UNIVERSIDAD DE **MURCIA**

FACULTY OF **MATHEMATICS**

Probability Theory

Syllabus

Course code:	1590
Number of ECTS credits:	6
Semester:	1st (September-January)
Prerequisites:	None
Recommended components:	Elements of probability and statistics (1576). Have general basic knowledge of Combinatorics as well as Matricial algebra, Mathematical Analysis and Measure Theory, particularly the Lebesgue's integral.
Language of instruction:	Spanish. (Students are allowed to write homework and exams in English)

Course description

In this subject the Probability Theory is treated from the point of view of the Measure theory. This measure-theoretic development provides a logically consistent foundation for probability theory and a strong mathematical theory.

Learning outcomes and competences

After completion of this course you will:

1. be able to handle the concept of probability space as a particular case of measure space.
2. know the concept of mathematical expectation for general random variables.
3. be able to handle random vectors and model with them real situations.
4. know and handle properly the concepts of independence of events, of families and of random variables.
5. handle and interpret moments, other characteristics of probability distributions and regression lines.
6. identify real situations which involve the most usual probability distributions.

Course contents

I. Review of the basic concepts of Probability.

   Probability space. Conditional Probability. Probability distributions on $\mathbb{R}$. Distribution function. Random variable.

II. Probability distributions on $\mathbb{R}$ and on $\mathbb{R}^k$.

Discrete distributions on $\mathbb{R}$ *and* $\mathbb{R}^k$*. Continuous distributions on* $\mathbb{R}$ *and* $\mathbb{R}^k$*. Singular distributions on* $\mathbb{R}$ *and* $\mathbb{R}^k$*. Lebesgue's decomposition theorem.*

III. Distribution function.

Distribution function on $\mathbb{R}$*. An example of singular distribution function on* $\mathbb{R}$*. Distribution function on* $\mathbb{R}^k$*.*

IV. Beta and gamma functions.

Beta function. Gamma function. Relationship between beta and gamma functions.

V. Random variables.

Univariate random variable. Multivariate random variable. Functions of a random variable. Functions of random vectors. Independent random variables.

VI. Marginal and conditional distributions.

Marginal distributions. Conditional distributions in the discrete and continuous cases. Independence case. General definition of the conditional distributions. Convolution.

VII. Mathematical expectation.

Mathematical expectation for simple random variables. Mathematical expectation for non negative random variables. Mathematical expectation for general real random variables. Mathematical expectation for complex random variables. Limit theorems. Abstract Lebesgue integral.

VIII. Moments.

Moments of unidimensional random variables. Relationship between moments. Tchebychev's inequality. Other characteristics of probability distributions. Moments for multidimensional random variables. Schwartz's inequality.

References

Main texts

1. Zoroa, P. and Zoroa, N. *Elementos de probabilidades*; DM, 2008.

Supplementary references

1. Evans, M. J. and Rosenthal, J.S. *Probabilidad y estadística*; Reverté, 2005.
2. Feller, W. *Introducción a la teoría de las probabilidades y sus aplicaciones*; Limusa, 1985.
3. Tijms, H. *Understanding probability*; Cambridge University Press, 2008.