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# Signals theory A

## Finalità

The course aims at providing the student with a basic knowledge of probability theory and random variables, with applications to Engineering.

## Programma

Probability theory: concepts from set theory, axioms of probability theory and their consequences. Elements of combinatorics. Conditional probability, total probability theorem and Bayes formula. Repeated trials.

Random variables: introduction to the concept of probability density function. Formal definition of probability density function and the cumulative distribution function. Dirac delta. Continuous and discrete random variables.

Trasformations of random variables: transformation of a single random variable and fundamental theorem. Expected value and Law of the Unconscious Statistician (LUS). Moments and moment generating function. Mixed Bayes formula and continuous version of the total probability theorem. Pairs of random variables and their transformations. Extensions to systems of n random variables. Generalization of the LUS and conditional expectation theorem for n random variables. Correlation. Independence and incorrelation.

Law of large numbers and its statistical interpretation. Statistical interpretation of the covariance. Correlation coefficient. Central limit theorem. De Moivre-Laplace theorem.

More information at:

- <http://www.tlc.unipr.it/bononi/teach.html>

- <http://www.tlc.unipr.it/ferrari/teaching.html>

## Attività d'esercitazione

Weekly assignment of homework problems to the students, without formal grading. Solutions available in the textbook.

## Modalità d'esame

The exam is written only. Duration: 3 hours. The grade of the written exam, if not smaller than 18, is registered as the final grade of the exam, except for special cases, at the teacher's discretion, in which an additional oral exam may be requested. The grade of the written exam must be registered before the next exam date, and expires after that date.

During the written exam, one is allowed to bring:

- 1) a calculator;
- 2) an A4 sheet of paper with formulas.

During the semester, a midterm exam (around the end of April) and an endterm exam (around the middle of June) will be held. All students (regardless of the immatriculation year) can participate.

## Propedeuticità

Geometria, Analisi A

## Testi consigliati

A. Bononi e G. Ferrari: "Teoria della probabilità e variabili aleatorie con applicazioni", McGraw-Hill-Italia, marzo 2005, ISBN: 88-386-62886.

Extra solved problems

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G. Prati: "Esercizi di teoria delle variabili casuali" (collection of solved exercises).