



### Thematic Course

<b>Academic Year</b>	2023-24
<b>Subject</b>	An introduction to Functional Data Analysis
<b>Instructor</b>	Valeria Vitelli, University of Oslo, Norway
<b>Course description</b>	Functional Data Analysis (FDA) is a branch of Statistics focused on the analysis and interpretation of data on a continuum, meaning that they can be described naturally as smooth curves or functions. Recent technological advances allow collection of data at such high-frequency that classical multivariate statistical techniques are not able to fully capture and describe their complexity, resulting in the flourishing of functional data methodology. FDA can easily be thought of as the collection of all statistical methodologies needed to handle samples of curves. These include mostly classical multivariate statistical methods adapted to the infinite dimensional case, such as regression models, inference, dimensional reduction, and clustering. However, methods that are specifically needed in this context have also been developed, such as data smoothing and registration. FDA methods have been applied quite broadly, from medicine to engineering, from business, to demography and social sciences, affecting nearly all fields of science. This course offers an introduction to FDA from a methodological viewpoint and gives practical guidance to R packages used in such context.
<b>Learning Objectives</b>	The overall objective of the course is that the PhD students in statistics at the DSEAS of the University of Palermo (Italy) develop skills in FDA, both at the theoretical (understanding the methodologies) and practical level (actual implementation in R). At the end of the course the students should be able to identify situations in which they can treat their data as functional, to apply standard FDA techniques (data description, dimensionality reduction, clustering, regression, and inference) and to visualize the results. The course will last 4 days, comprising lectures connected to practical hands-on sessions.
<b>Suggested readings</b>	Ramsay, J.O. and Silverman, B.W. (2005) Functional Data Analysis. Springer, New York. Wang J.-L. et al. (2016). Functional Data Analysis. Annual Review of Statistics and Its Application, Vol. 3:257-295 Gertheiss J. et al. (2023). Functional Data Analysis: An Introduction and Recent Developments. ( <a href="https://www.x-mol.net/paper/article/1734666725643489280">https://www.x-mol.net/paper/article/1734666725643489280</a> )
<b>Course Activity (hrs)</b>	16 hours
<b>Credits</b>	
<b>Assessment Method</b>	Evaluation of the course learning outcome will be carried out via a take-home exam. The students will receive a dataset on Day 3 at lunch time, and they will be requested to analyse the data via a selected FDA technique among those introduced during the course. Evaluation will be carried out in a seminar, where the students will be requested to motivate the choice of analysis, describe the chosen methodology, visualize the data and results, and properly discuss them.



**Università  
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**PhD in  
Economics, Business  
and Statistics**

Dipartimento di  
Scienze Economiche,  
Aziendali e Statistiche

**dSEAS**

<b>Teaching Methods</b>	Theory classes and computer labs
<b>Calendar</b>	25 <sup>th</sup> March - 28 <sup>th</sup> March 2024 (mornings and afternoon)
<b>Contacts</b>	