

MTH - Mathematics - S5



ANALYSE APPLIQUÉE

APPLIED ANALYSIS

Lecturers: Elisabeth MIRONESCU, Philippe MICHEL

| Lecturers : 14 | TC : 20.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This course presents the basic tools of mathematical analysis necessary for the study of the models encountered in engineering and research.

Keywords : Mathematical analysis, integration, optimization, ordinary differential equations.

Programme

Notions of differential calculus. Optimization: free and bound extrema. Integration. Ordinary differential equations.

Learning outcomes

- Be able to study an optimization problem without or with constraint, existence of extremum, optimality conditions, Lagrange multipliers.
- Mastering integral calculus.
- Be able to study a system of differential equations (existence, elementary qualitative analysis).
- Knowing how to situate the degree of difficulty in the mathematical analysis of a problem.

Independent study

Objectifs : This activity is not concerned with framed autonomy activities outside personal work.

Méthodes : This activity is not concerned with framed autonomy activities outside personal work.

Core texts

J. Saint Raymond, *TOPOLOGIE, CALCUL DIFFÉRENTIEL ET VARIABLE COMPLEXE.*, Calvage and Mounet, 2008
G. Allaire *ANALYSE NUMÉRIQUE ET OPTIMISATION.*, Editions de l'Ecole Polytechnique, Ellipses, 2005
S. Benzoni *CALCUL DIFFÉRENTIEL ET ÉQUATIONS DIFFÉRENTIELLES.*, Dunod, 2014

Assessment

Final mark = 80% Knowledge + 20% Know-how
Knowledge mark = 100% final exam + 0% continuous assessment
Know-how mark = 0% final exam + 100% continuous assessment



ANALYSE NUMÉRIQUE

NUMERICAL ANALYSIS

Lecturers: Laurent SEPPECHER, Grégory VIAL

| Lecturers : 12.0 | TC : 14 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

We will present basic numerical methods useful for engineering. Applications are given, which motivate the development of such methods, together with a systematic analysis of the accuracy.

Keywords : Approximation, linear systems, numerical integration, differential equations, optimisation.

Programme

- Linear systems, eigenvalues.
- Optimization, non-linear equation.
- Interpolation, numerical integration.
- Numerical approximation of ordinary differential equations.
- Discretization of linear partial differential equations.

Learning outcomes

- Identify the procedure of numerical simulation.
- Make a choice between different methods.
- Implement simple algorithms with Matlab.
- Combine several numerical methods.

Independent study

Objectifs : Learning basics, preparation of numerical simulations with Matlab.

Méthodes : Training exercises.

Core texts

A. QUARTERONI, R. SACCO, F. SALERI, *NUMERICAL MATHEMATICS*, Springer, 2006
J.RAPPAZ, M.PICASSO *INTRODUCTION À L'ANALYSE NUMÉRIQUE*, Presse polytechniques et universitaires romandes, 1998
G.ALLAIRE S.M. *KABER ALGÈBRE LINÉAIRE NUMÉRIQUE*, Ellipses, 2002

Assessment

valuation = 75% knowledge + 25% know-how (Knowledge = 100% final exam and know-how = 100% continuous assessment).



PROBABILITÉS STATISTIQUE

PROBABILITY THEORY AND STATISTICS

Lecturers: Marie-Christophette BLANCHET, Céline HARTWEG-HELBERT

| Lecturers : 14.0 | TC : 16.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This first part of the course deals with the modelling with random variables. We introduce the notion of density. Some methods of probability calculus, approximations and asymptotic theorems are studied. A important part of the course is devoted to the numerical simulation with MATLAB. The second part of the course deals with statistics. The notions of estimators and tests are introduced. A chapter is devoted to linear regression.

Keywords : Probability law, random variables, gaussian vectors, Monte-Carlo method, estimators, biais, statistic tests, linear regression.

Programme

Probability : (1) Random Variables (2) Mean and variance (3) Random vectors (4) Random variables sequences- Asymptotic results- Monte-Carlo method.

Statistic : (5) Estimation (6) Estimation by confidence intervalle (7) Statistic tests(8) Linear regression

Learning outcomes

- Be able to compute probabilities.
- Be able to simulate random variables with Matlab
- Be able to estimate some parameters of law from data.
- Be able to construct and analyse a linear regression.

Independent study

Objectifs :

Méthodes : On moodle: QCM, Reminders, Exercices on discrete random variables
Exercices with solutions
Exams of the past years

Core texts

Gilbert SAPORTA, *PROBABILITÉS, ANALYSE DES DONNÉES ET STATISTIQUE.* , Technip, 2011
Jean-Pierre Lecoutre *STATISTIQUE ET PROBABILITÉS*, Coll. Eco Sup. Dunod, 2012
Mario Lefebvre *PROBABILITÉS, STATISTIQUES ET APPLICATIONS*, Presse Internationales Polytechnique, 2011

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment

**MATHÉMATIQUES ADAPTÉES I : ANALYSE - ALGÈBRE****ADAPTED MATHEMATICS I : APPLIED ANALYSIS - ALGEBRA****Lecturers:** Abdel-Malek ZINE, Hélène HIVERT

| Lecturers : 18.0 | TC : 20.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

We present basic tools for algebra and analysis : vector spaces, polynomials, orthogonalization, matrices and diagonalization, integration, differential calculus, optimization, ordinary differential equations

Keywords : Polynomials, Hilbert spaces, matrix diagonalization, integration, functional space, ODE, differential calculus, optimisation

Programme

Algebra : Polynomials. Hilbert spaces, euclidean spaces. Matrices, determinant. Eigenvalues, eigenvectors and applications.

Analysis : Recap and complements. Lebesgue's integration. Integration : theorems and functional spaces. Differential calculus and optimization. Ordinary differential equations.

Learning outcomes

- Be able to use the fundamental tools of algebra.
- Be able to justify the computation of an integral with several variables.
- Be able to determine the extrema of a function defined over \mathbb{R}^d .
- Be able to determine qualitative properties of the solution of an ordinary differential equation

Independent study

Objectifs : Gain experience with exercises.

Méthodes : WIMS.

Core texts

C. Gasquet, P. Witomski, *ANALYSE DE FOURIER ET APPLICATIONS*, Masson, 1990
J.-M. Monier *MATHÉMATIQUES, MÉTHODES ET EXERCICES MP.*, Dunod, 2009
D. Fredon *MATHÉMATIQUES, RÉSUMÉ DU COURS EN FICHES MPSI-MP*, Vuivert, 2010

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge mark = 100% final exam
Know-how mark = 100% continuous assessment

**MATHÉMATIQUES ADAPTÉES II : PROBABILITÉS STATISTIQUE****ADAPTED MATHS II : PROBABILITY THEORY AND STATISTICS**

Lecturers: Céline HARTWEG-HELBERT, Marie-Christophette BLANCHET

| Lecturers : 14.0 | TC : 16.0 | PW : 0.0 | Autonomy : 0.0 | Study : 0.0 | Project : 0.0 | Language : FR

Objectives

This first part of the course deals with the modelling with random variables. We introduce the notion of density. Some methods of probability calculus, approximations and asymptotic theorems are studied. A important part of the course is devoted to the numerical simulation with MATLAB. The second part of the course deals with statistics. The notions of estimators and tests are introduced. A chapter is devoted to linear regression.

Keywords : Probability laws, Random variables with density, numerical simulations, estimators, parametric tests, linear regression.

Programme

- 1) Random Variables (Probability, density, distribution function)
- 2) Mean, Variance
- 3) Random vectors
- 4) Asymptotic theorems
- 5) Estimators
- 6) Estimators with confidence intervals
- 7) Statistical tests
- 8) Linear Regression

Learning outcomes

- Doing some calculus with computers.
- Simulations with MATLAB.
- Be able to run numeric calculus to solve statistical inference problem.
- Be able to construct and analyse a linear regression.

Independent study

Objectifs : First steps in random simulation with MATLAB.

Méthodes : Exercises and previous tests.

Core texts

GilBERT SaPorTa. , *PROBABILITÉS, ANALYSE DES DONNÉES ET STATISTIQUE*, Technip, 2011
Jean-Pierre Lecoutre *STATISTIQUE ET PROBABILITÉS*, coll. Eco Sup. Dunod, 2012
Mario Lefebvre *PROBABILITÉS, STATISTIQUES ET APPLICATIONS.*, Presse Internationales Polytechnique, 2011

Assessment

Final mark = 75% Knowledge + 25% Know-how
Knowledge = 100% final exam
Know-how = 100% continuous assessment