| Teaching Guide | | | | |
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| Identifying Data | | | | 2022/23 |
| Subject (*) | Statistical Models for Marine Technology Innovation | | Code | 730542016 |
| Study programme | Master Universitario Erasmus Mundus en Sostibilidade e Industria 4.0 aplicada ao Sector Marítimo | | | |
| Descriptors | | | | |
| Cycle | Period | Year | Type | Credits |
| Official Master's Degree | 2nd four-month period | First | Optional | 6 |
| Language | English | | | |
| Teaching method | Face-to-face | | | |
| Prerequisites | | | | |
| Department | Matemáticas | | | |
| Coordinador | Tarrio Saavedra, Javier | E-mail | javier.tarrio@udc.es | |
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| Web | http://www.master-seas40.unina.it | | | |
| General description | The course is applicative with the aim to train students on statistical tools for monitoring of complex data from marine technology systems. Applications and case studies are addressed to train students to formulate and define strategies for quality control and monitoring in order to support decision making process in a big data framework. | | | |

| Study programme competences | |
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| Code | Study programme competences |
| B2 | CB6 - Acquire and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, usually in a research context. |
| B3 | CB7 - That students know how to apply the acquired knowledge and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study. |
| B4 | CB8 - That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments. |
| B5 | CB9 ? That students are able to communicate their conclusions -and the knowledge and ultimate reasons that sustain them- to specialized and non-specialized publics in a clear and unambiguous way. |
| B6 | CB10 - That students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous. |
| B7 | CG1 ? To display the adequate intercultural competence to successfully navigating within multicultural learning environments and to implement basic management principles suitable for a multicultural working environment. |
| B8 | CG2 ? To express an attitude of intellectual inquisitiveness and open-mindedness. |
| B10 | CG4 ? To have the capability to think creatively and explore new ideas outside of current boundaries of the field |
| B13 | CG7 ? To have the capability to critically analyse, synthesise, interpret and summarise complex scientific processes. |
| C2 | CT2 - Mastering oral and written expression in a foreign language. |
| C4 | CT4 - Acting as a respectful citizen according to democratic cultures and human rights and with a gender perspective. |
| C6 | CT6 - Acquiring skills for healthy lifestyles, and healthy habits and routines. |
| C7 | CT7 -Developing the ability to work in interdisciplinary or transdisciplinary teams in order to offer proposals that can contribute to a sustainable environmental, economic, political and social development. |
| C8 | CT8 -Valuing the importance of research, innovation and technological development for the socioeconomic and cultural progress of society. |

| Learning outcomes | |
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| Learning outcomes | Study programme competences |

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| Ability to analyze data via regression analysis and to use statistical tool to reduce the dimensionality of a dataset.<br>Ability to perform analysis through R, an opensource package for statistics. | | BC1<br>BC2<br>BC3<br>BC4<br>BC5<br>BC6<br>BC7<br>BC9<br>BC12 | CC2<br>CC4<br>CC6<br>CC7<br>CC8 |

| Contents | |
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| **Topic** | **Sub-topic** |
| Multivariate data description and inference. | Exploratory analysis of multivariate data.<br>Statistical inference of multivariate data.<br>Introduction to R statistical software. |
| Elements of unsupervised learning. | Principal component analysis (PCA).<br>Unsupervised clustering or classification methods. |
| Elements of supervised learning. | Multivariate linear regression models. |
| Selection, regularization of linear models and dimension reduction methods. | Ridge regression.<br>Least absolute shrinkage and selection operator (LASSO).<br>Principal component regression.<br>Partial least squares (PLS) regression. |
| Classification methods. | Introduction.<br>Supervised classification methods. |
| Statistical Process Control (SPC). | Control charts of variables and attributes.<br>Hotelling's T2 control chart.<br>Regression adjustment.<br>Interpretation of out-of-control signals. |
| Case studies to be solved using R statistical software. | Case studies in the field of naval and maritime engineering. |

| Planning | | | | |
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| **Methodologies / tests** | **Competencies** | **Ordinary class hours** | **Student?s personal work hours** | **Total hours** |
| Guest lecture / keynote speech | B2 B6 B7 B8 B10 B13 C2 C4 C6 C8 | 21 | 21 | 42 |
| ICT practicals | B3 B4 B5 B6 B7 C2 C7 C8 | 21 | 21 | 42 |
| Supervised projects | B3 B4 B5 B6 B7 B8 B10 B13 C2 C4 C6 C7 C8 | 0 | 64 | 64 |
| Objective test | B2 B3 B4 C2 | 1 | 0 | 1 |
| Personalized attention | | 1 | 0 | 1 |
| **(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.** | | | | |

| Methodologies | |
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| **Methodologies** | **Description** |
| Guest lecture / keynote speech | Classroom activity that aims to show, describe and explain the fundamental concepts of the subject. It consists of oral exposition complemented with the use of audiovisual/multimedia and interaction with students, in order to provide knowledge and facilitate learning. |

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| ICT practicals | These are interactive sessions, developed using computer tools, in which the teachers will provide the necessary knowledge for the proper application of the statistical techniques taught in the keynote speech, in addition to supporting and supervising the practical work and knowledge acquired by the students. Different packages of the R statistical software will be used (which the student will have to know and handle) for the description and study of different real or simulated case studies. |
| Supervised projects | Individual and/or group work that will be carried out, supervised by the teachers of the subject. They will be dealing with the application and use of statistical techniques as well their application in the marine domain. |
| Objective test | Evaluation test that will be carried out at the end of the course in the corresponding official calls. It will consist of a written test in which it will be necessary to answer different theoretical and practical questions. |

| Personalized attention | |
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| **Methodologies** | **Description** |
| Guest lecture / keynote speech<br>ICT practicals<br>Supervised projects | In the master classes, debate between students and between students and the teacher will be encouraged at all times. In order to solve problems, it will be important to personally attend to the students in the event of any doubts that may arise. This attention will also serve, on the one hand, to the teacher to detect possible problems in the methodology used to teach the subject and, on the other, to the students to consolidate theoretical knowledge and to express their concerns about the subject. Personalized attention to the student during ICT practical classes will also be essential, especially until they become familiar with the statistical software to be used, as well in the supervision of the projects. |

| Assessment | | | |
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| **Methodologies** | **Competencies** | **Description** | **Qualification** |
| ICT practicals | B3 B4 B5 B6 B7 C2 C7 C8 | Practical classes using R statistical software will be developed. | 25 |
| Objective test | B2 B3 B4 C2 | Exam composed of both theoretical and practical questions about the contents of the subject. | 50 |
| Supervised projects | B3 B4 B5 B6 B7 B8 B10 B13 C2 C4 C6 C7 C8 | Individual and/or group work will be carried out, supervised by the teachers of the subject. They will be dealing with the application and use of statistical techniques as well their application in the marine domain. | 25 |

| Assessment comments |
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| Evaluation at the first opportunity: The grade of the objective test will be weighted with the grade corresponding to the delivery of work related to the practices carried out with R statistical software and the completion of supervised work (maximum 5 points out of 10).<br>Evaluation in the second opportunity: The evaluation will be made following the same procedure as in the first opportunity.<br>Academic dispensation will not be accepted.<br>All the activities will have only one opportunity for delivery during the academic year, except for the final exam, which will have two official exam opportunities.<br>General EMJMD Sustainable Ship and Shipping SEAS 4.0 evaluation rules:<br>- Students will have only two oportunities to pass a course. If failing to do so, they may be forced to leave the degree.<br>- No part time or lecture attendance exemption are allowed in this degree. |

| Sources of information | |
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| **Basic** | - James, G., Witten, D., Hastie, T., Tibshirani, R. 0. (2013). An introduction to statistical learning. New York: Springer<br>- Montgomery D. (2009 ). Introduction to Statistical Quality Control. Wiley & Sons<br>- Cano, E. L., Moguerza, J. M., & Redchuk, A. (2012). Six sigma with R: statistical engineering for process improvement (Vol. 36). . Springer Science & Business Media<br>- Flores, M., Fernández-Casal, R., Naya, S., & Tarrío-Saavedra, J. (2021). Statistical Quality Control with the qcr Package. The R Journal |
| **Complementary** | |

| Recommendations |
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| Subjects that it is recommended to have taken before |
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| Subjects that are recommended to be taken simultaneously |
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| Subjects that continue the syllabus |
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| Other comments |
| To help to achieve a sustainable environment and meet the objective of action number 5: ?Healthy and sustainable environmental and social teaching and research? of the "Green Campus Ferrol Action Plan":1.- The delivery of the documentary works carried out in this subject:1.1. It will be requested in virtual format and/or computer support.1.2. It will be done through Moodle, in digital format without the need to print them.1.3. If done on paper:-Plastics will not be used.- Double-sided prints will be made.- Recycled paper will be used.- Draft printing will be avoided.2.- A sustainable use of resources and the prevention of negative impacts on the natural environment must be made.3.- The importance of ethical principles related to the values ??of sustainability in personal and professional behavior must be taken into account.4.- As it is included in the different regulations of application for university teaching, the gender perspective must be incorporated in this subject (non-sexist language will be used, bibliography of authors of both sexes will be used, intervention in student class will be encouraged and students...).5.- We will work to identify and modify prejudices and sexist attitudes, and the environment will be influenced to modify them and promote values ??of respect and equality.6. Situations of discrimination based on gender must be detected and actions and measures will be proposed to correct them.7. The full integration of students who, due to physical, sensorial, psychic or sociocultural reasons, experience difficulties in an ideal, egalitarian and profitable access to university life will be facilitated |