UNIVERSIDAD DE CASTILLA - LA MANCHA
GUÍA DOCENTE

2. Pre-Requisites

To achieve the learning objectives of the subject, knowledge and skills are required that are supposed to be guaranteed in the training prior to access to the University. In particular, basic knowledge of calculus is necessary: elementary mathematical operations (powers, logarithms, exponentials, fractions...), elementary knowledge of differentiation and integration of real functions of real variables and fundamentals of graphic representation of functions.

3. Justification in the curriculum, relation to other subjects and to the profession

The mathematical concepts that are studied in this subject provide an essential tool and constitute a precise language that is later used by most of the basic and advanced subjects of Chemical Engineering. Everything related to descriptive statistics, statistical inference, regression and correlation and all the methods studied in this subject appear in the study, synthesis, development, design, operation and optimization of industrial processes that produce physical, chemical and/or biochemicals in the materials treated by Chemical Engineering. Statistics is present in the planning and development of all experimental, academic and professional activities in Chemical Engineering.

Another important aspect of the Statistics subject is that it is a subject that helps to enhance the capacity for abstraction, rigor, analysis and synthesis that are characteristic of mathematics and necessary for any other scientific discipline.

4. Degree competences achieved in this course

Course competences

Code	Description
CB01	Prove that they have acquired and understood knowledge in a subject area that derives from general secondary education and is appropriate to a level based on advanced course books, and includes updated and cutting-edge aspects of their field of knowledge.
CB02	Apply their knowledge to their job or vocation in a professional manner and show that they have the competences to construct and justify arguments and solve problems within their subject area.
CB03	Be able to gather and process relevant information (usually within their subject area) to give opinions, including reflections on relevant social, scientific or ethical issues.
CB04	Transmit information, ideas, problems and solutions for both specialist and non-specialist audiences.
E01	Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra; geometry; differential geometry; differential and integral calculation; differential equations and partial derivatives; numerical methods; numerical algorithm; statistics and optimization.
G03	Ability to solve problems with initiative, decision making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Chemical Engineering.
G12	Knowledge of Information and Communication Technologies (ICT).
G13	Proper oral and written communication
G14	ethical commitment and professional ethics
G17	Synthesis capacity
G19	Ability to analyze and solve problems
G20	Ability to learn and work autonomously
G21	Ability to apply theoretical knowledge to practice
G22	Creativity and initiative
G26	Obtaining skills in interpersonal relationships.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

To know and know how to calculate the fundamental parameters of descriptive statistics, approximate two-dimensional data through adjustments to functions, recognize different random variables and manage their tables, estimate statistical parameters, contrast hypotheses and make decisions.

To get used to teamwork, express yourself correctly orally and in writing in Spanish and English and behave respectfully.

Additional outcomes

The student will acquire general knowledge of Statistics that will allow him/her to understand advanced statistical methods and apply them in chemical engineering situations.

The student will acquire knowledge about the fundamental parameters of descriptive statistics, approximate two-dimensional data through adjustments to functions, recognize different random variables and manage their tables, estimate statistical parameters, test hypotheses and make decisions. She will use some statistical and data processing software packages at the user level. She will know how to apply this knowledge to chemical engineering problems.

6. Units / Contents

Unit 1: One-dimensional descriptive statistics
- **Unit 1.1** Frequency distribution
- **Unit 1.2** Graphic representations
- **Unit 1.3** Measures of centralization and dispersion
- **Unit 1.4** Practice with a computer. Introduction to Statistical Scientific Software, R

Unit 2: Two-dimensional descriptive statistics
- **Unit 2.1** Distribution of two variables
- **Unit 2.2** Representation of two variables
- **Unit 2.3** Relationship between quantitative variables
- **Unit 2.4** Linear Regression and Prediction
- **Unit 2.5** Regression models. Regression ANOVA Table
- **Unit 2.6** Practice with a computer with R. Scientific and technological applications

Unit 3: Introduction to probability
- **Unit 3.1** Experiments and random events. Probability Definitions
- **Unit 3.2** Conditional probability and independence of events
- **Unit 3.3** Fundamental theorems of probability

Unit 4: Random variables and probability distributions
- **Unit 4.1** Definitions
- **Unit 4.2** Probability and distribution functions of a random variable
- **Unit 4.3** Some distributions of discrete random variables
- **Unit 4.4** Some distributions of continuous random variables

Unit 5: Sampling and estimation
- **Unit 5.1** Fundamental concepts in sampling
- **Unit 5.2** Statistics and estimators. Properties
- **Unit 5.3** Sampling distributions
- **Unit 5.4** Estimation by confidence intervals
- **Unit 5.5** Practice with a computer with R. Scientific and technological applications

Unit 6: Contrasting hypotheses
- **Unit 6.1** Definitions
- **Unit 6.2** Parametric tests for one and two samples
- **Unit 6.3** Practice with a computer with R. Scientific applications and technologies

Unit 7: Perspectives of advanced statistical techniques. Introduction to Design of Experiments
- **Unit 7.1** One-way ANOVA
- **Unit 7.2** ANOVA of 2 factors without and with interactions
- **Unit 7.3** Practice with a computer with R. Scientific applications and technologies

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Lectures	CB01 CB03 E01 G03 G14 G17 G20 G22 G26	1.28	32	N	-	Master classes. Face-to-face teaching, giving theoretical classes and solving exercises.
Problem solving and/or case studies [ON-SITE]	Guided or supervised work	CB01 CB02 CB03 E01 G03 G12 G13 G14 G17 G19 G20 G22 G26	0.4	10	N	-	Seminars of problems and practical cases. -Problem resolution tutored work will be carried out in class.
Computer room practice [ON-SITE]	Practical or hands-on activities	CB02 CB03 E01 G03 G12 G13 G14 G17 G19 G20 G22 G26	0.32	8	Y	Y	Use of the computer in the classroom. - Practical face-to-face teaching of problem solving using computational techniques. - Tutored problem-solving work will be carried out using computational techniques in class. - The practices carried out by the student individually or in groups will be applied. - There will be a delivery of practices carried out by the student individually. 1. Attendance and active participation 2. Correction of the problem statement/practice 3. Correction of the solution and resolution method 10% of the grade
							Seminars of problems and practical cases. - Tutored problem solving work will be carried out in class. - Periodic deliveries of problems solved by the student individually in

Activity	Type	Competencies	Credits	Hours	As	Com	Description
Progress test [ON-SITE]	Assessment tests	CB01 CB02 CB03 CB04 E01 G03 G12 G13 G14 G17 G19 G20 G22 G26	0.08	2	Y	Y	class will be made. 1. Assistance and active participation 2. Correction of the problem statement 3. Correction of the solution 4. Correction of the written expression Concept errors and errors in basic mathematical operations will imply penalties. 10% of the grade
Project or Topic Presentations [ON-SITE]	Group Work	CB01 CB03 E01 G03 G14 G17 G19 G20 G22 G26	0.04	1	Y	Y	Teamwork. Group work will be proposed with data collection and analysis with application of everything discussed in the subject. There will be a delivery by groups of the memory of the work and/or a defense of it. 1. Correct data collection 2. Complete analysis of the data 3. The software studied in the collection, obtaining and interpretation of the results and conclusions will be applied to said results. 4. Quality of the memory presented and of the presentation. Synthesis and clarity of ideas. 10% of the grade
Progress test [ON-SITE]	Assessment tests	CB01 CB02 CB03 CB04 E01 G03 G12 G13 G14 G17 G19 G20 G22 G26	0.16	4	Y	Y	Exámenes parciales. Se realizarán dos exámenes parciales consistentes en la resolución de una serie de ejercicios propuestos. 1. Corrección del planteamiento del problema 2. Corrección de la solución 3. Corrección de la expresión escrita Los errores de concepto y los errores en operaciones matemáticas básicas implicarán penalizaciones. Los parciales superados supondrán la liberación de la materia correspondiente de cara al examen final. 70% de la nota
Final test [ON-SITE]	Assessment tests	CB01 CB02 CB03 CB04 E01 G03 G12 G13 G14 G17 G19 G20 G22 G26	0.12	3	Y	Y	Examen final. Se realizará un examen con toda la materia o el/los parciales no superado/s. El examen consistirá en la resolución de una serie de ejercicios propuestos. 1. Corrección del planteamiento del problema 2. Corrección de la solución 3. Corrección de la expresión escrita Los errores de concepto y los errores en operaciones matemáticas básicas implicarán penalizaciones. La asignatura será superada si la nota final (80% nota del examen final + 20% nota del trabajo de informática y trabajo en equipo) es igual o superior a 5.
Writing of reports or projects [OFF-SITE]	Self-study	CB01 CB02 CB03 CB04 E01 G03 G12 G13 G14 G17 G19 G20 G22 G26	3.6	90	Y	N	
Total:			6	150			
Total credits of in-class work: 2.4				Total class time hours: 60			
Total credits of out of class work: 3.6				Total hours of out of class work: 90			

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System			
Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Assessment of problem solving and/or case studies	10.00%	10.00%	-Continuous assessment: Seminars of problems and practical cases. - Tutored problem solving work will be carried out in class. - Periodic deliveries of problems solved by the student individually in class will be made. 1. Attendance and active participation. 2. Correction of the statement of the problem. 3. Correction of the solution. 4. Correction of written expression.

			Concept errors and errors in basic mathematical operations will imply penalties. 10% of the note - Non-continuous evaluation, these types of problems will be included in the final exam and the same as indicated in the continuous evaluation is evaluated
Assessment of activities done in the computer labs	10.00%	10.00%	-Continuous assessment 1. Correction of the solution and resolution method 4. An individual delivery will be made by the student of a series of exercises to be carried out with the statistical software studied. -Non-continuous evaluation: R exam
Test	70.00%	70.00%	-Continuous assessment: Partial exams. There will be two partial exams consisting of solving a series of proposed exercises. The partial passed will mean the release of the corresponding material for the final exam. -Non-Continuous Evaluation: Final exam. It is evaluated in both types of evaluation: 1. Correction of the problem statement. 2. Correction of the solution. 3. Correction of written expression. Concept errors and errors in basic mathematical operations will imply penalties.
Projects	10.00%	10.00%	-Continuous assessment: Teamwork. Group work will be proposed with data collection and analysis with application of everything discussed in the subject. There will be a delivery by groups of the memory of the work and/or a defense of it. 1. Correct data collection. 2. Complete data analysis. 3. Application of statistical software to data collection, obtaining results and interpretation and conclusions of the results 4. Quality of the memory presented and of the presentation. Synthesis and clarity of ideas. 10% of the note - Non-Continuous Evaluation: work
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

Final exam.
There will be an exam with all the material or the partial ones not passed during the course. The exam will consist of solving a series of proposed exercises.
1. Correction of the problem statement
2. Correction of the solution
3. Correction of written expression
Concept errors and errors in basic mathematical operations will imply penalties.
The course will be passed if the final mark (80% mark of the final exam + 20% mark of the computer work and teamwork) is equal to or greater than 5.

Non-continuous evaluation:

The student of this modality has to contact the teacher and indicate that he wants this type of evaluation and it has to be justified.
There will be a final exam with all the material and an R exam and the work requested in the course must be presented. The exam will consist of solving a series of proposed exercises.
1. Correction of the problem statement
2. Correction of the solution
3. Correction of written expression
Concept errors and errors in basic mathematical operations will imply penalties.
The course will be passed if the final mark (80% mark of the final exam + 20% mark of the computer work and teamwork) is equal to or greater than 5.

Specifications for the resit/retake exam:

If the student has not passed the subject in the Ordinary call, then: An exam will be carried out with all the subject or the partial ones not passed during the course. The exam will consist of solving a series of proposed exercises.
1. Correction of the problem statement
2. Correction of the solution
3. Correction of written expression
Concept errors and errors in basic mathematical operations will imply penalties.
The course will be passed if the final mark (80% mark of the final exam + 20% mark of the computer work and teamwork) is equal to or greater than 5.

Specifications for the second resit / retake exam:

A final exam will be held with all the subject for students who have not passed the subject in the ordinary call. The exam will consist of solving a series of

proposed exercises.
1. Correction of the problem statement
2. Correction of the solution
3. Correction of written expression
Concept errors and errors in basic mathematical operations will imply penalties.
The course will be passed if the final mark (80% mark of the final exam + 20% mark of the computer work and teamwork) is equal to or greater than 5.

9. Assignments, course calendar and important dates	
Not related to the syllabus/contents	
Hours	hours

Unit 1 (de 7): One-dimensional descriptive statistics	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	1
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Writing of reports or projects [AUTÓNOMA][Self-study]	8

Unit 2 (de 7): Two-dimensional descriptive statistics	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Progress test [PRESENCIAL][Assessment tests]	1
Writing of reports or projects [AUTÓNOMA][Self-study]	10

Unit 3 (de 7): Introduction to probability	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	4
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Progress test [PRESENCIAL][Assessment tests]	2
Writing of reports or projects [AUTÓNOMA][Self-study]	14

Unit 4 (de 7): Random variables and probability distributions	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	7
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Writing of reports or projects [AUTÓNOMA][Self-study]	16

Unit 5 (de 7): Sampling and estimation	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	1
Computer room practice [PRESENCIAL][Practical or hands-on activities]	1
Writing of reports or projects [AUTÓNOMA][Self-study]	15

Unit 6 (de 7): Contrasting hypotheses	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	2
Computer room practice [PRESENCIAL][Practical or hands-on activities]	2
Progress test [PRESENCIAL][Assessment tests]	1
Writing of reports or projects [AUTÓNOMA][Self-study]	15

Unit 7 (de 7): Perspectives of advanced statistical techniques. Introduction to Design of Experiments	
Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Lectures]	5
Computer room practice [PRESENCIAL][Practical or hands-on activities]	1
Project or Topic Presentations [PRESENCIAL][Group Work]	1
Progress test [PRESENCIAL][Assessment tests]	2
Final test [PRESENCIAL][Assessment tests]	3
Writing of reports or projects [AUTÓNOMA][Self-study]	12

Global activity	
Activities	**hours**
Progress test [PRESENCIAL][Assessment tests]	2
Project or Topic Presentations [PRESENCIAL][Group Work]	1
Progress test [PRESENCIAL][Assessment tests]	4
Final test [PRESENCIAL][Assessment tests]	3
Problem solving and/or case studies [PRESENCIAL][Guided or supervised work]	10
Class Attendance (theory) [PRESENCIAL][Lectures]	32
Computer room practice [PRESENCIAL][Practical or hands-on activities]	8
Writing of reports or projects [AUTÓNOMA][Self-study]	90
Total horas:	150

10. Bibliography and Sources						
Author(s)	**Title/Link**	**Publishing house**	**City**	**ISBN**	**Year**	**Description**
						Muy buen libro de

Canavos, George C.	Probabilidad y Estadística. Aplicaciones y Métodos	MCGrawHill				probabilidad y Estadística con gran cantidad de problemas resueltos.
De la Horra, J	Estadística Aplicada	Díaz de Santos	Madrid	84.7978-554-3	2003	
Dennis D. Wackerly, William Mendenhall III and Richard L. Scheaffer	Estadística Matemática con Aplicaciones	THOMSON			2002	Libro con muchas aplicaciones de la estadística y la probabilidad. Muchos problemas y ejercicios resueltos.
Herrero H. Díaz Cano A. ETSII de Ciudad Real-EÑE	Informática aplicada a las Ciencias y a la Ingeniería con MATLAB		Ciudad Real		2000	Es un manual de MATLAB muy pedagógico con múltiples ejemplos aplicados que contiene un tema de Estadística
Huehl,R, Thomson Learning	Diseño de experimentos: principios estadísticos para el diseño y análisis de investigaciones.		Mexico		2001	
J.C. Miller y J.N. Milller	Estadística para Química Analítica. Segunda edición	Addison-Wesley Iberoamérica			1993	Un libro muy bueno que muestra de forma sencilla y clara la aplicación tan importante y necesaria de la estadística en la Química Analítica. Gran cantidad de problemas y ejercicios resueltos. Libro muy fácil de leer.
Jay L.Devore	Probabilidad y Estadística para ingeniería y ciencias	Cengage Learning			2005	
Juan Camacho Rosales	Estadística con SPSS para Windows. Versión 11	Ra-Ma			2002	Da idea de las posibilidades del software estadístico
Peña, D	Estadística. Modelos y Métodos 1y 2	Alianza	Madrid		2000	
Profesorado del Grado en Ingeniería Química	Actividades Prácticas del Grado en Ingeniería Química		Ciudad Real	978-84-939630-4-0	2014	Actividades prácticas del Grado de Ingeniería Química que están desarrolladas por cursos y asignaturas. La asignatura de Estadística está en el capítulo 2, páginas 299-346 y autor Francisco Pla. En este capítulo se describe las prácticas de la asignatura usando SPSS y descripciones teóricas de los resultados.
Pérez, C	Técnicas de Análisis Multivariante	GARCETA, Grupo Editorial			2009	
Pérez, Cesar	Técnicas Estadísticas con SPSS 12. Aplicaciones al análisis de datos	Pearson.Prentice Hall	Madrid		2005	
	http://www.r-proyect.org/					