Approval date: **23/06/2023**

COURSE GUIDE

Mathematics for Economics II (2391125)

Grado (Bachelor's Degree)	Grado en Economía	**Branch**	Social and Legal Sciences
Module	Ampliación de Matemáticas	**Subject**	Matemáticas para la Economía II

Year of study	2º	**Semester**	1º	**ECTS Credits**	6	**Course type**	Compulsory course

PREREQUISITES AND RECOMMENDATIONS

Completion of the following courses: Mathematics and Mathematics for Economics I (Bachelor's Degree in Economics) or Mathematics for Business (Bachelor's Degree in Business).

BRIEF DESCRIPTION OF COURSE CONTENT (According to the programme's verification report)

• Mathematical programs with equality constraints. Method of Lagrange multipliers. Economical applications.
• Mathematical programs with inequality constraints. Karush-Kuhn-Tucker conditions. Economic interpretation of the multipliers.
• Linear programming. Simplex algorithm. Sensibility and post-optimization analysis.
• Differential and difference equations of greater order. Stability criteria

SKILLS

GENERAL SKILLS

- CG02 - Cognitive comprehension skills.
- CG03 - Ability to analyse and summarise.
- CG04 - Ability to organise and plan.
- CG08 - Problem-solving skills.
- CG09 - Ability to make decisions.
- CG16 - Ability to engage in critical and self-critical reasoning.
- CG17 - Ability to learn and work autonomously.
- CG18 - Ability to adapt to new situations
- CG19 - Creatividad o habilidad para generar nuevas ideas

SUBJECT-SPECIFIC SKILLS

- CE22 - Bring rationality to the analysis and description of any aspect of economic reality.
- CE23 - Evaluate the consequences of alternative courses of action and select the best ones given the objectives.
- CE37 - Mathematical optimisation.
- CE50 - Acquire skills in solving optimization problems in the economic field.
- CE51 - Understand the techniques of differential and integral calculus in several variables and their application to economic analysis.
- CE52 - Know and understand how to apply the different methods of Mathematical Optimisation and some of the main dynamic models in Economics.
- CE55 - Understand and operate generic optimisation software and specific linear programming software.

TRANSFERABLE SKILLS

- CT01 - Through the knowledge and application of concepts learnt in the Bachelor's Degree (Grado), be able to identify and anticipate economic problems relevant to the allocation of resources, both in the public and private sectors.
- CT02 - Know, understand and apply the different economic models to provide rationality to the analysis and description of any aspect of reality, and be able to know the economic choice criteria of the different agents that make up society.

LEARNING OUTCOMES

• Solve mathematical programs with equality constraints using substitution method and Lagrange multipliers.
• Aply Karush-Kuhn-Tucker multipliers method to solve programs with inequality constraints.
• Understand the economical interpretation of the multipliers.
• Know the utility of Weierstrass theorem and the implication of coercivity to guarantee the existence of solution in
optimization problems.
• Recognize quadratic functions and separate variables functions which are coercive.
• Aply simplex method to solve linear programs.
• Solve problems of production planification, diet, etc.
• Analize sensitivity in a linear program.
• Solve linear difference equations.
• Solve linear differential equations.
• Know stability criteria for dynamical systems.

PLANNED LEARNING ACTIVITIES

THEORY SYLLABUS

• Lesson 1. Ordinary differential equations.
  - Phase portrait for autonomous differential equations.
  - Linear differential equations.
  - Stability.
• Lesson 2. Ordinary Difference equations.
  - Autonomous difference equations.
  - Linear difference equations.

- Stability.

· Lesson 3. Linear programming.
- Simplex method.
- Two phases simplex method.
- Economical applications: Diet problem and production problem.
- Sensitivity analysis.

· Lesson 4. Optimization with equality constraints.
- Weierstrass theorem.
- Coercive functions.
- Method of Lagrange multipliers.
- Interpretation of the multipliers.

· Lesson 5. Optimization with inequality constraints.
- Method of the Karush-Kuhn-Tucker multipliers.
- Interpretation of the multipliers.

PRACTICAL SYLLABUS

Not applicable

RECOMMENDED READING

ESSENTIAL READING

- ARRANZ PEREZ, GARCILLAN Y OTROS, Ejercicios resueltos de Matemáticas para la Economía. Optimización y Operaciones financieras. Ed. AC, 1998.
- ÁLVAREZ DE MORALES, M. Y FORTES, M. A., Matemáticas Empresariales. Ed. GodelImpresiones Digitales S.L., 2009.
- GANDOLFO, G., Economic Dynamics, ED. Springer, 2010.
- GARCIA, J., MARTINEZ, C. Y RODRIGUEZ M.L., Optimización Matemática aplicada a la Economía. Ed.Godel Impresiones Digitales S.L., 2009.
- STEWART, J. Multivariable Calculus. Cengage Learning, 2012.
- SYDSATER, K Y HAMMOND, P. J., Further Mathematics for Economic Analysis Ed. Prentice Hall. 2008.
- SYDSATER, K Y HAMMOND, P. J., Essential Mathematics for Economic Analysis Ed. Prentice Hall. 2016.
- ZILL, D.G. Ecuaciones diferenciales con Aplicaciones. Ed. Grupo Iberoamérica. 1988

COMPLEMENTARY READING

- ALEGRE, P. Y OTROS, Ejercicios resueltos de Matemáticas Empresariales 2. Ed. AC,1993.
- BARBOLLA, S., CERDÁ, E. Y SANZ, P., Optimización (cuestiones, ejercicios y aplicaciones a la economía). Ed. Prentice Hall 2000.
- BORRELL, J., Métodos matemáticos de la Economía: Programación matemática. Ed. Pirámide, 1987.
- CABALLERO, R., CALDERON, S. Y OTROS, Matemáticas aplicadas a la economía y a la empresa. Ed. Pirámide, 1993.
- CHIANG, Métodos fundamentales en Economía Matemática. Ed. McGraw-Hill, 2006.
- DIAZ, A., NOVO, V. Y PERÁN, J., Optimización. Casos prácticos. UNED Ediciones, 2000.
- GARCÍA CABELLO J., Cálculo Diferencial de las Ciencias Económicas. Ed. Delta Publicaciones 2008.

- GASS, S.I, Programación lineal. Ed. Cecsa, 1978.
- HAEUSSLER, E. Y PAUL, E., Matemáticas para la Administración, Economía, Ciencias Sociales y de la Vida. Ed.Prentice Hall, 1997.
- PERIS, J.E. Y CARBONELL, L., Problemas de matemáticas para economistas. Ed. Ariel Economía, 1986.
- SOTO, M.D., Métodos de Optimización. Ed. Delta publicaciones, 2007.

RECOMMENDED LEARNING RESOURCES/TOOLS

- Teaching platform Matemapli: http://vvv.ugr.es
- Web site of the Department of Applied Mathematics: http://mateapli.ugr.es/

TEACHING METHODS

- MD01 - Docencia presencial en el aula
- MD02 - Estudio individualizado del alumno, búsqueda, consulta y tratamiento de información, resolución de problemas y casos prácticos, y realización de trabajos y exposiciones.
- MD03 - Tutorías individuales y/o colectivas y evaluación

ASSESSMENT METHODS (Instruments, criteria and percentages)

ORDINARY EXAMINATION DIET

According to University of Granada Assessment and Grading Regulations (see http://secretariageneral.ugr.es/bougr/pages/bougr71/ncg712/!), continuous and single final assessment are proposed for this subject.
Continuous assessment will be the default choice, unless another option be formally requested to the Head of the Department (University of Granada Assessment and Grading Regulations).
Continuous assessment is divided into two blocks. The score of each block is obtained by gathering the score of a partial test and other activities such as exercises, online tests, seminars/workshops, blackboard exhibitions, homeworks, etc. The breakdown of the grades is the following:

- Block I, related with lessons 1 and 2, will score 4 points maximum.
- Block II, related with lesson 3, 4 and 5, will score 6 points maximum.

The final grade will be:

- The sum of both block grades if this is greater than or equal to 5 points.
- If the sum is less than 5 points, students could make an exam of the blocks where the obtained mark is less than 50% of the maximum score (2 points in Block I, and 3 points in Block II). The final exam will consist of a global test comprising both blocks mentioned before with the same score (that is, Block I with maximum score 4 points and Block II with 6 points).
- If a student takes the part corresponding to one block in the final test, the student drops the previous score in this block. The grade obtained in each block in the final test will substitute the one obtained during the semester. The final grade will be the sum of both block marks.

EXTRAORDINARY EXAMINATION DIET

A single final test on the theoretical and practical contents of the course with a maximum score of 10 points.

SINGLE FINAL ASSESSMENT (evaluación única final)

The single final assessment will comprise a single test with a maximum score of 10 points. Every detail on the single final assessment regulations by UGR can be found at the following URL: http://secretariageneral.ugr.es/bougr/pages/bougr112/_doc/examenes%21.
Date and place of the exam will be set by the Faculty (as well as the final exam in the continuous assessment)

ADDITIONAL INFORMATION

All aspect related with both continuous and final assesment will be guided by current assessment regulations by UGR
(http://secretariageneral.ugr.es/bougr/pages/bougr112/_doc/examenes%21)