Preface

The Workshop on Branching Processes and their Applications (WBPA) was held during 20–23 April 2009 in Badajoz, Spain. This conference gave continuity to such important previous meetings as the First World Conference on Branching Processes held in Varna, Bulgaria, in 1993, the IMA workshop on Classical and Modern Branching Processes held in Minnesota, USA, in 1994, and the more recent Symposium: Branching in Biology held in Gothenburg, Sweden, in 2005. The WBPA was promoted and organized by the Branching Processes Research Group belonging to the Department of Mathematics of the University of Extremadura, Spain. There were 35 invited participants from 15 countries from all over the world.

The papers presented at the workshop maintained a healthy balance between the theoretical and practical aspects of branching process theory, showing it to be an area of active and interesting research. They clearly indicated the importance of branching concepts in the development of theoretical approaches to solving problems in applied fields such as Epidemiology, Cell Kinetics, Genetics, and, of course Population Dynamics.

The Proceedings consists of 20 papers. All of them have been thoroughly reviewed. Parts covered by the workshop have been classified into the following areas:

1. Population Growth Models in Random and Varying Environments
2. Special Branching Processes
3. Limit Theorems and Statistics
4. Applications in Cell Kinetics and Genetics
5. Applications in Epidemiology
6. Two-Sex Branching Models

The first part deals with Population Growth Models in Random and Varying Environments. V. Vatutin considers critical branching processes in independent and identically distributed random environment. He shows the asymptotic behaviour of the survival probability and proves a conditional functional limit theorem under hypotheses which are milder than those used in classical papers. G. Alsmeyer revisits the extinction problem in branching processes in a stationary ergodic environment.

The use of random times in connection with the stationary environment leads him quite naturally to the use of Palm-duality theory in some of his arguments. C. Braumann compares the density-independent models of population growth; namely the Galton–Watson process, the simple birth and death process, and the Malthusian stochastic differential equation model, the first two being demographic stochasticity models, and the third an environmental stochasticity model. P. Mayster establishes the existence of stationary distributions for alternating branching processes, where two Markov branching processes act alternately in random time periods of observation and treatment.

In Part 2, Special Branching Processes, F. Klebaner considers models of population–size–dependent branching processes with the feature that they are supercritical when the population reaches a certain threshold, near critical around that value, and subcritical below it. G. Yanev reviews the existing results and presents new ones on certain subtrees of the Galton–Watson family tree. He considers rooted and complete subtrees, i.e., subtrees rooted at the ancestor and being family trees of a deterministic branching process. K. Mitov et al. study Bienaymé–Galton–Watson processes subordinated by a renewal process for which the interarrival periods have a finite mean or heavy tails. V. Topchii studies renewal measure densities associated with the problem of determining the expected number of particles at the origin of catalytic branching random walks.

Part 3 focuses on Limit Theorems and Statistics. I. Rahimov considers a branching stochastic process with non-stationary immigration given by an offspring distribution depending on an unknown parameter. He estimates this parameter and introduces a bootstrap process. The paper deals with how good the estimator must be in order for the bootstrap process to have the same asymptotic properties as the original process. M. Ispàny and G. Pap investigate critical and nearly critical Galton-Watson branching processes with immigration, obtaining related functional limit theorems by using a general convergence theorem for martingale differences. M. González and I. del Puerto propose a weighted conditional least squares estimator of the offspring mean matrix for a multitype controlled branching process and study its asymptotic properties in the supercritical case.

Part 4 comprises some applications of the branching processes theory in Cell Kinetics and Genetics. N. Yanev considers some new ideas for branching process theory that arise in cell proliferation modeling. He considers distributions of discrete and continuous labels and of ages and residual lifetimes, models of leukemia cell kinetics, age-dependent branching populations with randomly chosen paths of evolution as models of (in vitro) progenitor cell populations and the estimation of offspring distributions, multitype branching populations with a large number of ancestors, and asymptotic likelihood estimation of the basic mitotic parameters. M. Kimmel and M. Mathaes propose a modification of the discrete time branching process described by Griffith and Pakes to model the amplification, mutation, and selection forces of Alu elements. They derive a limit frequency spectrum of the Alu element distribution, which serves as the theoretical, neutral frequency with which real Alu insertion data can be compared through statistical goodness of fit tests. M. González et al. use a two-type bisexual branching process to model, in a two-sex monogamic population, the evolution of the number of carriers of the two alleles of a gene linked to the *Y* chromosome. They deal with inferential problems arising from this model, considering a frequentist and parametric approach. They consider the situation in which the only data available are the total number of females and the total number of males of each genotype in each generation. This leads them to use the expectation-maximization (EM) method in order to obtain maximum likelihood estimators.

Part 5 is about applications in Epidemiology. This is an applied area in which a number of new and exciting contributions were made at the Workshop. F. Ball and P. Neal are concerned with applications of branching processes to model the spread of an SIR (susceptible–infective–removed) epidemic among a closed, homogeneously mixing population consisting initially of certain numbers of infective and susceptible individuals. Each infective remains infectious for a period sampled independently from an arbitrary but specified distribution, during which he/she contacts susceptible individuals independently with some rate for each susceptible. C. Jacob et al. treat the problem of modeling the propagation of Bovine Spongiform Encephalopathy at the scale of a very large population (Great Britain) in order to predict its extinction time and to evaluate the efficiency of the main feed-ban regulation. They elaborate a multitype branching process in discrete time with age and population dependent individual transitions. The types are the health states at each age. M. González et al. use a Sevast'yanov age-dependent branching process to describe outbreaks of infectious diseases with an incubation period. They propose a method to obtain the optimal proportion of susceptible individuals that have to be vaccinated in order to eliminate the disease from the population. D. Heinzmann is interested in modeling the transmission dynamics of the macroparasite *Echinococcus granulosus.* He presents an approximation for the time to extinction in a sub-critical epidemic two-host interaction process for this macroparasite by using multitype branching processes.

Part 6, Two-Sex Branching Models, has contributions from S. Ma and Y. Xing who introduce and study a class of discrete time bisexual branching processes in which in each generation there is allowed the immigration of females and males, depending on the current numbers of females and males in the population, and from M. Molina who presents a summary of the literature associated with the classes of two-sex branching processes.

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On behalf of the Editors

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