



*Research Group of Stochastic Analysis  
and Mathematical Statistics*

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**Name of the group's leader:**

**Katarzyna Borkowska, Ph.D.**

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Ph.D. in Mathematics, Nicolaus Copernicus University, 2008

Dissertation topic: Approximation of reflected backward stochastic differential equations

M.Sc. in Mathematics, Nicolaus Copernicus University, Faculty of Mathematics and Computer Science, 2001

Thesis title: Modelling of the term structure of interest rates

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**Name of the group's members:**

**Magdalena Alama-Bućko, Ph.D.**

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University of Science and Technology  
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Ph.D. in Mathematics, Nicolaus Copernicus University, 2010

Dissertation topic: Optimal confidence regions for location-scale parameters

M.Sc. in Mathematics, Nicolaus Copernicus University, Faculty of Mathematics and Computer Science, 2002

Thesis title: On optimal confidence regions within the models with location and scale parameters

**Alina Semrau-Giłka, Ph.D.**

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University of Science and Technology  
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Ph.D. in Mathematics, Nicolaus Copernicus University, 2011

Dissertation topic: On approximation of solutions of reflecting stochastic differential equations with discontinuous coefficients

M.Sc. In Mathematics, Nicolaus Copernicus University, Faculty of Mathematics and Computer Science, 2002

Thesis title: On continuous Dirichlet processes

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## Leading research topics of the group:

### Backward stochastic differential equations

We are interested in backward stochastic differential equations, generalized backward stochastic differential equations and reflected backward stochastic differential equations. Our research focuses on finding conditions ensuring the existences and uniqueness of the solution of classical reflected backward stochastic differential equations, backward stochastic differential equations with respect to fractional Brownian motion and reflected backward stochastic differential equations with respect to fractional Brownian motion (one dimensional and multi dimensional cases). We developed approximation schemes for multi dimensional reflected backward stochastic differential equations and we search for approximating of backward stochastic differential equations and reflected backward stochastic differential equations with respect to fractional Brownian motion. Among others we elaborate algorithms of image restoration using backward stochastic differential equations and reflected backward stochastic differential equations.

### Stochastic differential equations

We are interested in stochastic differential equations and stochastic differential equations with reflecting boundary conditions. Our research focuses on finding conditions ensuring weak and strong convergence of general schemes approximating solutions of multidimensional reflecting stochastic differential equations with discontinuous coefficients. We are also trying to weaken conditions for convergence of sequences approximating solutions of reflected stochastic differential equations with respect to processes with finite  $p$ -variation.

### Confidence area of distribution parameters

We are interested in constructing confidence areas of distribution parameters. Above all, we search for new statistics to the construction of confidence regions for the parameters of the position and scale. We consider optimal order statistics based on linear combinations of certain statistics  $t$  and  $s$ . We plan to generalize the estimation of statistics on the case when statistics  $t$  and  $s$  are any number of combinations of order statistics. Moreover our aim is to build confidence regions based on  $L$ -statistics and their generalizations. Subsequently, we plan to compare the results with existing ones. In addition, it is intended to examine the field of data analysis and statistics, which are used in areas of confidence.

## Selected Publications

- Dariusz Borkowski, Katarzyna Jańczak-Borkowska, *Generalized Backward Stochastic Variational Inequalities Driven by a Fractional Brownian Motion*, Brazilian Journal of Probability and Statistics, Vol. 30, No. 3, 2016, 502–519.
- Alina Semrau-Giłka, *On approximation of solutions of one-dimensional reflecting SDEs with discontinuous coefficients*, Statistics and Probability Letters 96, 2015, 315–321.
- Katarzyna Jańczak-Borkowska, *Generalized BSDEs driven by fractional Brownian motion*, Statistics and Probability Letters, Volume 83, Issue 3, March 2013, Pages 805–811.
- Alina Semrau-Giłka, *Euler's approximations of solutions of reflecting SDEs with discontinuous coefficients*, Bull. Pol. Acad. Sci. Math. 61, No. 1, 2013, 79–95.
- Magdalena Alama-Bućko, Aleksander Zaigraev, *On optimal choice of order statistics in large samples for the construction of confidence regions for the location and scale*, Metrika, 76, 2013 577-593.
- Dariusz Borkowski, Katarzyna Jańczak-Borkowska, *Application of Backward Stochastic Differential Equations to Reconstruction of Vector-Valued Images*, Lecture Notes in Computer Science Vol. 7594, 2012, 38–47.
- Magdalena Alama-Bućko, Aleksander V. Nagaev, Aleksander Zaigraev, *Asymptotic analysis of minimum volume confidence regions for location-scale families*, Applicationes Mathematicae (Warszawa), 33, 2006 1–20.