



## IDENTIFYING DATA

### Mathematics: Algebra and Statistics

|                     |  |                 |      |            |
|---------------------|--|-----------------|------|------------|
| Subject             | Mathematics:<br>Algebra and<br>Statistics  |                 |      |            |
| Code                | V12G380V01103  |                 |      |            |
| Study programme     | (*)Grao en<br>Enxeñaría<br>Mecánica  |                 |      |            |
| Descriptors         | ECTS Credits   | Choose          | Year | Quadmester |
|                     | 9  | Basic education | 1st  | 1st        |
| Teaching language   | Spanish<br>Galician<br>English   |                 |      |            |
| Department          |  |                 |      |            |
| Coordinator         | Pardo Fernández, Juan Carlos   |                 |      |            |
| Lecturers           | Alvarez Hernandez, Maria<br>Area Carracedo, Iván Carlos<br>Castejón Lafuente, Alberto Elias<br>Díaz de Bustamante, Jaime<br>Fernández García, José Ramón<br>Fiestras Janeiro, Gloria<br>Fonseca Bon, Cecilio<br>Godoy Malvar, Eduardo<br>Gómez Rúa, María<br>Illán González, Jesús Ricardo<br>Luaces Pazos, Ricardo<br>Martín Méndez, Alberto Lucio<br>Matías Fernández, José María<br>Pardo Fernández, Juan Carlos<br>Rodríguez Campos, María Celia<br>Villaverde Taboada, Carlos |                 |      |            |
| E-mail              | juancp@uvigo.es  |                 |      |            |
| Web                 | http://fatic.uvigo.es  |                 |      |            |
| General description | The aim of this course is to provide the student with the basic techniques in Algebra and Statistics that will be necessary in other courses of the degree.  |                 |      |            |

## Competencies

|      |   |
|------|---|
| Code |   |
| B3   | CG3 Knowledge in basic and technological subjects that will enable students to learn new methods and theories, and provide them the versatility to adapt to new situations.   |
| C1   | CE1 Ability to solve mathematical problems that may arise in engineering. Ability to apply knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, differential equations and partial differential equations, numerical methods, numerical algorithms, statistics and optimization. |
| D2   | CT2 Problems resolution.  |
| D5   | CT5 Information Management.   |
| D6   | CT6 Application of computer science in the field of study.  |
| D9   | CT9 Apply knowledge.  |

## Learning outcomes

| Expected results from this subject   | Training and Learning Results |    |    |
|--|-------------------------------|----|----|
| Acquire the basic knowledge on matrices, vector spaces and linear maps.                                      | B3                            | C1 |    |
| Handle the operations of the matrix calculation and use it to solve problems to systems of linear equations. | B3                            | C1 | D2 |

|  |    |    |          |
|--|----|----|----------|
| Understand the basic concepts on eigenvalues and eigenvectors, vector spaces with scalar product and quadratic forms used in other courses and solve basic problems related to these subjects. | B3 | C1 | D2<br>D9 |
| Perform basic exploratory analysis of databases.   | B3 | C1 | D5       |
| Model situations under uncertainty by means of probability.  | B3 | C1 | D2       |
| Know basic statistical models and their application to industry and perform inferences from data samples.  | B3 | C1 | D2<br>D9 |
| Use computer tools to solve problems of the contents of the course.  | B3 |    | D2<br>D6 |

## Contents

| Topic  |  |
|--|--|
| Preliminaries  | The field of complex numbers.  |
| Matrices, determinants and systems of linear equations.    | Definition and types of matrices.<br>Matrices operations.<br>Elementary transformations, row echelon forms, rank of a matrix.<br>Inverse and determinant of a square matrix.<br>Consistency of systems of linear equations and their solutions.  |
| Vector spaces and linear maps.                             | Vector space. Subspaces.<br>Linear independence, basis and dimension.<br>Coordinates, change of basis.<br>Basic notions on linear maps.  |
| Eigenvalues and eigenvectors.                              | Definition of eigenvalue and eigenvector of a square matrix.<br>Diagonalization of matrices by similarity transformation.<br>Applications of eigenvalues and eigenvectors.   |
| Vector spaces with scalar product and quadratic forms.     | Vectorial spaces with scalar product. Associated norm and properties.<br>Orthogonality. Gram-Schmidt orthonormalization process.<br>Orthogonal diagonalization of a real and symmetric matrix.<br>Quadratic forms.   |
| Descriptive statistics and regression.                     | Concept and uses of the statistics. Variables and attributes. Types of variables. Representations and charts. Position and dispersion measures.<br>Analysis of bivariate data. Linear regression. Correlation.   |
| Probability.   | Concept and properties.<br>Conditional probability and independence of events.<br>Bayes Theorem.   |
| Discrete random variables and continuous random variables. | Definition of random variable. Types of random variables.<br>Distribution function.<br>Discrete random variables. Continuous random variables.<br>Characteristics of a random variable.<br>Main distributions: Binomial, Geometric, Poisson, Hypergeometric, Uniform, Exponential, Normal.<br>Central Limit Theorem. |
| Statistical inference.                                     | General concepts.<br>Sampling distributions.<br>Point estimation.<br>Confidence intervals.<br>Tests of hypotheses.   |

## Planning

|   | Class hours | Hours outside the classroom | Total hours |
|---|-------------|-----------------------------|-------------|
| Master Session                                | 40          | 81                          | 121         |
| Troubleshooting and / or exercises            | 12          | 12                          | 24          |
| Laboratory practises                          | 24          | 12                          | 36          |
| Autonomous troubleshooting and / or exercises | 0           | 40                          | 40          |
| Long answer tests and development             | 4           | 0                           | 4           |

\*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

## Methodologies

|   | Description  |
|---|--|
| Master Session                                | The lecturer will explain the contents of the course.  |
| Troubleshooting and / or exercises            | Problems and exercises will be solved during the classes. Students will also solve similar problems and exercises. |
| Laboratory practises                          | Computer tools will be used to solve problems related to the contents of the course.                               |
| Autonomous troubleshooting and / or exercises | Student will have to solve problems and exercises by their own.  |

| Personalized attention                        |   |
|---|---|
| Methodologies                                 | Description   |
| Laboratory practises                          | Doubts and queries from the students will be solved during the lectures, laboratories and office hours. |
| Master Session                                | Doubts and queries from the students will be solved during the lectures, laboratories and office hours. |
| Troubleshooting and / or exercises            | Doubts and queries from the students will be solved during the lectures, laboratories and office hours. |
| Autonomous troubleshooting and / or exercises | Doubts and queries from the students will be solved during the lectures, laboratories and office hours. |

| Assessment                         |   |   |                               |    |    |    |
|------------------------------------|---|---|-------------------------------|----|----|----|
|                                    | Description   | Qualification   | Training and Learning Results |    |    |    |
| Troubleshooting and / or exercises | Students will make several mid-term exams of Algebra and Statistics during the course.        | 40 por ciento en Álgebra; 20 por ciento en Estadística. | B3                            | C1 | D2 | D5 |
|                                    |   |   |                               |    | D6 | D9 |
| Long answer tests and development  | At the end of the semestre there will a final exam of Algebra and a final exam of Statistics. | 60 por ciento en Álgebra; 80 por ciento en Estadística. | B3                            | C1 | D2 | D5 |
|                                    |   |   |                               |    | D6 | D9 |

#### Other comments on the Evaluation

At the end of the \*cuadrimestre, once realized the proofs of continuous evaluation and the examinations, the student will have of a qualification on 10 points of \*Álgebra (A) and a qualification on 10 points of Statistical (E). The final qualification of the subject will calculate of the following form:

- Both notes, A and E, are senior or equal to 3.5, then the final qualification will be  $(A+E)/2$ .
- Any of the notes A or E is low that 3.5, then the final qualification will be the minimum of the quantities  $(A+E)/2$  and 4.5.

The students to the that the Centre concede them renounces it to the continuous evaluation will be evaluated through a final examination of \*Álgebra (that will suppose 100% of the note of this part) and another of Statistical (that will suppose 100% the note of this part). The final qualification will calculate second the \*prodecemento described previously.

IT a student #award him the qualification of no presented if no presents it none of the final examinations of the two parts of the subject; in contrary case will consider presented and #award him the note that correspond him.

The evaluation of the students in the second edition of the @acta will realize by means of an examination of \*Álgebra and another of Statistics that will suppose 100% of the final note of each part. To calculate the final qualification of the subject will apply the procedure described arrive.

If at the end of the \*cuadrimestre (first edition of @acta) a student obtains an upper qualification or the same to 5 points (on 10) in an of the parts (\*Álgebra or Statistical) then, in the second edition, will be able to not to present to the final examination of this part and maintain the note obtained in the first edition.

**Ethical commitment:** Ethical commitment: It is expected an adequate ethical behaviour of the student. In case of detecting unethical behaviour (copying, plagiarism, unauthorized use of electronic devices, etc.) shall be deemed that the student does not meet the requirements for passing the subject. In this case, the overall rating in the current academic year will be Fail (0.0).

The use of any electronic device for the assessment tests is not allowed unless explicitly authorized. The fact of introducing unauthorized electronic device in the examination room will be considered reason for not passing the subject in the current academic year and will hold overall rating (0.0).

#### Responsible professors by group:

Group A: Eduardo \*Godoy \*Malvar / Glory Windows \*Janeiro

Group \*B: Alberto Martín Méndez / José María Matías Fernández

Group \*C: Jaime Díaz of \*Bustamante / José María Matías Fernández and Juan Carlos \*Pardo Fernández

Group \*D: Cecilio \*Fonseca \*Bon / José María Matías Fernández

Group And: Alberto \*Castejón Lafuente / Glory Windows \*Janeiro

Group \*F: Alberto Martín Méndez / José María Matías Fernández

Group \*G: José Ramón Fernández García / Carlos Villaverde Taboada

Group \*H: José Ramón Fernández García / Carlos Villaverde Taboada

Group \*I: Jesús \*Illán González / Juan Carlos \*Pardo Fernández

Group \*J: Jesús \*Illán González / Ricardo \*Luaces \*Pazos

Group \*K: Cecilio \*Fonseca \*Bon / Juan Carlos \*Pardo Fernández

Group \*L: Cecilio \*Fonseca \*Bon / Carlos Villaverde Taboada

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### Sources of information

Lay, David C., **Álgebra lineal y sus aplicaciones**, 4<sup>a</sup>,  
Nakos, George; Joyner, David, **Álgebra lineal con aplicaciones**, 1<sup>a</sup>,  
de la Villa, A., **Problemas de álgebra**, 3<sup>a</sup>,  
Cao, Ricardo et al., **Introducción a la Estadística y sus aplicaciones**, 1<sup>a</sup>,  
Devore, Jay L., **Probabilidad y estadística para ingeniería y ciencias.**, 7<sup>a</sup>,  
Devore, Jay L., **Probability and statistics for engineering and sciences**, 8<sup>a</sup>,

### FURTHER REFERENCES:

1. G. Strang, *Álgebra lineal y sus aplicaciones*, Addison-Wesley Iber., 2007.
2. de Burgos, J. (2006). *Álgebra lineal y geometría cartesiana*. McGraw-Hill, 2006.
3. C. Pérez, *Estadística aplicada: conceptos y ejercicios a través de Excel*, Ibergaceta Publicaciones., 2012.
4. W. Navidi, *Estadística para ingenieros y científicos*, McGraw-Hill, 2006.

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### Recommendations

#### Subjects that are recommended to be taken simultaneously

Mathematics: Calculus I/V12G380V01104