



Teaching Guide

Identifying Data					2023/24
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		
Lecturers	Naya Fernandez, Salvador	E-mail	salvador.naya@udc.es		
	Tarrio Saavedra, Javier		javier.tarrio@udc.es		
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 / results

Code	Study programme competences / results
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

Learning outcomes	Study programme competences / results



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

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

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	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	
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.



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

Methodologies	Description
Guest lecture / keynote speech ICT practicals 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

Methodologies	Competencies / Results	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

<p>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).</p> <p>Evaluation in the second opportunity: The evaluation will be made following the same procedure as in the first opportunity.</p> <p>Academic dispensation will not be accepted.</p> <p>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.</p> <p>General EMJMD Sustainable Ship and Shipping SEAS 4.0 evaluation rules:</p> <ul style="list-style-type: none"> - Students will have only two opportunities to pass a course. If failing to do so, they may be forced to leave the degree. - No part time or lecture attendance exemption are allowed in this degree.

Sources of information

Basic	<ul style="list-style-type: none"> - James, G., Witten, D., Hastie, T., Tibshirani, R. O. (2013). An introduction to statistical learning. New York: Springer - Montgomery D. (2009). Introduction to Statistical Quality Control. Wiley & Sons - Cano, E. L., Moguerza, J. M., & Redchuk, A. (2012). Six sigma with R: statistical engineering for process improvement (Vol. 36). Springer Science & Business Media - Flores, M., Fernández-Casal, R., Naya, S., & Tarrío-Saavedra, J. (2021). Statistical Quality Control with the qcr Package. The R Journal
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Complementary

Recommendations

Subjects that it is recommended to have taken before

Subjects that are recommended to be taken simultaneously

Subjects that continue the syllabus

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

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.