NAJKRÓTSZY PRZEDZIAŁ UFNOŚCI DLA KOMBINACJI LINIOWEJ DWÓCH PRAWDOPODOBIEŃSTW SUKCESU

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Streszczenie: Rozważane jest zagadnienie przedziałowej estymacji prawdopodobieństwa sukcesu w modelu dwumianowym. Zieliński (2018, *Confidence interval for the weighted sum of two Binomial proportions. Applicationes Mathematicae 45(1), 53-60, doi: 10.4064/am2349-12-2017*) pokazał, że estymator wykorzystujący informację o niejednorodności próby jest precyzyjniejszy od klasycznego estymatora. W pracy zaprezentowana będzie konstrukcja najkrótszego przedziału ufności dla niejednorodnej próby.

THE SHORTEST CONFIDENCE INTERVAL FOR THE WEIGHTED SUM OF TWO BINOMIAL PROPORTIONS

Abstract: Interval estimation of the probability of success in a Binomial model is considered. Zieliński (2018*, Confidence interval for the weighted sum of two Binomial proportions. Applicationes Mathematicae 45(1), 53-60, doi: 10.4064/am2349-12-2017*) showed that the confidence interval which uses information about non-homogeneity of the sample is better than the classical one. In the following paper the shortest confidence interval for non-homogenous sample is constructed.

COMPARISON OF THE NORMAL RANDOM NUMBER GENERATORS

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Abstract: The sampling in the context of statistical surveys and in the context of numerical calculations as well as simulation testing of probabilistic models in virtually all fields of knowledge require computer to generate pseudorandom numbers. The main goal of the paper is to compare the normal random number generators using various criteria. The properties of 12 normal random number generators were investigated. Then, the family of generators was extended by two so-called application generators and a new approach to checking the quality of generators. The next part presents a ready-made tool prepared in C++ and in Visual Basic for Application (VBA) for conduct research using generators. All Monte Carlo simulations were carried out in C++, while the calculations were performed in the VBA editor using the Microsoft Excel 2016 spreadsheet. The analysis of the obtained results shows that the generators that have best properties are: MP Monty Python, R, Biegun and Ziggurat. The worst generators are: BM Box-Muller, Wallace, Iloraz and Excel.

Keywords: Monte Carlo simulation, normal distribution, pseudo-random number generator.

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A DATA DRIVEN KERNEL ESTIMATOR OF THE DENSITY FUNCTION

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Abstract: In the article we propose the concept of local effectiveness of kernel density estimator (kde) based on the distance from Marczewski-Steinhaus (cf Karczewski and Michalski, 2018a, 2018b), Literature suggests several different approaches to kernel density estimation. We focused on three main approaches: Silverman's rule of thumb, cross-validation methods and the plug-in methods (Silverman, 1986, Givens and Hoeting, 2005, Wand and Jones, 1995). We demonstrate that none of considered estimators are optimal on each of selected intervals. In this paper, we present a data driven estimator based on a linear convex combination of the most effective kernel density estimators. Thus we create a new estimator combining the best features of all previously assessed estimators. All numerical calculations were done for an experimental data recording groundwater level on a melioration facility (see Michalski, 2016).

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REMARKS ABOUT CONSTRUCTION METHODS OF D-OPTIMAL CHEMICAL BALANCE WEIGHING DESIGN

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Abstract: This paper presents new construction of regular D-optimal weighing design based on the incidence matrices of balanced incomplete block design, balanced bipartite weighing design and ternary balanced block design. The aim of this work is determining D-optimal chemical balance weighing design in given class $\mathbf{\Phi}_{n\times p}(-1,0,1)$ i.e. to give the design matrix for fixed number of p objects and n measures. Here we determine optimality conditions, relations between the parameters of design, give examples and preset the application.

Key words: balanced bipartite weighing design, balanced incomplete block design, D-optimality, ternary balanced block design

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A SYSTEMATIC REVIEW AND META-ANALYSIS FOR BETAINE SUPPLEMENTATION MODERATELY INCREASES TOTAL CHOLESTEROL LEVELS

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Abstract: Betaine is a natural substance found in various food products. It can be also synthesized in the human body by the liver and kidneys. Betaine plays to major roles as a methyl group donor and as an osmolyte. Betaine can lower plasma homocysteine levels by donating its methyl group to form methionine. This is advantageous, because high concentration of homocysteine is correlated the incidence of cardiovascular diseases (CVD) and Alzheimers disease. However, there are some premises that betaine may have a negative effect on blood lipids, which offsets its benefits. Betaine supplementation is becoming more and more common, but the relationship between betaine supplementation and blood lipoprotein levels is unclear. The purpose of the study described here was thus to perform a meta-analysis of randomized placebo-controlled trials on the effects of betaine supplementation at a daily dose of at least 4 g on blood lipids in adults. Six randomized controlled trials published between 2002 and 2018 were identified. All six studies used adult participants supplemented with at least 4 g/d of betaine for six to twenty-four weeks. A meta-analysis was carried out using a random-effects model, and the overall effect size was calculated for changes in plasma total cholesterol (TC), HDL cholesterol, LDL cholesterol, and triglycerides (TG). The pooled estimate of the effects of betaine supplementation compared to placebo on TC was 0.34 mmol/L (95% CI: 0.02, 0.65), p = 0.0352. No significant effect was observed for LDL, HDL, or TG. Supplementation with at least 4 g/d of betaine for a minimum of six weeks can moderately increase plasma TC, which might be important in the context of cardiovascular health.

Key words: betaine, supplementation, cholesterol, lipids, triglycerides

MEASURING AND TESTING MUTUAL DEPENDENCE FOR FUNCTIONAL DATA

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Abstract: We propose new measures of mutual dependence for multivariate functional data. Each measure is zero if and only if the vectors of functional features are mutually independent. The proposed measures base on the functional rV coefficient (Escoufier, 1973) and distance correlation coefficient (Székely et al., 2007). The first one is appropriate for linear mutual dependence and the second one for non-linear mutual dependence between the vectors of functional features. Based on the proposed coefficients we can test mutual dependence. The implementation of corresponding tests is demonstrated by both simulation results and real data examples.

Key words: functional data; mutual dependence

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THE EFFECT OF SOIL AND COURSE OF WEATHER CONDITIONS DURING THE GROWTH AND MATURATION OF WINTER WHEAT ON YIELDS IN MULTI-ENVIRONMENTAL TRIALS

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Abstract: Drought reduces crop yield not only in areas of arid climate. In some environments, excess of water or heat (without the drought) may limit crop yields. The impact of moisture on crop yields depends on crop growth stage and soil properties. The drought frequency will increase due climate change. It is important to determine the environmental variables with the strongest effect on wheat yields . The effect of soil and weather on wheat yield was evaluated in 2015 - 2018. The winter wheat yield data from 17 - 19 trial locations of the Research Center of Cultivar Testing (COBORU), Poland was used. Soil data of trial locations, mean temperature (T) and precipitation (P) were considered as environmental factors, as well as the climatic water balance (CWB). The hydrothermic coefficient (HTC) that is based on P and T was also used. The effect of these factors on winter wheat yield was related to the weather conditions in particular year and growth stage. The soil had greater effect than the weather conditions. CWB and P, T and HTC showed a clear relationship with winter wheat yield.

Key words: climatic water balance, drought, growth stages, hydrothermic coefficient, precipitation, soil, temperature

INFLUENCE OF AGROTECHNICAL FACTORS ON THE YIELD OF TWO MAIZE VARIETIES

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Abstract. This paper presents selected results of field experiments carried out to assess the yield of maize varieties with different genetic profiles, depending on the method of preparation of the soil for sowing and the method of NP fertilizer application. The yield and water content in the grain were significantly dependent on changing weather conditions in the growing seasons. Maize yield was found to be positively influenced by traditional soil cultivation (autumn plowing), the use of stay-green varieties, and row fertilization. The stay-green hybrid had a higher yield than the traditional variety, the difference being significant in a year characterized by an unfavourable distribution (deficit) of precipitation in the growing season. The stay-green variety reacted favourably to the localized application of NP fertilizer, a clear result of which was an increase in grain yield. Calculations were performed using a four-stratum model of analysis of variance with fixed effects of the factors and study years. Particular analyses of significant effects were also carried out.

Key words: ANOVA, fertilization; maize varieties, methods of sowing; Tukey's HSD test.

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MULTIVARIATE NORMALITY TEST USING NORMALIZING TRANSFORMATION FOR MARDIA'S MULTIVARIATE KURTOSIS

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Abstract. In the paper, we consider the normal approximation of the multivariate sample measure of kurtosis defined by Mardia when the population covariance matrix is unknown. The accuracy of the normal approximation of this statistic, i.e., its expectation, variance, skewness, kurtosis, sample error Type I, and power for chosen alternative distributions, was investigated by Monte Carlo simulations for given sizes and dimensions. Moreover, the power of the normalizing transformation statistic is compared with powers of Mardia's normality test statistics, the Wilson-Hilferty transformation test statistics, and the Henze-Zirkler test considered in the literature of the subject as very powerful.

All calculations were conducted in Mathematica 11.3.

Key words and phrases: asymptotic distribution; asymptotic expansion; multivariate normal distribution; multivariate sample kurtosis; normalizing transformation.

Classification AMS 2010: 62H15, 62F12

CLASSIFICATION AND APPLICATION OF ARTIFICIAL NEURAL NETWORKS

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Abstract. The classification of neural networks can be based on their organization and structure. The structure of an artificial neural networks (ANN) is often very complex and advanced but every network has same basic elements such as: input layer, one or more hidden layers and output layer. Also, connection between perceptrons can be one-directed or have feedback loops. Every modern ANN is a mix of these basic elements.

An artificial neural network just after creation is useless in itself because after creation is initialized with random weights and computes nothing. The true power of ANN will be unleashed if ANN will be well trained with good and enough learning data. There are many methods of learning ANN. These methods belong to one of three main categories. Supervised learning (output is known), unsupervised learning (output is only predicted) or reinforcement learning (output is not known).

Application of ANN is a process consisting of many choices. First, if we know what kind of data we have and what we want to receive as a result we should choose correct model/structure of an ANN. The last stage is to select the correct learning method and this is one of the most difficult steps. There are plenty of implementations for this task and one of the more popular is called Back Propagation algorithm which implies a gradient descent optimization algorithm.

Key words: ANN, artificial neural network, perceptron, machine learning

APPLICATION OF MASH DISTANCE FOR ANALYSIS OF TRANSCRIPTOMIC DATA

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Abstract. Nowadays a large part of biological research uses genomic sequencing to obtain the knowledge about investigated organisms. The output of this process are sequences which are analyzed to extract the crucial information. There are plenty of parameters, features, facts which can tell something important about sequenced organisms: from the most basic (like, e.g., proportions of particular nucleotides) to complex ones (expressed genes and proteins). In some cases, the task is to compare two or more data sets obtained by sequencing, and one of the first parameters we usually think of is a distance.

There are different ways to calculate the distance between two sets of sequences and one of them is Mash [1]. We will present a short description of the Mash algorithm. Next, we will show how does it work on some simulated data to understand the meaning of large and small distances. A usage of Mash on the real data will also be presented.

Key words: distance, genome sequencing data, Mash

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Acknowledgements

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THE PROBLEMS OF MULTIVARIATE ANALYSES (PCA AND FA) OF CATEGORICAL - ORDINAL VARIABLES IN SOCIOLOGY AND IN EDUCATION
Part C. University student's knowledge of mathematics and their evaluation

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Abstract. In our previous papers various approaches of multivariate statistical analyses (PCA and FA) were analyzed with focus on categorical-ordinal variables in sociology and in educations, concretely in the past paper of gymnasium student's knowledge. The issue of effectiveness of teaching mathematics at universities is nowadays constantly relevant. The various factors have impact on the differences in study attainments from mathematics. Those factors underlie the development of the student's abilities to apply theoretical knowledge and utilize it in solving tasks in the specialized subjects. The main objective of the present paper is the preliminary analyses of the mathematical knowledge of students in the managerial and economics study programs at the Faculty of Economics and Management in the Slovak University of Agriculture in Nitra in academic years 2015/2016 and 2016/2017 based on tests contained the assignments related to the graphic description of function, analytical formulation of elementary functions, derivative of function, indefinite and definite integrals and linear algebra by the adequate statistical methods.

Key words: mathematics, univariate and multivariate statistical analyses, categorical and ordinal variables, knowledge application, exam tests.

TESTING HYPOTHESES ABOUT BANDED TOEPLITZ COVARIANCE STRUCTURE UNDER THE HIGH-DIMENSIONAL MODELS

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Abstract. The goal of this talk is to present the procedure for testing banded Toeplitz structure of covariance matrix under the multivariate model. Proposed tests are based on the likelihood ratio and Rao score test statistics, in which the maximum likelihood estimator of a penta-diagonal Toeplitz matrix have been replaced by asymptotic estimator (see [1]) or shrinkage estimator (cf. [2]). The properties of the test will be verified and possible corrections will be proposed.

Key words: Banded Toeplitz matrix, Likelihood ratio test, Rao score test, Shrinkage estimator

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ESTIMATION AND TESTING IN A RANDOMIZATION MODEL FOR A ROW-COLUMN DESIGN

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Abstract: In the presented manuscript, any row-column designs are considered, within which object effects are deduced, while row effects and column effects are random variables. The randomization model, parameter estimation in the obtained model and parameter estimation and testing of hypotheses in the stratums were presented for such defined design. It also presents an example illustrating the theory obtained.

ESTYMACJA I TESTOWANIE W MODELU RANDOMIZACYJNYM DLA UKŁADU WIERSZOWO-KOLUMNOWEGO

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Streszczenie: W prezentowanej pracy rozważa się dowolne układy wierszowo-kolumnowe, w ramach których wnioskuje się o efektach obiektowych, podczas gdy efekty wierszowe i efekty kolumnowe są zmiennymi losowymi. Dla tak określonych układów przedstawiono model randomizacyjny, estymację parametrów w otrzymanym modelu oraz estymację parametrów i testowanie hipotez w warstwach. Zaprezentowano także przykład ilustrujący otrzymaną teorię.

D – OPTIMAL CHEMICAL BALANCE WEIGHING DESIGNS WITH DIAGONAL MATRIX OF EXPERIMENTAL ERRORS

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Abstract: Here, the problem of estimation of unknown parameters of p objects in n measurement operations is studied. In each measurement operation, the result of experiment is considered as linear combination of unknown measurements of parameters with factors equal to -1, 0 or 1. Moreover, the experimental errors are uncorrelated and they have different variances. The estimators of unknown parameters are determined from the point of view of D-optimality. New construction method of such designs is presented and some construction examples are given.

Key words: chemical balance weighing design, D-optimality

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SZTUCZNE SIECI NEURONOWE. PROGNOZOWANIE ZBIEŻYSTOŚCI ODCINKÓW STRZAŁ SOSNY

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Streszczenie. W pracy podjęto próbę prognozowania zbieżystości dwumetrowych odcinków strzały sosny zwyczajnej na podstawie pierśnicy i wysokości drzewa oraz klasy wieku za pomocą sztucznych sieci neuronowych. Do stworzenia sieci neuronowej wykorzystano generator sieci wchodzący w skład pakietu programu Statistica. Baza danych składała się z cech 200 drzew modelowych – pierśnicy, wysokości i klasy wieku oraz obliczonej zbieżystości dwumetrowego odcinka strzały położonego powyżej pierśnicy. Drzewa próbne reprezentowały kolejne podklasy wieku od IIa do Vb, a pochodziły z drzewostanów sosnowych rosnących na siedlisku boru mieszanego świeżego w Nadleśnictwie Doświadczalnym Zielonka. Generator sieci neuronowych stworzył 100 sieci, z których procedura testowanego oprogramowania wybrała 5 o najlepszych parametrach. Wybrane sieci zostały poddane testowaniu i walidacji na danych niewchodzących w skład bazy uczącej oraz została oceniona ich skuteczność. Przeprowadzona analiza wykazała, że prognozowanie zbieżystości badanego odcinka strzały sosny według wytycznych przyjętych w badaniu jest możliwe, a jej skuteczność wynosi nieco powyżej 60%.

IMPLICATIONS OF THE RICHNESS OF CEMETERY VASCULAR PLANT FLORA FOR NATIVE BIODIVERSITY

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Abstract. Cemetery vascular plant flora interacts with native biodiversity. The richness of the flora provides resources for wildlife. Understanding the variation in cemetery flora depending on cemetery location, size, and human impact will help evaluate the effect of its diversity as a source of non-native species for the wider environment. The richness of the vascular plant flora was measured in a study area (1314 km^2) located in south-eastern Poland. The study area included two landscape parks (LPs): South Roztocze LP and part of Solska Forest LP. The compositions of vascular plant flora were measured in a stratified sample of 78 cemeteries. The entire studied flora contained 525 species. For the results of the research, regression analyses were performed to assess whether there is a relationship between the number of observed species and cemetery size, separately for each of the categories of cemeteries. The significance of differences between the number of species occurring in cemeteries from 11 classes, and between the cover of species forming the tree layer, the shrub layer and the herb layer, was verified by the Kruskal–Wallis test.

The diversity of vascular plants was evaluated on the basis of species richness and four diversity indices: Shannon index (H), Simpson index (D), Pielou evenness index (E), and maximum diversity (Hmax). The significance of differences between biodiversity in the 11 considered classes was determined for the Shannon index (H) using the Hutchison t-test. General species similarity between pairs of cemeteries was expressed using the Marczewski–Steinhaus index. Cluster analysis was performed to show the similarity of studied classes in terms of extensive species characteristics: number of species, percentage share of species representing a particular class of cover-abundance, percentage share of various life-forms, share of various geographic-historical groups, and percentage share of various socio-ecological groups.

Principal Component Analysis (PCA) on the correlation matrix was used additionally to examine the studied cemeteries in terms of characteristics of the flora. The number of significant principal components was found using a scree test (Cattel, 1966). The features with the highest factor loadings on the significant components ($r>0.80$) were determined.

The differences between shares of native and alien plants between pairs of cemetery classes were tested with 2×2 contingency tables and chi-squared tests. The data on alien plants recorded in the studied

cemeteries were also compared using canonical correspondence analysis (CCA) with the Monte-Carlo-based permutation test (MCP) set for 400 permutations. Cemetery size, use and location were taken as explanatory variables. The statistical analyses were performed using STATISTICA ver. 12 or the CANOCO for Windows 4.5 software package.

Key words: biodiversity, cemetery vascular plant flora, Solska Forest LP, South Roztocze LP

EVALUATION OF LAND COVER CHANGES IN SOUTH-WESTERN LITHUANIA IN YEARS 1984-2018 USING LANDSAT AND SENTINEL-2 SATELLITE IMAGERY

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Abstract. In the study land cover changes in South-Western Lithuania in years 1984-2018 were evaluated. These changes were examined using satellite data from Landsat 5, Landsat 8 and Sentinel-2 multispectral data. Multivariate image unsupervised classification was applied to distinguish various types of land cover. Water cover was delinetated using Normalized Difference Water Index (NDWI). Because the area of study is located in Nemunas Delta it is characterized by large seasonal changes of water cover. Area of water during dry seasons, i.e. in summer and early autumn was quite stable across the years. Significant increase of forest area was observed during the period of study (from 15.1% to 19.0% of total area). During the examined period average size of agricultural parcels decreased several times (from about 35 ha to about 5 ha) which was caused by transition of ownership from national to private in early 1990s. Almost all the changes were rather positive for environment. One of the negative change is construction of wind turbines (about 50 in the area of study) which were not present in the beginning of study period and negatively contribute to the natural landscape of the region.

Key words: land cover, Nemunas Delta, remote sensing, satellite

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GENOTYPE× ENVIRONMENT INTERACTION AND CULTIVAR ADAPTABILITY PATTERNS OF TRITICALE GRAIN YIELD IN POLISH AGRO-ECOLOGICAL REGIONS

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Abstract. The recommendation of cultivars for a larger number of locations relies on similarities of their agricultural environment or similar crop yield obtained. There are many studies on the impact of environmental conditions of different locations on the yield of agricultural crop cultivars and cultivars recommendation to its. However, there is no such study on triticale. We presented the influence of Cultivar, Location and Year and their interactions on triticale grain yield separately for two levels of crop management intensity. In this work, we used 6 agro-ecological regions of Poland with similar environmental conditions. In addition, we checked compatibility in the rankings of cultivars between 6 agro-ecological regions and compatibility in the rankings of cultivars between the locations belonging to one agro-ecological region. The obtained results indicate a large variation in the rankings of cultivars between the locations in the regions, i.e. the ranking of cultivars in locations belonging to the same region turned out to be different. It can mean that the existing division into 6 agro-ecological regions is not correct for recommending triticale cultivars and cannot be used effectively. In addition, we presented the adaptation response of 12 cultivars in 6 agro-ecological regions at two levels of crop management intensity and their stability during 5 growing seasons.

Key words: agro-ecological regions, crop management intensity, cultivars ranking, cultivar x environments interactions, linear mixed model.

COMPARISON OF BIODIVERSITY BETWEEN ECOLOGICAL GROUPS OF RIVER MACROPHYTES. I COMPARISON OF ECOLOGICAL GROUPS

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Abstract. The research was carried out to compare the diversity of various ecological groups of aquatic plants in rivers. Submerged, emerged and floating-leaved macrophytes were distinguished as well as bryophytes, structural aquatic algae and terrestrial plants rooted in water. Measures of the complexity of composition and environmental structure are key tools for naturalists. Many such measures of biodiversity have been defined in the literature, however, the most commonly used is the family of measures including Hill numbers or indicators of biodiversity. Biodiversity coefficients are parameterized by order of $q \in \mathbb{R}$. The $q \geq 0$ parameter specifies the sensitivity of the indicator to the abundance of species. The measure with the use of $q = 0$ equally treats all species, regardless of their relative abundance, and thus a species richness ratio is obtained. The higher the value of q, the more sensitive to dominant species (frequent). For $q = 1$, the measure gives the Shannon index which can be interpreted as the number of frequent species, and for $q = 2$ - the inverse of Gini-Simpson interpreted as the count of very frequent species. In practice, all these measures are often included in the description of the research problem. The diversity of the considered macrophyte groups was assessed on the basis of the reference sample, and on the basis of data standardized by the use of rarefaction and extrapolation, which allowed predicting the actual diversity, taking into account the expected number of species not detected by the sampling effort in each of the considered groups of ecological macrophytes.

Key words: Biodiversity indices, growth forms, Hill's numbers, · Macrophytes

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COMPARISON OF BIODIVERSITY BETWEEN ECOLOGICAL GROUPS OF RIVER MACROPHYTES II. BIODIVERSITY PROFILES

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Abstract. The complexity of the ecosystems structure can not be limited to a single number. Standard biodiversity indexes: species richness, Shannon and Gini-Simpson index (Hill numbers) change in order of q, which defines the focus on rare or common species. Ranking and comparing groups of organisms depends on the choice of q. Instead of selecting one or several indicators independently to describe the problem, it is worth presenting a continuous diversity profile, in the form of a Hill numbers dependency curve for $q \geq 0$. This approach allows a visual comparison of the complexity of the composition of the studied groups and the assessment of the equality of their relative abundance distributions. In our work, we consider two approaches: standard - where profiles are generated taking into account the empirical measures of diversity. This empirical approach usually "underestimates" the real value of diversity for small q. The second approach, using estimators of slope coefficients of the species accumulation curve based on Good-Turing frequencies, allows to reduce underestimation and present a continuous, corrected biodiversity profile. We use the bootstrap method here to get approximate variances of the proposed profiles and to construct related confidence intervals.

Key words: Biodiversity indices, biodiversity profile, growth forms, Hill's numbers, · Macrophytes

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ASSESSMENT OF SPATIAL VARIABILITY OF SOME SOIL PROPERTIES USING GEOSTATISTICAL APPROACH

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Abstract. The aim of the study was to provide the most accurate spatial predictor using different interpolation methods in order to evaluate selected soil properties.

Four interpolation methods were then used to generate spatial distribution of soil properties; they include inverse distance weighting (IDW), modified Shepard's method (MS), radial basis functions (RBF), ordinary kriging (OK).

Cross-validation was applied to evaluate the accuracy of interpolation methods in terms of the mean absolute error (*MAE*), the root mean square error (*RMSE*), the relative mean absolute error (*RMAE*), the relative mean square error (*RMSE2*) and Willmott's index of agreement (*D*).

Geostatistical interpolation and visualization were performed in Surfer 16, ArcGis 10.6.1. All further data analysis was carried out using R software (ver. 3.4.3).

Key words: cross-validation, geostatistical methods, interpolation, prediction maps, soil properties

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EFFECT OF HEATING OF THE PROTECTED WOOD AND THE TIME OF STORAGE OF THE PREPARATION ON FIRE PROTECTION EFFECTIVENESS

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There are many reports regarding the protection durability of wood and wood-based materials with salt and coating preparations, subjected to the aging process in natural and laboratory conditions. In the literature of the subject, there are no reports about the effect of storing the preparation and heating on the quality of the protection [1]. In most cases fire-proof wood is used in construction in roof trusses. In such conditions, the wood is exposed not only to increased humidity, periodic moistening of roof coverings in cases of leaks, but also to higher temperatures resulting from the heating of roofing materials.

In the present research, it was decided to determine if and how the storage time of the fireproof salt preparation influences the effectiveness of wood protection. Additionally, it was decided to determine the effect of long-term heating in constant climatic conditions on its effectiveness.

A commercial fire protection preparation was used for the tests, in three variants of storage time A - 5 years, B - 3 years and C - from the current production line, and five variants of concentrations: I - 20%, II - 10%, III - 5%, IV - 2.5% and V - 1%, K - control. The above variants were also subjected to a heating process carried out in incubators with constant humidity of 65 ± 5% at 40 ° C for 6 weeks. (series is marked as X). For each variant, 10 replicas were made. Samples of white pine (*Pinus sylvestris* L.) were used.

The flammability tests were performed using the MFT (Mini Fire Tube) [2] method determining the effectiveness of the protection, the operation of which is based on measurements of mass loss and exhaust gases temperature at the outlet of the pipe. For 6 minutes, every 1 second the change in mass and temperature of the tested sample was recorded. The assessment of the protective effect was determined, at the critical point - at the time when the control samples reached the maximum value of the temperature, based on the following formula:

$$W = 100\% * (1 - \frac{E}{A})$$

Where:

W - conventional effectiveness of the impregnation [%]

E - final mass loss of protected samples [%]

A - final mass loss of control samples [%]

A statistical analysis of the flammability characteristics of wood treated with the preparation was performed using the k-means method [3]. In this method, the objects were divided into the number of clusters k = 4, allowing interpretation of the protection variants in terms of mass losses. The research was based on the Statistica 13.1 package [4].

Based on the conducted research, critical points for individual variants were determined. The critical point for the non-heated series was determined for 120 s of the test where the obtained maximum temperature of exhaust gases was 410.72°C, while for a heated series for 105 s with a temperature of 487.13°C. The results of the calculated efficacy are shown in Table 1.

Preparation	Concentration	Heated Effectiveness [%]/	Non heated - Effectiveness [%]/
A	20	90,98/3	89,77/3
	10	88,60/3	85,11/3
	5	69,96/1	55,24/1
	2,5	29,12/2	47,36/2
	1	24,54/4	88,00/1
B	20	89,95/3	89,19/3
	10	86,83/3	86,24/3
	5	67,05/1	71,14/1
	2,5	37,75/2	49,34/2
	1	46,31/2	34,75/4
C	20	90,85/3	89,08/3
	10	87,44/3	82,96/3
	5	66,14/1	54,43/2
	2,5	55,03/2	42,53/2
	1	31,11/4	15,96/4

Analysing the elements obtained for 4 clusters, for the full test time (360 s), it can be concluded that for most variants examined at critical points these elements coincide with those in the given clusters. Only in three cases (AIV, AXII and AXV) the efficacy values deviate from the range for a given focus.

Conclusions

1. Based on the efficacy results obtained for critical points, it can be stated that the storage time of the preparation does not significantly affect the efficacy values, the efficiency is affected by the process of heating wood treated with the preparation.

2. The obtained results suggest the possibility of shortening the duration of the test from 360 seconds to about 180 seconds. Shortening the time will not cause significant changes in the study of the trend of effectiveness.

3. The use of protected wood in accordance with the recommendations of the preparation manufacturer (at concentrations of at least 10%) and subjected to heating, causes slight changes in the fire

protection effectiveness. These changes do not affect the degree of fire safety of protected structural components.

Key words: fire retardant, heating, k-means, mass loss, statistical analysis, wood

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STRENGTH DISTRIBUTION OF MINERAL FERTILIZERS GRANULES UNDER COMPRESSION

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Abstract. Granular fertilizers are subject to comprehensive quality control and one of the criteria for their evaluation is the compression strength test. Four fertilizers divided into fractions have been exposed to a strength test. After removing the outlier observations, empirical distributions of the crushing force were determined. Theoretical distributions were adjusted by means of simulation. The most suitable were Gaussian mixture, generalized extreme-value, log-normal and Jonhson's SB distributions.

Key words: crushing force, mineral fertilizers, particle strength distribution

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THE EVALUATION OF POLISH VERSION OF OABSS QUESTIONNAIRE FOR OAB AND MUI FEMALE PATIENTS

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Abstract. The broad definition makes overactive bladder (OAB) and Mixed Urinary Incontinence (MUI) difficult to diagnose. Medicines need a tool to confirm the diagnosis and start treatment. The Overactive Bladder Symptom Score (OABSS) is used in the objective diagnosis of OAB.

The aim of this study was to evaluate the effectiveness of OABSS for Polish population in patients suffering from OAB and MUI and correlate it with urodynamic diagnosis (UDS) making on the basis of validated UDI-6 and IIQ-7 questionnaires. The validation of OABSS Polish version included the application of PCA to assess construct validity, correlation with Urogenital Distress Inventory (UDI-6) and the Incontinence Impact Questionnaire (IIQ-7) questionnaires for criterion validity, as well as using Cronbach's alpha and ICC to assess the reliability in terms of internal consistency and test-retest repeatability.

Although our study shows that the OABSS is a reliable tool for the assessing of degree of symptoms in females suffering from MUI and OAB, the insignificant differences in results of these two questionnaires between patients from OAB and MUI groups make this tool ineffective in diagnostic distinguishing between these two groups.

Key words: Cronbach's alpha, evaluation of questionnaire, intraclass correlation coefficient, PCA.

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THE USE OF SURVIVAL ANALYSIS TO MODEL THE RELEASE TIME OF THE SPORES *V. INAEQUALIS*

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Abstract. The scope of this paper includes two scientific fields: agronomy and applied mathematics. The agronomic aim is to develop effective methods of apple scab control, the most dangerous and common disease of apple orchards in Poland, caused by fungus *Venturia inaequalis*. The contribution of statistical methods is based on developing models forecsting the discharges of *Venturia inaequalis* ascospores with sufficient precision and thus ensuring a reduction of fungicide treatments in orchards. The general aim of this paper is to develop a model that predicts the releases of *Venturia inaequalis* ascospores, based on the experimental data from the orchard of Research Institute of Horticulture in Skierniewice. The Polish database contains the data of spore counting in the orchard as well as the weather conditions that may influence the spore releases. The modelling approach will be based on the methods of survival analysis, developed and applied by the French team. In this paper, we characterizing and preparing the experimental data on the release time of *Venturia inaequalis* spores, and fitting the Cox regression model to the data. This model builds the relationship between the measure of risk of spores releases and the set of explanatory variables (here the weather conditions). The model fit will be based on the algorithms developed by the French team.

Keywords: apple scab, survival analysis, release time of the spores

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ZRÓŻNICOWANIE POTENCJAŁU PRODUKCYJNEGO I EFEKTYWNOŚCI GOSPODARSTW PAŃSTW CZŁONKOWSKICH UNII EUROPEJSKIEJ

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Streszczenie. Artykuł zawiera ocenę zróżnicowania potencjału produkcyjnego i efektywności gospodarstw państw członkowskich Unii Europejskiej w latach 2013–2016. Analizę wykonano w oparciu o informacje pobrane z sieci danych rachunkowych gospodarstw rolnych UE (FADN) wykorzystując metodę taksonomiczną – syntetyczny wskaźnik rozwoju Hellwiga. Wyniki wskazują, że państwa członkowskie takie jak Holandia, Dania, Luksemburg, Belgia, Wielka Brytania i Słowacja charakteryzowały się najlepszym potencjałem produkcji rolnej. Pierwsze cztery państwa wykazały również najwyższą efektywność pod względem wykorzystania czynników produkcji. Niski oraz średni potencjał i wydajność były charakterystyczne dla gospodarstw przynależących w większości do nowych państw członkowskich.

Słowa kluczowe: rolnictwo; członkowie Unii Europejskiej; potencjał gospodarstw; czynniki produkcji; syntetyczny wskaźnik rozwoju.

NOTA O PRAWOSTRONNIE UCIĘTYM DWUPARAMETROWYM ROZKŁADZIE WEIBULLA

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Streszczenie. W niniejszej pracy rozważamy prawostronnie ucięty dwuparametrowy rozkład Weibulla.([4]) Rozkład ten jest często stosowany do opisu siły niszczącej granule nawozów przy nawożeniu mineralnym roślin.([1],[2],[3],[5],[6],[8]) Dla oceny parametrów rozkładu stosujemy metodę największej wiarogodności. W niniejszej nocie wyprowadzone są równania wiarogodności dla rozpatrywanego rozkładu. Stanowi to pierwszy etap prowadzonych badań.

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