Pedagogic case and specific course in which designed tasks and units are used

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Pedagogic case:	• Inquiry-based approach to Ordinary and Generalized Least Squares, for 3rd year Mathematical Engineering students.
Description (including temporal scheme for design, development and implementation)	• To introduce some inquiry-based activity in teaching-learning: inquiry-based tasks. • Computers will be used to let student explore real data and to let them find out most appropriate tools for the proposed goals. • Rough planning: design and development: January-February 2019, implementation March-April 2019

Aim of pedagogic case	• Let students learn concepts related to parameters estimation in mathematical models; appropiate methods to solve problems in the field of science, technology and society.

Mathematical concepts	• Ordinary least squares (OLS).
	  ○ Problem statement: Linear regression; geometric interpretation.
	  ○ Fitting data to linear models by ordinary least square.
	• Generalized and weighted least squares.
	  ○ Modification of the OLS to take into account the inequality of variance in the observations and correlations.
	  ○ Gauss Markov Theorem.

Addressed practice	• 3rd year of the bachelor program in mathematical engineering.
Place in specific course Course name Place of units	• The course is called Error's Theory. • Teaching units will be used the second month of course (when students already know more about matrix algebra and multivariate statistics).
Learners profile orientation, year, age, prior knowledge, other such as math anxiety, special needs, ..	• Orientation: 3rd year of the bachelor programs in 'mathematical engineering' and 'mathematics'. • Prior knowledge. Basic linear algebra, statistics. • Special needs: For a large number of students statistics (parameter estimation) is not an attractive subject and many want to see applications.
Organisation of specific course study credits/hours, location, group size	• 6 credits ECTS course. • Course runs on weekly basis from first week of February 2019 up to the second week of May 2019. • Each week provides two lectures (50 mins each) and two tutorials (one with computers). Tutorials allow students to work on set tasks and discuss them with the lecturer. • Units developed takes 2 weeks in total. • Number of students: 80. Two computers sessions (one for each half of the cohort).
Expected learning outcomes	• Student will learn to estimate unknow parameters in linear models and analyse results. • They will use and implement themselves computer models to explore the techniques used.

	• They will use real data to propose, analyze, validate and interpret models of real situations, using most appropriate mathematical tools for the proposed goal.
Envisioned use of digital technology	• Maple, Matlab and/or R-Studio environment for inquiring approach and digital practice tasks.
Planning of tasks	• Performing an a priori analysis of the mathematics in the topic. • Fitting new forms of activity into the teaching schedule developed in the previous year of the module. • Design of inquiry-based tasks and teaching approaches. • Design of R-studio/Maple/Matlab tasks. • Keeping a record of new tasks/approaches for the current cohort – to include specific details of tasks and approaches, and teacher reflections on the teaching and learning that takes place. • Student scores from a computer-based task on this material.
Names of persons involved	Prof. M. Benavent; all the Professors of the Spanish Platinum Team and Students of the course.
Course:	Error's Theory
Learning objectives	Students learn • To adjust observations in any of the experimental sciences in which the least squares methods are used. • To solve problems and real cases in the field of science, technology and society through modeling skills, numerical calculation and optimization. • Use computer applications of statistical analysis, numerical and symbolic calculation and graphic visualization to solve problems. • Develop programs that solve mathematical problems using the appropriate computer environment for each case.
Learning contents	• Linear regression, multiple regression, ordinary least squares, variance, best unbiased minimun variance estimator, weighted least squares, Gauss-Markov theorem.
teaching /learning activities	• Each week provides two lectures (50 mins each) and two tutorials (one with computers). Tutorials allow

	students to work on set tasks and discuss them with the lecturer.
Media	• Tutorials, computers, statistical numerical and symbolic computation software.
Evaluation	• A percentage in the standard course evaluation.
Instructor role	• Development of course contents and presentation of course material in lectures. • In lectures, discussing the mathematical concepts and appliation of them in the context of study cases in fields of mathematical engineering. • Tutor – working with students in tutorials encouraging their own activity and thinking and providing support.
Student roles	• Active participation in the lectures. • Inquiry-based activities in tutorials: Learning about fitting data to linear and non linear models by ordinary and generalized least squares techniques. • Practising methods with computer-based tasks.