Universidad Carlos III de Madrid
Master in Economic Analysis
Mathematics (2015/2016)
Syllabus

DESCRIPTION

This course covers the fundamentals of real analysis and Euclidean spaces, including open and closed sets, compact sets, sequences, series, limits, continuity, differentiability and Riemann integral. It also studies functional sequences and uniform convergence. Some of the topological notions given for the Real Line are generalized to metric and normed spaces. The last topics of the course include fixed point theory for functions and correspondences and the Theorem of the Maximum.

CONTENTS

1. - Set Theory and the Real Line

> Ordered Sets
> Finite, Countable and Uncountable Sets
> The Real Field
> Euclidean Spaces. Open, Closed and Bounded Sets

2. - Numerical Sequences and Series

> Convergent Sequences
> Subsequences
> Cauchy Sequences
> Convergent and Divergent Series
> Series of Nonnegative Terms
> The Root and Ratio Test
> Power Series
> Absolute Convergence

3. - Continuity

> Limits of Functions
> Continuous Functions
> Theorems on Continuous Functions
> Monotonic Functions
> Convex and Concave Functions

4. - Differentiation

> The Derivative of a Real Function
> Partial and Directional Derivatives
> Differentiability
> Inverse and Implicit Function Theorems
> Higher Order Derivatives
> Taylor's Theorem

5. - Integration

Definition and Properties of the Riemann Integral
Fundamental Theorem of Integral Calculus and Barrow's Rule
Improper Integrals
Introduction to the Lebesgue Integral

6. - Sequences and Series of Functions

Punctual and Uniform Convergence
Equicontinuity
Uniform Convergence and Continuity
Uniform Convergence and Differentiation
Uniform Convergence and Integration

7. - Metric Spaces

Distance
Open, Closed and Compact Sets
Normed Spaces
Complete Metric Spaces
Function Spaces

8. - Fixed Point Theorems of Functions

Theorem of Brower
Theorem of Schauder-Tychonoff
Theorem of Banach
Theorem of Tarski

9. - Correspondences

Definition and Properties of Correspondences
Lower and Upper Hemi-Continuous Correspondences
Theorem of the Fixed Point of Kakutani

10. - Parametric Optimization

Maximum Theorem
Supermodularity and Monotonicity

TEXTBOOKS

- Apostol, T.M. *Mathematical An alysis,* Second Edition, Addison-Wesley, 1974.

- Berge, C. *Espaces Topologiques. Fonctions Multivoques*, *Deuxième Édition,* Dunod, 1966.

- Chen, W.W.L. *Lecture Notes* available at
https://rutherglen.science.mq.edu.au/wchen/lnfafolder/lnfa

- de la Fuente, A. *Mathematical Methods and Models for Economists.* Cambridge University Press, 2005.

- Kolmogorov, A.N. and S.V. Fomin. *Elements of the Theory of Functions and Functional Analysis*, Dover, 1999.

- Ok, F.A. *Real Analysis with Economic Applications*, Princeton University Press, 2007.

- Royden, H. and P. Fitzpatrick. *Real Analysis, Fourth Edition,* Pearson, 2010.

- Rudin, W. *Principles of Mathematical Analysis*, Third Edition, McGraw-Hill, 1976.

- -----------. *Real and Complex Analysis, Third Edition*, McGraw-Hill, 1987.

- Sundaram, R.K. *A First Course in Optimization Theory*, Cambridge University Press, 2005.

- Sydsaeter, Hammond, Seierstad, Strom. *Further Mathematics for Economic Analysis*, *Second Edition*, Prentice Hall, 2008.

Assessment System: Based on individual homework (20%), a mid-term (40%) and a final (40%).

Instructor: