# Functional data analysis

**Academic Year: ( 2020 / 2021 )** **Review date: 09-07-2020**

**Department assigned to the subject:**

**Coordinating teacher: MUÑOZ GARCIA, ALBERTO**

**Type: Electives ECTS Credits : 6.0**

**Year : 2 Semester : 1**

## REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Multivariate Analysis, general Statistics, Calculus

## OBJECTIVES

1 Knowledge of advanced multivariate data analysis techniques, including functional data analysis tools, support vector machines and neural networks.
2. Ability to describe efficiently multivariate complex data sets.
3. Knowledge of Regression techniques with complex and non-linear data, in very general settings.
4. Knowledge of Classification tecniques for complex and non-linear data, in very general settings.
5. Ability to apply the previous techniques to time series, structured data, biological data, quality control data, etc.

## DESCRIPTION OF CONTENTS: PROGRAMME

Lesson 1: Introduction.
1.1 Introduction to FDA.
Lesson: Learning as function approximation.
2.1 Elements of learning theory.
2.2 Error functions.
2.3 Variational problem in learning theory.
Lesson 3: Basics on Mathematics: topology, linear normed spaces, functional analysis (Hilbert spaces, operators).
3.1 Functional analysis notions.
Lesson 4: Support Vector Machines. Regularization point of view.
4.1 Support vector machines and regularization theory.
4.2 Computational solution.
Lesson 5: Support Vector Machines. Geometric point of view. Equivalency with the regularization point of view.
5.1 Geometric support vector machines.
5.2 R implementations.
Lesson 6: Applications of Support Vector Machines.
6.1 Classification with SVMs.
6.2 Regression with SVMs.
Lesson 7: Traditional FDA.
7.2 Functional PCA.
Tema 8: Applications and extensions.
8.1 Kernel Methods.
8.2 FDA for time series.
8.3 FDA with structured data.

## LEARNING ACTIVITIES AND METHODOLOGY

Magistral classes plus problem classes and practical computer sessions using functional data analysis software.

## ASSESSMENT SYSTEM

Final grade (60%), Homework and exercises (10%) , final homework (30%).

Continuous evaluation: homework exercises.

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| **% end-of-term-examination:** | 60 |
| **% of continuous assessment (assigments, laboratory, practicals…):** | 40 |

BASIC BIBLIOGRAPHY

- B. Schölkopf, A.J. Smola Learning with Kernels. Support Vector Machines, Regularization, Optimization and Beyond., MIT Press, 2002
- F. Cucker, D.X. Zhou Learning Theory: an approximation point of view, Cambridge University Press, 2007
- J.O. Ramsay, B.W. Silverman Functional Data Analysis, 2nd Edition, Springer, 2005
- J.O. Ramsay, G. Hooker, S. Graves Functional Data Analysis with R and Matlab, Springer, 2009
- V. Cherkassky, F. Mulier Learning from Data. Concepts, theory and methods, IEEE Press, 2007

ADDITIONAL BIBLIOGRAPHY

- Lutz Hamel Knowledge Discovery with Support vector Machines, Wiley, 2009