	Introduction to Probability and Statistics	Semester 1
Contributes to	MICAS	

Coordinators:	Philippe CIBLAT, Telecom Paris Aslan TCHAMKERTEN, Telecom Paris	
Volume:	45h	**4.5 ects**
Hours:	Lectures: 30h, Exercises: 12h	
Assessment:	Final Exam	
Language:	English	

Objectives:
The course presents basic statistical concepts needed for communications and learning.

Outcomes:
On completion of the course students should be able to:
- Understand certain fundamental limitations to inference
- Apply the tools to communication and learning problems

Prerequisite
- Real analysis

Syllabus
- Probability
  - probability space
  - independence
  - random variables
  - LLN
  - central limit theorem
  - tails
  - concentration
  - subgaussianity
- Detection and estimation
  - Hypothesis testing, performance bounds
  - Detection: max a posteriori detector
  - Estimation: bayesian approach (mean a posteririo) performance bounds (Cramer-Rao Bound)
  - Estimation: deterministic approach (maximum likelihood, least square), asymptotic analysis.
  - unbiasedness and equivariance
  - Data reduction

Bibliography:

- S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Vol. 1, Prentice Hall, 1993.
- P. Moulin and V. V. Veeravalli, "Statistical Inference for Engineers and Data Scientists", Cambridge, 2019.
- H. Vincent Poor, "An Introduction to Signal Detection and Estimation", 2nd Edition, Springer, 1998.
- H. L. Van Trees, "Detection, Estimation and Modulation Theory", Wiley, 2001.