MATHEMATICS I

BACHELOR IN POLITICS, LAW AND ECONOMICS

Professor: ANTONIO GARCIA ROMERO

E-mail: agr22@faculty.ie.edu

Academic year: 18-19
Degree course: FIRST
Semester: 1º
Category: COMPULSORY
Number of credits: 3.0
Language: English

PREREQUISITES

Basic elements of algebra (pre-calculus) such as operations with powers (including negative and fractional powers) and fractions. Factorization, solving basic equations, working with inequalities and absolute values. It is also recommended to have a basic knowledge of elementary functions (polynomial, rational, power, exponential and logarithmic). [SJM1] A good knowledge of MS-EXCEL® is highly recommendable.

SUBJECT DESCRIPTION

People often think of Mathematics as a collection of different axioms and theorems, which build a complete theoretical system but have few connections (or no connections at all) with real life problems. Fortunately, this conception of Mathematics, or at least of what we could call “applied mathematics in social sciences,” has changed over the last decades. From this new point of view, one must think of Mathematics, not as a subject but as a collection of tools that are needed in any rigorous and complete analysis of complex problems in different contexts such as the economy, business, society or public policies.

We are living the birth of the fourth industrial revolution in light of some extraordinary technological advances. Simultaneous to this significant upheaval are an arrangement of financial, geopolitical and demographic drivers of progress, each interacting in multiple directions and intensifying one another. This challenging scenario opens new opportunities for those professionals capable of managing and analyzing such complex situations.

A recently published report from the World Economic Forum states that to be able to solve complex problems is going to be the most valuable skill for coming years. A lack of proficiency in mathematics is probably the primary limitation to improving the power of abstraction which is a crucial requirement for complex problem-solving. Students following this course will learn useful tools to analyze economic, social and political problems.
OBJECTIVES AND SKILLS

The objective of this course is to provide the student with part of the quantitative tools required to analyze economic, social or political problems. Regarding its contents, this first course comprises some elementary topics of Calculus of one-real variable. In brief, topics covered will include functions of one variable and derivatives.

We classify the skills in two groups: specific and generic. Regarding the specific skills, the student will be able to:

- Recognize and analyze functions of one-real variable.
- Acquire ability with calculus of derivatives and integrals of functions of one-real variable.

Regarding the general skills, the student will develop the abilities:

- To address economic problems by means of abstract models.
- To solve the above formal models.
- To use the basic tools which are needed in the modern analysis of economic problems.

Throughout the course, the student should maintain:

- An inquisitive attitude when developing logical reasoning, being able to tell apart a proof from an example.
- An entrepreneurial and imaginative attitude towards the examples studied.
- A critical attitude towards the formal results.

The course lectures will be based on a combination of theoretical explanations and several practical exercises. Students should attempt to solve the exercises that will be given to them as homework in each lecture. Student participation is considered very important to acquire the skills needed to pose and solve exercises.

METHODOLOGY

All the material will be covered in class, so students should be present and active during the lectures. In this course, most of the homework will be released online through Maple T.A which is integrated on the IE Campus. Maple T.A. provides an adaptive Study Plan and interactive exercises with immediate feedback. We strongly recommend that you do the exercises given as homework during the course and not leave them for a date close to the exam.

Students are encouraged to work in groups when solving homework problems. However, it is highly recommended that each student tries, at the same time, to solve problems by himself.

<table>
<thead>
<tr>
<th>Teaching methodology</th>
<th>Weighting</th>
<th>Estimated time a student should dedicate to prepare for and participate in</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>33.34 %</td>
<td>25 hours</td>
</tr>
<tr>
<td>Discussions</td>
<td>0.0 %</td>
<td>0 hours</td>
</tr>
<tr>
<td>Exercises</td>
<td>33.34 %</td>
<td>25 hours</td>
</tr>
<tr>
<td>Group work</td>
<td>33.34 %</td>
<td>25 hours</td>
</tr>
<tr>
<td>Other individual studying</td>
<td>66.67 %</td>
<td>50 hours</td>
</tr>
<tr>
<td>TOTAL</td>
<td>166.7 %</td>
<td>75 hours</td>
</tr>
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</table>
TOPIC 1: LINEAR MODELS AND BUSINESS APPLICATIONS
T. Bradley: Chapters 2 and 3.
EXCEL exercises: Chapters 2 and 32.

TOPIC 1: LINEAR MODELS AND BUSINESS APPLICATIONS [Sessions 1-6]
T. Bradley: Chapters 2 and 3.
EXCEL exercises: Chapters 2 and 3

SESSION 1
Course presentation. Introduction to learning materials and MS-EXCEL®.

Readings: T. Bradley: 1.9
- Self-evaluation: Test Exercises 1 (pages 35-36).
- EXCEL exercises Chapter 1. (Read 1.9. Introducing EXCEL)
  - Readings: T. Bradley: 1.9
  - Self-evaluation: Test Exercises 1 (pages 35-36).
  - EXCEL exercises Chapter 1. (Read 1.9. Introducing EXCEL)

SESSION 2

- Readings: T. Bradley: 2.1, 2.2, 2.4, and 2.5.
- Worked examples: 2.1, 2.2, 2.3, 2.4, 2.5, and 2.13.
- Progress exercises 2.2 (page 54).
- EXCEL Exercises Chapter 2: 1-4 (Read 2.8. Excel for linear functions)

SESSION 3
Business applications: Demand, Supply, Cost and Revenue.

- Readings: T. Bradley: 2.3.
- Worked examples: 2.6, 2.7, 2.8, 2.9, 2.10a, and 2.10b
- Progress exercises 2.3 (page 68), and 2.4 (page 75).
- EXCEL Exercises Chapter 2. 5-11 (Read 2.8. Excel for linear functions)
SESSION 4

Elasticity of Demand, Supply, and Income. Budget constraints.

- Readings: T. Bradley: 2.6., 2.7.
- Worked examples: 2.19 and 2.24 (EXCEL).
- Progress exercises 2.7 (page 91).
- EXCEL Exercises Chapter 2. 12-14 (Read 2.8. Excel for linear functions)

SESSION 5

Solving Simultaneous Linear Equations. Market Equilibrium.

- Readings: T. Bradley: 3.1., 3.2.
- Worked examples: 3.1, 3.2, 3.3, 3.4, 3.5, 3.7, and 3.8.
- Progress exercises 3.1 (page 111).
- EXCEL Exercises Chapter 3. 1-7 (Read 3.5. Excel for Simultaneous Linear Equations)

SESSION 6

Break-even points. Consumer and Producer Surplus.

- Readings: T. Bradley: 3.2, 3.3.
- Worked examples: 3.14, 3.15.
- Progress exercises 3.3 (page 126), and 3.4 (131).
- EXCEL Exercises Chapter 3: 8 and 9 (Read 3.5. Excel for Simultaneous Linear Equations)

TOPIC 2: NON-LINEAR FUNCTIONS AND BUSINESS APPLICATIONS [Sessions 7-11]

T. Bradley: Chapter 4.
EXCEL exercises Chapter 4.

SESSION 7

Quadratic Functions. Non-linear Demand and Supply Functions.

- Worked examples: 4.1, 4.2, 4.3, 4.5, and 4.7.
- Progress exercises: 4.2 (page 158).
- EXCEL Exercises Chapter 4: 1-6 (Read 4.5. Excel for Non-Linear Functions)
SESSION 8
Non-linear Total Revenue and Total Profit Functions. Break-even points. Cubic functions and General Polynomials
- Worked examples: 4.8, 4.9, 4.10a, 4.10b, and 4.11.
- Progress exercises: 4.3 (page 163), and 4.4 (page 170).
- EXCEL Exercises Chapter 4: 7-10 (Read 4.5. Excel for Non-Linear Functions)

SESSION 9
Exponential Functions
- Readings: T. Bradley: 4.2.
- Worked examples: 4.13, 4.14, 4.15.
- Progress exercises 4.5 (page 177), and 4.6 (page 179).
- EXCEL Exercises Chapter 4: 11-12 (Read 4.5. Excel for Non-Linear Functions)

SESSION 10
Logarithmic Functions
Readings: T. Bradley: 4.3.
Worked examples: 4.17, 4.18, and 4.20.
Progress exercises 4.10 (page 188), and 4.11 (page 196).
EXCEL Exercises Chapter 4: 13, 14, and 15 (Read 4.5. Excel for Non-Linear Functions)

SESSION 11
Hyperbolic (Rational) Functions
- Progress exercises 4.12 (page 199), and 4.13 (page 201).
- EXCEL Exercises Chapter 4: 16,17 (Read 4.5. Excel for Non-Linear Functions)

Midterm exam

SESSION 12
Midterm Exam
The exam will consist of TWO questions from Topics 1&2. Its duration will be 30 minutes. Neither graphical nor programmable calculators are allowed for this Exam

TOPIC 3: DIFFERENTIATION AND APPLICATIONS [Sessions 13-19]
T. Bradley: Chapter 6.
EXCEL exercises Chapter 6.
SESSION 13
Slope of a Curve and Differentiation. Differentiation Rules (I)
- Worked examples: 6.1, 6.2, 6.3.
- Progress exercises: 6.1 (page 268).
- EXCEL Exercises Chapter 6: 1, 2, and 3

SESSION 14
Business Applications of Differentiation: Marginal Functions and Average Functions
- Worked examples: 6.6, 6.8, 6.10.
- Progress exercises: 6.3 (page 280), and 6.4 (286).
- EXCEL Exercises Chapter 6: 4, 5, and 6

SESSION 15
Optimization for Functions of One Variable
- Readings: T. Bradley: 6.3.
- Worked examples: 6.16, 6.17, 6.18.
- Progress exercises: 6.5 (page 289), 6.6 (page 295), 6.7 (page 300), and 6.8 (304).
- EXCEL Exercises Chapter 6: None

SESSION 16
Economic Applications of Maximum and Minimum Points
- Progress exercises: 6.9 (page 318).
- EXCEL Exercises Chapter 6: 7, 8, and 9

SESSION 17
Curvature and Other Applications
- Readings: T. Bradley: 6.5.
- Worked examples: 6.27, 6.28, 6.31, 6.32.
- Progress exercises: 6.10 (page 326), and 6.11 (page 332).
- EXCEL Exercises Chapter 6: 10

SESSION 18
Further Differentiation and Applications
- Worked examples: 6.33, 6.34, 6.35, 6.36.
- Progress exercises: 6.12 (page 335), 6.13 (page 338), 6.14 (page 340), 6.15 (page 344), and 6.16 (page 345
SESSION 19
Elasticity and the Derivative
- Progress exercises: 6.17 (page 355)

TOPIC 4: INTEGRATION AND APPLICATIONS [Sessions 20-25]
T. Bradley: Chapter 8

SESSION 20
Integration as the Reverse of Differentiation. Rules for Integration (Power, exponential and logs)
- Readings: T. Bradley: 8.1, 8.2, and 8.3
- Worked examples: 8.1, 8.2, 8.3, 8.4.
- Progress exercises: 8.1 (page 435)

SESSION 21
The Definite Integral and the Area under a Curve
- Readings: T. Bradley: 8.5.
- Worked examples: 8.8, 8.9, and 8.9.
- Progress exercises: 8.3 (page 447)

SESSION 22
Consumer and Producer Surplus
- Worked examples: 8.12, 8.13, 8.14.
- Progress exercises: 8.4 (page 455)

SESSION 23
First-order Differential Equations. Some Economic Applications
- Worked examples: 8.15, 8.16, 8.17, 8.18, 8.19, 8.20, and 8.21.
- Progress exercises: 8.5 (page 459), 8.6 (page 463), and 8.8 (page 471)

SESSION 24
Final Exam Review
Readings: T. Bradley: 8.8

SESSION 25
FINAL EXAM
The final exam will consist of FOUR open questions from Topics 1-4 and its duration will be 90 minutes. Neither graphical nor programmable calculators are allowed for the Final Exam
BIBLIOGRAPHY
The followings books or articles used in this course will be:

COMPULSORY

Title: Essential Mathematics for Economics and Business
Author: Bradley, Teresa
Publisher / Edition / Year: John Wiley & Sons/ 4yh / 2013
Medium: PRINT ELECTRONIC

Book’s student companion site:
http://bcs.wiley.com/he-bcs/Books?action=index&bcsId=7971&itemId=1118358295

OTHER RESOURCES (INTERNET):
Khan Academy: www.khanacademy.org
Wolfram Mathworld: http://mathworld.wolfram.com/
Integral calculator: http://integrals.wolfram.com/
Geogebra: http://www.geogebra.org
Desmos: http://www.desmos.com/calculator

EVALUATION CRITERIA

Your final grade in the course will be based on both individual and group work of different characteristics that will be weighted in the following way:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Percentage</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Participation</td>
<td>10 %</td>
<td></td>
</tr>
<tr>
<td>Assignment with MS-EXCEL®</td>
<td>25 %</td>
<td></td>
</tr>
<tr>
<td>Mid-Term exam</td>
<td>25 %</td>
<td></td>
</tr>
<tr>
<td>Final Exam</td>
<td>40 %</td>
<td></td>
</tr>
</tbody>
</table>

A. CLASS PARTICIPATION
It will be worth 10% of the overall grade - students are expected to come prepared and participate actively (and voluntarily) during lectures. Your class grade will be based also on attendance, punctuality, participation, and class conduct – there may be a penalty if you create a disruption, talk excessively, or use electronic devices.

B. ASSIGNMENT.
It will be worth 25% of the overall grade. The assignment should be done in groups, and could require the use of MS-EXCEL®.

C. MID-TERM
It will count for 25% of the final grade. This exam will consist of TWO open questions from Topics 1 & 2. Moreover, neither graphical nor programmable calculators are allowed for these Exams. Notice that the date of the Mid-term could change. This is, the mid-term date need to be considered with flexibility (around session 12). The precise date of the exams will be communicated to students at least two weeks ahead of time.

D. FINAL EXAM
It is worth 40% of the overall grade. You need to score at least 3.5 on the final exam to pass the overall course, even if you have already passed the course through the other course assessments. The final exam will consist of FOUR open questions that will cover the whole subject (i.e.: Topics 1-4). Neither graphical nor programmable calculators are allowed

- Sobresaliente/Outstanding: 9.0-10.0 (A to A+)
Consistently produces work of the highest quality and craft; exhibits notable progress and development over the course of the semester; meets all course objectives at highest level; attendance is near-perfect, and contributions to course discussions are extremely valuable.
- Notable: 7.0-8.9 (B to B+)
Completes all assignments with work of above-average quality and craft; exhibits significant progress and development; meets most course objectives; attendance and participation are very good.
- Aprobado: 6.0-7.0 (C to C+)
Completes all assignments with work of acceptable quality and craft; exhibits some progress and development; meets a majority of course objectives. Attendance and participation are acceptable.
- Aprobado: 5.0-6.0 (D)
Assignments are delivered but are incomplete and/or of low quality and craft; exhibits little progress and development; meets few course objectives. Attendance and participation are poor, but absences do not total more than 30%.
- Suspenso: 0-4.9 (F)
Work is incomplete, missing, or does not meet course objectives. Attendance and participation are poor.
- Automatic Failure/Suspenso: 0 (F)
Please note that a student who misses 30% or more of the scheduled sessions receives an automatic 0.0, and loses his or her right to the second "convocatoria."

RETAKE POLICY
- Each student has 4 chances to pass any given course distributed in two consecutive academic years (regular period and July period).
- Students who do not comply with the 70% attendance rule will lose their 1st and 2nd chance, and go directly to the 3rd one (they will need to enrol again in this course next academic year).
- Grading for retakes will be subject to the following rules:
  o Students failing the course in the first regular period will have to do a retake in July (except those not complying with the attendance rules, which are banned from this possibility).
  o Dates and location of the July retakes will be posted in advance and will not be changed. Please take this into consideration when planning your summer.
  o The maximum grade that a student may obtain in any type of retake will be 8 out of 10.
  o The retakes will consist on a comprehensive exam. The grade will depend only on the performance in this exam; continuous evaluation over the semester will not be taken into account. This exam will be designed bearing in mind that the passing grade is 5 and the maximum grade that can be attained is 8.

The students in their third attempt must do:
  o Assignments (30%)
  o Mid-term exam (30%)
  o Final exam (40%)
To pass the subject in this attempt, you need a minimum grade of 5 points in the retake. Be aware that you need to score at least 3.5 on the final exam to pass the overall course, even if you have already passed the course through the other course assessments. The maximum grade that a student may obtain in any type of retake will be 8 out of 10
ANTONIO GARCIA ROMERO
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His professional experience is a blend of academic activity, advisory positions at public administration and, recently, entrepreneurship. From 1998, he has been teaching Mathematics for Economics & Business at U. Carlos III where he obtained various recognitions of teaching excellence. He also has taught at UOC (2000-03), and U. Europea de Madrid (2007-09). In addition, he has a wide experience teaching at the graduate level (Survey Research, Data Analysis, R&D Evaluation). He is member of the Advisory Board of the Management of Healthcare Organizations at the IE Business School.

Research background
He has over 20 years of experience in Studies Science, Technology and Innovation. He is member of ENID (European Network of Indicators Designers). He has published his research results in leading academic journals, and he is referee for various national and international journals in the fields of Economics, Medicine and Information Science.

Recent publications:

Corporate experience
From the period 2003-13, he was the Head of the Biomedical Research Policy Unit at the Regional Government of Madrid. In March 2013, he started his consultancy activity in the field of Innovation Measurement.

OTHER INFORMATION
Office Hours:
Madrid Campus: María de Molina 31 BIS, 6th floor.
Segovia Campus, BBA Office, 3rd floor.
Please send an email (agr22@faculty.ie.edu) to arrange a meeting.
CODE OF CONDUCT IN CLASS

1. Be on time: Students arriving more than 5 minutes late will be marked as “Absent”. Only students that notify in advance in writing that they will be late for a specific session may be granted an exception (at the discretion of the professor).

2. **If applicable, bring your name card and strictly follow the seating chart.** It helps faculty members and fellow students learn your names.

3. **Do not leave the room during the lecture:** Students are not allowed to leave the room during lectures. If a student leaves the room during lectures, he/she will not be allowed to re-enter and, therefore, will be marked as “Absent”.

   Only students that notify that they have a special reason to leave the session early will be granted an exception (at the discretion of the professor).

4. **Do not engage in side conversation.** As a sign of respect toward the person presenting the lecture (the teacher as well as fellow students), side conversations are not allowed. If you have a question, raise your hand and ask it. If you do not want to ask it during the lecture, feel free to approach your teacher after class.

   If a student is disrupting the flow of the lecture, he/she will be asked to leave the lecture and, consequently, will be marked as “Absent”.

5. **Use your laptop for course-related purposes only.** The use of laptops during lectures must be authorized by the professor. The use of Social Media or accessing any type of content not related to the lecture is penalized. The student will be asked to leave the room and, consequently, will be marked as “Absent”.

6. **No cellular phones:** IE University implements a “Phone-free Classroom” policy and, therefore, the use of phones, tablets, etc. is forbidden inside the classroom. Failing to abide by this rule entails expulsion from the room and will be counted as one absence.

7. **Escalation policy: 1/3/5.** Items 4, 5, and 6 above entail expulsion from the classroom and the consequent marking of the student as “Absent.” IE University implements an “escalation policy”: The first time a student is asked to leave the room for disciplinary reasons (as per items 4, 5, and 6 above), the student will incur one absence, the second time it will count as three absences, and from the third time onward, any expulsion from the classroom due to disciplinary issues will entail 5 absences.