# Záznamy vložené do ASEP za ÚI (1. 3. – 31. 3. 2023)

# New ICS records in ASEP (1. 3. – 31. 3. 2023)

**Jakl, M. - Červinka, P. - Kanovský, J. - Kala, P. - Poloczek, M. - Červinková, M. - Bezerra, H. G. - Valenta, Zdeněk - Costa, M. A.**
Randomized comparison of 9-month stent strut coverage of biolimus and everolimus drug-eluting stents assessed by optical coherence tomography in patients with ST-segment elevation myocardial infarction. Long-term (5-years) clinical follow-up (ROBUST trial).
*Cardiology Journal*. Online February 2023 (2023). ISSN 1897-5593. E-ISSN 1898-018X

BACKGROUND: The aim of the study was to compare healing (assessed by optical coherence tomography [OCT]) of biolimus A9 (BES) and everolimus drug-eluting stents (EES) at 9-month follow-up in patients with ST-segment elevation myocardial infarction (STEMI) treated by primary percutaneous coronary intervention (pPCI). Nine-month clinical and angiographic data were also compared in both groups as well as clinical data at 5 years of follow-up. METHODS: A total of 201 patients with STEMI were enrolled in the study and randomized either to pPCI with BES or EES implantation. All patients were scheduled for 9 months of angiographic and OCT follow-up. RESULTS: The rate of major adverse cardiovascular events (MACE) was comparable at 9 months in both groups (5% in BES vs. 6% in the EES group; p = 0.87). Angiographic data were also comparable between both groups. The main finding at 9-month OCT analysis was the greatly reduced extent of mean neointimal area at the cost of a higher proportion of uncovered struts in the BES group (1.3 mm2 vs. 0.9 mm2; p = 0.0001 and 15.9% vs. 7.0%; p = 0.0001, respectively). At 5 years of clinical follow-up the rate of MACE was comparable between both groups (16.8% vs. 14.0%, p = 0.74). CONCLUSIONS: The study demonstrates a very low rate of MACE and good 9-month stent strut coverage of second-generation BES and EES in patients with STEMI. BES showed greatly reduced extent of mean neointimal hyperplasia area at the cost of a higher proportion of uncovered struts when compared to EES. The rate of MACE was low and comparable in both groups at 5 years.
**Permanent link:** https://hdl.handle.net/11104/0342048

**Hng, Eng Keat**
Minimum Degrees for Powers of Paths and Cycles.
*SIAM Journal on Discrete Mathematics*. Roč. 36, č. 4 (2022), s. 2667-2736. ISSN 0895-4801. E-ISSN 1095-7146

We study minimum degree conditions under which a graph G contains kth powers of paths and cycles of arbitrary specified lengths. We determine precise thresholds, assuming that the order of G is large. This extends a result of Allen, Böttcher, and Hladký [J. Lond. Math. Soc. (2), 84 (2011), pp. 269--302] concerning the containment of squares of paths and squares of cycles of arbitrary specified lengths and settles a conjecture of theirs in the affirmative.
**Permanent link:** https://hdl.handle.net/11104/0342025

We study the scenario in which traveling pulses emerge in a prototypical type-I one-dimensional excitable medium, which exhibits two different routes to excitable behavior, mediated by a homoclinic (saddle-loop) and a saddle-node on the invariant cycle bifurcations. We characterize the region in parameter space in which traveling pulses are stable together with the different bifurcations behind either their destruction or loss of stability. In particular, some of the bifurcations delimiting the stability region have been connected, using singular limits, with the two different scenarios that mediated type-I local excitability. Finally, the existence of traveling pulses has been linked to a drift pitchfork instability of localized steady structures
**Permanent link:** https://hdl.handle.net/11104/0341321

Railway scheduling is a problem that exhibits both non-trivial discrete and continuous behavior. In this paper, we model this problem using a combination of SAT and ordinary differential equations (SAT modulo ODE). In addition, we adapt our existing method for solving such problems in such a way that the resulting solver is competitive with methods based on dedicated railway simulators while being more general and extensible.

**Permanent link:** https://hdl.handle.net/11104/0342060

Hawkes processes are a special class of temporal point processes which exhibit a natural notion of causality, as occurrence of events in the past may increase the probability of events in the future. Discovery of the underlying infuence network among the dimensions of multi-dimensional temporal processes is of high importance in disciplines where a high-frequency data is to model, e.g. in fnancial data or in seismological data. This paper approaches the problem of learning Granger-causal network in multi-dimensional Hawkes processes. We formulate this problem as a model selection task in which we follow the minimum description length (MDL) principle. Moreover, we propose a general algorithm for MDL-based inference using a Monte-Carlo method and we use it for our causal discovery problem. We compare our algorithm with the state-of-the-art baseline methods on synthetic and real-world fnancial data. The synthetic experiments demonstrate superiority of our method in causal graph discovery compared to the baseline methods with respect to the size of the data. The results of experiments with the G-7 bonds price data are consistent with the experts' knowledge.

**Permanent link:** https://hdl.handle.net/11104/0341202

Discovering cause and effect variables from observational data is an important but challenging problem in science and engineering. In this work, a recently proposed brain inspired learning algorithm namely-Neurochaos Learning (NL) is used for the classification of cause and effect time series generated using coupled autoregressive processes, coupled 1D chaotic skew tent maps, coupled 1D chaotic logistic maps and a real-world prey-predator system. In the case of coupled skew tent maps, the proposed method consistently outperforms a five layer Deep Neural Network (DNN) and Long Short Term Memory (LSTM) architecture for unidirectional coupling coefficient values ranging from 0.1 to 0.7. Further, we investigate the preservation of causality in the feature extracted space of NL using Granger Causality for coupled autoregressive processes and Compression-Complexity Causality for coupled chaotic systems and real-world prey-predator dataset. Unlike DNN, LSTM and 1D Convolutional Neural Network, it is found that NL preserves the inherent causal structures present in the input timeseries data. These findings are promising for the theory and applications of causal machine learning and open up the possibility to explore the potential of NL for more sophisticated causal learning tasks.

**Permanent link:** https://hdl.handle.net/11104/0341401

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**Martinková, Patrícia - Potužníková, E. - Netík, Jan**
Interaktivní nástroj pro podporu vyhodnocování dat ze standardizovaných testů.
[An interactive tool to support the evaluation of data from standardized tests.]
*Proměny výchovy a vzdělávání a jejich reflexe v pedagogickém výzkumu: Sborník příspěvků XXX. výroční konference České asociace pedagogického výzkumu.* Brno: Masarykova univerzita, 2022 - (Švaříček, R.; Voňková, H.), s. 29-31. ISBN 978-80-280-0090-5.
[ČAPV 2022: Proměny výchovy a vzdělávání a jejich reflexe v pedagogickém výzkumu /30./. Babice / virtual (CZ), 29.08.2022-31.08.2022]
https://drive.google.com/file/d/1inlseHD6yp7pNcax6yCF61O_HUlHj0ME/view

ZÁKLADNÍ ÚDAJE: Proměny výchovy a vzdělávání a jejich reflexe v pedagogickém výzkumu: Sborník příspěvků XXX. výroční konference České asociace pedagogického výzkumu. Brno: Masarykova univerzita, 2022 - (Švaříček, R., Voňková, H.), s. 29-31. ISBN 978-80-280-0090-5. [ČAPV 2022: Proměny výchovy a vzdělávání a jejich reflexe v pedagogickém výzkumu /30./. Babice / virtual (CZ), 29.08.2022-31.08.2022]. ABSTRAKT: V příspěvku představujeme možnosti využití modulu interaktivního nástroje pro vyhodnocování dat ze znalostních testů na příkladu dat z maturitní zkoušky z matematiky. Představujeme metody pro detekci odlišného fungování položek pro různé typy škol nebo pro porovnání vybrané školy s ostatními. Ukazujeme, že nástroj má potenciál přispět k informovanému využívání dat z testování a rozhodování na úrovni škol i vzdělávací politiky.

*In this work, we present features of an interactive tool module for supporting analyses of data from achievement tests by presenting an example of data from the Matura (graduation) exam in mathematics. We present methods for detection of different functioning of items for different types of school, or for comparison of a selected school with other schools. We show that the tool has a potential to help with informed use of achievement test data and to support decision making on both the school and the system levels.*

**Permanent link:** https://hdl.handle.net/11104/0341421

0570000 - ÚI 2024 RIV CZ eng L4 - Software
**Martinková, Patrícia** - **Hladká, Adéla** - **Netík, Jan**
ShinyItemAnalysis: Test and Item Analysis via Shiny, v. 1.4.2.
**Interní kód**: ShinyItemAnalysis v. 1.4.2 ; 2022
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
Statistics and probability
https://cran.r-project.org/web/packages/ShinyItemAnalysis/index.html
Package including functions and interactive shiny application for the psychometric analysis of educational tests, psychological assessments, health-related and other types of multi-item measurements, or ratings from multiple raters.
**Permanent link:** https://hdl.handle.net/11104/0341329
**Vědecká data:** CRAN


0570067 - ÚI 2024 RIV cze U - Conference, Workshop Arrangement
**Martinková, Patrícia**
Projekt EduTest: Workshop pro aplikačního garanta.
[Praha, 08.04.2022-08.04.2022, (W)]
**R&D Projects:** GA TA ČR(CZ) TL05000008
**Institutional support:** RVO:67985807
Workshop se uskutečnil 8. 4. 2022. Účastníci byli seznámeni s psychometrickými metodami implementovanými v interaktivním nástroji a s průběžnými výsledky analýz dat z maturitních testů v oblasti vyrovnávání testových skóre a odhadování obtížnosti na základě textu.
**Permanent link:** https://hdl.handle.net/11104/0341425


0570068 - ÚI 2024 RIV cze U - Conference, Workshop Arrangement
**Martinková, Patrícia**
Projekt EduTest: Workshop pro ředitele škol.
[Praha, 08.12.2022-08.12.2022, (W)]
**R&D Projects:** GA TA ČR(CZ) TL05000008
**Institutional support:** RVO:67985807
Workshop se uskutečnil 8. 12. 2022. Účastníci byli seznámeni s interaktivním nástrojem určeným pro analýzu výsledků středních škol, vyzkoušeli si práci s daty své školy a poskytli zpětnou vazbu pro další rozvoj nástroje.
**Permanent link:** https://hdl.handle.net/11104/0341426


0570033 - ÚI 2023 RIV CZ eng D - Dissertation
**Hladká, Adéla**
Statistical models for detection of differential item functioning.
Matematicko-fyzikální fakulta, Univerzita Karlova v Praze. **Obhájeno**: Praha. 17. 3. 2021. - Praha: Univerzita Karlova, Matematicko-fyzikální fakulta, 2021. 166 s.
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
**Keywords:** differential item functioning * generalized logistic regression * nonparametric methods * differential distractor functioning
**OECD category:** Statistics and probability
https://dspace.cuni.cz/handle/20.500.11956/125037

ZÁKLADNÍ ÚDAJE: Disertační práce. Matematicko-fyzikální fakulta, Univerzita Karlova v Praze. Obhájeno: Praha. 17. 3. 2021. ABSTRAKT: This thesis focuses on topic of Differential Item Functioning (DIF), a phenomenon that can arise in various contexts of educational, psychological, or health-related multiitem measurements. We discuss several statistical methods and models to detect DIF among dichotomous, ordinal, and nominal items. In the first part, generalized logistic regression models for DIF detection among dichotomous items are introduced, which account for possibility of guessing and/or inattention. Techniques for estimation of item parameters are presented, including a newly proposed algorithm based on a parametric link function. Two simulation studies are presented. The first compares the generalized logistic regression models to other widely used DIF detection methods. The second illustrates differences between the techniques to estimate item parameters. Implementation of the models into the R software and its difNLR package is illustrated. In the second part, generalized logistic regression models for DIF detection among polytomous items are discussed. Cumulative logit, adjacent category logit, and nominal models are introduced together with the maximum likelihood method to estimate itemparameters and with examples of implementation in the difNLR package. The third part deals with a nonparametric comparison of regression curves for DIF detection based on kernel smoothing. We discuss several settings and we newly propose an estimate of an optimal weight function for a test statistic to identify DIF. Nonparametric approaches are compared to the logistic regression method in a simulation study. In the fourth and last part, further topics of DIF detection are discussed, including item purification, multiple comparison corrections, and DIF effect sizes. Different approaches are compared in a complex simulation study on three of the most used DIF detection methods.
**Permanent link:** https://hdl.handle.net/11104/0341403

0570690 - ÚI 2024 DE eng A - Abstract
**Paluš, Milan**
Non-Shannonian information theory connects inference of causality and understanding of extreme events.
*EGU General Assembly 2023 Abstracts.* Münich: Copernicus GmbH, 2023.
[EGU General Assembly 2023. 23.04.2023-28.04.2023, Vienna]
**R&D Projects:** AV ČR(CZ) AP1901
**Program:** Akademická prémie - Praemium Academiae
**Institutional support:** RVO:67985807
DOI: 10.5194/egusphere-egu23-10707
Inference of causality and understanding of extreme events are two intensively developing multidisciplinary areas highly relevant for the Earth sciences. Surprisingly, there is only a limited interaction of the two research areas.
**Permanent link:** https://hdl.handle.net/11104/0342017

0570101 - ÚI 2023 GB eng A - Abstract
**Kathpalia, Aditi** - Nagaraj, N.
Causal Properties of Synchronizing Systems.
*Dynamics Days Europe 2022. Abstract Book.* Aberdeen: University of Aberdeen, 2022. s. 151-151.
[Dynamics Days Europe 2022. 22.08.2022-26.08.2022, Aberdeen]
**R&D Projects:** GA ČR(CZ) GA19-16066S
**R&D Projects:** AV ČR(CZ) AP1901
**Program:** Akademická prémie - Praemium Academiae
**Institutional support:** RVO:67985807
https://www.abdn.ac.uk/events/documents/Dynamics%20Days%20Abstract%20Book%202022%20online%20version%20(002).pdf

The idea of 'causal stability' and the 'causal stability synchronization theorem' have recently been proposed and proved by us [1]. This work theoretically establishes the 'causal' or 'spatial' conditions for chaotic synchronization. Synchronization of coupled chaotic systems is a ubiquitous phenomenon in nature, of much interest to the dynamical systems community. However, from the time it was discovered, synchronization has always been considered as a temporal phenomenon with the 'temporal conditions' required for systems to synchronize thoroughly studied and well established. On the other hand, 'causality estimators' based on time-series are widely used to study coupled dynamical systems. Though the fate of many coupled systems is synchronization, no rigorous mathematical relationship has been established between 'causal properties' of systems and their ability to synchronize. By proving the causal stability synchronization theorem for identical chaotic systems coupled unidirectionally, our work opens up the possibility to study chaotic synchronization with the lens of causality. Alongside, we provide causality based empirical conditions to predict 'synchronizing variables' based on the time series of the master system alone. Synchronizing variables are the variables which when coupled lead the systems to synchronization. In this work, we test for the robustness of the proposed empirical conditions on different dynamical systems started with different initial conditions. This is important for future real word applications where prediction of synchronizing variables is essential, e.g., in the control of chaos and the control of synchronization (such as in epilepsy, communication or electrical circuits). We also compare our empirical criterion with the criterion of 'negative conditional Lyapunov exponents', an existing necessary temporal criterion for synchronization.

**Permanent link:** https://hdl.handle.net/11104/0341454

0570107 - ÚI 2023 IN eng A - Abstract
**Kathpalia, Aditi**
Causality and machine learning.
*International (Online) Workshop on Reservoir Computing & Neural Networks. Confirmed Speakers.* Madras: Complex Systems & Dynamics, Indian Institute of Technology Madras, 2022. [International (Online) Workshop on Reservoir Computing & Neural Networks. 23.11.2022-24.11.2022, Madras / virtual]
**R&D Projects:** GA ČR(CZ) GA19-16066S
**R&D Projects:** AV ČR(CZ) AP1901
**Program:** Akademická prémie - Praemium Academiae
**Institutional support:** RVO:67985807
https://web.iitm.ac.in/ccsd/workshops/reservoir/index.html
Despite the recent success and widespread applications of machine learning (ML) algorithms for classification and prediction in a variety of fields, they face difficulty in interpretability, trustworthiness and generalization. One of the main reasons for this is that these algorithms are building black-box models by learning statistical associations between the given 'input' and its 'output'. Decisions made solely based on 'associational learning' are insufficient to provide explanations and hence difficult to be employed in real world tasks requiring transparency and reliability. To overcome these limitations of ML algorithms, researchers are moving towards 'causal machine learning' by aiding ML decision-making based on causal reasoning and understanding. We will discuss 'the science of causality', its requirements in ML and possible means of integration with ML. We will also compare different ML algorithms based on their performance in learning temporal order/ structure in single time series as well as their ability to classify coupled pairs of time-series based on their cause-effect (or driver-driven) relationship.
**Permanent link:** https://hdl.handle.net/11104/03414570570096 - ÚI 2023 ES eng A - Abstract

0570102 - ÚI 2023 DE eng A - Abstract

**Kathpalia, Aditi - Nagaraj, N.**
Multivariate Granger Causal Discovery for Compressively Sensed Signals.
*Ordinal methods: Concepts, applications, new developments and challenges. Scientific*
*Program.* Dresden: Max Planck Institute for the Physics of Complex Systems, 2022.
[Ordinal methods: Concepts, applications, new developments and challenges. 28.02.2022-04.03.2022]
**R&D Projects:** GA ČR(CZ) GA19-16066S
**R&D Projects:** AV ČR(CZ) AP1901
**Program:** Akademická prémie - Praemium Academiae
**Institutional support:** RVO:67985807
https://www.pks.mpg.de/orpatt22/scientific-program

Compression-Complexity Causality (CCC) is a recently proposed causality detection method for time series data. It employs complexity estimation techniques based on lossless data-compression algorithms. Along with being formulated as an 'interventional' scheme of causality estimation, it overcomes several limitations of traditional causality estimation methods based on Wiener-Granger's idea, such as the requirement of long-term stationarity and long length data suitable for the estimation of joint probability distributions. It has been shown to be robust for bivariate systems with low temporal resolution, missing samples, long-term memory and finite length data [1]. However, a straightforward extension of CCC for multivariate systems is yet not available. Direct application of bivariate CCC for such systems can give spurious causal estimates, for example, in the presence of indirect and confounding causal variables. In the case when we are interested in determining causal interaction between two observed variables from coupled dynamical systems with multiple variables, the time-delay embedding of the two observables based on Taken's theorem can help to determine the dynamics of the entire system. Further, the depiction of embedded variables using ordinal patterns-based quantization (symbolization) can help to reduce the dimensionality of the coupled systems to single variable systems. Since the use of ordinal patterns helps to preserve the dynamics of the systems, causal estimation can now be done for these symbolized variables. The technique of ordinal pattern-based coding has been employed in earlier studies for other causality estimation measures such as Transfer Entropy/ Conditional Mutual Information. When used with CCC, this technique combines the strengths of the data-compression and ordinal pattern methodologies, giving promising results on challenging data with irregular and low-resolution sampling, missing samples and short length time series from multivariate systems. We show the performance of this novel 'permutation CCC' approach on simulated dynamical systems data and real data from climate system. References: [1] Kathpalia, A., & Nagaraj, N. (2019). Data-based intervention approach for Complexity-Causality measure. PeerJ Computer Science, 5, e196. Authors: Aditi Kathpalia, Pouya Manshour, Milan Paluš Acknowledgements: This study is supported by the Czech Science Foundation, Project No.~GA19-16066S and by the Czech Academy of Sciences, Praemium Academiae awarded to M. Paluš.
**Permanent link:** https://hdl.handle.net/11104/0341455


**Nagaraj, N. - Kathpalia, Aditi**
Strengths of Effort-To-Compress Complexity for analyzing time series from complex systems.
*Conference on Complex Systems 2022 - Programme at a Glance, Paralell Sessions.* Palma de Mallorca: Conference on Complex Systems, 2022.
[CCS 2022: Conference on Complex Systems 2022. 17.10.2022-21.10.2022, Palma de Mallorca]
**R&D Projects:** GA ČR(CZ) GA19-16066S
**R&D Projects:** AV ČR(CZ) AP1901
**Program:** Akademická prémie - Praemium Academiae
https://www.ccs2022.org/images/Poster%20Sessions%20-%20CCS22-.pdf
**Permanent link:** https://hdl.handle.net/11104/0341449

0570094 - ÚI 2023 ES eng A - Abstract
**Kathpalia, Aditi** - **Manshour, Pouya** - **Paluš, Milan**
Permutation Compression-Complexity Causality for robust causal inference from irregularly sampled time series.
*Conference on Complex Systems 2022 - Programme at a Glance, Paralell Sessions.* Palma de Mallorca: Conference on Complex Systems, 2022.
[CCS 2022: Conference on Complex Systems 2022. 17.10.2022-21.10.2022, Palma de Mallorca]
**R&D Projects:** GA ČR(CZ) GA19-16066S
**R&D Projects:** AV ČR(CZ) AP1901
**Program:** Akademická prémie - Praemium Academiae
https://www.ccs2022.org/images/site/ParallelSessions-CCS22-.pdf
**Permanent link:** https://hdl.handle.net/11104/0341448


0570099 - ÚI 2023 GB eng A - Abstract
**Kathpalia, Aditi** - **Manshour, Pouya** - **Paluš, Milan**
Robust Causal Inference for Irregularly Sampled Time Series from Dynamical Systems.
*Dynamics Days Europe 2022. Abstract Book.* Aberdeen: University of Aberdeen, 2022. s. 125-125.
[Dynamics Days Europe 2022. 22.08.2022-26.08.2022, Aberdeen]
**R&D Projects:** GA ČR(CZ) GA19-16066S
**R&D Projects:** AV ČR(CZ) AP1901
**Program:** Akademická prémie - Praemium Academiae
**Institutional support:** RVO:67985807
https://www.abdn.ac.uk/events/documents/Dynamics%20Days%20Abstract%20Book%202022%20online%20version%20(002).pdf

While equation-based approaches allow us to describe and model different dynamical systems, their limited domain of applicability and validity, especially in nonlinear and non-equilibrium circumstances, has led numerous data-driven approaches to come into play. Among these, causal inference from time series has proved itself as a useful tool for studying the interactions between coupled systems and giving insights into their underlying mechanisms. Although a lot of causality estimation techniques have been proposed for non-linear systems, they usually give spurious results when applied to time series with short length, missing samples and unevenly sampled data. CompressionComplexity Causality (CCC) [1] is a recently proposed causality measure inspired from complexity estimators based on lossless 'data-compression' algorithms and has been found to be robust to the above-mentioned limitations. However, this measure is still limited to scalar time series. To extend CCC applicability to complex real-world systems, which are most-often multi-dimensional, we propose a method that first symbolizes the time-series from an observable of a multidimensional dynamical system based on Taken's method of time-delayed embedding. Time-delayed vectors are transformed into a one-dimensional sequence using permutation or ordinal patterns coding [2]. The combination of permutation coding and CCC enables us to propose and apply the novel 'Permutation CCC (PCCC)' on simulated data. Simulation analyses reveal that PCCC retains the original strengths of CCC and performs much better than some existing state-of-the-art approaches. We apply PCCC to some real-world data from climatology and paleoclimatology with missing samples, irregular sampling and/or short length to make useful inferences about the major drivers of climate on different temporal-scales.
**Permanent link:** https://hdl.handle.net/11104/0341452

0570098 - ÚI 2023 DE eng A - Abstract
**Kathpalia, Aditi** - Nagaraj, N.
Multivariate Granger Causal Discovery for Compressively Sensed Signals.
*Inverse Network Dynamics - Network structure and function from nonlinear dynamics and time series data. Scientific Program.* Dresden: Max Planck Institute for the Physics of Complex Systems, 2022.
[Inverse Network Dynamics - Network structure and function from nonlinear dynamics and time series data. 12.09.2022-21.09.2022, Dresden]
**R&D Projects:** GA ČR(CZ) GA19-16066S
**R&D Projects:** AV ČR(CZ) AP1901
**Program:** Akademická prémie - Praemium Academiae
**Institutional support:** RVO:67985807
https://www.pks.mpg.de/netdat22/scientific-program

Analysis of networks with multiple variables using causal inference tools has become very popular recently because of the development of mathematical tools and algorithms for causal discovery. For systems where temporal measurements are available, the pioneering concept of Granger Causality as well as its many extensions are being employed. These methods help to capture the interactions between network variables where exact model discovery is difficult. Contemporaneously, the field of compressed sensing (CS) has seen an increasing interest in the number and scope of its applications for the acquisition, storage and transmission of signals. While conventional signal acquisition protocols require that the signals are sampled at atleast the Nyquist frequency to keep the signal information intact, CS allows for the possibility of using far fewer number of measurements to acquire and represent the signal. The only requirement of CS is that the signal being sensed be `sparse' in some domain, which is satisfied by many naturally occurring signals. Hence, CS has been adopted rapidly in the design of signal and image acquisition strategies, e.g., magnetic resonance imaging, scanning tunneling microscopy, quantum state tomography, analog to digital conversion technologies. Currently, the compressed signals are required to be reconstructed in order to make causal discovery analysis from compressively sensed signals possible. In this work, we provide a mathematical proof that structured compressed sensing matrices, specifically Circulant and Toeplitz, preserve Granger causality relationships in the compressed signal domain. This theorem is then verified on bivariate and multivariate sparse neuronal spike train simulations compressed using the recommended structured matrices. The approach is also applied to real neuronal spike trains from a rat prefrontal cortex to infer network causal connectivity. Demonstration of the possibility to make causal inferences in the compressed domain is useful to reduce computational-cost, to correctly apply the well-known Granger-Causality and to design appropriate sensing matrices. Authors: Aditi Kathpalia, Nithin Nagaraj Acknowledgements: This study is supported by the Czech Science Foundation, Project No. GA19-16066S and by the Czech Academy of Sciences, Praemium Academiae awarded to M. Paluš. Nithin Nagaraj gratefully acknowledges the financial support of Cognitive Science Research Initiative, Dept. of Science & Tech., Govt. of India (CSRI-DST) Grant No. DST/CSRI/2017/54(G).
**Permanent link:** https://hdl.handle.net/11104/0341450

0570052 - ÚI 2023 RIV AM eng A - Abstract
**Martinková, Patrícia** - Potužníková, E. - **Vařejková, Michaela**
Repeated Covariate Equating to Provide Comparable Scores from Matura Exam in Case of Non-Equivalent Groups.
*ECER 2022 Abstracts.* Yerevan: EERA - European Educational Research Association, 2022.
[ECER 2022: European Conference on Educational Research. 23.08.2022-25.08.2022, Yerevan]
**R&D Projects:** GA TA ČR(CZ) TL05000008
**Institutional support:** RVO:67985807
**Keywords:** equating * matura exam * multiple test administrations
**OECD category:** Education, general; including training, pedagogy, didactics [and education systems]

ZÁKLADNÍ ÚDAJE: ECER 2022 Abstracts. Yerevan: EERA - European Educational Research Association, 2022. KONFERENCE: ECER 2022: European Conference on Educational Research. 23.08.2022-25.08.2022, Yerevan. ABSTRAKT: In large-scale assessments that involve multiple test forms, individual student test scores are expected to be comparable regardless of which form the students take (DePacale & Gong, 2020). Test scores are considered comparable if the same interpretations can be made, with the same level of confidence, from variations of the same test (Winter et al., 2010). In relation to high-stakes testing programmes, a more stringent claim for "interchangeability" has been raised (Dorans & Walker, 2007, Holland, 2007). According to the Standards of for Educational and Psychological Testing (AERA, APA, & NCME, 2014), appropriate statistical methodology should be applied to ensure that test scores from alternate test forms can be used interchangeably, which often involves score equating (DePacale & Gong, 2020, Holland, 2007).
**Permanent link:**  https://hdl.handle.net/11104/0341438

0570010 - ÚI 2023 RIV IT eng A - Abstract
**Netík, Jan - Martinková, Patrícia**
Revisiting parametrizations for the nominal response model.
*IMPS 2022 International Meeting of the Psychometric Society. Book of Abstracts (Talks, Posters).* Bologna: Psychometric Society, 2022. s. 206-206.
[IMPS 2022. International Meeting of the Psychometric Society. 11.07.2022-15.07.2022, Bologna]
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
**Keywords:**  item response theory * nominal response model * estimation
**OECD category:**  Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)
https://www.psychometricsociety.org/sites/main/files/file-attachments/imps2022-version-7-abstract.pdf?1656714871

ZÁKLADNÍ ÚDAJE: IMPS 2022 International Meeting of the Psychometric Society. Book of Abstracts (Talks, Posters). Bologna: Psychometric Society, 2022. s. 206-206. [IMPS 2022. International Meeting of the Psychometric Society. 11.07.2022-15.07.2022, Bologna] ABSTRAKT: In this work, we revisit the existing parametrizations of the Nominal Response Model (NRM). We consider two parametrizations of NRM directly linked to the baseline-category logit (BL) nature of the model and using the information on correct answer in multiple-choice items: the BL intercept-slope (BL-IS) parametrization, and BL parametrization using a discrimination and difficulty parameters as is usual in the item response theory models (BL-IRT). An advantage of the BL-IRT parametrization is the graphical interpretation of the model parameters while BL-IS is more often encountered in the GLM framework. We hypothesize that the proposed parametrization accounting for the information on correct answer, and the related setup of starting values, may lead to numerically more precise results and less convergence issues. The relationship between the Bock's, Thissen et al.'s, and two newly considered parametrizations is explained and illustrated on practical examples
**Permanent link:**  https://hdl.handle.net/11104/0341346

0570048 - ÚI 2023 RIV IT eng A - Abstract
**Dlouhá, Jana - Štěpánek, Lubomír - Martinková, Patrícia**
Item difficulty prediction using computational psychometrics and linguistic algorithms.
*IMPS 2022 International Meeting of the Psychometric Society. Book of Abstracts (Talks, Posters).* Bologna: Psychometric Society, 2022. s. 169-169.
[IMPS 2022. International Meeting of the Psychometric Society. 11.07.2022-15.07.2022, Bologna]

ZÁKLADNÍ ÚDAJE: IMPS 2022 International Meeting of the Psychometric Society. Book of Abstracts (Talks, Posters). Bologna: Psychometric Society, 2022. s. 169-169. [IMPS 2022. International Meeting of the Psychometric Society. 11.07.2022-15.07.2022, Bologna]. ABSTRAKT: Item characteristics such as difficulty or discrimination power are typically estimated from data. When little or no data are available at the pre-test, the test developers rely on their experience in how items of different content and wording influence item characteristics. In this work, we explore various item features gathered from text analysis of item wording to predict item difficulty. We illustrate the methods using the English language test of the Czech matura exam.
**Permanent link:**  https://hdl.handle.net/11104/0341417

0570063 - ÚI 2023 RIV CZ cze A - Abstract
**Martinková, Patrícia - Hladká, Adéla - Netík, Jan**
Psychometrická analýza interaktivně a v R: Co je nového v ShinyItemAnalysis.
[Psychometric analysis interactively and in R: What's new in ShinyItemAnalysis.]
*Konference Psychologická diagnostika Brno 2021 - program.* Brno: Fakulta sociálních studií MU, 2021. [Konference Psychologická diagnostika Brno 2021. 22.04.2021-23.04.2021, Brno / virtual]

ZÁKLADNÍ ÚDAJE: Konference Psychologická diagnostika Brno 2021 - program. Brno: Fakulta sociálních studií MU, 2021. [Konference Psychologická diagnostika Brno 2021. 22.04.2021-23.04.2021, Brno / virtual]. ABSTRAKT: ShinyItemAnalysis je interaktivní aplikace pro psychometrickou analýzu, a také knihovna volně šiřitelného statistického prostředí R. ShinyItemAnalysis byla původně připravena pro analýzu přijímacích testů na vysoké školy, nově si klade za cíl nabídnout komplexní analýzu pro širokou škálu testů v oblasti didaktických, psychologických a dalších vícepoložkových měření. Zatímco hlavní psychometrické koncepty zůstávají stejné, s novými daty vždy přichází i nová úskalí. V přednášce představíme novinky v ShinyItemAnalysis, i to, jak ji lze využít v psychometrické analýze či ve výuce.

ShinyItemAnalysis is an interactive application for psychometric analysis, as well as a package of the open-source statistical environment R. ShinyItemAnalysis was originally prepared for the analysis of university entrance tests, now it aims to offer a comprehensive analysis for a wide range of tests in the field of didactic, psychological and other multi-item measurements . While the core psychometric concepts remain the same, new pitfalls always come with new data. In the lecture, we will present the news in ShinyItemAnalysis, as well as how it can be used in psychometric analysis or in teaching.
**Permanent link:**  https://hdl.handle.net/11104/0341424

0570007 - ÚI 2023 RIV IT eng A - Abstract
**Štěpánek, Lubomír - Dlouhá, Jana - Martinková, Patrícia**
Machine-learning methods for item difficulty prediction using item text features.
*IMPS 2022 International Meeting of the Psychometric Society. Book of Abstracts (Talks, Posters).* Bologna: Psychometric Society, 2022. s. 161-161.
[IMPS 2022. International Meeting of the Psychometric Society. 11.07.2022-15.07.2022, Bologna]
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
**Keywords:** item difficulty * machine learning * text analysis
**OECD category:** Computer sciences, information science, bioinformathics (hardware development to be 2.2, social aspect to be 5.8)
https://www.psychometricsociety.org/sites/main/files/file-attachments/imps2022-version-7-abstract.pdf?1656714871

ZÁKLADNÍ ÚDAJE: IMPS 2022 International Meeting of the Psychometric Society. Book of Abstracts (Talks, Posters). Bologna: Psychometric Society, 2022. s. 161-161. [IMPS 2022. International Meeting of the Psychometric Society. 11.07.2022-15.07.2022, Bologna]. ABSTRAKT: Item difficulty predictions using various text features extracted from items' wordings may help to build a test appropriately, particularly when pre-tests are limited. In this work, we examine and compare different machine learning methods for prediction of item difficulty using features from text analysis of item wordings. We employ multivariate regression, support vector machine, regression trees, random forests, and back-propagation neural networks in both frameworks, i.e., as supervised regression and classification algorithms, respectively. Furthermore, for item difficulty classification, we also build naïve Bayes classifier, and the multivariate regression designed in multinomial fashion. While the supervised regression algorithms consider the item difficulty as a continuous dependent variable, the supervised classification approaches treat the item difficulty as a variable split into a few disjunctive classes. Methods are illustrated on items of an English language test of the Czech matura exam. Although the regression and classification tasks could not be mutually compared, within the given task, the models differ in their performance. Using k-fold cross validation and several performance metrics, support vector machines and random forests usually outperform others.
**Permanent link:** https://hdl.handle.net/11104/0341343

0570060 - ÚI 2023 RIV IT cze A - Abstract
**Štěpánek, Lubomír - Netík, Jan**
Testujeme testy. Přijímačky a maturity z pohledu psychometrie a data science.
[Testing the tests. Admissions and matura exams from the perspective of psychometrics and data science.]
*Den otevřených dveří Ústavu informatiky AV ČR 2022 - program.* Praha: Ústav informatiky AV ČR, 2022.
[Týden Akademie věd ČR 2022. 31.10.2022-06.11.2022, Praha]
**R&D Projects:** GA TA ČR(CZ) TL05000008
**Institutional support:** RVO:67985807
**Keywords:** admission tests * psychometrics * analysis of educational measurement
**OECD category:** Education, general; including training, pedagogy, didactics [and education systems]
https://www.cs.cas.cz/news/2022-11-02-Den-otevrenych-dveri/cs
ZÁKLADNÍ ÚDAJE: Den otevřených dveří Ústavu informatiky AV ČR 2022 - program. Praha: Ústav informatiky AV ČR, 2022. [Týden Akademie věd ČR 2022. 31.10.2022-06.11.2022, Praha]. ABSTRAKT: Přijímací a maturitní testy jsou bezesporu klíčovým momentem pro mnoho mladých lidí, ale také pro školy, které se snaží získat co nejkvalitnější uchazeče. Jak se vlastně ověřuje, zda takový test měří to, co chceme, a jak zjistit, nakolik je spolehlivý? V této přednášce si ukážeme komplexní analýzu testů a

položek. Zaměříme se na to, jak lze předpovídat obtížnost položek z textového zadání pomocí machine-learningu nebo vytvářet adaptivní testy na míru šité respondentům.

Admission and matura tests are undoubtedly a key moment for many young people, but also for schools which try to get the best possible applicants. How do we actually verify that such a test measures what we want it to measure, and how do we determine how reliable it is? In this talk, we will show a comprehensive analysis of tests and items. We will focus on how one can predict the difficulty of items from a text input using machine-learning or create adaptive tests tailored to respondents.

**Permanent link:** https://hdl.handle.net/11104/0341423

0570036 - ÚI 2023 RIV eng A3 - Přednáška/prezentace nepublikovaná
**Martinková, Patrícia**
Computational aspects of psychometrics taught with R and Shiny.
[useR! 2021. Zürich / virtual, 05.07.2021-09.07.2021]
**Organizer**: R Foundation
**UR**: https://user2021.r-project.org/
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
**Keywords:**  computational aspects * psychometrics * shiny
**OECD category:**  Statistics and probability
http://www.shinyitemanalysis.org/docs/useR2021.pdf

ZÁKLADNÍ ÚDAJE: Computational aspects of psychometrics taught with R and Shiny. [useR! 2021. Zürich / virtual, 05.07.2021-09.07.2021]. ABSTRAKT: Psychometrics deals with advancement of quantitative measurement practices in psychology, education, health, and many other fields. It covers number of statistical methods that are useful for the behavioral and social sciences. Among other topics, it includes the estimation of reliability to deal with the omnipresence of measurement error, as well as a more detailed description of item functioning encompassed in item response theory models. In this talk, I will discuss some computational aspects of psychometrics, and how understanding these aspects may be supported by real and simulated datasets, interactive examples, and hands on methods. First, I will first focus on the reliability estimation and the issue of restricted range, showing that zero may not always be zero. Then I will focus on a deeper understanding of the context behind more complex models and their much simpler counterparts. The last example discusses group-specific models and importance of item-level analysis for situations where differences in overall gains are not apparent but the differences in item gains may be. Finally, I will discuss experiences from teaching computational aspects of psychometrics to a diverse group of students from various fields, including statistics, computer science, psychology, education, and medicine, and participants from the industry. I will discuss the challenges and joys of creating a truly interdisciplinary course.

**Permanent link:** https://hdl.handle.net/11104/0341407

0570045 - ÚI 2023 RIV eng A3 - Přednáška/prezentace nepublikovaná
**Martinková, Patrícia**
Does a zero inter-rater reliability mean grant peer review is arbitrary?
[Metascience 2021. Virtual, 16.09.2021-25.09.2021]
**Method of presentation:** Přednáška
**Organizer**: Center for Open Science, Association for Interdisciplinary Meta-Research and Open Science, Research on Research Institute
**URL akce**: https://metascience2021.org
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807

ZÁKLADNÍ ÚDAJE: Does a zero inter-rater reliability mean grant peer review is arbitrary? [Metascience 2021. Virtual, 16.09.2021-25.09.2021]. ABSTRAKT: Are grant funding outcomes arbitrary? Those who argue "yes" often cite low inter-rater reliability (IRR) in grant peer review to support their claims. Inspired by a recent study that reported an IRR of zero in the mock peer review of top-quality grant proposals, we use real data from a complete range of submissions to the National Institutes of Health and to the American Institute of Biological Sciences to demonstrate that (1) estimating local IRR from subsets of restricted-quality proposals will likely result in zero estimates under many scenarios and (2) zero estimates of IRR are possible even when the true value is not zero. Zero estimates from range-restricted data should not be interpreted as indicating arbitrariness in peer review because, despite different scoring scales used by the two agencies, when complete ranges of proposals are considered, IRR estimates are above 0.6 which indicates good reviewer agreement.
**Permanent link:**  https://hdl.handle.net/11104/0341415

0570043 - ÚI 2023 RIV eng A3 - Přednáška/prezentace nepublikovaná
**Martinková, Patrícia - Bartoš, František - Brabec, Marek**
Inter-Rater Reliability In Complex Situations: Model Selection.
[IMPS 2021: The Annual Meeting of the Psychometric Society. Virtual, 20.07.2021-23.07.2021]
**Method of presentation:**Přednáška
**Organizer**: Psychometric Society
**URL akce**: https://www.psychometricsociety.org/imps-2021
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
**Keywords:**  reliability * model selection * measurement error
**OECD category:**  Statistics and probability
ZÁKLADNÍ ÚDAJE: Inter-Rater Reliability In Complex Situations: Model Selection. [IMPS 2021: The Annual Meeting of the Psychometric Society. Virtual, 20.07.2021-23.07.2021]. ABSTRAKT: Inter-rater reliability (IRR) is a prerequisite of high-quality ratings and assessments. However, the estimates of IRR may be affected by contextual factors such as rater's or ratee's age, gender, major, or internal vs. external status (Martinková, Goldhaber & Erosheva, 2018). In a previous simulation study, we explored how different methods can estimate heterogeneity in IRR if the data-generating model is known (Bartoš, Martinková & Brabec, 2019). We extend the previous work by considering cases when the true data-generating model is unknown. First, we evaluate several frequentist (forward, backward, AIC, and BIC) and Bayesian (Bayes factors, LOO, and WAIC) model selection techniques in their ability to choose the true model. Second, we compare estimates of variance components and IRR for models resulting from different model selection techniques in terms of bias and RMSE. Finally, we consider model-averaged estimates which incorporate uncertainty in the model selection process into the final estimate. Our results suggest that despite the differences in the performance of model selection techniques, the model-averaged estimates perform better than the estimates based on the selected models, regardless of the model selection criteria. We conclude with discussion of further computational aspects of IRR estimation (Erosheva, Martinkova, & Lee, 2021) and of generalizations to more complex designs.
**Permanent link:**  https://hdl.handle.net/11104/0341412

0570044 - ÚI 2023 RIV eng A3 - Přednáška/prezentace nepublikovaná
**Hladká, Adéla - Martinková, Patrícia - Brabec, Marek**
Estimation In Generalized Logistic Regression Models For DIF Detection.
[IMPS 2021: The Annual Meeting of the Psychometric Society. Virtual, 20.07.2021-23.07.2021]
**Method of presentation:**Přednáška
**Organizer**: Psychometric Society
**URL akce**: https://www.psychometricsociety.org/imps-2021
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
**Keywords:** differential item functioning * logistic regression
**OECD category:** Statistics and probability
ZÁKLADNÍ ÚDAJE: Estimation In Generalized Logistic Regression Models For DIF Detection. [IMPS 2021: The Annual Meeting of the Psychometric Society. Virtual, 20.07.2021-23.07.2021]. ABSTRAKT: Generalized logistic regression models are extensions of logistic regression method for differential item functioning (DIF) detection among binary data which account for possibility of guessing or inattention when responding. In this talk we will discuss several approaches to estimate item parameters including nonlinear least squares, maximum likelihood method and a newly implemented expectation-maximization algorithm. We will further propose a new algorithm based on parametric link function. Differences in estimation procedures will be illustrated with a simulation study and we will also show their implementation in the statistical software R including its package difNLR (Hladká & Martinková, 2020).
**Permanent link:** https://hdl.handle.net/11104/0341414


0570004 - ÚI 2023 US eng V - Výzkumná zpráva
**Martinková, Patrícia - Bartoš, František - Brabec, Marek**
*Assessing inter-rater reliability with heterogeneous variance components models: Flexible approach accounting for contextual variables.*
Cornell University: Cornell University, 2022. arXiv.org e-Print archive, 2207.02071.
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
https://doi.org/10.48550/arXiv.2207.02071
**Permanent link:** https://hdl.handle.net/11104/0341337


0570003 - ÚI 2023 US eng V - Výzkumná zpráva
**Bartoš, František - Martinková, Patrícia**
*Selecting applicants based on multiple ratings: Using binary classification framework as an alternative to inter-rater reliability.*
Cornell University: Cornell University, 2021. arXiv.org e-Print archive, 2207.09101.
**R&D Projects:** GA ČR(CZ) GA21-03658S
**Institutional support:** RVO:67985807
https://arxiv.org/abs/2207.09101
**Permanent link:** https://hdl.handle.net/11104/0341335


0570704 - ÚI 2024 US eng V - Výzkumná zpráva
**Hladký, Jan - Hng, Eng Keat**
*Approximating fractionally isomorphic graphons.*
Cornell University: Cornell University, 2023. 22 s. arXiv.org e-Print archive, 2210.14097.

Grebík and Rocha [Fractional Isomorphism of Graphons, Combinatorica 42, pp 365-404 (2022)] extended the well studied notion of fractional isomorphism of graphs to graphons. We prove that fractionally isomorphic graphons can be approximated in the cut distance by fractionally isomorphic finite graphs. This answers the main question from ibid. As an easy but convenient corollary, we deduce that every regular graphon can be approximated by regular graphs.
**Permanent link:**  https://hdl.handle.net/11104/0342029

0570702 - ÚI 2024 US eng V - Výzkumná zpráva
**Bílková, Marta - Frittella, S. - Kozhemiachenko, D.**
*Crisp bi-Gödel modal logic and its paraconsistent expansion*.
Cornell University: Cornell University, 2023. 29 s. arXiv.org e-Print archive, 2211.01882.

In this paper, we provide a Hilbert-style axiomatisation for the crisp bi-Gödel modal logic KbiG. We prove its completeness w.r.t. crisp Kripke models where formulas at each state are evaluated over the standard bi-Gödel algebra on [0, 1]. We also consider a paraconsistent expansion of KbiG with a De Morgan negation ¬ which we dub KG2. We devise a Hilbert-style calculus for this logic and, as a consequence of a conservative translation from KbiG to KG2, prove its completeness w.r.t. crisp Kripke models with two valuations over [0, 1] connected via ¬. For these two logics, we establish that their decidability and validity are PSPACE-complete. We also study the semantical properties of KbiG and KG2. In particular, we show that Glivenko theorem holds only in finitely branching frames. We also explore the classes of formulas that define the same classes of frames both in K (the classical modal logic) and the crisp Gödel modal logic GKc. We show that, among others, all Sahlqvist formulas and all formulas $\emptyset \rightarrow \chi$ where $\emptyset$ and $\chi$ are monotone, define the same classes of frames in K and GKc.
**Permanent link:**  https://hdl.handle.net/11104/0342026

0570005 - ÚI 2023 US eng V - Výzkumná zpráva
**Hladká, Adéla - Martinková, Patrícia - Brabec, Marek**
*Parameter estimation in generalised logistic model with application to DIF detection*.
Cornell University: Cornell University, 2023. arXiv.org e-Print archive, 2302.12648.
**Permanent link:**  https://hdl.handle.net/11104/0341338
**Vědecká data:** preprint v arXiv.org