



A note on Turán type and mean inequalities for the Kummer function

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ABSTRACT

Turán-type inequalities for combinations of Kummer functions involving $\Phi(a \pm v, c \pm v, x)$ and $\Phi(a, c \pm v, x)$ have been recently investigated in [Á. Baricz, Functional inequalities involving Bessel and modified Bessel functions of the first kind, Expo. Math. 26 (3) (2008) 279–293; M.E.H. Ismail, A. Laforgia, Monotonicity properties of determinants of special functions, Constr. Approx. 26 (2007) 1–9]. In the current paper, we resolve the corresponding Turán-type and closely related mean inequalities for the additional case involving $\Phi(a \pm v, c, x)$. The application to modeling credit risk is also summarized.

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1. Introduction

The Kummer confluent hypergeometric function is given by

$$\Phi(\alpha, \beta, x) = \sum_{n=0}^{\infty} \frac{(\alpha)_n x^n}{(\beta)_n n!},$$

where $(\alpha)_n$ is the Pochhammer symbol defined by $(\alpha)_n = \Gamma(\alpha + n)/\Gamma(\alpha) = \alpha(\alpha + 1) \cdots (\alpha + n - 1)$ for $n \in \mathbb{N}$, $(\alpha)_0 = 1$, $(\alpha + 1)_{-1} = \frac{1}{\alpha}$, and the Gamma function is $\Gamma(x) = \int_0^{\infty} t^{x-1} e^{-t} dt$, for $x > 0$.

Inequalities involving contiguous Kummer confluent hypergeometric functions of the form $\Phi(a \pm v, c \pm v, x)$ and $\Phi(a, c \pm v, x)$ were presented in Theorem 2 of [4] and Theorem 2.7 of [11]. These inequalities are of the Turán type [15] in the case that $v = 1$. In the present note, we resolve the remaining Turán-type case involving $\Phi(a \pm 1, c, x)$ and extend it to include $\Phi(a \pm v, c, x)$, $v \in \mathbb{N}$. We then establish a closely related mean inequality that provides simultaneous upper and lower bounds for $\Phi(a, c, x)$. Turán-type inequalities, which are of independent interest, also have important applications in Information Theory (as demonstrated by McEliece, Reznick, and Shearer in their paper [12]) and in modeling credit risk, as summarized below.

In particular, Carey and Gordy [9] model a lending relationship in which the bank has an option to foreclose upon the borrower at any time. Following the seminal models of Merton [13] and Black and Cox [6], it is assumed that the value of the firm's assets follows a geometric Brownian motion. It is shown that the bank's optimal foreclosure threshold solves a first order condition involving a ratio of contiguous Kummer functions, which implies that a Turán-type inequality for the Kummer function arises naturally in studying the comparative statics of the model. A proof of this key Turán-type

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Journal of analysis and its application ,2002 Journal of Mathematical Analysis and Applications ,1985-10 **The Journal of Analysis** ,2006 Wavelet Analysis on the Sphere Sabrine Arfaoui,Imen Rezgui,Anouar Ben Mabrouk,2017-03-20 The goal of this monograph is to develop the theory of wavelet harmonic analysis on the sphere By starting with orthogonal polynomials and functional Hilbert spaces on the sphere the foundations are laid for the study of spherical harmonics such as zonal functions The book also discusses the construction of wavelet bases using special functions especially Bessel Hermite Tchebychev and Gegenbauer polynomials **Qualitative Analysis of Delay Partial Difference Equations** B. G. Zhang,Yong Zhou,2007 **Dynamic Modeling and Applications for Global Economic Analysis** Elena Ianchovichina,Terrie L. Walmsley,2012-02-20 A sequel to Global Trade Analysis Modeling and Applications Cambridge University Press 1996 edited by Thomas W Hertel this new volume presents the technical aspects of the Global Trade Analysis Program s global dynamic framework GDyn and its applications within important global policy issues The book covers a diverse set of topics including trade reform growth investment technology demographic change and the environment Environmental issues are particularly well suited for analysis with GDyn and this volume covers its uses with climate change resource use and technological progress in agriculture Other applications presented in the book focus on integration issues such as rules governing foreign investment e commerce regulations trade in services harmonization of technical standards sanitary and photo sanitary regulations streamlining of customs procedures and demographic change and migration **Materials Characterization by Thermomechanical Analysis** Alan T. Riga,C. Michael Neag,1991 Fifteen papers from the symposium held in Philadelphia March 1990 examine the uses of thermomechanical analysis and thermodilatometry in materials science addressing instrumentation techniques and applications Annotation copyright Book News Inc Portland Or Issues in Calculus, Mathematical Analysis, and Nonlinear Research: 2013 Edition ,2013-05-01 Issues in Calculus Mathematical Analysis and Nonlinear Research 2013 Edition is a ScholarlyEditions book that delivers timely authoritative and comprehensive information about Mathematical Analysis The editors have built Issues in Calculus Mathematical Analysis and Nonlinear Research 2013 Edition on the vast information databases of ScholarlyNews You can expect the information about Mathematical Analysis in this book to be deeper than what you can access anywhere else as well as consistently reliable authoritative informed and relevant The content of Issues in Calculus Mathematical Analysis and Nonlinear Research 2013 Edition has been produced by the world s leading scientists engineers analysts research institutions and companies All of the content is from peer reviewed sources and all of it is written assembled and edited by the editors at ScholarlyEditions and available exclusively from us You now have a source you can cite with authority confidence and credibility More information is available at <http://www.ScholarlyEditions.com> Randomized Algorithms for Analysis and Control of Uncertain Systems Roberto Tempo,Giuseppe Calafiore,Fabrizio Dabbene,2005-09-05 Moving on from

earlier stochastic and robust control paradigms this book introduces the fundamentals of probabilistic methods in the analysis and design of uncertain systems The use of randomized algorithms guarantees a reduction in the computational complexity of classical robust control algorithms and in the conservativeness of methods like H infinity control Features self contained treatment explaining randomized algorithms from their genesis in the principles of probability theory to their use for robust analysis and controller synthesis comprehensive treatment of sample generation including consideration of the difficulties involved in obtaining independent and identically distributed samples applications in congestion control of high speed communications networks and the stability of quantized sampled data systems This monograph will be of interest to theorists concerned with robust and optimal control techniques and to all control engineers dealing with system uncertainties

Analysis of Structures on Elastic Foundation Levon G. Petrosian, 2022-06-12 This book is devoted to the static and dynamic analysis of structures on elastic foundation Through comprehensive analysis the book shows analytical and mechanical relationships among classic and modern methods of solving boundary value problems The book provides a wide spectrum of applications of modern techniques and methods of calculation of static and dynamic problems of engineering design It pursues both methodological and practical purposes and the accounting of all methods is accompanied by solutions of the specific problems which are not merely illustrative in nature but may represent an independent interest in the study of various technical issues Two special features of the book are the extensive use of the generalized functions for describing the impacts on structures and the substantiations of the methods of the apparatus of the generalized functions The book illustrates modern methods for solving boundary value problems of structural mechanics and soil mechanics based on the application of boundary equations The book presents the philosophy of boundary equations and boundary element methods A number of examples of solving different problems of static and dynamic calculation of structures on an elastic foundation are given according to the methods presented in the book Introduces a general approach to the method of integral transforms based on the spectral theory of the linear differential operators The Spectral Method of Boundary Element SMBE is developed based on using integral transforms with an orthogonal kernel in the extended domain Presents a new versatile foundation model with a number of advantages over the ground based models currently used in practical calculations Provides new transforms which will aid in solving various problems relevant to bars beams plates and shells in particular for the structures on elastic foundation Examines the methods of solving boundary value problems typical for structural mechanics and related fields

Dynamic and Stochastic Efficiency Analysis Jatikumar Sengupta, 2000 This book extends the dynamic and stochastic analysis of economic efficiency by using the recent techniques of data envelopment analysis New results and applications of these techniques in numerous areas of economics finance and management are provided including treatment of private sector industries portfolio models in finance quality control techniques in managerial performance the role of market competition policy applications in investment models in finance risk aversion and efficiency

and technology and innovation The most up to date tools of efficiency analysis developed here will be valuable for students and researchers in operations research applied management science and applied microeconomics

Astronomical Image and Data Analysis J.-L. Starck,F. Murtagh,2013-04-17 When we consider the ever increasing amount of astronomical data available to us we can well say that the needs of modern astronomy are growing by the day Ever better observing facilities are in operation The fusion of information leading to the coordination of observations is of central importance The methods described in this book can provide effective and efficient ripostes to many of these issues Much progress has been made in recent years on the methodology front in line with the rapid pace of evolution of our technological infrastructures The central themes of this book are information and scale The approach is astronomy driven starting with real problems and issues to be addressed We then proceed to comprehensive theory and implementations of demonstrated efficacy The field is developing rapidly There is little doubt that further important papers and books will follow in the future Colleagues we would like to acknowledge include Alexandre Aussem Albert Bijaoui Francis Bonnarel Jonathan G Campbell Ghada Jammal Rene Gastaud Pierre Francis Honore Bruno Lopez Mireille Louys Clive Page Eric Pantin Philippe Querre Victor Racine Jerome Rodriguez and Ivan Valtchanov

Dietary Fiber: Properties, Recovery, and Applications Charis M. Galanakis,2019-06-15 Dietary Fiber Properties Recovery and Applications explores the properties and health effects of dietary fiber along with new trends in recovery procedures and applications The book covers the most trending topics of dietary fiber applications emphasizing polyphenol properties bioavailability and metabolomics target sources recovery and emerging technologies technological aspects stability during processing and applications in the food beverage and nutraceutical sectors Written by a team of experts in the field of dietary fiber this book is ideal for chemists food scientists technologists new product developers and academics

Brain Source Localization Using EEG Signal Analysis Munsif Ali Jatoti,Nidal Kamel,2017-12-14 Of the research areas devoted to biomedical sciences the study of the brain remains a field that continually attracts interest due to the vast range of people afflicted with debilitating brain disorders and those interested in ameliorating its effects To discover the roots of maladies and grasp the dynamics of brain functions researchers and practitioners often turn to a process known as brain source localization which assists in determining the source of electromagnetic signals from the brain Aiming to promote both treatments and understanding of brain ailments ranging from epilepsy and depression to schizophrenia and Parkinson s disease the authors of this book provide a comprehensive account of current developments in the use of neuroimaging techniques for brain analysis Their book addresses a wide array of topics including EEG forward and inverse problems the application of classical MNE LORETA Bayesian based MSP and its modified version M MSP Within the ten chapters that comprise this book clinicians researchers and field experts concerned with the state of brain source localization will find a store of information that can assist them in the quest to enhance the quality of life for people living with brain disorders

Food Authentication Contantinos A. Georgiou,Georgios P. Danezis,2017-05-08 The determination of food

authenticity is a vital component of quality control Its importance has been highlighted in recent years by high profile cases in the global supply chain such as the European horsemeat scandal and the Chinese melamine scandal which led to six fatalities and the hospitalisation of thousands of infants As well as being a safety concern authenticity is also a quality criterion for food and food ingredients Consumers and retailers demand that the products they purchase and sell are what they purport to be This book covers the most advanced techniques used for the authentication of a vast number of products around the world The reader will be informed about the latest pertinent analytical techniques Chapters focus on the novel techniques markers that have emerged in recent years An introductory section presents the concepts of food authentication while the second section examines in detail the analytical techniques for the detection of fraud relating to geographical botanical species and processing origin and production methods of food materials and ingredients Finally the third section looks at consumer attitudes towards food authenticity the application of bioinformatics to this field and the Editor s conclusions and future outlook Beyond being a reference to researchers working in food authentication it will serve as an essential source to analytical scientists interested in the field and food scientists to appreciate analytical approaches This book will be a companion to under and postgraduate students in their wander in food authentication and aims to be useful to researchers in universities and research institutions

Phraseology Sylviane Granger, Fanny Meunier, 2008 Long regarded as a peripheral issue phraseology is now taking centre stage in a wide range of fields This recent explosion of interest undoubtedly has a great deal to do with the development of corpus linguistics research which has both demonstrated the key role of phraseological expressions in language and provided researchers with automated methods of extraction and analysis The aim of this volume is to take stock of current research in phraseology from a variety of perspectives theoretical descriptive contrastive cultural lexicographic and computational It contains overview chapters by leading experts in the field and a series of case studies focusing on a wide range of multiword units collocations similes idioms routine formulae and recurrent phrases The volume is an invitation for experienced phraseologists to look at the field with different eyes and a useful introduction for the many researchers who are intrigued by phraseology but need help in finding their way in this rich but complex domain

Biomedical Image Analysis and Mining Techniques for Improved Health Outcomes Karâa, Wahiba Ben Abdessalem, 2015-11-03 Every second users produce large amounts of image data from medical and satellite imaging systems Image mining techniques that are capable of extracting useful information from image data are becoming increasingly useful especially in medicine and the health sciences Biomedical Image Analysis and Mining Techniques for Improved Health Outcomes addresses major techniques regarding image processing as a tool for disease identification and diagnosis as well as treatment recommendation Highlighting current research intended to advance the medical field this publication is essential for use by researchers advanced level students academicians medical professionals and technology developers An essential addition to the reference material available in the field of medicine this timely publication covers a

range of applied research on data mining image processing computational simulation data visualization and image retrieval

Handbook of Analysis and Extraction Methods of Anthocyanins Leo M.L. Nollet, Semih Otles, 2025-04-11 Handbook of Analysis and Extraction Methods of Anthocyanins provides a comprehensive guide to learning about the properties of anthocyanins which have gained increasing importance in recent years and have attracted widespread attention from industry academia and government as well as the precise applicable and modern methods of their analysis developed to date The first part of the book introduces the structure biochemical properties health effects and high antioxidant capacity of anthocyanins based on scientific developments in recent years The second part of the book is aimed at the technological use of anthocyanins in industry focusing on the effects of food processing methods on anthocyanins encapsulation the possibilities of using them as colorants in industry and their importance as a functional ingredient as well as a healthy ingredient The third part of the book presents in detail the extraction and purification methods of anthocyanins in different food products as well as sensitive quantitative applicable and newly developed NMR HPLC UHPLC GC MS UHPLC MS and LC MS methods Key Features Minimal Prerequisites No prior functional food experience is needed making the content accessible to a wide audience New and Real World Data Learn with real scientific information on anthocyanins including all biological properties of anthocyanins antioxidant activities and new datasets on health protection functional food development encapsulation and uses of anthocyanins as food colorant Expanded Theoretical and Practical Data on Methods of Analysis of Anthocyanins Includes deeper coverage of theory based approaches of modern methods of analysis of anthocyanins their connection with GC MS LC MS etc based approaches and a presentation of newly developed and formal aspects of these methods of anthocyanins Ideal for those interested in or looking to deepen their knowledge of functional foods and nutraceuticals this edition provides a clear introduction to the antioxidant structure and health protective properties of anthocyanins and current modern analysis methods *Pseudo-Differential Operators: Partial Differential Equations and Time-Frequency Analysis* Luigi Rodino, Bert-Wolfgang Schulze, Man Wah Wong, 2007 This volume is based on lectures given at the workshop on pseudo differential operators held at the Fields Institute from December 11 2006 to December 15 2006 The two main themes of the workshop and hence this volume are partial differential equations and time frequency analysis The contents of this volume consist of five mini courses for graduate students and post docs and fifteen papers on related topics Of particular interest in this volume are the mathematical underpinnings applications and ramifications of the relatively new Stockwell transform which is a hybrid of the Gabor transform and the wavelet transform The twenty papers in this volume reflect modern trends in the development of pseudo differential operators *Evaluation of the Economic Relationships on the Basis of Statistical Decision-Making in Complex Neutrosophic Environment* Abdul Nasir, Naeem Jan, Abdu Gumaei, Sami Ullah Khan, Mabrook Al-Rakhami, Fuzzy sets and fuzzy logics are used to model events with imprecise incomplete and uncertain information Researchers have developed numerous methods and techniques to cope

with fuzziness or uncertainty This research intends to introduce the novel concepts of complex neutrosophic relations CNRs and its types based on the idea of complex neutrosophic sets CNSs

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