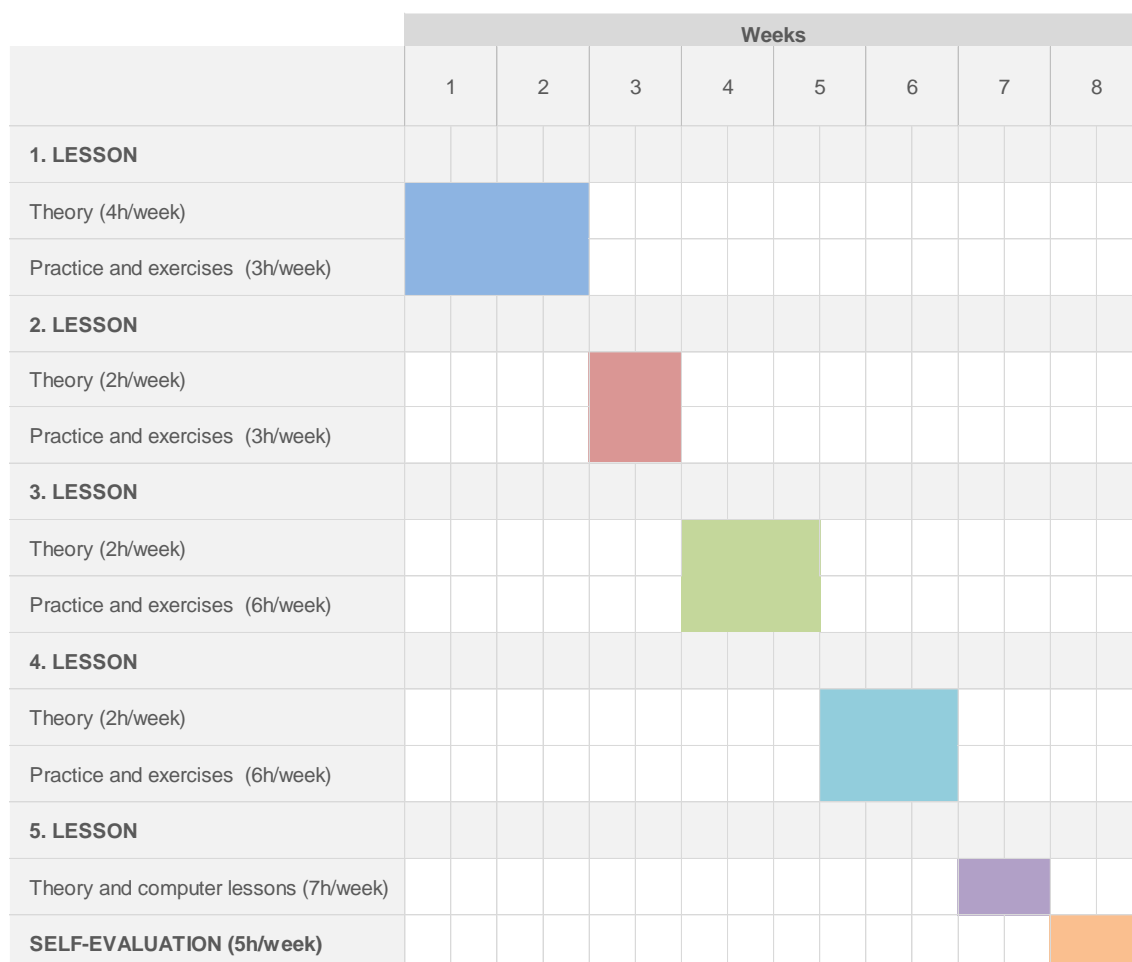


Figure 1. Course timeline.

9. RESOURCES

To carry out this course, it is necessary to have a computer to be able to complete lesson 5: Free R software. Moreover, in addition to the material provided in this course, proposed readings and other resources will be also recommended material.