

RIMS Kôkyûroku Bessatsu B34

Functions in Number Theory and Their Probabilistic Aspects

edited by Kohji Matsumoto (Editor in Chief), Shigeki Akiyama,
Katusi Fukuyama, Hitoshi Nakada, Hiroshi Sugita
and Akio Tamagawa

August, 2012

**Research Institute for Mathematical Sciences
Kyoto University**

RIMS Kôkyûroku Bessatsu B34

*Functions in Number Theory and
Their Probabilistic Aspects*

December 13 ~17, 2010

*edited by Kohji Matsumoto (Editor in Chief), Shigeki Akiyama,
Katusi Fukuyama, Hitoshi Nakada, Hiroshi Sugita
and Akio Tamagawa*

August, 2012

Research Institute for Mathematical Sciences

Kyoto University, Kyoto, Japan

The papers presented in this volume of RIMS Kôkyûroku Bessatsu are in final form and refereed.
©2012 by the Research Institute for Mathematical Sciences, Kyoto University. All rights reserved.
Printed in Japan.

Preface

The present volume is the collection of papers submitted by speakers and poster session presenters of the international conference "Functions in Number Theory and Their Probabilistic Aspects" held at RIMS, Kyoto University, 13-17 December, 2010. The total number of the participants of the conference is 93, including people coming from Austria, France, Germany, Israel, Korea, Lithuania, Poland, and USA.

This conference was the main event of the 2010 Project Research sponsored by RIMS, which had the same title as the conference. We express our sincere gratitude to Professor Yoichiro Takahashi, who first recommended us to propose the plan of this project, and was a member of the organizing committee of the project till his retirement from Kyoto University.

The theme of the conference was the interplay between probability theory and number theory, especially various applications of probabilistic methods to number theory. Conference talks and posters covered topics such as probabilistic theory of arithmetical functions, value-distribution and the universality of zeta and L -functions, random matrix theory, metric results on continued fractions and discrepancies, arithmetic algorithm and dynamical systems, tilings, fractals, and many other related matters. We are indebted to RIMS for the financial support, and also grateful to the staff of RIMS, without their effort the conference would not have been so smoothly managed.

Many speakers and some of poster session presenters submitted their papers to the present Proceedings. All of them were strictly refereed. We thank all the authors and the referees for their contribution.

It is to be mentioned that Professor Yasunori Okabe, one of the speakers of the conference and also one of the contributors of the Proceedings, passed away on 19 November, 2011. His paper included in the present Proceedings is the very last paper of him. We express our sincere condolences. After this sad news, some of the authors inserted his condolence to his paper.

It is our great pleasure that the present volume is now published by RIMS as one of the "Kôkyûroku Bessatsu" series. We hope that this volume will be useful for all researchers who are working, and students who are fascinated, in this wonderful research field.

July 2012

The Editorial Committee

Kohji Matsumoto (Editor in Chief,
Nagoya University)
Shigeki Akiyama (Niigata University)
Katusi Fukuyama (Kobe University)
Hitoshi Nakada (Keio University)
Hiroshi Sugita (Osaka University)
Akio Tamagawa (Kyoto University)

Contents

On permutations of lacunary series C. AISTLEITNER, I. BERKES, and R. TICHY	1
Surveying some notions of complexity for finite and infinite sequences J.-P. ALLOUCHE	27
Zeros of zeta functions and zeta distributions on \mathbb{R}^d T. AOYAMA and T. NAKAMURA	39
Remarks on value distributions of general Dirichlet series T.K. DUỠY	49
Rauzy fractals induced from automorphisms on the free group of rank 2 related to continued fractions H. EI	69
Operator norms and the mean values of multiplicative functions P. D. T. A. ELLIOTT	81
An analytic function in 3 variables related to the value-distribution of $\log L$, and the “Plancherel volume” Y. IHARA	103
On the divisibility of class numbers of imaginary quadratic fields whose discriminant has only two odd prime factors A. ITO	117
On the fractional parts of powers of algebraic numbers H. KANEKO	127
Multiplicative functions on \mathbb{Z}_+^n and the Ewens Sampling Formula T. KARGINA and E. MANSTAVIČIUS	137
The Takagi function and its properties J. C. LAGARIAS	153
Universality of composite functions A. LAURINČIKAS	191
Zeros of partial zeta functions off the critical line Y. LEE	205

On joint universality for the zeta-functions of newforms and periodic Hurwitz zeta-functions R. MACAITIENĖ	217
On joint universality for derivatives of the Riemann zeta function and automorphic L -functions H. MISHOU	235
An extension of Voronin's functional independence for a general Dirichlet series H. NAGOSHI	247
The generalized strong recurrence and the Riemann hypothesis T. NAKAMURA	265
Riemann's zeta function and T-positivity (3): Kummer function and inner product representation Y. OKABE	277
On hybrid universality for L-functions L. PAŃKOWSKI	319
Limit theorems for random analytic functions and their zeros T. SHIRAI	335
Sampling the Lindelöf hypothesis with an ergodic transformation J. STEUDING	361
Partial Epstein zeta functions on binary linear codes and their functional equations K. SUZUKI	383
A canonical system of differential equations arising from the Riemann zeta-function M. SUZUKI	397
Expressions of pattern sequences Y. TACHIYA	437
Unitary matrices and random permutations: conjecture and degenerated Laplacian Y. TAKAHASHI	445
Some aspects of multidimensional continued fraction algorithms J. TAMURA and S. YASUTOMI	463

Program of the international conference

Title Functions in Number Theory and Their Probabilistic Aspects
Organizers S. Akiyama, K. Fukuyama, K. Matsumoto, H. Nakada,
H. Sugita, Y. Takahashi, A. Tamagawa
Place Room 420, Research Institute for Mathematical Sciences, Kyoto University
Dates December 13–17, 2010

December 13

10:00–10:50 J.-P. Allouche
Inconstancy of finite and infinite sequences

11:00–11:50 Y. Takahashi
Unitary matrices and probability

13:30–14:20 P. D. T. A. Elliott
Operator norms and the mean-values of multiplicative functions

14:30–15:20 E. Manstavičius
Probabilistic number theory on permutations

15:50–16:20 Y. Tachiya
Linear relations between pattern sequences in a $\langle q, r \rangle$ -numeration system

16:30–17:00 H. Ei
On Rauzy fractals generated by some automorphisms

December 14

10:00–10:50 V. Bergelson
Ramsey theory in the multiplicative integers and Diophantine approximations

11:00–11:50 A. Hora
Characters and harmonic functions related to infinite wreath product groups

13:30–14:20 R. F. Tichy
Recent developments in discrepancy theory

14:30–15:20 J. Lagarias
The Takagi function and related functions

15:50–16:40 Y. Okabe
Hamiltonian associated with stationary process having T -positivity
and Riemann hypothesis

16:50–17:20 H. Kaneko

On the fractional parts of powers of algebraic numbers

December 15

10:00–11:00 E. Lindenstrauss

On Linnik type problems

11:10–12:10 H. Furstenberg

Diophantine Equations and WM (weakly mixing) Sets

December 16

10:00–10:50 T. Shirai

Determinantal point processes and the zeros of analytic functions

11:00–11:50 Y. Ihara

An analytic function in 3 complex variables related to the value-distribution of $\log L$, and the “Plancherel volume”

13:30–14:20 A. Laurinćikas

Universality of the Riemann zeta-function

14:30–15:20 J. Steuding

Discrete moments of the Riemann zeta-function on deterministic and random sequences

15:50–16:20 H. Nagoshi

Independence of L -functions

16:30–17:00 L. Pańkowski

Hybrid universality for L -functions without the Euler product

December 17

10:00–10:50 R. Garunkštis

Universality of the Selberg zeta-function for the modular group

11:00–11:50 T. Tate

Asymptotic Euler-Maclaurin formula over lattice polytopes

13:30–14:00 S. Yasutomi

Some aspects of a multicontinued fraction algorithm

14:10–14:40 R. Natsui

Euclidean algorithm over $\mathbb{F}_q[X]$ and its cost functions

15:10–15:40 H. Mishou

The joint universal property for derivatives of the Riemann zeta function

15:50–16:20 Y. Lee

The universality theorem for Hecke L -functions

16:30–17:00 T. Nakamura

The generalized strong recurrence and the Riemann hypothesis

Posters

S. Akiyama

Spectra of self-affine tiling dynamics

M. Aoki

How many zeros of $\zeta^{(k)}(s)$ are there in $\{\frac{1}{2} < \sigma, 0 < t < T\}$?

T. Aoyama and T. Nakamura

Multidimensional infinitely divisible zeta distributions

T. K. Duy

Limit-periodic arithmetical functions and the ring of finite integral adeles

K. Fukuyama

Metric discrepancy results for lacunary sequences

A. Ito

On the divisibility of class numbers of imaginary quadratic fields whose discriminant has only two odd prime factors

D. Kwon

Ordered orbits of the β -transformations, and a devil's slope

R. Macaitiene

The discrete universality of the periodic Hurwitz zeta function.

S. Matsumoto

Unitary matrix integrals and enumerations of permutations

T. Murayama

The behavior of the limit distribution in Bohr-Jessen's limit theorem as $\sigma \searrow \frac{1}{2}$

K. Nakaishi

Pisot conjecture and Rauzy fractals

K. Suzuki

Partial Epstein zeta functions on linear binary codes and its functional equations

M. Suzuki

An equivalence condition for the Riemann hypothesis.

N. Terai

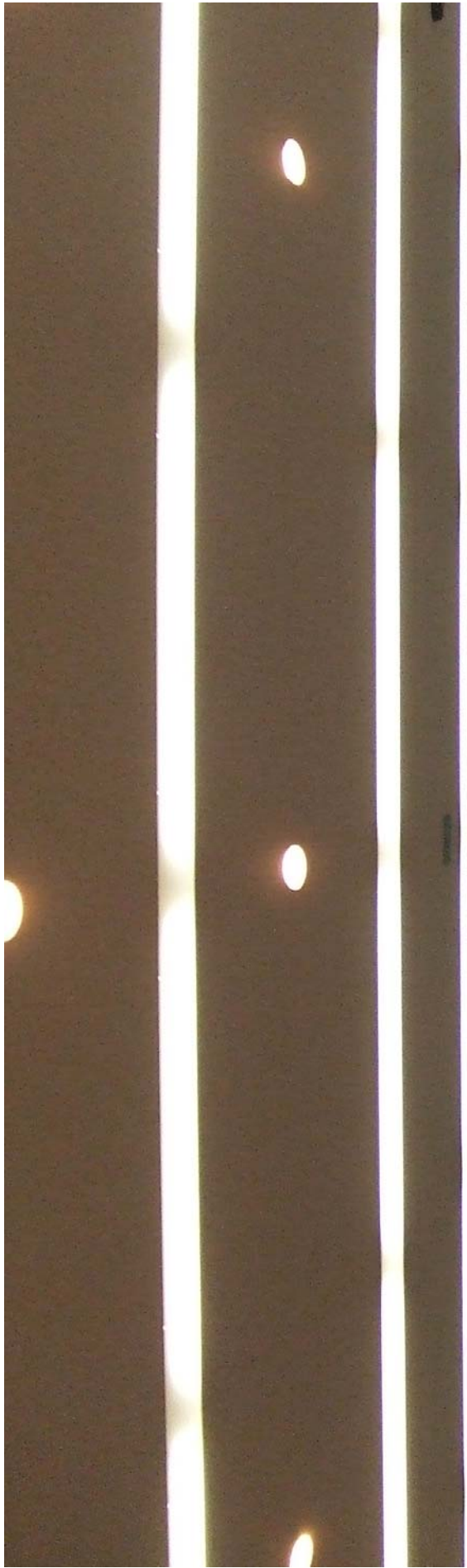
On the generalized Ramanujan-Nagell equations

R. Tomiyasu

On the distribution of vanishing Fourier coefficients of average theta series in the Conway topograph and its application to crystallography.

N. Ushiroya

Multiplicative functions of several variables and mean value theorems



$M(x, y, z) = \int_0^1 \int_0^1 \int_0^1 f(x, y, z) dx dy dz$
 $f(x, y, z) = 1 + \frac{2x}{y} + \frac{3z}{x}$
 $M(x, y, z) = \int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $M(x, y, z) = \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $M(x, y, z) = \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$

$(p, q, r) \geq 0$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$

$\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$

$M(x, y, z) = \int_0^1 \int_0^1 \int_0^1 f(x, y, z) dx dy dz$
 $f(x, y, z) = 1 + \frac{2x}{y} + \frac{3z}{x}$
 $M(x, y, z) = \int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $M(x, y, z) = \int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$

$(p, q, r) \geq 0$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$

$\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$
 $\int_0^1 \int_0^1 \int_0^1 (1 + \frac{2x}{y} + \frac{3z}{x}) dx dy dz$