

COURSE GUIDE FOR
MATHEMATICS FOR ECONOMICS II

Academic year 2020-2021

(Date last update: 13/07/2020)

(Date approved in Department Council: 13/07/2020)

MODULE	SUBJECT MATTER	YEAR	SEMESTER	CREDITS	TYPE
Quantitative Methods	Mathematics for Economics II	2	1	6	Compulsory
TEACHING STAFF ⁽¹⁾			ADDRESS, TELEPHONE NUMBER, EMAIL, ETC. DIRECCIÓN COMPLETA DE CONTACTO PARA TUTORÍAS (Dirección postal, teléfono, correo electrónico, etc.)		
<u>Theory:</u> <ul style="list-style-type: none"> Lidia Fernández Rodríguez: groups A and B José Miguel Alonso Alonso: groups C and D <u>Practice:</u> <ul style="list-style-type: none"> Lidia Fernández Rodríguez José Miguel Alonso Alonso Joaquín Sánchez Lara <p>Coordinator: José Miguel Alonso Alonso</p>			DEPT Applied Mathematics, Faculty of Economics and Business. Office number: B03, B06 and B02. Email: lidiafr@ugr.es , jmaa@ugr.es , jslara@ugr.es		
			TIMETABLE FOR TUTORIALS OR LINK TO WEBSITE		
			Available in: <ul style="list-style-type: none"> http://mateapli.ugr.es/ and: <ul style="list-style-type: none"> http://vvv.ugr.es 		
BELONGS TO UNDERGRADUATE DEGREE PROGRAMME			AND ALSO TO OTHER UNDERGRADUATE DEGREE PROGRAMMES		

¹ Consult any updates in Acceso Identificado > Aplicaciones > Ordenación Docente

(∞) This course guide should be filled in according to UGR regulations on assessment of student learning: (<http://secretariageneral.ugr.es/pages/normativa/fichasugr/ncg7121/>)



Grado in Economics

Grado in Business, *Grado* in Finance and Accounting and *Grado* in Marketing and Market Research.

PREREQUISITES OR RECOMMENDATIONS (where applicable)

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 CONTENT (ACCORDING TO OFFICIAL VALIDATION 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

GENERAL AND SPECIFIC COMPETENCES

General Competences:

- CG2 - Cognitive comprehension skills.
- CG3 - Capacity for analysis and synthesis.
- CG4 - Ability of organization and planning.
- CG8 - Ability in solving problems.
- CG9 - Ability in decision making.
- CG16 - Ability in critical and self-critical reasoning.
- CG17 - Learning capacity and autonomous work.
- CG18 - Capacity for adapting to new situations.
- CG19 - Creativity or ability to develop new ideas.

Basic Competences:

- CB1 - Students will acquire competence in an area of study that, starting from secondary education level and through the use of advanced textbooks, requires some expertise because it deals with some aspects that imply knowledge coming from the vanguard of its field of study.
- CB2 - Students will be able to apply their knowledge to their work or vocation in a professional manner, and provide them with the skills to elaborate and defend their position and with the problem-resolution abilities in their area of application.
- CB3 - Students will get the ability to gather and interpret relevant data (usually within their area of study) to make judgments that include a reflection on relevant issues of social, scientific or ethical nature.
- CB5 - Students will acquire those learning skills necessary to undertake further studies with a high degree of autonomy.



Transversal Competences:

- CT1 - Students will be able to identify and anticipate relevant economic problems related to resource allocation in general -both in the private and public area- using the knowledge and concepts provided in the degree.
- CT2 - Students will learn how to evaluate, from the relevant information records, the situation and foreseeable evolution of a company and issue reports on specific situations of companies and markets or make decisions based on the obtained information.

Specific Competences:

- CE22 - Provide 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 options given the objectives previously set.
- CE37 - Mathematical optimization.
- CE52 - Know, understand and apply different methods of mathematical optimization as well as some of the main dynamical models in economics.
- CE50 - Get skills in solving optimization problems in the economic field.
- CE51 - Learn techniques of differential and integral calculus in several variables and their applications in economical analysis.
- CE55 - Get introduced to the knowledge and use of generic purpose software for optimization and specific software for linear programming.

OBJECTIVES (EXPRESSED AS EXPECTED LEARNING OUTCOMES)

- Solve mathematical programs with equality constraints using substitution method and Lagrange multipliers.
- Apply 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.
- Apply simplex method to solve linear programs.
- Solve problems of production planification, diet, etc.
- Analyze sensitivity in a linear program.
- Solve linear difference equations.
- Solve linear differential equations.
- Know stability criteria for dynamical systems.



DETAILED SYLLABUS

THEORY:

- 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 and 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.

BIBLIOGRAPHY

BASIC READING LIST

- 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. Godel Impresiones Digitales S.L., 2009.
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- STEWART, J. Cálculo Multivariante. Ed. Thomson, 2002.
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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.
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- GARCÍA CABELLO J., Cálculo Diferencial de las Ciencias Económicas. Ed. Delta



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- GASS, S.I, Programación lineal. Ed. Cecs, 1978.
- HAEUSSLER, E. Y PAUL, E., Matemáticas para la Administración, Economía, Ciencias Sociales y de la Vida. Ed. Prentice Hall, 1997.
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RECOMMENDED LINKS

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

TEACHING METHODOLOGY

- Master clases.
- Study and individual work by the student, including the search, checking and treatment of the necessary information sources.
- Case studies and problem solving.
- Classroom works and presentations.
- Individual or group tutoring.
- Online tests.

ASSESSMENT (ASSESSMENT INSTRUMENTS, CRITERIA AND PERCENTAGE VALUE OF FINAL OVERALL MARK, ETC.)

ORDINARY ASSESSMENT SESSION:

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).

During the semester students will make a theoretical-practical test for each lesson. Every test will score 1.5 points maximum. Those students who get a mark equal to or higher than 0.75 points can keep it for their final score. Those students who get a mark lower than 0.75 will have to repeat the test on the final examination.

The final exam will score up to 2.5 points for those students who have passed the previous five partial tests.

The final grade will be the sum of the six marks as stated below:

$$N = P_1 + P_2 + P_3 + P_4 + P_5 + F$$

where every P_k is the score corresponding to the lesson k test (for $k=1,2,3,4,5$) and F is the score corresponding to the final exam.



The test could be different according to the student's involvement in the classroom activities.

EXTRAORDINARY ASSESSMENT SESSION:

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

DESCRIPTION OF THE EXERCISES WHICH WILL CONSTITUTE SINGLE FINAL ASSESSMENT AS ESTABLISHED IN UGR REGULATIONS

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)

SCENARIO A (ON-CAMPUS AND REMOTE TEACHING AND LEARNING COMBINED)

TUTORIALS

TIMETABLE

(According to Official Academic Organization Plan)

TOOLS FOR TUTORIALS

(Indicate which digital tools will be used for tutorials)

Available at <https://mateapli.ugr.es> and <http://vvv.ugr.es>

On scenario A, except in justified cases, tutorials will be held online using either any authorized tool by UGR or email. Individual tutorial will be held under each student's request. Teaching staff could propose supporting group tutorials, that can be compulsory or optional, in an asynchronous online teaching situation.

MEASURES TAKEN TO ADAPT TEACHING METHODOLOGY

- Following the guidelines of the *Plan de adaptación de la enseñanza en el curso académico 2020-2021 a las medidas sanitarias derivadas de la pandemia de la covid-19*, Scenario A teaching methodology is defined as a multimodal or blended system which combines the highest possible level of classroom activity with online teaching (synchronous sessions) and remote training activities focused on the students' autonomous learning.
- The distribution of classroom and remote activities and the way they are held will follow the guidelines established by the Faculty of Economics and Business, UGR and the health authorities
- Tasks and exercises delivery will be done using authorized teaching online tools.
- Additionally, special attention will be paid to provide the students with supporting teaching material through authorized teaching online tools.

MEASURES TAKEN TO ADAPT ASSESSMENT (Instruments, criteria and percentage of final overall



mark)

Ordinary assessment session

Continuous assessment will be the preferred choice. Tests and marks will be identical to those established for the on-campus scenario.

If the health situation allows it, tests will be held on classroom. If this is not possible, tests will take place using authorized teaching online tools.

Extraordinary assessment session

The extraordinary assessment session will consist of a single test with a maximum score of 10 points.

If the health situation allows it, tests will be held on classroom. If this is not possible, tests will take place using authorized teaching online tools.

Single final assessment

Single final assessment will consist of a single test with a maximum score of 10 points.

If the health situation allows it, tests will be held on classroom. If this is not possible, tests will take place using authorized teaching online tools.

SCENARIO B (ONCAMPUS ACTIVITY SUSPENDED)

TUTORIALS

TIMETABLE
(According to Official Academic Organization Plan)

TOOLS FOR TUTORIALS
(Indicate which digital tools will be used for tutorials)

Available at <https://mateapli.ugr.es> and <http://vvv.ugr.es>

On scenario B tutorials will be held online using either any authorized tool by UGR or email. Individual tutorial will be held under each student request. Teaching staff could propose supporting group tutorials, that can be compulsory or optional, in an asynchronous online teaching situation

MEASURES TAKEN TO ADAPT TEACHING METHODOLOGY

- Teaching will be online using authorized teaching tools. Synchronous teaching will be the prime choice although the health situation could lead to an asynchronous scenario where lessons will be recorded, shared and supported with additional teaching strategies (group tutorials, online tasks,...)
- Tasks and exercises delivery will be done using always either authorized teaching tools or institutional email.
- Additionally, special attention will be paid to provide the students with supporting teaching material through authorized teaching online tools.



MEASURES TAKEN TO ADAPT ASSESSMENT (Instruments, criteria and percentage of final overall mark)

Ordinary assessment session

The distribution of tests and evaluation tasks will be identical to the previous scenario but they will be held on-line using authorized teaching tools.

Extraordinary assessment session

Extraordinary assessment session will consist of a single test with a maximum score of 10 points.

Tasks and exercises delivery will be done using authorized teaching online tools.

Single final assessment

Single final assessment will consist of a single test with a maximum score of 10 points.

Test will be done using authorized teaching online tools.

ADDITIONAL INFORMATION (if necessary)

