AMISTAT 2024
BARDĚJOV
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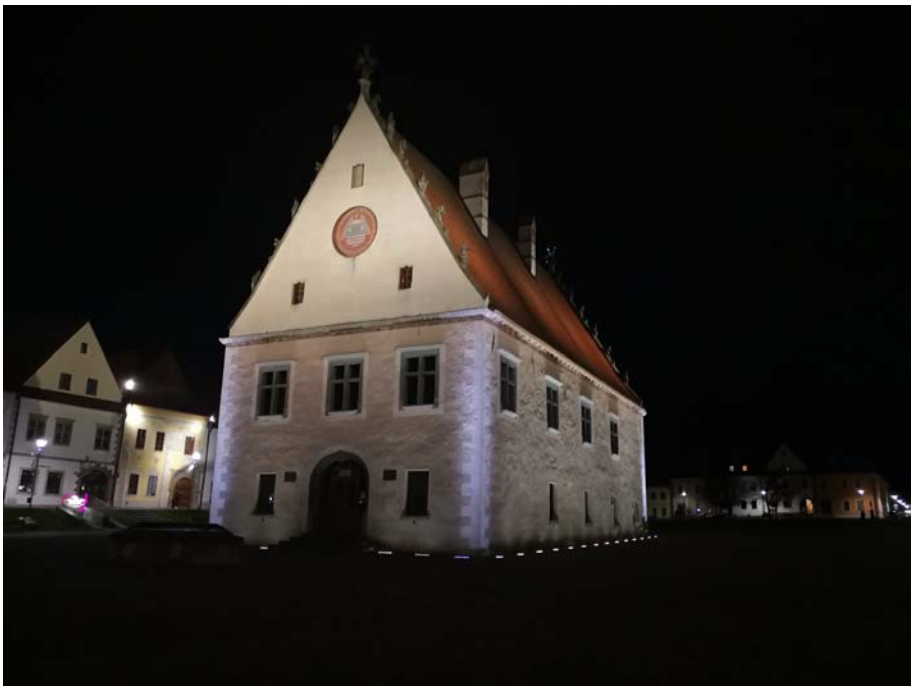
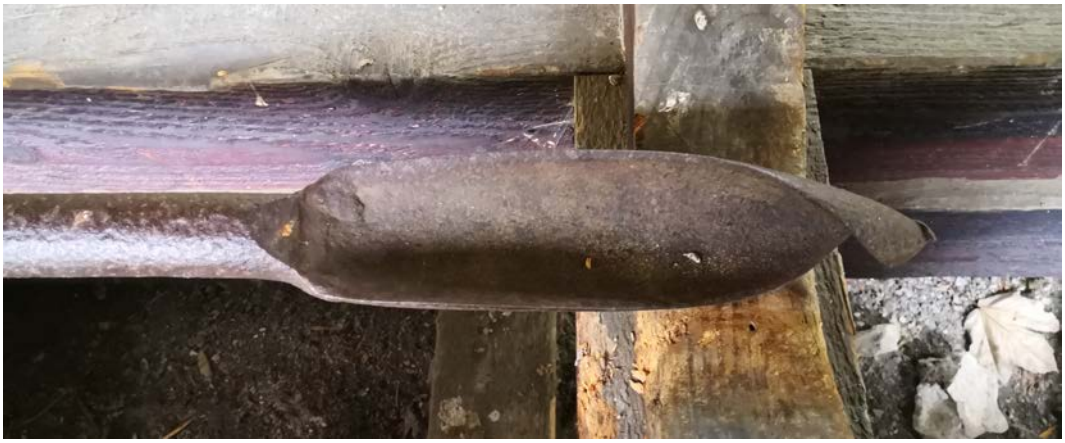
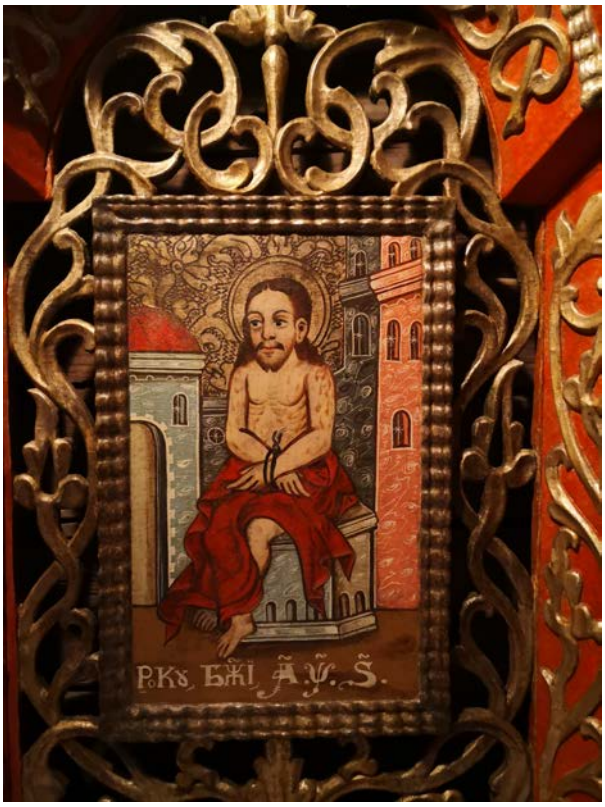
Book of Abstracts



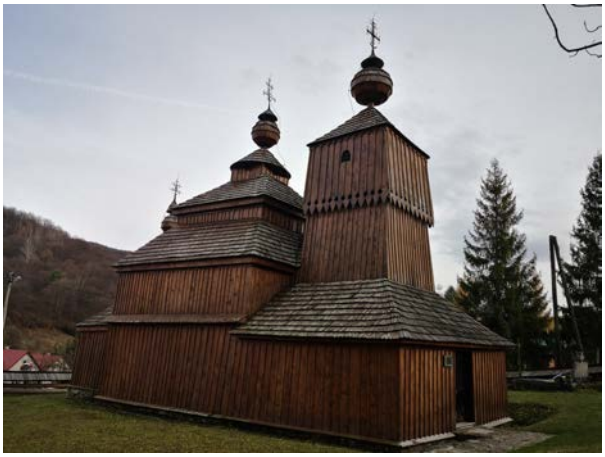
The organizers of the Amistat 2024 conference would like to thank all those who helped in the preparation and realization of the event. It was very important to us moral support from the Czech Mathematical Society, and material and financial support from the Czech Science Foundation Grant 22-03636S. Not less important was the support of several workplaces, which allowed the participation of students. We look forward to meeting you at the next Amistat conference.



Bardejov The oldest written mention of Bardejov is an entry in the Ipatijevsk chronicle from 1241. At that time, it was already an important site on the trade route between the Black and Baltic Seas. It is therefore not surprising that in 1320 the city was given extensive privileges and ordered to build walls. Since 1365 the executioner also resided here. Bardejov became a free royal city in 1376. The city gradually grew, and according to the 1437 tax list, within the walls there were 517 houses, more than 3,000 free citizens lived here, and 64 crafts, 51 guilds, and 146 master craftsmen were listed. In the 16th century, a humanistic school was established that became a center of culture and education for a wide area. In the 17th century, due to wars and recurring fires, a gradual decline of the city occurred. A partial flowering can then be observed at the end of the 19th century. On the other hand, weak industry and undeveloped agriculture led at the turn of the 19th and 20th centuries to a massive wave of emigration, especially to America. The greatest flourishing occurred after the Second World War, when a series of new factories was created that attracted many people to Bardejov. Unfortunately, after 1989, many industrial enterprises disappeared. The historical center of the city was declared already in 1950 a monument reserve and gradually reconstructed. In 2008 the historic center and the ensemble of buildings of the Synagogue was registered in the World Register UNESCO cultural heritage.



Slovakia is a country known not only for its beautiful nature, but also for important cultural monuments. Undoubtedly, these include East Slovak wooden churches. From an urbanistic point of view, it forms a beautiful local dominant of the landscape. Already in 1967, 27 of them were declared national cultural monuments. In 2008, eight of them were also enrolled in the UNESCO list.



Content

MICHEL BRONIATOWSKI, WOLFGANG STUMMER

Minimization of divergences and functionals through a bare simulation approach

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In a first Section this talk develops the strong relation between divergences of Csiszar type

$$\Phi(Q,P) := \sum_{k=1}^{K} p_k \varphi\left(\frac{q_k}{p_k}\right)$$

where $P := (p_1,..,p_K)$ is a vector with positive entries and $Q := (q_1,..,q_K)$ is a vector in $\mathbb{R}^K$ and the large deviation rate of some explicitly constructible random sequence V_n of vectors in $\mathbb{R}^K$ with distribution Π_n for which

$$-\lim_{n\to\infty}\frac{1}{n}\log\Pi_n\left(V_n\in\Omega\right)=\inf\left\{\Phi(Q,P),Q\in\Omega\right\} \tag{1}$$

for subsets $\Omega\subset\mathbb{R}^K$ with non void interior and with quite general smoothness. The generator φ of the corresponding divergence should be the Legendre Fenchel transform of some moment generating function, a property which is shared by most currently used divergences of this class. With specific choice of P this result allows for explicit bare simulation methods for the maximization of many entropies under constraints which can be deduced from the optimization of corresponding divergences.

As a second by-product, specifying the vector P, this property allows for the explicit minimization of such divergences over sets Ω; When Ω is included in $\mathbb{S}^K$, the set of all probability measures on $\{1,..,K\}$, a variant of (1) also holds; in statistical context, P is often known only through sampling, namely through the empirical measure P_m pertaining to a sample $(X_1,..,X_m)$ for which

$$\lim_{m\to\infty}\frac{1}{m}\sum\delta_{X_i}=:\lim_{m\to\infty}P_m=P$$

holds. Then $\inf\left\{\Phi(Q,P_m),Q\in\Omega\right\}$ represents a proxy of some index of the adequacy of the model Ω for the description of P. Explicit formulation and estimators of $\inf\left\{\Phi(Q,P_m),Q\in\Omega\right\}$ will be presented together with the properties of the corresponding algorithms, in relation with Importance Sampling issues.

The second part of the talk pertains to the extension of the above results for divergences which are not of Csiszar type; we will exhibit similar constructions for general Bregman divergences, with corresponding algorithms for their minimization under smooth constraints.

The Large Deviation Principle (1), or its corresponding formulation for Bregman divergences can be used together with Varadhan's Lemma in the following form

$$-\lim_{n\to\infty}\frac{1}{n}\log E_{\Pi_n}\left[\exp n\left(\Phi(V_n,P)-\Psi\left(V_n\right)\right)\right]1_\Omega(V_n)=\inf\left\{\Psi(V);V\in\Omega\right\} \tag{2}$$

for continuous functions Ψ (under additional condition according to Ω), and V_n is a random sequence with large deviation rate $\Phi(.,P)$ for some given P. Exploiting this asymptotic property allows to propose explicit algorithms for the optimization of general cases, with simple estimates of both the minimal value of Ψ on Ω and proxies of the minimizers. Applications when Ψ depends on some statistics based on some sampling will be presented.

As a concluding Section a simple application to some Neural Network context in supervised image classification will be presented, where the above methods are applied for the minimization both of the l_1 norm of a vector of parameters in dimension 4.10^5 and of the number of its non null coefficients under a constraint pertaining to the quality of the recovery of the classes on some test sample.

Reference

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PETER FILZMOSER, MARCUS MAYRHOFER

Explainable outlier identification for vector- and matrix-valued observations

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In explainable AI it is common to use Shapley values to interpret model outcomes on the observation level. Their usefulness has also been demonstrated in the context of multivariate outlier detection, where the contributions of single variables to the overall outlyingness are evaluated. This allows for an alternative view to cellwise outlyingness, where the interest is in identifying deviating cells of a data matrix. We extend the ideas to matrix-valued observations, show how the parameters for Mahalanobis distances can be robustly estimated, and present the usefulness of Shapley values for outlier explanation in this setting.

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JOSEPH L. GASTWIRTH, XINYUE ZHAO

New curves and measures of inequality utilizing transformations of the Lorenz curve: Evaluating the increase in income inequality in the U.S. from 1993 to 2022

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The Lorenz curve and the Gini coefficient based on it are the primary inequality measures relied on by the statistical agencies of many nations and international organizations. Several articles published in the last decade have shown that the Gini coefficient does not fully reflect the shift in the income distribution in favor of the upper end. Several new curves and related inequality measures that provide additional insight into the changes of a distribution of income over time are proposed. Starting with the data for 1993 the U.S. Bureau of the Census made substantial changes in its procedures that were designed to capture more income sources. Comparing the trends in inequality from 1993 until 2022 obtained by analyzing the data with the new measures as well as the Gini coefficient show that inequality grew about twice as fast as the Gini. Two of the new measures are shown to be highly correlated with the mean log-deviation and Theil index, also published by the Bureau. Because about one percent of families and five percent of unrelated individuals report no or negative income, those observations cannot be used in calculating those two measures, while the new ones can accommodate negative values deserve further consideration.

MARC HALLIN

The long quest for quantiles and ranks in $\mathbb{R}^d$ and manifolds

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Quantiles are a fundamental concept in probability, and an essential tool in statistics, from descriptive to inferential. Still, despite half a century of attempts, no satisfactory and fully agreed-upon definition of the concept, and the "dual" notion of ranks, is available beyond the well-understood case of univariate variables and distributions. The need for such a definition is particularly critical for variables taking values in $\mathbb{R}^d$, for directional variables (values on the hypersphere), and, more generally, for variables with values on manifolds. Unlike the real line, indeed, no canonical ordering is available on these domains. We show how measure transportation brings a solution to this problem by characterizing distribution-specific (data-driven, in the empirical case) orderings and *center-outward* distribution and quantile functions (ranks and signs in the empirical case) that satisfy all the properties expected from such concepts while reducing, in the case of real-valued variables, to the classical univariate notion.

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Semiparametric fiducial inference

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R.A. Fisher introduced the concept of fiducial as a potential replacement for the Bayesian posterior distribution in the 1930s. During the past century, fiducial approaches have been explored in various parametric and nonparametric settings. However, to the best of our knowledge, no fiducial inference has been developed in the realm of semiparametric statistics. In this lecture, we propose a novel fiducial approach for semiparametric models. To streamline our presentation, we use the Cox proportional hazards model, which is the most popular model for the analysis of survival data, as a running example. Other models and extensions are also discussed. In our experiments, we find our method to perform well especially in situations when the maximum likelihood estimator fails.

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JANA JUREČKOVÁ

Estimation of quantile functionals in linear model

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Many indicators and measures of technical or social procedures rise up as linear func- tionals of the quantile process of a parent random variable Z. These measures can fur- ther depend on covariates whose intensities are not under our control; moreover, the distribution of Z is unknown. Let F and Q denote the respective (unknown) distribution and quantile functions of Z. Our problem is to estimate the value of the linear functional $\mathcal{S}_Z(Q)$ in the situation that the values of Z are observable only by means of responses in a linear regression model. More precisely, we only observe the responses

$$Y_i = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_p x_{ip} + Z_i, \qquad i = 1, \ldots, n.$$

The values $\left(x_{i1}, \ldots, x_{ip}\right)$ of covariates are observable, but the regression coefficients $\left(\beta_0, \beta_1, \ldots, \beta_p\right)$ are unknown. If we knew the sample quantiles $Z_{n:1}, \ldots, Z_{n:n}$, then $\mathcal{S}_Z(Q)$ can be estimated by the functional of the empirical quantile function $\widehat{Q}_n$. Without knowledge of sample quantiles, we only have the regression quantile and its two-step version at disposal. Incidentally, the empirical quantile function of Z is under some conditions approximated by the averaged version of the two-step regression quantile process. This in turn enables to approximate the functional $\mathcal{S}$, as we shall illustrate on some examples.

The typical quantile functionals are measures of risk in finances, in health problems, and the environmental and technical risks. The popular risk measure is the Conditional Value-at-Risk (or Expected Shortfall). It is also used in water management, in insurance and elsewhere. The closely related concepts are the *mean excess function* and *the Lorenz curve*. The ratios of the Lorenz curve are proposed for a characterization of income inequalities. Some types of entropy of a probability distribution can be expressed as quantile functionals and as such can be estimated. The nuisance covariates of the model can characterize the weather conditions, market conditions, uctuations of energy, etc., hence they also play an important role.

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ROGER KOENKER

Biased treatment allocation: An empirical Bayes perspective

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Evaluation of treatment effects is considered in two simple settings in which treatment is assigned only to subjects exhibiting symptomatic risk based on an initial screening, and heterogeneous risk and treatment effects create incidental parameters problems. In the first setting a conditional maximum likelihood estimator is shown to be fully nonparametrically efficient. In the second, a modified difference-in-differences estimator that exploits a nonparametric maximum likelihood estimator of the mixing distribution of incidental parameters is shown to perform well. Results build upon two papers by Herbert Robbins and Cun-Hui Zhang from 1988 and 1989.

HIRA L. KOUL, PERERA I., BALAKRISHNA N.

A class of Minimum distance estimators in Markovian multiplicative error models

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The multiplicative error models of Engle1 have been found to be highly useful in modeling numerous financial time series. In this talk we shall present a class of minimum distance estimators for the underlying parameters in a Markovian parametric multiplicative error time series model. This class of estimators is based on the integrals of the square of a certain marked residual empirical process. We shall describe the asymptotic distributions of the proposed estimators and the findings of a finite sample study. Some members of the proposed class of estimators dominate a generalized method of moments estimator in terms of the finite sample bias at a variety of chosen error distributions while neither dominate each other in terms of the finite sample mean squared error at these error distributions. A real data example to illustrate the proposed estimation procedures will be also presented.

Reference

[1] Engle, R. (2002). New frontiers for ARCH models. J. Appl. Econ. 17, 425 – 446

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REGINA LIU

Fusion and i-Fusion learning: Combining inferences from diverse data sources

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Advanced data collection technology has often made inferences from diverse data sources easily accessible, thus prompting the desire and need to combine the inferences from those data sources. Fusion learning refers to combining inferences from multiple sources to achieve a more effective overall inference than that from any individual source alone. We focus on the tasks:

1. Whether/When to combine inferences?
2. How to combine inferences efficiently?
3. How to combine inference to enhance an individual or target study, thus named i-Fusion?

We present a general framework for nonparametric and efficient fusion learning for inference on multi-parameters, which are allowed to be correlated. The main tool underlying this framework is the new notion of depth confidence distribution (depth-CD), developed by applying data depth, bootstrap and confidence distributions. This approach is shown to be efficient, general and robust. It readily applies to heterogeneous studies with a broad range of complex and irregular settings. The approach will be illustrated with simulation studies and real applications in tracking aircraft landing performance and in zero-event studies in clinical trials. Furthermore, 'i-Fusion' will be presented as an individualized fusion learning by borrowing strength from other studies for a target study, such as in the context of precision medicine.

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URSULA MÜLLER

Estimation for Markov Chains with periodically missing observations

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When we observe a stationary time series with observations missing at periodic time points, we can still estimate its marginal distribution well, but the dependence structure of the time series may not be recoverable at all, or the usual estimators may have much larger variance than in the fully observed case. We show how nonparametric estimators can often be improved by adding unbiased estimators. We consider a simple setting, first-order Markov chains on a finite state space, and an observation pattern in which a fixed number of consecutive observations is followed by an observation gap of fixed length, say workdays and weekends. In this talk I will focus on the simplest reasonable scenario, namely when every third observation is missing. The new estimators perform astonishingly well, as illustrated with simulations for this scenario. This talk is based on joint work with Anton Schick and Wolfgang Wefelmeyer.

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WINFRIED STUTE

Extremes – the proper approach

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For iid data the CLT provides an attractive tool to obtain confidence intervals for means.One should not forget what is called standardization. About 100 years ago people began to find some interest in the extremes of a distribution.Standardization was again through an affine transformation.Approximations were in general very bad.In this talk we will see that in extreme value it is time to get rid of dominating „normal“ ideas.

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SILVELYN ZWANZIG, RAUF AHMAD

On the proof of consistency for regularized estimators using Bayesian method

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In a Bayesian setting, the regularized estimators come out to be special cases of Bayesian estimators under certain priors. The aim of the present project is to show the consistency of such regularized estimators. In particular, an alternative to the proof of consistency provided by the Schwartz theorem is worked out.