

# SUITES DE MATRICES ET MARCHES ALEATOIRES

## I. Suites de matrices colonnes

### 1) Exemples :

a) La suite  $(U_n)$  définie pour tout entier naturel  $n$  par  $U_n = \begin{pmatrix} n^2 \\ 3n+1 \end{pmatrix}$  est une suite de matrices colonnes dont les coefficients sont les suites numériques  $(u_n)$  et  $(v_n)$  définies pour tout entier naturel  $n$  par  $u_n = n^2$  et  $v_n = 3n+1$ .

b) Soit deux suites numériques couplées  $(u_n)$  et  $(v_n)$  définies pour tout entier naturel  $n$  par :  $u_0 = 2$ ,  $v_0 = 4$  et  $\begin{cases} u_{n+1} = 2u_n - 3v_n + 1 \\ v_{n+1} = -u_n + 5v_n - 4 \end{cases}$

On pose pour tout entier naturel  $n$  :  $U_n = \begin{pmatrix} u_n \\ v_n \end{pmatrix}$

On pose encore :  $A = \begin{pmatrix} 2 & -3 \\ -1 & 5 \end{pmatrix}$  et  $B = \begin{pmatrix} 1 \\ -4 \end{pmatrix}$ .

On a alors  $U_n = \begin{pmatrix} 2 \\ 4 \end{pmatrix}$  et pour tout entier naturel  $n$ , la relation matricielle de récurrence :  $U_{n+1} = AU_n + B$ .

En effet :

$$AU_n + B = \begin{pmatrix} 2 & -3 \\ -1 & 5 \end{pmatrix} \begin{pmatrix} u_n \\ v_n \end{pmatrix} + \begin{pmatrix} 1 \\ -4 \end{pmatrix} = \begin{pmatrix} 2u_n - 3v_n + 1 \\ -u_n + 5v_n - 4 \end{pmatrix} = \begin{pmatrix} u_{n+1} \\ v_{n+1} \end{pmatrix} = U_{n+1}$$

c) Soit une suite numérique  $(u_n)$  définie par une relation de récurrence d'ordre 2 :  $u_0 = 2$ ,  $u_1 = -1$  et  $u_{n+2} = 2u_{n+1} + 3u_n$ .

On pose pour tout entier naturel  $n$  :  $U_n = \begin{pmatrix} u_n \\ u_{n+1} \end{pmatrix}$

On pose encore :  $A = \begin{pmatrix} 0 & 1 \\ 3 & 2 \end{pmatrix}$ .

# Matrices Aleatoires

**CH Cherryholmes**



## Matrices Aleatoires:

**Matrices aléatoires en physique** Hervé Kunz, 1998-01-01      **Random Matrices** Alexei Borodin, Ivan Corwin, Alice Guionnet, 2019-10-30 Random matrix theory has many roots and many branches in mathematics statistics physics computer science data science numerical analysis biology ecology engineering and operations research This book provides a snippet of this vast domain of study with a particular focus on the notations of universality and integrability Universality shows that many systems behave the same way in their large scale limit while integrability provides a route to describe the nature of those universal limits Many of the ten contributed chapters address these themes while others touch on applications of tools and results from random matrix theory This book is appropriate for graduate students and researchers interested in learning techniques and results in random matrix theory from different perspectives and viewpoints It also captures a moment in the evolution of the theory when the previous decade brought major break throughs prompting exciting new directions of research      [An Introduction to Random Matrices](#) Greg W. Anderson, Alice Guionnet, Ofer Zeitouni, 2010 A rigorous introduction to the basic theory of random matrices designed for graduate students with a background in probability theory

*Introduction to Random Matrices* Giacomo Livan, Marcel Novaes, Pierpaolo Vivo, 2018-01-16 Modern developments of Random Matrix Theory as well as pedagogical approaches to the standard core of the discipline are surprisingly hard to find in a well organized readable and user friendly fashion This slim and agile book written in a pedagogical and hands on style without sacrificing formal rigor fills this gap It brings Ph D students in Physics as well as more senior practitioners through the standard tools and results on random matrices with an eye on most recent developments that are not usually covered in introductory texts The focus is mainly on random matrices with real spectrum The main guiding threads throughout the book are the Gaussian Ensembles In particular Wigner s semicircle law is derived multiple times to illustrate several techniques e g Coulomb gas approach replica theory Most chapters are accompanied by Matlab codes stored in an online repository to guide readers through the numerical check of most analytical results      [Topics in Random Matrix Theory](#) Terence Tao, 2012-03-21 The field of random matrix theory has seen an explosion of activity in recent years with connections to many areas of mathematics and physics However this makes the current state of the field almost too large to survey in a single book In this graduate text we focus on one specific sector of the field namely the spectral distribution of random Wigner matrix ensembles such as the Gaussian Unitary Ensemble as well as iid matrix ensembles The text is largely self contained and starts with a review of relevant aspects of probability theory and linear algebra With over 200 exercises the book is suitable as an introductory text for beginning graduate students seeking to enter the field      **Random Matrix Models and their Applications** Pavel Bleher, Alexander Its, 2001-06-04 Expository articles on random matrix theory emphasizing the exchange of ideas between the physical and mathematical communities      *Random Matrices* Madan Lal Mehta, 2004-10-06 Random Matrices gives a coherent and detailed description of analytical methods devised to study random matrices These

methods are critical to the understanding of various fields in mathematics and mathematical physics such as nuclear excitations ultrasonic resonances of structural materials chaotic systems the zeros of the Riemann and other zeta functions More generally they apply to the characteristic energies of any sufficiently complicated system and which have found since the publication of the second edition many new applications in active research areas such as quantum gravity traffic and communications networks or stock movement in the financial markets This revised and enlarged third edition reflects the latest developments in the field and convey a greater experience with results previously formulated For example the theory of skew orthogonal and bi orthogonal polynomials parallel to that of the widely known and used orthogonal polynomials is explained here for the first time Presentation of many new results in one place for the first time First time coverage of skew orthogonal and bi orthogonal polynomials and their use in the evaluation of some multiple integrals Fredholm determinants and Painlevé equations The three Gaussian ensembles unitary orthogonal and symplectic their  $n$  point correlations spacing probabilities Fredholm determinants and inverse scattering theory Probability densities of random determinants

**Orthogonal Polynomials and Random Matrices** Percy Deift, This volume expands on a set of lectures held at the Courant Institute on Riemann Hilbert problems orthogonal polynomials and random matrix theory The goal of the course was to prove universality for a variety of statistical quantities arising in the theory of random matrix models The central question was the following Why do very general ensembles of random  $n$  times  $n$  matrices exhibit universal behavior as  $n$  infinity The main ingredient in the proof is the steepest descent method for oscillatory Riemann Hilbert problems Titles in this series are copublished with the Courant Institute of Mathematical Sciences at New York University **Modern Aspects of Random Matrix Theory** Van H. Vu, 2014-07-16 The theory of random matrices is an amazingly rich topic in mathematics Random matrices play a fundamental role in various areas such as statistics mathematical physics combinatorics theoretical computer science number theory and numerical analysis This volume is based on lectures delivered at the 2013 AMS Short Course on Random Matrices held January 6 7 2013 in San Diego California Included are surveys by leading researchers in the field written in introductory style aiming to provide the reader a quick and intuitive overview of this fascinating and rapidly developing topic These surveys contain many major recent developments such as progress on universality conjectures connections between random matrices and free probability numerical algebra combinatorics and high dimensional geometry together with several novel methods and a variety of open questions *Random Matrices and Their Applications* Joel E. Cohen, Harry Kesten, Charles Michael Newman, 1986 Features twenty six expository papers on random matrices and products of random matrices This work reflects both theoretical and applied concerns in fields as diverse as computer science probability theory mathematical physics and population biology **Random Matrices and Iterated Random Functions** Gerold Alsmeyer, Matthias Löwe, 2013-08-28 Random Matrices are one of the major research areas in modern probability theory due to their prominence in many different fields such as nuclear physics statistics telecommunication free probability

non commutative geometry and dynamical systems A great deal of recent work has focused on the study of spectra of large random matrices on the one hand and on iterated random functions especially random difference equations on the other However the methods applied in these two research areas are fairly dissimilar Motivated by the idea that tools from one area could potentially also be helpful in the other the volume editors have selected contributions that present results and methods from random matrix theory as well as from the theory of iterated random functions This work resulted from a workshop that was held in Münster Germany in 2011 The aim of the workshop was to bring together researchers from two fields of probability theory random matrix theory and the theory of iterated random functions Random matrices play fundamental yet very different roles in the two fields Accordingly leading figures and young researchers gave talks on their field of interest that were also accessible to a broad audience

Random Matrices Madan Lal Mehta, 2014-05-19 Since the publication of Random Matrices Academic Press 1967 so many new results have emerged both in theory and in applications that this edition is almost completely revised to reflect the developments For example the theory of matrices with quaternion elements was developed to compute certain multiple integrals and the inverse scattering theory was used to derive asymptotic results The discovery of Selberg's 1944 paper on a multiple integral also gave rise to hundreds of recent publications This book presents a coherent and detailed analytical treatment of random matrices leading in particular to the calculation of  $n$  point correlations of spacing probabilities and of a number of statistical quantities The results are used in describing the statistical properties of nuclear excitations the energies of chaotic systems the ultrasonic frequencies of structural materials the zeros of the Riemann zeta function and in general the characteristic energies of any sufficiently complicated system Of special interest to physicists and mathematicians the book is self contained and the reader need know mathematics only at the undergraduate level

**Key Features** The three Gaussian ensembles unitary orthogonal and symplectic their  $n$  point correlations and spacing probabilities The three circular ensembles unitary orthogonal and symplectic their equivalence to the Gaussian Matrices with quaternion elements Integration over alternate and mixed variables Fredholm determinants and inverse scattering theory A Brownian motion model of the matrices Computation of the mean and of the variance of a number of statistical quantities Selberg's integral and its consequences

**A Dynamical Approach to Random Matrix Theory** László Erdős, Horng-Tzer Yau, 2017-08-30 A co publication of the AMS and the Courant Institute of Mathematical Sciences at New York University This book is a concise and self contained introduction of recent techniques to prove local spectral universality for large random matrices Random matrix theory is a fast expanding research area and this book mainly focuses on the methods that the authors participated in developing over the past few years Many other interesting topics are not included and neither are several new developments within the framework of these methods The authors have chosen instead to present key concepts that they believe are the core of these methods and should be relevant for future applications They keep technicalities to a minimum to make the book accessible to graduate students With this in mind they include in this

book the basic notions and tools for high dimensional analysis such as large deviation entropy Dirichlet form and the logarithmic Sobolev inequality This manuscript has been developed and continuously improved over the last five years The authors have taught this material in several regular graduate courses at Harvard Munich and Vienna in addition to various summer schools and short courses Titles in this series are co published with the Courant Institute of Mathematical Sciences at New York University

Random Matrices And Random Partitions: Normal Convergence Zhonggen Su,2015-04-20 This book is aimed at graduate students and researchers who are interested in the probability limit theory of random matrices and random partitions It mainly consists of three parts Part I is a brief review of classical central limit theorems for sums of independent random variables martingale differences sequences and Markov chains etc These classical theorems are frequently used in the study of random matrices and random partitions Part II concentrates on the asymptotic distribution theory of Circular Unitary Ensemble and Gaussian Unitary Ensemble which are prototypes of random matrix theory It turns out that the classical central limit theorems and methods are applicable in describing asymptotic distributions of various eigenvalue statistics This is attributed to the nice algebraic structures of models This part also studies the Circular Ensembles and Hermitian Ensembles Part III is devoted to the study of random uniform and Plancherel partitions There is a surprising similarity between random matrices and random integer partitions from the viewpoint of asymptotic distribution theory though it is difficult to find any direct link between the two finite models A remarkable point is the conditioning argument in each model Through enlarging the probability space we run into independent geometric random variables as well as determinantal point processes with discrete Bessel kernels This book treats only second order normal fluctuations for primary random variables from two classes of special random models It is written in a clear concise and pedagogical way It may be read as an introductory text to further study probability theory of general random matrices random partitions and even random point processes

**Russian Mathematical Surveys** ,1996 **Spectral Analysis of Large Dimensional Random Matrices** Zhidong Bai,Jack W. Silverstein,2009-12-10 The aim of the book is to introduce basic concepts main results and widely applied mathematical tools in the spectral analysis of large dimensional random matrices The core of the book focuses on results established under moment conditions on random variables using probabilistic methods and is thus easily applicable to statistics and other areas of science The book introduces fundamental results most of them investigated by the authors such as the semicircular law of Wigner matrices the Marcenko Pastur law the limiting spectral distribution of the multivariate F matrix limits of extreme eigenvalues spectrum separation theorems convergence rates of empirical distributions central limit theorems of linear spectral statistics and the partial solution of the famous circular law While deriving the main results the book simultaneously emphasizes the ideas and methodologies of the fundamental mathematical tools among them being truncation techniques matrix identities moment convergence theorems and the Stieltjes transform Its treatment is especially fitting to the needs of mathematics and statistics graduate students and beginning researchers

having a basic knowledge of matrix theory and an understanding of probability theory at the graduate level who desire to learn the concepts and tools in solving problems in this area It can also serve as a detailed handbook on results of large dimensional random matrices for practical users This second edition includes two additional chapters one on the authors results on the limiting behavior of eigenvectors of sample covariance matrices another on applications to wireless communications and finance While attempting to bring this edition up to date on recent work it also provides summaries of other areas which are typically considered part of the general field of random matrix theory

**Applications of Random Matrices in Physics** Édouard Brezin, 2006-03-03 Proceedings of the NATO Advanced Study Institute on Applications of Random Matrices in Physics Les Houches France 6-25 June 2004

**On Products of Random Projections** Göran Högnäs, 1984

*Random Matrices and Their Applications* Joel E. Cohen, 1888

Actes du congrès international des mathématiciens, 1970: Géométrie et topologie (C); analyse (D), 1971

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