FACULTY
OF MATHEMATICS
AND PHYSICS
Charles University

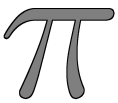
25th Annual Student Conference

Week of Doctoral Students

Book of Abstracts

of the

Week of Doctoral Students
of the School of Mathematics 2016
June 6, 2016



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http://www.karlin.mff.cuni.cz/~rokyta/WDS-M/2016/
http://www.mff.cuni.cz/veda/konference/wds/

Vytisklo Reprostředisko MFF UK Praha

WDS - M 2016, 6.6.2016, K1

Conference schedule

8 : 55 - 9 : 00	**Opening**						
9 : 00 - 9 : 30	1	Mgr.	Samuel	Mokriš	4M1	The realization problem for von Neumann regular rings
9 : 30 - 10 : 00	2	Mgr.	Tomáš	Roskovec	4M3	Lusin (N) condition for Sobolev homeomorphism
10 : 00 - 10 : 10	**Break**					
10 : 10 - 10 : 40	3	Mgr.	Filip	Dohnálek	4M9	Random excursion set
10 : 40 - 11 : 10	4	Mgr.	Šárka	Rusá	4M9	Modelling the covariance matrix
11 : 10 - 11 : 40	5	Mgr.	Xeniya	Yermolenko	4M9	Main points of quantile regression
11 : 40 - 13 : 00	**Break**					
13 : 00 - 13 : 30	6	Mgr.	Lucie	Schaynová	OSU / 4M9	An individual eating plan using a linear optimization mode
13 : 30 - 14 : 00	7	Mgr.	Jiří	Vančura	4M8	Using Khan Academy to prepare high school students for the Matfyz experience
14 : 00 - 14 : 30	8	Mgr.	Erika	Maringová	4F11	Variational problems with linear growth - regularity up to the boundary in non-convex domains

Preface

In the beginning of 2014, the Management of the Faculty of Mathematics and Physics decided that the traditional conference of PhD students called the WDS (Week of Doctoral Students) would not be organized as an activity of the entire faculty. Instead, the decision as to whether to organize the conference or not was left to the respective Schools (of Computer Science, of Mathematics, and of Physics).

Already for the third year since then the School of Mathematics organizes this WDS-M (Week of Doctoral Students of the School of Mathematics, `http://www.karlin.mff.cuni.cz/~rokyta/WDS-M/2016/`), this time as a one-day conference, in the framework, and as a continuation of, the (25th) WDS of the Faculty of Mathematics and Physics (`http://www.mff.cuni.cz/veda/konference/wds/`).

This year eight students have registered as active participants to the conference, among them also a student form University of Ostrava. We believe that this event, which takes place in the "mathematical" Karlín building of the faculty, will attract the attention of the students but also of the broad mathematical audience. We thus encourage all of those interested in the scientific activities of our doctoral students to attend this meeting.

Prague, May 30, 2016

doc. RNDr. Mirko Rokyta, CSc.
Vice-Dean for Mathematics
Faculty of Mathematics and Physics
Charles University Prague

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The realization problem for von Neumann regular rings

Mgr. Samuel Mokriš

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Ročník: 1.
Školitel: Mgr. Pavel Růžička, Ph.D.

Abstract

The 'realization problem' is the quest for characterization of monoids that arise as the monoid of isomorphism classes of finitely generated projective right modules over a von Neumann regular ring. For some direct sum cancellation properties, it is still not known whether they are satisfied by all such monoids.

The aim of the talk is to present variations on the problem, relationships between them, and some known cases. In particular, monoids associated with quivers will be presented as a class of monoids for which the realization problem has been solved.

Lusin (N) condition for Sobolev homeomorphism

Mgr. Tomáš Roskovec

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Ročník: 4.
Školitel: doc. RNDr. Stanislav Hencl, Ph.D., DSc.

Abstract

Lusin (N) condition claims that the mapping can not map a set of zero measure to a set of positive measure. The classic results claim that this condition holds for Sobolev mappings in $W^{1,p}(\mathbb{R}^n,\mathbb{R}^n), p > n$ and for Sobolev homeomorphisms in $W^{1,p}(\mathbb{R}^n,\mathbb{R}^n), p \geq n$ and both these results are sharp. We study the validity of this condition for natural generalization of these spaces for a higher derivative. We introduce the method how to modify the classical counterexamples and prove that this condition can fail in case of Sobolev homeomorphism $W^{k,p}(\mathbb{R}^n,\mathbb{R}^n), p < \frac{n}{k}$.

Using Khan Academy to prepare high school students for the Matfyz experience

Mgr. Jiří Vančura

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Školitel: doc. RNDr. Jarmila Robová, CSc.

Abstract

Khan Academy is a non-profit organization that provides free educational resources at `http://www.khanacademy.org` since 2008. At present, Khan Academy has one of the most used educational websites in the world that attracts a lot of attention from the media, educational professionals, scientists, administrators and students.

We will present the results of our exploratory research concerning the use of Khan Academy at two Prague high schools. Within the research, we conducted and analysed questionnaire survey among the students ($n = 141$). Based on the results, we selected 11 students that disliked the Khan Academy the most and interviewed them.

We will also introduce possible ways of employing Khan Academy's resources to prepare high school students for studying mathematics at the university level and to enhance their learning opportunities in the early years of undergraduate study.

Random excursion set

Mgr. Filip Dohnálek

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Ročník: 2.
Školitel: Prof. RNDr. Jan Rataj, CSc.

Abstract

Let f be a real random field on $\mathbb{R}^d$. We defined the excursion set by

$$A_u(f,M) := \{t \in M : f(t) \geq u\}$$

where $u \in \mathbb{R}$ is a parameter and $M \subset \mathbb{R}^d$ is a testing set. We are interested in intrinsic volumes $V_i(A_u(f,M))$ and mainly in densities of intrinsic volumes $\overline{V}_i(f^{-1}([u,\infty)))$. Up to now we have known theoretical values of densities of intrinsic volumes for the Boolean model and so all invented estimations of densities were applied with the Boolean model. The excursion model gives a new scope of activity where we can compare our estimations. The aim of the talk is to present different models of random excursion set and their estimations.

Modelling the covariance matrix

Mgr. Šárka Rusá

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Abstract

Modelling a covariance matrix is one of the most important issues in statistics but it has been often overlooked due to the complexity of the problem. Some useful models have been suggested for the one-dimensional case where the only constraint imposed on the variance is its positivity. In the multi-dimensional setting it is necessary to deal with the more complex requirement that the matrix be non-negative definite. Moreover, the number of parameters may be very large.

The Bayesian approach to solving these issues turned out to be very useful as it is often more straightforward to fit complex Bayesian models than to use frequentist methods based on the maximum likelihood estimation.

The recent popularity of this topic resulted in various approaches aiming to solve this issue, such as the variance-correlation separation strategy, the logarithmic covariance model, Cholesky decomposition or the nonparametric approach.

The same problems were also addressed in the literature on multilevel models that are needed for the analysis of clustered data. The attention was given to modelling heterogeneity of residual variances in linear mixed effect models or generalized linear mixed effect models. In double hierarchical generalized linear models the residual variance is allowed to depend on random effects as it is done for the mean. This approach was further extended to allow for random effects model to be included in the variances of random effects.

In this talk, I will present several possible approaches to modelling the covariance matrix in complex multi-level models which are motivated by real data.

An individual eating plan using a linear optimization model

Mgr. Lucie Schaynová

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Ročník: 2.
Školitel: doc. RNDr. David Bartl, PhD.

Abstract

In this contribution, we analyse daily nutrient requirements of an individual person from the point of view of the nutrition adviser. The goal is to simplify the adviser's menu planning for a client as much as possible. We design an individual eating plan for a week using a linear optimization model. The model is made up so that the final dietary plan for the client is as natural as possible. The model gives recommended amounts of foods for recipe weekly planning.

Main points of quantile regression

Mgr. Xeniya Yermolenko

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Školitel: prof. RNDr. Jana Jurečková, DrSc.

Abstract

In the paper I would like to describe relatively new method of statistical analysis - quantile regression. Consider the linear regression model

$$\mathbf{Y_n} = \mathbf{X_n}\beta + \varepsilon_\mathbf{n}, \tag{1}$$

with observations $\mathbf{Y_n} = (Y_1, \ldots, Y_n)^T$, i.i.d. errors $\varepsilon_\mathbf{n} = (\varepsilon_1, \ldots, \varepsilon_n)$ and unknown parameter $\beta = (\beta_0, \ldots, \beta_p)^T$. The traditional squares estimator is obtained as the solution of the minimization

$$\min_{\beta \in \mathbf{R}^{p+1}} \sum_{i=1}^{n} (Y_i - x_i^T \beta)^2 \tag{2}$$

Unlike that, the τ - regression quantile $\widehat{\beta}_n(\tau)$ is a solution of the minimization

$$\min_{\beta \in \mathbf{R}^{p+1}} \sum_{i=1}^{n} \rho_\tau(Y_i - x_i^T \beta), \tag{3}$$

where $\rho_\tau(z) = |z|\{\tau \mathbf{I}[z > 0] + (1-\tau)\mathbf{I}[z < 0]\}, \quad z \in R$.

I will give some simple examples illustrating and motivating the quantile regression methods.

Variational problems with linear growth - regularity up to the boundary in non-convex domains

Mgr. Erika Maringová

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Ročník: 1.
Školitel: RNDr. Miroslav Bulícek, Ph.D.

Abstract

The classical example of a variational problem with linear growth is the minimal surface problem. It is well known that for smooth data such problem posses a regular (up to the boundary) solution if the domain is convex (or has positive mean curvature). On the other hand, for non-convex domains we know that there always exist data for which the solution does exists only in the space BV (the desired trace is not attained). Recently, in continuum mechanics, there were identified problems (limiting strain) that can be under certain circumstances rewritten as the variational problems with linear growth but possibly having different structure than the minimal surface problem. We sharply identify the class of functionals for which we always have regular (up to the boundary) solution in any dimension for arbitrary $C^{1,1}$ domain. Furthermore, we show that the class is sharp, i.e., whenever the functional does not belong to the class then we can find data for which the solution does not exist.

Remarks and notes

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