

Multiple Orthogonal Polynomials

Let μ be a given positive measure with moments $m_n (= \int_{\mathbb{R}} x^n d\mu(x))$. The n th degree monic orthogonal polynomial P_n is defined by requiring that

$$\int_{\mathbb{R}} P_n(x) x^k d\mu(x) = 0, \quad k = 0, 1, \dots, n-1, \quad (23.0.1)$$

and the n th degree orthonormal polynomial $p_n = \gamma_n P_n$ is defined by taking γ_n from

$$\int_{\mathbb{R}} P_n(x) x^n d\mu(x) = \frac{1}{\gamma_n}, \quad \gamma_n > 0. \quad (23.0.2)$$

The system (23.0.1) is a linear system of n equations for the n unknown coefficients $a_{k,n}$ ($k = 1, \dots, n$) of the monic polynomial $P_n(x) = \sum_{k=0}^n a_{k,n} x^{n-k}$, with $a_{0,n} = 1$. This system of equations always has a unique solution since the matrix of the system is the Gram matrix

$$\begin{pmatrix} m_0 & m_1 & m_2 & \cdots & m_{n-1} \\ m_1 & m_2 & m_3 & \cdots & m_n \\ m_2 & m_3 & m_4 & \cdots & m_{n+1} \\ \vdots & \vdots & \vdots & \cdots & \vdots \\ m_{n-1} & m_n & m_{n+1} & \cdots & m_{2n-2} \end{pmatrix},$$

which is a positive definite matrix whenever the support of μ contains at least n points, see Chapter 2.

Multiple orthogonal polynomials are polynomials of one variable which are defined by orthogonality relations with respect to r different measures $\mu_1, \mu_2, \dots, \mu_r$, where $r \geq 1$ is a positive integer. These polynomials should not be confused with multivariate or multivariable orthogonal polynomials of several variables. Other terminology is also in use:

- Hermite–Padé polynomials (Nuttall, 1984) is often used because of the link with Hermite–Padé approximation or simultaneous Padé approximation (de Bruin, 1985), (Bultheel et al., 2005), (Sorokin, 1984), and (Sorokin, 1990).
- Polyorthogonal polynomials is used in (Nikishin and Sorokin, 1991).

Multivariable Orthogonal Polynomials And Quantum Grabmannians

Ying Guang Shi



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Multivariable Orthogonal Polynomials and Quantum Grassmannians [i.e. Grassmannians] Jasper V. Stokman, 2001

Algebraic Combinatorics and Quantum Groups Naihuan Jing, 2003 Algebraic combinatorics has evolved into one of the most active areas of mathematics. Its developments have become more interactive with not only its traditional field representation theory but also geometry, mathematical physics and harmonic analysis. This book presents articles from some of the key contributors in the area. It covers Hecke algebras, Hall algebras, the Macdonald polynomial and its deviations and their relations with other fields. *Mathematical Reviews*, 2005 *Brinkman's catalogus van boeken en tijdschriften*, 2001

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Nikiforov, Sergei K. Suslov, Vasilii B. Uvarov, 2012-12-06. While classical orthogonal polynomials appear as solutions to hypergeometric differential equations, those of a discrete variable emerge as solutions of difference equations of hypergeometric type on lattices. The authors present a concise introduction to this theory, presenting at the same time methods of solving a large class of difference equations. They apply the theory to various problems in scientific computing, probability, queueing theory, coding and information compression. The book is an expanded and revised version of the first edition published in Russian (Nauka, 1985). Students and scientists will find a useful textbook in numerical analysis.

Multivariate Polynomial Approximation Manfred Reimer, 2012-12-06. Multivariate polynomials are a main tool in approximation. The book begins with an introduction to the general theory by presenting the most important facts on multivariate interpolation, quadrature, orthogonal projections and their summation, all treated under a constructive view and embedded in the theory of positive linear operators. On this background, the book gives the first comprehensive introduction to the recently developed theory of generalized hyperinterpolation. As an application, the book gives a quick introduction to tomography. Several parts of the book are based on rotation principles which are presented in the beginning of the book together with all other basic facts needed. Orthogonal Polynomials of Several Variables Charles F. Dunkl, Yuan Xu, 2014-08-21. Updated throughout, this revised edition contains 25% new material covering progress made in the field over the past decade. **Classical and Quantum Orthogonal Polynomials in One Variable** Mourad E. H. Ismail, 2005. The

first modern treatment of orthogonal polynomials from the viewpoint of special functions is now available in paperback

Orthogonal Polynomials Walter Gautschi, 2004-04-29 This is the first book on constructive methods for and applications of orthogonal polynomials and the first available collection of relevant Matlab codes The book begins with a concise introduction to the theory of polynomials orthogonal on the real line or a portion thereof relative to a positive measure of integration Topics which are particularly relevant to computation are emphasized The second chapter develops computational methods for generating the coefficients in the basic three term recurrence relation The methods are of two kinds moment based methods and discretization methods The former are provided with a detailed sensitivity analysis Other topics addressed concern Cauchy integrals of orthogonal polynomials and their computation a new discussion of modification algorithms and the generation of Sobolev orthogonal polynomials The final chapter deals with selected applications the numerical evaluation of integrals especially by Gauss type quadrature methods polynomial least squares approximation moment preserving spline approximation and the summation of slowly convergent series Detailed historic and bibliographic notes are appended to each chapter The book will be of interest not only to mathematicians and numerical analysts but also to a wide clientele of scientists and engineers who perceive a need for applying orthogonal polynomials

Orthogonal Polynomials in MATLAB Walter Gautschi, 2016-05-23 Techniques for generating orthogonal polynomials numerically have appeared only recently within the last 30 or so years Orthogonal Polynomials in MATLAB Exercises and Solutions describes these techniques and related applications all supported by MATLAB programs and presents them in a unique format of exercises and solutions designed by the author to stimulate participation Important computational problems in the physical sciences are included as models for readers to solve their own problems

Orthogonal Polynomials Mama Foupouagnigni, Wolfram Koepf, 2020-05-01 This book presents contributions of international and local experts from the African Institute for Mathematical Sciences AIMS Cameroon and also from other local universities in the domain of orthogonal polynomials and applications The topics addressed range from univariate to multivariate orthogonal polynomials from multiple orthogonal polynomials and random matrices to orthogonal polynomials and Painlevé equations The contributions are based on lectures given at the AIMS Volkswagen Stiftung Workshop on Introduction of Orthogonal Polynomials and Applications held on October 5-12 2018 in Douala Cameroon This workshop funded within the framework of the Volkswagen Foundation Initiative Symposia and Summer Schools was aimed globally at promoting capacity building in terms of research and training in orthogonal polynomials and applications discussions and development of new ideas as well as development and enhancement of networking including south south cooperation

Power Orthogonal Polynomials Ying Guang Shi, 2006 The first chapter lists the basic results of orthogonal polynomials Jacobi Laguerre and Hermite polynomials and collects some frequently used theorems and formulas As a base and useful tool the representation and quantitative theory of Hermite interpolation is the subject of Chapter 2 The theory of power orthogonal polynomials begins in

Chapter 3 existence uniqueness Characterisations properties of zeros and continuity with respect to the measure and the indices are all considered Chapter 4 deals with Gaussian quadrature formulas and their convergence Chapter 5 is devoted to the theory of Christoffel type functions which are related to Gaussian quadrature formulas and is one of the important contents of power orthogonal polynomials The explicit representation of power orthogonal polynomials is an interesting problem and is discussed in Chapter 6 Chapter 7 is a detailed treatment of zeros in power orthogonal polynomials Chapter 8 is devoted to bounds and inequalities of power orthogonal polynomials In Chapters 9 and 10 we study asymptotics of general polynomials and power orthogonal polynomials respectively In Chapter 11 we discuss convergence of power orthogonal series Lagrange and Hermite interpolation and two positive operators constructed by power orthogonal polynomials In Chapter 12 we investigate Gaussian quadrature formulas for extended Chebyshev spaces In Chapter 13 we give construction methods for power orthogonal polynomials and Gaussian quadrature formulas we also provide numerical results and numerical tables

Bounds and Asymptotics for Orthogonal Polynomials for Varying Weights Eli Levin, Doron S. Lubinsky, 2018-02-13 This book establishes bounds and asymptotics under almost minimal conditions on the varying weights and applies them to universality limits and entropy integrals Orthogonal polynomials associated with varying weights play a key role in analyzing random matrices and other topics This book will be of use to a wide community of mathematicians physicists and statisticians dealing with techniques of potential theory orthogonal polynomials approximation theory as well as random matrices

Orthogonal Polynomials and their Applications Manuel Alfaro, Jesus S. Dehesa, Francisco J. Marcellan, Jose L. Rubio de Francia, Jaime Vinuesa, 2006-11-14 The Segovia meeting set out to stimulate an intensive exchange of ideas between experts in the area of orthogonal polynomials and its applications to present recent research results and to reinforce the scientific and human relations among the increasingly international community working in orthogonal polynomials This volume contains original research papers as well as survey papers about fundamental questions in the field Nevai Rakhmanov Lpez and its relationship with other fields such as group theory Koornwinder Pad approximation Brezinski differential equations Krall Littlejohn and numerical methods Rivlin

Orthogonal Polynomials: Current Trends and Applications Francisco Marcellán, Edmundo J. Huertas, 2021-02-11 The present volume contains the Proceedings of the Seventh Iberoamerican Workshop in Orthogonal Polynomials and Applications EIBPOA which stands for Encuentros Iberoamericanos de Polinomios Ortogonales y Aplicaciones in Spanish held at the Universidad Carlos III de Madrid Legan s Spain from July 3 to July 6 2018 These meetings were mainly focused to encourage research in the fields of approximation theory special functions orthogonal polynomials and their applications among graduate students as well as young researchers from Latin America Spain and Portugal The presentation of the state of the art as well as some recent trends constitute the aim of the lectures delivered in the EIBPOA by worldwide recognized researchers in the above fields In this volume several topics on the theory of polynomials orthogonal with respect to different inner products are analyzed both

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