

Guía docente / *Course Syllabus*

2019-20

1. Descripción de la Asignatura / *Course Description*


Asignatura <i>Course</i>	MATEMÁTICA EMPRESARIAL I (docencia en inglés)
Códigos <i>Code</i>	504003; 902005
Facultad <i>Faculty</i>	Facultad de Ciencias Empresariales
Grados donde se imparte <i>Degrees it is part of</i>	Grado en Administración y Dirección de Empresas (Inglés); Doble Grado en Administración y Dirección de Empresas (Inglés) y Derecho
Módulo al que pertenece <i>Module it belongs to</i>	Formación básica en ciencias económicas y empresariales
Materia a la que pertenece <i>Subject it belongs to</i>	Matemáticas
Departamento responsable <i>Department</i>	Economía, Métodos Cuantitativos e Historia Económica
Curso <i>Year</i>	1º
Semestre <i>Term</i>	1º
Créditos totales <i>Total credits</i>	6
Carácter <i>Type of course</i>	Básica
Idioma de impartición <i>Course language</i>	Inglés
Modelo de docencia <i>Teaching model</i>	C1

Clases presenciales del modelo de docencia C1 para cada estudiante: 23 horas de enseñanzas básicas (EB), 22 horas de enseñanzas prácticas y de desarrollo (EPD) y 0 horas de actividades dirigidas (AD). Hasta un 10% de la enseñanza presencial puede sustituirse por docencia a distancia (también presencial, pero posiblemente asíncrona), de acuerdo con la programación de la Asignatura publicada antes del comienzo del curso.

Number of classroom teaching hours of C1 teaching model for each student: 23 hours of general teaching (background), 22 hours of theory-into-practice (practical group tutoring and skill development) and 0 hours of guided academic activities. Up to 10% of face-to-face sessions can be substituted by online teaching, in accordance with the course schedule published before it begins.

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2. Responsable de la Asignatura / *Course Coordinator*


Nombre <i>Name</i>	Ana María Martín Caraballo
Departamento <i>Department</i>	Economía, Métodos Cuantitativos e Historia Económica
Área de conocimiento <i>Field of knowledge</i>	Métodos Cuantitativos para la Economía y Empresa
Categoría <i>Category</i>	Profesora Colaboradora
Número de despacho <i>Office number</i>	3.2.18
Teléfono <i>Phone</i>	954978044
Página web <i>Webpage</i>	https://www.upo.es/profesorado/ammarrar
Correo electrónico <i>E-mail</i>	ammarrar@upo.es

3. Ubicación en el plan formativo / *Academic Context*

Breve descripción de la asignatura <i>Course description</i>	Basic elements of Linear Algebra and Matrix Theory. Matrix operations. Basic elements of functions: continuity, differentiability and integration.
Objetivos (en términos de resultados del aprendizaje) <i>Learning objectives</i>	<ul style="list-style-type: none">- To provide students with mathematical knowledge and techniques; these will be useful to complete their higher education and to carry out their professional life.- To supply the student with the basic, indispensable tools needed in order to easily interpret and tackle mathematical models associated with the economic problems that can be found in other subjects and in the business world.- To give elemental tools from Linear Algebra, Matrix Theory, and Elements of Functions, to facilitate the comprehension of economic results.- To make the student familiar with the daily mathematical vocabulary, and to make him used to a logic reasoning to carry out the resolutions of problems.- To introduce the student to the use of the computational software program Mathematica, and to facilitate the application of this computational tool for the resolution of problems posed within the course.
Prerrequisitos <i>Prerequisites</i>	There are no previous requirements for the course.
Recomendaciones <i>Recommendations</i>	Although this is not a formal prerequisite, in order to understand the course, it is required to have basic knowledge from the Bachillerato and previous years. Especially for those students who do not have a Bachillerato de Ciencias, it would be appropriate a first stage where contents will be leveled.
Aportaciones al plan formativo <i>Contributions to the educational plan</i>	Mathematics for Business I is a 6-credit core subject, belonging to the following plans: Business Administration and Management Degree, and Double Degree in Business Administration and Management, and Law. It is taught in the first year of both

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Degrees, and it depends on the Academic Area of Quantitative Methods in the Department of Economics, Quantitative Methods and Economic History (Departamento de Economía, Métodos Cuantitativos e Historia Económica).

Due to the contents of these Degrees, this course must be essentially practical, so that it can be applied to other subjects. The contents of the course have been selected considering the requirements of the others. We want to emphasize the utility of mathematical tools in other subjects, such as: Introducción a la Economía (Introduction to Economics), Economía de la Empresa (Business Administration), Microeconomía (Microeconomics), Matemática Empresarial II (Mathematics for Business II), Estadística Empresarial I (Business Statistics I), Estadística Empresarial II (Business Statistics II), Matemática Financiera (Financial Mathematics), Macroeconomía (Macroeconomics), Métodos Estadísticos y Econométricos en la Empresa (Statistical and Econometric Methods for Business), Modelos para la Programación y Planificación Empresarial (Business Programming and Planning Models) and Técnicas Matemáticas de Decisión (Mathematical Techniques for Decision Making).

The importance of mathematical results explained in this course is rooted in their capacity to open different ways of solving problems from a range of different fields. The lecturers will show the straightest applications for each introduced topic, making the learning process more dynamic, and increasing the motivation of the student towards Mathematics.

In spite of the practical nature of this course, it cannot be reduced to a simple collection of methods to solve particular problems. Its formative nature must be taken into account, which will allow the student to develop skills in logic reasoning and in comprehension of formal language. It is necessary to make the student realize the importance of studying quantitative techniques because they are useful, but it is opportune to establish a minimum level of rigor which cannot be left aside under the pretext that Mathematics implies a basic knowledge for the economist and the businessperson.

4. Competencias / Skills

Competencias básicas de la Titulación que se desarrollan en la Asignatura
Basic skills of the Degree that are developed in this Course

CB1 - Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio
CB2 - Que los estudiantes sepan aplicar sus conocimientos a su trabajo o vocación de una forma profesional y posean las competencias que suelen demostrarse por medio de la elaboración y defensa de argumentos y la resolución de problemas dentro de su área de estudio
CB3 - Que los estudiantes tengan la capacidad de reunir e interpretar datos relevantes (normalmente dentro de su área de estudio) para emitir juicios que incluyan una reflexión sobre temas relevantes de índole social, científica o ética
CB4 - Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado

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	CB5 - Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía
Competencias generales de la Titulación que se desarrollan en la Asignatura <i>General skills of the Degree that are developed in this Course</i>	CG11 - Capacidad de análisis y síntesis CG12 - Capacidad de organización y planificación CG17 - Capacidad para la resolución de problemas. CG19 - Habilidad para analizar y buscar información proveniente de fuentes diversas CGP1 - Capacidad para trabajar en equipo CGP6 - Capacidad crítica y autocrítica CGP8 - Trabajar en entornos de presión CGS3 - Capacidad de aprendizaje autónomo CGS4 - Creatividad CGS5 - Motivación por la Calidad CGS6 - Capacidad de Adaptación a nuevas situaciones
Competencias transversales de la Titulación que se desarrollan en la Asignatura <i>Transversal skills of the Degree that are developed in this Course</i>	CT1 - Comunicación oral y escrita en castellano. CT2 - Comunicación oral y escrita en una lengua extranjera. CT4 - Conocimientos de informática relativos al ámbito de estudio. CT6 - Compromiso ético en el trabajo. CT8 - Actuar de acuerdo con criterios de responsabilidad social, principios de igualdad de oportunidades entre hombres y mujeres, principios de igualdad de oportunidades y accesibilidad universal de las personas con discapacidad y los valores propios de una cultura de la paz y de valores democráticos.
Competencias específicas de la Titulación que se desarrollan en la Asignatura <i>Specific competences of the Degree that are developed in the Course</i>	CE19 - Conocer las técnicas matemáticas y estadísticas básicas aplicadas al ámbito económico-empresarial, y analizar cuantitativamente la realidad económico-empresarial e Interrelacionar los conocimientos adquiridos en diversas materias de la titulación en el ámbito matemático, estadístico y de teoría económica
Competencias particulares de la asignatura, no incluidas en la memoria del título <i>Specific skills of the Course, not included in the Degree's skills</i>	- Knowledge of basic mathematical techniques in Linear Algebra and Calculus; application of the presented techniques in order to resolve specific problems in business. - Ability to connect the concepts studied in this course with other subjects.

5. Contenidos de la Asignatura: temario / *Course Content: Topics*

TEMA 1	BASIC ELEMENTS ON LINEAR ALGEBRA AND MATRIX THEORY
1.1	Representation of Economic Data through Real Matrices. Types of Matrices and Matrix Operations.
1.2	Considering Variables of Several Dimensions. Vector Operations. Linear Dependence and Linear Independence.
1.3	Linear Models of Several Equations. Solving and Interpreting Systems of Linear Equations.
1.4	Computer Applications.
TEMA 2	REAL-VALUED FUNCTIONS OF ONE REAL VARIABLE
2.1	Analysis of Basic Functions in the Context of Economics, Business and Management. Domain, Continuity and Graphical Representation.
2.2	Absolute Variation and Relative Variation.
2.3	Computing Derivatives of Functions of One Real Variable. Higher Derivatives. Economic Interpretation.

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2.4	Computer Applications.
TEMA 3	FUNCTIONS OF SEVERAL VARIABLES
3.1	Real-valued Function. Functions in Economics. Real-valued Function of Several Variables. Graph of a Function. Some Type of Functions According to Their Economic Interpretation. Contour Lines (or Level Set).
3.2	Continuity. Properties.
3.3	Partial Derivatives. Gradient. Marginal Values. Elasticity. Interpretation.
3.4	Homogeneous Functions.
3.5	Computer Applications.
TEMA 4	INTEGRATION
4.1	Primitive and Indefinite Integral. Computing Primitives.
4.2	Definite Integral: Interpretation and Properties. Barrow's Rule.
4.3	Improper Integrals.
4.4	Double Integral. Integrals on General Regions.
4.5	Computer Applications.
TEMA 5	SEQUENCES AND SERIES
5.1	Numerical Sequence. Limits of Sequences. Convergent and Divergent Sequences. Computing of Limits.
5.2	Numerical Series: Series with All their Terms Positive.
5.3	Addition of Series: Arithmetic Series and Geometric Series.
5.4	Functional Sequences. Convergence.
5.5	Computer Applications.

6. Metodología y recursos / *Methodology and Resources*

Metodología general <i>Methodology</i>	<p>On-line and on-site teaching will be combined in the development of the subject.</p> <p>The theoretical part, in which the basic aspects of the subject will be shown, should be taken by the students mainly on-line, using the Blackboard Learn platform, according to the schedule specified by the lecturers. On-site classes are mostly intended to solve problems related to Business Sciences, highlight their right understanding and apply the right mathematical theorems and make the subject as practical as possible.</p> <p>As regards on-site teaching, it will be organized into the following two modules:</p> <ul style="list-style-type: none"> • General/background teaching (GT). • Practical/developmental knowledge-building teaching (PT). <p>Finally, personalized tutorials are optional for students. Lecturers will give students some guidance on their personal study, if they need so, to clarify specific doubts related to the subject contents, to correct wrong achieved concepts and habits, to make up some basic knowledge from students with a previous low-level and to provide additional bibliography. Every lecturer will provide some office hours for students, which will be communicated to them at the beginning of the course and they will be published on the Blackboard Learn.</p>
Enseñanzas básicas (EB) <i>General teaching</i>	<p>General/background teaching (GT):</p> <p>On-site sessions of 1.5 hours each (one per week) will be set throughout the whole term. These classes will be based on formal lessons taught by the lecturer and their main aim will be to</p>

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	introduce, in a schematic and general way, the main theoretical aspects of every unit, so that students can deal with their on-line development by themselves later on. Sessions will be also devoted to solve problems on the blackboard by the lecturer. To do this, skills developed in theoretical lessons and on-line will be applied.
Enseñanzas prácticas y de desarrollo (EPD) <i>Theory-into-practice</i>	Practical/developmental knowledge-building teaching (PT): These teachings will be also developed throughout on-site sessions, of 1.5 hours each, during the whole term. Lessons will be mainly practical and they will be devoted to solving problems by students. Some of these sessions will be hold in the computers room and directed by the lecturer. The final aim of these special sessions in the computers room (SSC) consists on providing students with the opportunity to learn how to use the symbolic computing software Mathematica so that they will apply it to solve similar problems to those set out during the other sessions. Specific notes about this program will be presented to students prior to SSC taking place, so that students could work on them beforehand.
Actividades académicas dirigidas (AD) <i>Guided academic activities</i>	Therea are not.

7. Criterios generales de evaluación / *Assessment*

Primera convocatoria ordinaria (convocatoria de curso) <i>First session</i>	<p>El 50% de la calificación procede de la evaluación continua. El 50% de la calificación procede del examen o prueba final. According to Article 5 of the Normativa de Evaluación de los Estudiantes de Grado de la Universidad Pablo de Olavide, de Sevilla, the ongoing assessment system will be considered preferential. This preference will allow the student to reach the competences and knowledge progressively and sequentially. In this sense, the student will complete different activities during the term and all of them will be taken into account. They will be weighted differently in the final assessment depending on how important and difficult they are and how much effort has been put in by the students.</p> <ul style="list-style-type: none"> • Continuous evaluation (ongoing assessment): Throughout the term, several tests and exercises will be carried out to follow student development in the acquisition of competences proposed in the Course. This ongoing assessment will take up 50% of the final mark, that is, 5 points out of 10. There will be various types of test: <ul style="list-style-type: none"> - Theoretical knowledge will be tested at the end of each unit through an on-line, multiple choice questionnaire (with one or more true answers). If technical requirements meet, these exams will be taken through the Blackboard Learn platform on the dates assigned at the time; on the contrary, the corresponding tests will take place on the sessions determined by the lecturers. The total value of these tests will be 1 point (i.e., 10% of the total mark of the course and 20% of the continuous evaluation). - At the end of each unit, and in the PT session which will be announced, the student will have to solve different exercises corresponding to the unit. These will be corrected and will have a total value of 2 points (that is, 20% of the total mark of the course and 40% of the continuous evaluation). - Throughout the term, there will be some computer room sessions (SSC). The use of Mathematica software will be assessed within
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these sessions by solving some practical exercises using the computer, as well as practical exercises proposed by the lecturer and related to those given out to students before the computer room sessions. These exercises will have a total value of 2 points (what is 20% of the total mark of the course and 40% of the continuous evaluation).

In order to pass the continuous evaluation, the student has to reach at least 2.5 points (out of 5) in this part (i.e., 25% of the total mark of the course and 50% of the continuous evaluation). In the 1st summons, only those students fitting the conditions of the current regulations (i.e., proved illness, labor incompatibility, talented sportsmen and sportswomen, etc.) can resit the ongoing assessment. In the 2nd summons, the ongoing assessment can be retaken by those students who failed the continuous evaluation during the term and by those student who passed but decided to refuse to his/her mark; in this second case, the student must notify his/her decision 10 days prior the 2nd summons exam to the course coordinator (ammarcar@upo.es).

Final exam (1st summons):

According to Article 7 of the Normativa de Evaluación de los Estudiantes de Grado de la Universidad Pablo de Olavide, de Sevilla, the evaluation in the convocatoria de curso (1st summons) will be shaped by the characteristics of the ongoing assessment. This exam will be taken at the end of the term and will make up 50% of the final mark, that is, 5 points out of a total of 10.

Theoretical knowledge will be evaluated through short questions or through multiple choice questions with a value of 1.5 points. Practical knowledge will be worth 3.5 points and will be tested by resolving problems.

WARNING: In order to pass the course in this first summons, the two following minimal marks are needed:

- Ongoing assessment: 2.5 points out of 5.
- Total mark (ongoing assessment + final exam): 5 points out of 10.

That is, if the minimal mark in the ongoing assessment is reached, the final mark of this course will be the addition of the marks obtained in the written exam and in the ongoing assessment. A total of 5 points is needed to pass this course.

Segunda convocatoria ordinaria
(convocatoria de recuperación)
Second session (to re-sit the exam)


According to Article 8 of the Normativa de Evaluación de los Estudiantes de Grado de la Universidad Pablo de Olavide, de Sevilla, students who failed the course in the 1st summons have a second chance of passing it in the so-called convocatoria de recuperación de curso (2nd summons) which will take place within June/July.

In this second summons, the students will have to take a final exam. Besides, the mark obtained in the ongoing assessment will also be considered. There are three possible cases here:

a) If the student reached the minimum in the ongoing assessment during the term (2.5 points out of 5), then his/her mark can be computed by adding the mark in the ongoing assessment with the mark in this final exam (2nd summons). This sum has to reach at least 5 points (out of 10) in order to pass the course.


b) If the ongoing assessment had not been completed during the term, the student will also be tested on them in the 2nd summons (so, this second final exam will include an extra part). Please remember that, in this course, and regarding the aspects indicated by Article 8 of the assessment regulations, the continuous evaluation is said to be completed (or passed) during the term when the student have at least 2.5 points (out of 5) in the sum of all

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	<p>the tests involving such ongoing assessment.</p> <p>The written part of this second final exam will have a maximum mark of 5 points (out of 10), and it will have the same characteristics than the first summons' final exam. The additional tests regarding the ongoing assessment will take place in the computers room, and this part of the exam consists of theoretical and practical exercises that will be solved with the aid of Mathematica program. In order to pass the course in this second summons is again needed that the total mark (ongoing assessment + final exam): 5 points out of 10.</p> <p>c) The student that reached the minimum in the ongoing assessment has the chance of refusing to his/her mark, in order to sit an exam with a maximum mark of 10 points. In this specific case, all the rules of section b) apply, and the student has to take both tests specified in that section b). This decision must be notified to the course coordinator (ammarcar@upo.es) 10 days prior the 2nd summons exam.</p> <p>When taking exams (either the 'minimal knowledge' or the written exam), students will not be allowed to use reference or support materials, except from those explicitly authorised by the course lecturers. Specifically, mobile phones or any other kind of devices that store, communicate or share information are totally forbidden; its use will imply a failing grade and can bring academic sanctions. To sit exams, students must be officially identified through their ID or another official form of identification.</p>
Convocatoria extraordinaria de noviembre <i>Extraordinary November session</i>	<p>Se activa a petición del alumno siempre y cuando éste esté matriculado en todas las asignaturas que le resten para finalizar sus estudios de grado, tal y como establece la Normativa de Progreso y Permanencia de la Universidad.</p> <p>Se evaluará del total de los conocimientos y competencias que figuren en la guía docente del curso anterior, mediante el sistema de prueba única.</p> <p>It will be the same than the resisting exam (2nd summons).</p>
Criterios de evaluación de las enseñanzas básicas (EB) <i>General teaching assessment criteria</i>	<p>Durante la evaluación continua: Theoretical knowledge will be tested at the end of each unit through an on-line, multiple choice questionnaire (with one or more true answers). If technical requirements meet, these exams will be taken through the Blackboard Learn platform on the dates assigned at the time; on the contrary, the corresponding tests will take place on the sessions determined by the lecturers. The total value of these tests will be 1 point (i.e., 10% of the total mark of the course and 20% of the continuous evaluation).</p> <p>Durante el examen o prueba final (1ª convocatoria): Theoretical knowledge will be evaluated through short questions or through multiple choice questions with a value of 1.5 points.</p> <p>Durante el examen o prueba final (2ª convocatoria): Theoretical knowledge will be tested at the final exam with test question in a questionnaire (with one true answers)</p>
Criterios de evaluación de las enseñanzas prácticas y de desarrollo (EPD) <i>Theory-into-practice assessment criteria</i>	<p>Durante la evaluación continua: - At the end of each unit, and in the PT session which will be announced, the student will have to solve different exercises corresponding to the unit. These will be corrected and will have a total value of 2 points (that is, 20% of the total mark of the course and 40% of the continuous evaluation).</p> <p>- Throughout the term, there will be some computer room sessions (SSC). The use of Mathematica software will be assessed within these sessions by solving some practical exercises using the computer, as well as practical exercises proposed by the lecturer</p>

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	<p>and related to those given out to students before the computer room sessions. These exercises will have a total value of 2 points (what is 20% of the total mark of the course and 40% of the continuous evaluation).</p> <p>Durante el examen o prueba final (1ª convocatoria): The student will have to solve different exercises and problems corresponding to the units of the course. Practical knowledge will be worth 3.5 points and will be tested by resolving problems.</p> <p>Durante el examen o prueba final (2ª convocatoria): The student will have to solve different exercises and problems corresponding to the units of the course, and they have to solve some problems using Mathematica software.</p>
<p>Crterios de evaluación de las actividades académicas dirigidas (AD)</p> <p><i>Criteria of assessment of guided academic activities</i></p>	<p>Durante la evaluación continua:</p> <p>Durante el examen o prueba final (1ª convocatoria):</p> <p>Durante el examen o prueba final (2ª convocatoria):</p>
<p>Puntuaciones mínimas necesarias para aprobar la Asignatura</p> <p><i>Minimum passing grade</i></p>	<p>1ª convocatoria: In order to pass the continuous evaluation, the student has to reach at least 2.5 points (out of 5) in this part (i.e., 25% of the total mark of the course and 50% of the continuous evaluation). In the 1st summons, only those students fitting the conditions of the current regulations (i.e., proved illness, labor incompatibility, talented sportsmen and sportswomen, etc.) can resit the ongoing assessment.</p> <p>WARNING: In order to pass the course in this first summons, the two following minimal marks are needed:</p> <ul style="list-style-type: none"> - Ongoing assessment: 2.5 points out of 5. - Total mark (ongoing assessment + final exam): 5 points out of 10. <p>That is, if the minimal mark in the ongoing assessment is reached, the final mark of this course will be the addition of the marks obtained in the written exam and in the ongoing assessment. A total of 5 points is needed to pass this course.</p> <p>2ª convocatoria: In the 2nd summons, the ongoing assessment can be retaken by those students who failed the continuous evaluation during the term and by those student who passed but decided to refuse to his/her mark; in this second case, the student must notify his/her decision 10 days prior the 2nd summons exam to the course coordinator (ammarcar@upo.es).</p>
<p>Material permitido</p> <p><i>Materials allowed</i></p>	
<p>Identificación en los exámenes</p> <p><i>Identification during exams</i></p>	<p>En cualquier momento de la realización de una prueba de evaluación los profesores podrán requerir la acreditación de la identidad de cualquier estudiante, mediante la exhibición de su carnet de estudiante, documento nacional de identidad, pasaporte u otro documento válido a juicio del examinador. Si no lo hiciese, el estudiante podrá continuar la prueba, que será calificada solo si la documentación es presentada en el plazo que el examinador establezca.</p>
<p>Observaciones adicionales</p> <p><i>Additional remarks</i></p>	<p>There are not.</p>

Los estudiantes inmersos en un programa de movilidad o en un programa de deportistas de alto nivel, así como los afectados por razones laborales, de salud graves o por causas de fuerza mayor debidamente acreditadas, tendrán derecho a que en la convocatoria de curso se les evalúe mediante un sistema de evaluación de prueba única. Para ello, deberán comunicar la circunstancia al profesor responsable de la asignatura antes del fin del periodo docencia presencial.


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Students enrolled in a mobility program or a program for high-level athletes, as well as students affected by work or serious health problems or reasons of force majeure duly accredited, will have the right to be evaluated during the first session through a single test evaluation system. To do this, they must report changes in their circumstances to the program coordinator before the end of the teaching period.

8. Bibliografía / Bibliography

General reading	<ul style="list-style-type: none"> FEDRIANI, E.M.; MELGAR, M.C. (2010) “Matemáticas para el éxito empresarial”, <i>Pirámide</i> LARSON, R.E.; HOSTETLER, R.P; EDWARDS, B.H. (2003) “Calculus with Analytic Geometry”, <i>McGraw-Hill</i>
Further reading	<ul style="list-style-type: none"> LARSON, R; HOSTERLER, R.P. (2005) “Algebra for College Students”, <i>Houghton Mifflin Company</i> WEISSTEIN, E.W. (2002) “Concise Encyclopedia of Mathematics”, <i>Chapman & Hall/CRC</i>,
Linear algebra reading	<ul style="list-style-type: none"> AXLER, S. (1997) “Linear Algebra”, <i>Springer Verlag</i> BAKER, A.C; PORTEONS, H.L. (1990) “Linear Algebra and Differential Equations”, <i>Ellis Horwood</i> BERBERIAN, S.K. (1992) “Linear Algebra”, <i>Oxford University Press</i> BLYTH, T.S; ROBERTSON, E.F. (2002) “Basic Linear Algebra”, <i>Springer Verlag</i> BRONSON, R. (1991) “Matrix Methods. An Introduction”, <i>Academic Press</i> JACOB, B (1995) “Linear Functions and Matrix Theory”, <i>Springer Verlag</i> LIU, B; LAI, H.J. (2000) “Matrices in Combinatorics and Graph Theory”, <i>Kluwer Academic Publishers, cop. Dordrech</i> NICHOLSON, W.K. (2001) “Elementary Linear Algebra”, <i>Díaz de Santos</i> SENETA, E. (1973) “Non-negative Matrices”, <i>Allen and Unwin</i> SHAFAREVICH, I.R. (2002) “Discourses on Algebra”, <i>Springer Verlag</i> ZHAN, X. (2002) “Matrix inequalities”, <i>Springer Verlag</i>
Differential calculus an integral calculus reading	<ul style="list-style-type: none"> ARYA, J.C; LARDNER, R.W. (1993) “Mathematical Analysis”, <i>Prentice-Hall International Editions</i> BERCK, P. (1991) “Economist’s Mathematical Manual”, <i>Springer Verlag</i> BIRCHENHALL, C; GROUTH, P. (1984) “Mathematics for Modern Economics”, <i>Phillips Allan</i> GOLDSTEIN, L; LAY, D; SCHNEIDER, D. (1993) “Calculus and its Applications”, <i>Prentice-Hall International Editions</i> KHOURY, J; PARSONS, T. (1981) “Mathematical Methods in Finance and Economics”, <i>North Holland</i> KLEIN, M.W. (1997) “Mathematical Methods for Economics”, <i>Addison Westley Reading Mass</i> NICHOLSON, R.H. (1986) “Mathematics for Business and Economics”, <i>McGraw Hill</i>,

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	<ul style="list-style-type: none"> • SENGUPTA, J.K. (1987) “Applied Mathematics for Economics”, <i>D. Reidel Publishing Company</i> • TAKAYAMA, A. (1988) “Mathematical Economics”, <i>Cambridge University Press</i>
Sequences and series reading	<ul style="list-style-type: none"> • BLACK, A; BRADLEY, W. (1975) “Essential Mathematics for Economists”, <i>Wiley and Sons</i> • SYDSAETER, K. (1981) “Topics in Mathematical Analysis for Economists”, <i>Academic Press</i>
Mathematica reading	<ul style="list-style-type: none"> • FEDRIANI, E.M.; GARCÍA, A. (2004) “Guía rápida para el nuevo usuario de Mathematica 5.0.”, <i>EUMED•NET</i> • WOLFRAM, S. (2003) “The Mathematica Book”, <i>Ed. Cambridge University Press</i>

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