| Teaching Guide | | | | | |
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| Identifying Data | | | | | 2015/16 |
| Subject (*) | Matemáticas II | | | Code | 611G02010 |
| Study programme | Grao en Administración e Dirección de Empresas | | | | |
| Descriptors | | | | | |
| Cycle | Period | Year | | Type | Credits |
| Graduate | 2nd four-month period | First | | FB | 6 |
| Language | SpanishGalician | | | | |
| Teaching method | Face-to-face | | | | |
| Prerequisites | | | | | |
| Department | Economía Aplicada 2 | | | | |
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| Lecturers | Blanco Louro, Amalia<br>Gómez Suárez, Manuel Alberto<br>Lema Fernández, Carmen Socorro<br>Saez Diaz, Maria Consuelo<br>Seijas Macias, Jose Antonio | | E-mail | amalia.blanco.louro@udc.es<br>manuel.gomez@udc.es<br>carmen.lemaf@udc.es<br>consuelo.saez@udc.es<br>antonio.smacias@udc.es | |
| Web | moebius.udc.es | | | | |
| General description | The objective of this course is to introduce students to the basics of differential calculus of several variables and mathematical programming, which will be necessary for learning other subjects of the grade and for their future career. The student will understand the basic concepts presented and the results that relate them, and will be able to properly and rigorously apply this knowledge to solving practical problems. An special emphasis will be made on the application of the course contents to economic problems, and on the interpretation of the results.<br>Another aim is to help students develop generic skills such as analysis and synthesis, logical reasoning, problem solving, critical thinking, independent learning, or retrieving and using information from various sources. | | | | |

| Study programme competences | |
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| Code | Study programme competences |
| A3 | Evaluate and foreseeing, from relevant data, the development of a company. |
| A4 | Elaborate advisory reports on specific situations of companies and markets |
| A6 | Identify the relevant sources of economic information and to interpret the content. |
| A8 | Derive, based on from basic information, relevant data unrecognizable by non-professionals. |
| A9 | Use frequently the information and communication technology (ICT) throughout their professional activity. |
| A10 | Read and communicate in a professional environment at a basic level in more than one language, particularly in English |
| A11 | To analyze the problems of the firm based on management technical tools and professional criteria |
| A12 | Communicate fluently in their environment and work by teams |
| B1 | CB1-The students must demonstrate knowledge and understanding in a field of study that part of the basis of general secondary education, although it is supported by advanced textbooks, and also includes some aspects that imply knowledge of the forefront of their field of study |
| B2 | CB2 - The students can apply their knowledge to their work or vocation in a professional way and have competences typically demostrated by means of the elaboration and defense of arguments and solving problems within their area of work |
| B3 | CB3- The students have the ability to gather and interpret relevant data (usually within their field of study) to issue evaluations that include reflection on relevant social, scientific or ethical |
| B4 | CB4-Communicate information, ideas, problems and solutions to an audience both skilled and unskilled |
| B5 | CB5-Develop skills needed to undertake further studies learning with a high degree of autonomy |
| B10 | CG5-Respect the fundamental and equal rights for men and women, promoting respect of human rights and the principles of equal opportunities, non-discrimination and universal accessibility for people with disabilities. |
| C1 | Express correctly, both orally and in writing, in the official languages of the autonomous region |
| C4 | To be trained for the exercise of citizenship open, educated, critical, committed, democratic, capable of analyzing reality and diagnose problems, formulate and implement knowledge-based solutions oriented to the common good |

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| C5 | Understand the importance of entrepreneurial culture and know the means and resources available to entrepreneurs |
| C6 | Assess critically the knowledge, technology and information available to solve the problems and take valuable decisions |
| C7 | Assume as professionals and citizens the importance of learning throughout life. |
| C8 | Assess the importance of research, innovation and technological development in the economic and cultural progress of society. |

| Learning outcomes | | | |
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| Learning outcomes | Study programme competences | | |
| Identify the notable sets of a subset of IRn. | A8<br>A11 | | |
| Understand the basic concepts of the euclidean space IRn. | A8<br>A11 | | |
| Determine if a set is open, closed, bounded, compact and convex. | A8<br>A11 | | |
| Understand the concept of function of several variables. | A8<br>A11 | | |
| Draw the level set of a function of two variables. | A8<br>A11 | | |
| Understand the concept of limit of a function at a point. | A8<br>A11 | | |
| Find the limit of a function at a point. | A8<br>A11 | | |
| Understand the concept of continuous function. | A8<br>A11 | | |
| Determine if a function is continuous or not. | A8<br>A11 | | |
| Recognize a linear function. | A8<br>A11 | | |
| Recognize a quadratic form. | A8<br>A11 | | |
| Classify a quadratic form by examining the signs of the principal minors. | A8<br>A11 | | |
| Classify a constrained quadratic form. | A8<br>A11 | | |
| Calculate and interpret partial derivatives and elasticities. | A4<br>A8<br>A11 | B1<br>B2<br>B5<br>B10 | C1<br>C7 |
| Analyze the differentiability of a function of several variables. | A8<br>A11 | | |
| Know the relationship between differentiability, derivability and continuity. | A8<br>A11 | | |
| Find the Taylor polynomial of a function. | A8<br>A11 | | |
| Calculate the partial derivatives of a compounded function. | A8<br>A11 | | |
| Use the existence theorem to analyze if a equation defines an implicit real function. | A8<br>A11 | | |
| Find the partial derivatives and elasticities of an implicit function, and interpret them. | A8<br>A11 | | |

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| Understand the concept of homogeneous function and determine if a function is homogeneous. | A8<br>A11 | | |
| Analyze the convexity of a set. | A8<br>A11 | | |
| Analyze the concavity/convexity of a function. | A8<br>A11 | | |
| Formulate mathematical programming problems. | A3<br>A4<br>A6<br>A8<br>A9<br>A10<br>A11 | B1<br>B2<br>B3<br>B4<br>B5<br>B10 | C1<br>C4<br>C5<br>C6<br>C7<br>C8 |
| Distinguish between local and global optima. | A8<br>A11 | | |
| Solve graphically problems with two variables. | A8<br>A11 | | |
| Analyze the existence of global optima using the Weierstrass theorem. | A8<br>A11 | | |
| Find the critical points of a function of several variables. | A8<br>A11 | | |
| Classify the critical points using the second-order conditions. | A8<br>A11 | | |
| Determine the local or global character of the optima of an unconstrained problem. | A8<br>A11 | | |
| Formulate economic problems as mathematical programs with equality constraints. | A8<br>A11 | | |
| Find the critical points of a mathematical program with equality constraints. | A8<br>A11 | | |
| Classify the critical points and interpret the Lagrange multipliers. | A8<br>A11 | | |
| Determine the local or global character of the optima of an equality-constrained problem. | A8<br>A11 | | |
| Know the structure and basic properties of a linear program. | A8<br>A11 | | |
| Formulate simple economic problems as linear programs. | A3<br>A4<br>A8<br>A11<br>A12 | B1<br>B2<br>B3<br>B4<br>B5<br>B10 | C1<br>C4<br>C6<br>C7<br>C8 |
| Solve linear programs by the simplex algorithm. | A3<br>A4<br>A6<br>A8<br>A9<br>A11 | B1<br>B2<br>B3<br>B4<br>B5<br>B10 | C1<br>C4<br>C5<br>C6<br>C7<br>C8 |
| Formulate and solve the dual of a given linear program. | A8<br>A11 | | |

| Contents | |
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| **Topic** | **Sub-topic** |
| 1. The euclidean space IRn. | The vector space IRn.<br>Inner product. Norm. Distance.<br>Interior, closure, isolated, limit and boundary points.<br>Open and closed sets.<br>Compact and convex sets. |
| 2. Functions of several variables. | Basic concepts.<br>Graphical representation of real functions. Level sets.<br>Limit of a function at a point.<br>Continuity.<br>Linear functions.<br>Quadratic forms. Classification. Constrained quadratic forms. |
| 3. Differentiability of functions of several variables. | Partial derivatives.<br>Differentiability. Continuously differentiable function.<br>Theorems relative to differentiability. The chain rule.<br>Partial derivatives of higher order. Taylor theorem.<br>Implicit function theorem.<br>Homogeneous functions. Euler theorem. |
| 4. Convexity of sets and functions. | Convex sets. Properties.<br>Convex functions. Properties.<br>Characterization of twice continuously differentiable convex functions. |
| 5. Introduction to mathematical programming. | Formulation of a mathematical program.<br>Local and global optima.<br>Fundamental theorems of optimization. |
| 6. Unconstrained optimization. | First-order necessary conditions.<br>Second-order conditions.<br>The convex case. |
| 7. Equality-constrained optimization | Formulation.<br>First-order necessary conditions: the Lagrange theorem.<br>Second-order conditions.<br>The convex case.<br>Interpretation of the multipliers. |
| 8. Linear programming. | Formulation of linear programs.<br>Basic feasible solutions.<br>Fundamental theorems.<br>The simplex algorithm.<br>Finding an initial basic feasible solution.<br>Duality. |

| Planning | | | | |
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| **Methodologies / tests** | **Competencies** | **Ordinary class hours** | **Student?s personal work hours** | **Total hours** |
| Introductory activities | A6 A9 A12 C1 | 1 | 0 | 1 |
| Multiple-choice questions | A10 B2 B3 B4 | 2 | 7 | 9 |
| Mixed objective/subjective test | A10 B2 B3 B4 | 3 | 15 | 18 |
| Guest lecture / keynote speech | A3 A4 A8 A9 A11 A12 B1 B5 C7 C6 | 15 | 15 | 30 |
| Seminar | B10 C4 C5 C8 | 2 | 4 | 6 |

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| Practical test: | A11 A8 B1 B2 B3 B4 B5 C1 | 2 | 8 | 10 |
| Problem solving | A6 B1 | 25 | 50 | 75 |
| 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** |
| Introductory activities | It will be the presentation of the course (one hour). |
| Multiple-choice questions | There will be two multiple-choice exams. These exams will have questions with several given answers --only one will be correct-- related to theoretical and practical concepts covered in the course. |
| Mixed objective/subjective test | At the end of the course, there will be a mixed (theoretical/practical) exam. This exam will take place at the official date determined by the Faculty. |
| Guest lecture / keynote speech | There will be 15 hours of keynote speech, that will be focused on the exposition of the theoretical contents. |
| Seminar | The group will be divided into two subgroups for the seminars. |
| Practical test: | There will two in-class practical exams. |
| Problem solving | There will be 25 hours of problem solving classes, which will be focused on the formulation and solving of problems related to the practical contents of the subject. |

| Personalized attention | |
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| **Methodologies** | **Description** |
| Problem solving<br>Seminar | The student will be able to contact the teacher by the following means:<br>- Moodle (using the forums or direct messages).<br>- Email.<br>- Personal tutoring in the office (at the official dates or at other dates upon request).<br>- Seminars in small groups (group tutorials). |

| Assessment | | | |
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| **Methodologies** | **Competencies** | **Description** | **Qualification** |
| Practical test: | A11 A8 B1 B2 B3 B4 B5 C1 | There will be two presential exams. Each of them will represent a 10% of the final grade (1 point each). It will be valued a good understanding of the concepts, the use of appropriate reasoning, the proper use of mathematical language, and the skills in formulating and solving problems. | 20 |
| Mixed objective/subjective test | A10 B2 B3 B4 | The final (presential) exam will represent a 50% of the final mark (5 points). It will be valued a good understanding of the concepts, the use of appropriate reasoning, the proper use of mathematical language, and the skills in formulating and solving problems. | 50 |
| Guest lecture / keynote speech | A3 A4 A8 A9 A11 A12 B1 B5 C7 C6 | It will be valued active participation and doing assigned activities for each season. | 4 |
| Problem solving | A6 B1 | It will be valued active participation and doing assigned activities for each season. | 5 |
| Seminar | B10 C4 C5 C8 | It will be valued active participation and doing assigned activities for each season. | 1 |
| Multiple-choice questions | A10 B2 B3 B4 | There will be two multiple-choice presential exams. Each of them will represent a 10% of the final grade (1 point each). | 20 |

| Assessment comments |
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Continuous assessment will consist of valuing active participation and doing assigned activities for each season (lectures, problem solving and seminars) (10%), two in-class multiple-choice quizzes (10% each) and two in-class "probas prácticas" (10% each). Non-attendance to more than four class sessions (lecture, practice or seminar) will lead to not computing the continuous assessment qualification. To qualify an absence as justified or not we will follow the provisions of Article 12, points 1 and 5, of the Normas de avaliación, revisión e reclamación das cualificacións dos estudos de grao e mestrado universitarios. In case of disrespectful behavior with peers or teacher, or using electronic devices (tablet, computer, telephone, ...) or other material unrelated to the class activities, you will be required to leave the classroom, and it will be counted as an non-justified absence.The qualification of NOT-TAKEN will alsol be awarded to the student who has only
participated in assessment activities that have a weighting below 20% of
the final grade, regardless of the qualification obtained.The final grade for students applying to the call of December will be the weighted sum of the qualification of the final exam (70%) and the continuous assessment qualification attained in the course 2014-2015 (30%) .Conditions
for carrying out exams: During the examination you
cannot have access to any device that allows communication with the
outside and/or storage of information. Entry to the examination room with these devices may be denied. The student may use a scientific calculator non graphic and non programmable. Exams written in pencil will not be admitted.Virtual Platform: To follow the course the student will have to use the virtual platform of Mathematics, MOEBIUS (http://moebius.udc.es/). For that, each student will be provided a personal username and password. The information needed to access the virtual platform with these credentials is in http://moebius.udc.es/. In
this virtual platform the materials of the course will will be available:
summaries, slide presentations, exercises, and the qualifications of the tests.

| Sources of information | |
|---|---|
| Basic | - K. Sydsæter, P. J. Hammond y P. Carvajal (2012). Matemáticas para el análisis económico . Madrid, Pearson |
| Complementary | - A. C. Chiang y K. Wainwright (2006). Métodos fundamentales de economía matemática . Madrid, McGraw-Hill<br>- M. Hoy, J. Livernois, C. McKenna, R. Rees y T. Stengos (2001). Mathematics for economics. Cambridge, MA, The MIT Press<br>- E. Minguillón, I. Pérez Grasa y G. Jarne (2004). Matemáticas para la economía. Libro de ejercicios. Álgebra lineal y cálculo diferencial. Madrid, McGraw-Hill<br>- I. Pérez Grasa, G. Jarne y E. Minguillón (1997). Matemáticas para la economía: álgebra lineal y cálculo diferencial . Madrid, McGraw-Hill<br>- I. Pérez Grasa, G. Jarne y E. Minguillón (2001). Matemáticas para la economía: programación matemática y sistemas dinámicos . Madrid, McGraw-Hill<br>- R. Caballero, S. Calderón, T. P. Galache, A. C. González, Mª. L. Rey y F. Ruiz (2000). Matemáticas aplicadas a la economía y la empresa. 434 ejercicios resueltos y comentados . Madrid, Pirámide<br>- R. M. Barbolla, E. Cerdá y P. Sanz (2001). Optimización. Cuestiones, ejercicios y aplicaciones a la economía . Madrid, Prentice Hall |

| Recommendations |
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| Subjects that it is recommended to have taken before |
| Matemáticas I/611G02009 |
| Subjects that are recommended to be taken simultaneously |
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| Subjects that continue the syllabus |
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| Other comments |
| It is advisable to have passed Mathematics I. Students must be familiar with the concepts and fundamental results of linear algebra (matrices, determinants and systems of linear equations), and differential calculus in one variable (limit, continuity, derivative, elasticity, optima, convexity). |

(*)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.