#### 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. |