

MATH-665

**Functional Data Analysis**

Panaretos Victor

Cursus	Sem.	Type
Mathematics		Obl.

Language of teaching	English
Credits	2
Session	
Exam	Written
Workload	60h
<b>Hours</b>	<b>34</b>
Lecture	22
Practical work	12
<b>Number of positions</b>	<b>30</b>

**Frequency**

Only this year

**Remark**

The lectures will run weekly on Thursdays (13:15-15:00) starting on October 3rd and running through the end of the semester.

**Summary**

A rigorous introduction to the statistical analysis of random functions and associated random operators. Viewing random functions either as random Hilbert vectors or as stochastic processes, we will see the interplay between nonparametrics and multivariate statistics in infinite dimensions.

**Content**

Random functions can be viewed as random vectors in a Hilbert space, or as stochastic processes. The former is mathematically convenient, whereas the latter is somewhat more suitable from an applied perspective. This course will consider the statistical analysis of random functions through both lenses and present some of the "curses" and "blessings" of infinite dimensions.

Bochner integration  
 Reproducing kernel Hilbert Spaces  
 Basic operator Theory, Mercer's theorem  
 Random vectors and random functions  
 Mean square vs sample path regularity  
 Karhunen-Loève theorem  
 Weak Convergence, tightness, CLT  
 Gaussian measures and the Hajék-Feldman dichotomy  
 The problem of measurement  
 Functional Principal Components  
 Estimation, testing, regression, (perfect) discrimination  
 The positive definite continuation problem  
 Intrinsic and extrinsic functional graphical models

**Keywords**

Hilbert space, non-parametric statistics, stochastic processes

**Learning Prerequisites****Required courses**

Multivariate Statistics (MATH-444), Probability Theory (MATH-432)

**Recommended courses**

Functional Analysis I (MATH-302)

**Learning Outcomes**

By the end of the course, the student must be able to:

- Describe the main features of the theory and methodology for functional data;
- Operate basic (nonparametric) statistical analyses pertaining to random functions

**Resources****Bibliography**

Hsing & Eubank, "Theoretical Foundations of Functional Data Analysis, with an Introduction to Linear Operators", Wiley

DaPrato and Zabczyk "Stochastic Equations in Infinite Dimensions" Cambridge

**Moodle Link**

- <https://go.epfl.ch/MATH-665>