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(book of abstracts)

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Efficiency of Public Research Institutes in Poland – DEA Approach

The purpose of this paper is to attempt to measure and assess the efficiency of research institutes in Poland operating on the basis of various legal frameworks, but serving for a common purpose and with a joint area of activity, which is research and development.

The SBM model was used, belonging to the non-parametric Data Envelopment Analysis (DEA) methodology, to analyze the efficiency of research institutes in 2019. The Metafrontier approach was also employed to verify whether the mentioned different legal framework contribute to the functioning of entities.

Histograms of the efficiency measure indicate a large dispersion of its value, in particular, there is a significant fraction of units characterized by extremely high values of this measure. Average MTRs, calculated using the Metafrontier approach, are mostly significantly lower than one.

The obtained results indicate that groups of institutes with different legal framework function differently. Moreover, a large proportion of the analyzed objects is characterized by quite a large inefficiency within the area of R&D. The paper lists the potential reasons, which will be the object of further, in-depth research.

Keywords: public research institutes, efficiency, R&D, DEA

JEL classification: C67, I23, O31, O32

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Mechanisms leading to equilibrium in economy with financial market

Economic mechanisms, understood as the set of rules and regularities explaining the social and economic life play the significant role in the economic theory. The Hurwicz concept of economic mechanisms is used to rigorously study the processes within which real and financial innovations are adopted into routine agents' activities. Mechanisms that could result in the existence of equilibrium in the economy with financial markets and private ownership are specifically under our consideration. Due to the above, qualitative properties of analyzed mechanisms can be examined with respect to Schumpeter's concepts. The presented set-up significantly differs from the traditional models used for studying the economic growth. Modelling the mechanisms of economic evolution in the Hurwicz apparatus emphasizes the significant role of information and the way of its exchanging during economic processes. The research links the areas of general equilibrium theory, theory of economic development and mechanism design theory.

Keywords: competitive economy, financial market, innovations, equilibrium, mechanisms

JEL classification: D53, L20, O12

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Two proposals on Thurstone method

The Thurstone model has been used for over 100 years, and it is generally considered to be better than simple rank averaging in that it produces an interval scale rather than an ordinal one. However, this claim can be challenged on the basis of an analysis of the dependence of the results on irrelevant alternatives. In this work, it was examined in what percentage of scales obtained with the Thurstone method there are changes in the relative positions of objects as compared to the scale built using the full set of objects. It is proposed that when using the Thurstone method, each time an analysis of the stability of the results should be carried out, using a program in the R language, which is made available for use.

Finally, it is proposed to replace the minimization formula in the Thurstone method with a more accurate one that better corresponds to the applied criterion of fitting the model to empirical data.

Keywords: Thurstone, paired comparison, irrelevant alternatives

JEL classification: C830, C810

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Identify significant changes in the ranking and structural table

Many research, project and innovation programs are related to transformation. A vital aspect of this type of research and introduced solutions is to evaluate the changes that have occurred due to the implemented activities — in particular, identifying the areas that have undergone the most significant transformations and comparing the changes that have happened in the rankings due to the actions. We propose a method to identify substantial changes in structural tables and rankings.

In the numerical analyses, we focus on identifying the changes in mortality in Poland. Among others, we examine the changes in the overall mortality structure (including the structure of the causes of death and the age structure of the dead) that occurred in Poland under the impact of the pandemic. The analysis was conducted based on actual data from Statistics Poland, covering selected years from 2000 to 2021.

Keywords: structural similarity index, age at death

JEL classification: C43, I19, J11

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The Profit Volatility Reduction by Means of EuroCall Options in Container Shipping

The net freight in container shipping on the most important route from South-East Asia to Europe has varied strongly in the last 20 years. Therefore, the carriers have been facing the problem of an unstable income which is especially significant in the periods of price decreases. The phenomenon could be possibly reduced by bilateral EuroCall options for the net freight issued by carriers.

In this paper we consider the impact of such options on the final carriers' profit. Options are thought to be issued physically by a carrier as a guarantee for transporting the shipper's cargo at a specified future time for the rate not higher than the strike price. The option premium is calculated numerically based on the jump-diffusive model which was previously checked as the appropriate one in this market. The options may reduce carriers' profit when transportation prices rise, however, an additional income from the option premiums should compensate the profit decrease when the prices fall. Thus, the final income should behave more stable. Its behavior will be discussed based on the profit volatility.

Keywords: container shipping, freight options, jump-diffusion

JEL classification: C2, C6

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Dealing with negative observations while calculating inequalities – examining asset declarations of Polish deputies

Nowadays, having debts becomes more and more popular. Most frequently used measure of inequality – Gini index – faces some interpretational problems dealing with negative observations (lack of normalization). Thus it seems urgent to adopt a common convention of dealing with negatives. Moreover, as it is suggested that high debts do not necessarily mean low standard of living (often quite the opposite) it arises a question, how to access such debts, if our aim in calculating inequality is usually estimating inequalities in quality of life. One way may be examining the subjective perceptions of possession and debts.

In this paper, basing on ERIF data, increasing tendencies both in the number of debtors and in height of a single debt, are presented. Problems of calculating inequality in the presence of negative observations are discussed and illustrated with the example of declared assets of Polish deputies. Preliminary results of the survey of perceptions of debts are also presented.

Keywords: Gini index, negative observations, debt

JEL classification: D63, I32

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Study of dependence

We consider various ways of describing and analyzing the dependent structure of variables. First, we briefly presented the global approach based on the copulas. Next, we will discuss the basic measures of dependence: the Pearson, Spearman, and Kendall coefficients of correlation. We will present their classical definition, and equivalent definitions based on the copulas and the concordant functions. We will discuss their advantages and disadvantages. We will introduce their estimators, giving their properties and the tests of significance. We will also give a set of properties that a “well-defined” measure of concordance should fulfill.

Keywords: dependence, coefficient of correlation, copula, concordant function, measure of concordance

JEL classification: C14

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**The importance of the seasonal component estimation approach
in intraday trading volume forecasting via ACV models
-for stock markets' data**

High-frequency financial data are typically subject to strong intraday periodicities. In the high-frequency financial literature, one common solution in the MEM framework is to apply a two-step estimation approach. In the first step, the seasonal component is estimated and intraday data are seasonally filtered, whereas in the second step, the main model is estimated based on seasonally adjusted data. Nevertheless, two-step estimation procedure can be inefficient and in some cases even inconsistent. In this situation, it is desirable to jointly estimate both seasonal component and parameters of main model.

The aim of this research is to empirically examine the influence of both estimation approaches on modelling of and forecasting intraday trading volume via autoregressive conditional volume (ACV) model of Manganelli (2005). In the exercise, we analyse the probabilistic forecasting performance for 10-minute intraday volume data from stock markets, in particular from the Polish stock market.

Keywords: trading volume, ACV model, intraday periodicity, probabilistic forecasting

JEL classification: C50, C58, C11, C22, G12

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An econometric model for the analysis of risk spillovers in the European banking sector

To enable the application of a well-established systemic risk measure CoVaR to analyze emerging and frontier markets, we modify and estimate an econometric quantile-based model called Delta CoVaR used for systemic risk analyses of developed markets and apply it to a large set of systemically important banks in developed, emerging and frontier Europe to analyze the risk spill-over effects in the European financial system. We estimate our empirical results based on the processes modeled with GARCH GJR and GARCH DCC models. The new model allows us to expand the sample significantly above what has been analyzed so far in the literature. Thus, we can draw conclusions about the spill-over of risk into the CEE region. Hence, the results are of consequences for regulators, central banks, and other banking system stakeholders.

Keywords: systemic risk, contagion, econometric models, tail risk, conditional Value of Risk

JEL classification: G01, G21, C58, E44, E58

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On testing the significance of differences in population structures based on small sample sizes

In economic and social research, multiple categories of qualitative variables are often distinguished. In such cases, contingency tables are most often used to describe the study's results. Statistical inference based on the data contained in such tables is most often carried out using the chi-square test of independence or the chi-square test of homogeneity.

This article proposes a statistical test for detecting the significant differences in structures based on data in contingency tables. Detection of differences in structures can be related to tests conducted in two or more periods or a single period, for example, for different groups of subjects or territorial units. The application of the proposed test is exemplified by the results of our research on the cultural participation of active participants in Internet portals immediately before and during the COVID-19 pandemic.

Keywords: statistical inference, permutation methods, population structures

JEL classification: C12, C15, C18

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Influence of macroeconomics policy on life expectancy.

The extensive literature on extrapolative stochastic mortality models mainly focuses on extrapolating past trends in mortality and summarizes these trends by one or more latent factors. However, the interpretation of these trends is usually not very clear. In contrast, multi-population mortality modeling research focuses mainly on extrapolating past mortality trends and summarizing these trends using one or more common latent factors. The aim of the study is to show that long-term life expectancy and economic growth are related to each other, which allows the use of economic factors in predictive mortality models. This relationship is studied within groups of countries with a similar welfare model, which has been the subject of research by sociologists for many years. The analysis is based in particular on the level of economic growth, represented by real gross domestic product (GDP) per capita, to capture a common trend in mortality for a group of populations with similar socio-economic conditions.

Keywords: life expectancy, macroeconomic factors, predictive mortality models

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Ecological preferences of households versus investments

In the talk a macroeconomic model of economy, being on its way to become green, will be presented. Production of energy from both non-renewable and renewable sources is considered. The gross product is spend on the consumption, the investment and the production of the energy from renewable resources. What's more, the scale effect in production of "green" energy is taken into account, both increasing and decreasing. The model concentrates on the behavior of the households willing to employ "green" energy and facing the necessity to choose optimal level of consumption. The sensivity of the households' optimal policy on the investment rate and the current ecological state of environment will be investigated.

Keywords: ecological preferences, complementarity between natural resources and capital, energy, natural resource use, scale effect

JEL classification: O44, Q32, Q43

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Selected measures of systemic risk in the context of macroprudential policy

Identifying and assessing systemic risk is the first step in the activities of the macroprudential authority. Given the systemic dimension of macroprudential policy, this assessment should be based on a wide range of indicators and use various analytical methods.

The aim of the article is to present selected measures of systemic risk. The work also aims to determine methods for identifying and measuring systemic risk and ways to reduce it.

The article verifies the hypothesis formulated as follows: Systemic risk measures enable accurate and early identification of systemic risk, constituting a prerequisite for the effectiveness of macroprudential supervision.

An empirical analysis was performed for Polish financial system.

Keywords: measures of systemic risk, systemic risk, macroprudential policy

JEL classification: C10, E58, G32

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On the properties of predictors under some class of linear mixed models.

We consider the problem of predicting selected subpopulation characteristics assuming a linear mixed model with two correlated vectors of random effects. The aim of the analyses is a simulation comparison of the properties of selected predictors based on the aforementioned model belonging to the class of linear mixed models, their counterparts that do not consider the correlation of random effects, and some estimators of characteristics in domains. The conducted research considered, among others, predictors belonging to class EB and plug-in. In particular, measures of accuracy and precision of the estimates were included in the studies. Monte Carlo simulation analyses were carried out using the R language, based on longitudinal data from the Local Data Bank of the Statistics Poland.

Keywords: linear mixed model, predictor, EBP, plug-in, Monte Carlo

JEL classification: C15, C53, H20

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Outlier detection using permutation methods for modeling economic phenomena

Outliers are data points for which relationships between variables are significantly different than the ones that can be observed under normal circumstances. Their presence in data used for estimating an econometric model may substantially influence the values of the parameters. The result is a skewed projection of the real world and less accurate forecasts.

This paper proposes a method of identifying data points with the most significant influence on the model's parameters using permutations of the dataset. The method was applied to data generated using copula functions, and outliers were generated by changing the marginal distribution of the dependent variable. A fixed percentage of data points was identified as outliers and removed. The exclusion of the outliers identified by the proposed method resulted in models with a significantly lower prediction error.

Keywords: outlier detection, permutation methods, econometric model

JEL classification: C15, C18, C51

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A locally fat-tailed symmetric distributions

The aim of this paper is to introduce a new locally fat-tailed symmetric distributions, which was firstly introduced by Lenart *et al.* (2021) as a special case of scale mixture of normal (SMN) distributions. Unlike to the typical fat-tailed distributions (e.g. Cauchy distribution) all moments exist for proposed distributions and the fat-tailedness are only local and controlled by one parameter. The kurtosis, as a function of this censoring parameter, is not a bounded function for proposed distributions. Hence such distributions may be an alternative to the known fat-tailed distributions. The Bayesian estimation was proposed.

Lenart, Ł.; Pajor, A.; Kwiatkowski, Ł. A Locally Both Leptokurtic and Fat-Tailed Distribution with Application in a Bayesian Stochastic Volatility Model. *Entropy* 2021, 23, 689. <https://doi.org/10.3390/e23060689>

Keywords: heavy-tailed distribution, scale mixture of normal distributions, censoring parameter, Gibbs sampling

JEL classification: C10, C11

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Technical efficiency of the crop farms under non-standard assumptions about the error term

The aim of this research is to evaluate efficiency of crop farming in the UE. The analysis is based on unbalanced aggregated panel data from 404 representative farms located in 99 regions of 24 countries of the UE and observed over 14 years (2004-2017). In order to do this, we first apply standard stochastic frontier analysis models, i.e., with normal–half-normal and normal–exponential error specification. These results suggest that farms are almost fully efficient, which is in contrast with common knowledge about individual farms and other authors’ research findings. An in-depth analysis reveals that such results are likely due to strong assumptions about the compound error term. Consequently, models with the specification of generalized t – generalized beta are proposed and validated so far.

Keywords: fat-tailed distributions, stochastic frontier analysis, Bayesian approach

JEL classification: C23, C51, D24, R11, Q18

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Impact of the COVID-19 pandemic on reverse annuities benefits

The COVID-19 pandemic has affected many areas of society and the economy. In the epidemiological field, it has significantly increased mortality, especially in the elderly population. It has greatly affected the real estate and financial market. The price of housing, inflation and interest rates have raised.

Higher mortality rates have an impact on the cash flow associated with insurance and reverse annuity contracts. Reverse annuity benefits also depend on the value of the property and the interest rate. This presentation analyses the impact of higher mortality rates, property values, and interest rates on annuity benefits considered from the perspective of widows.

Keywords: mortality rate, elderly population, reverse annuity contract, benefit

JEL classification: C5, C6, G17, G22, I13, J1

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Assessing forecasting abilities of spatial relational models for mortality predictions in small-area populations.

Relational mortality forecasting models scale sex-age mortality rates for a particular country into smaller subregions. Standardized Mortality Ratios (SMR) and Rate Ratios (RR) are among the characteristics used for scaling. However, when subregion populations are small the estimates of these characteristics may become unreliable because of the low number of deaths in analysed periods resulting in large forecast error.

The study proposes complementing the insufficient data by neighborhood subregions data to improve accuracy of the forecasts. The spatial approach is applied for forecasting sex-age mortality rates for 379 Polish districts (sub-NUTS-3 regions). The results are compared with the standard forecasts based on SMR and RR. We also discuss the problem of selecting the appropriate number of neighborhoods that maximize forecast accuracy.

The results show that taking into account the spatial aspect in relational models improves forecasting accuracy of RR-based scaling but is neutral in the case of SMR approach. The prognostic capabilities of the implemented models vary across age cohorts.

Keywords: spatial relational mortality models, forecasting.

JEL classification: J11, C53

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Predictive performance of Bayesian VEC-SV-GARCH models in times of a global polycrisis

The legacy of Covid-19 and the ongoing war in Ukraine have been having an immense impact on most of the economies across the world, triggering severe geopolitical tensions, energy shocks, and risks of stagflation, to name a few. A question arises about the possibilities of accurate prediction of the economies' key macroeconomic characteristics in such volatile times. In this paper, we focus on cointegrated VAR models with a time-varying conditional covariance matrix, and investigate if accounting for long-term relationships in such models actually improve their predictive abilities in these turbulent times of the current polycrisis.

The underlying structure of the models at hand will be a small model for monetary policy, combining inflation, unemployment and interest rates. The models will be analyzed for four different economies: the U.S., the United Kingdom, Poland and 19 countries of the Eurozone. The basic comparison of the models' forecasting accuracy will be conducted by means of the predictive density values at the realized data.

Keywords: cointegration; error correction models, conditional heteroskedasticity, Bayesian methods, density forecasts

JEL classification: C11, C32, C53

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On diversity in Schumpeterian games

In an evolutionary approach to economics, the potential emergence, disappearance, and dynamics of diversity are of keen interest.

It is possible to study the mutual influence of economic evolution on economic diversity using the contribution to diversity proposed by Nehring and Puppe (*Theory of diversity*, *Econometrica*, 2002). The properly defined diversity value of the set of production possibilities allows the analysis of the production system's technological diversity at every stage of economic development (Pliś, *Diversity and innovation in economic evolution*, CEJEME, 2020).

In the paper, I study the Schumpeterian evolution from a microeconomic perspective using a game-theoretic approach. I consider a game in which players are producers who choose between different strategies connected with various attributes. I seek an answer to the question of how decisions made by producers impact the diversity change in the production system in the course of innovation-driven economic development.

Keywords: diversity, innovation, economic evolution, game theory

JEL classification: O12, C02, C73

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Methods of determining the fiscal targeting rules

The application of fiscal rules allows for taking into account the fiscal discipline regarding the general government deficit and general government debt in decision making process. The other variables, such as production or inflation, should also be taken into account when fiscal decisions are made. Fiscal targeting rules can be helpful in achieving the objectives.

The aim of this article is to present the selected models that allow for determining the fiscal targeting rules, which are the optimal values of the selected fiscal instrument, as which the ratio of general government debt to GDP, as well as optimal values of GDP and inflation rate. The empirical analysis was carried out for Poland.

Keywords: public debt, fiscal targeting rule, intertemporal loss function, law of motion for debt

JEL classification: C61, C54, E62

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Pricing in incomplete markets

The classical approach to the pricing of unattainable instruments, for which full hedging is not possible, is to find the cheapest super-replicating strategy. However, the cost of a strategy whose a terminal value is a random variable dominating the payoff may be too high in practice. In this talk we discuss the class of financial instruments for which the super-replication price is equal to the replication one in a complete market model introduced by Cox, Ross and Rubinstein.

Keywords: financial market models, super-hedging prices, incomplete market

JEL classification: C6, G1

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Application of the EM algorithm to the estimation of the likelihood function in financial auditing

In financial accounting, data about the economic activities of a given firm is collected and then summarized and reported in the form of financial statements. Auditing, on the other hand, is the independent verification of the fairness of these financial statements. An item in an audit sample produces two pieces of information: the book (recorded) amount and the audited (correct) amount. The difference between the two is called the error amount. The error rates are usually very low, which render many existing statistical procedures inappropriate for estimating and hypothesis testing of error rates and error amounts. The book amounts are treated as values of a random variable whose distribution is a mixture of the distributions of the correct amount and the true amount contaminated by error. The mixing coefficient is equal to the proportion of the items with non-zero errors amounts. Below we consider a problem of testing appropriately formulated statistical hypotheses about admissibility of the total or the mean accounting errors. Hypotheses can be verified by the likelihood ratio test. The parameters of likelihood function can be estimated using the EM algorithm.

Keywords: EM algorithm, Likelihood ratio test, Mixture of probability distribution

JEL classification: C13, C51, M49

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Quantification of orders on a set of decision variants in a problem of allocation of homogenous goods applying Multiple Criteria Decision Making methods

In issues related to the problem of multi-criteria decision-making, the key is to determine the way in which decision-makers define their preferences regarding individual decision variants. One way is for each decision-maker to indicate the corresponding order on the set of decision variants. Widely used for ordering information representation in decision making are linear orders. However, as many real world relations are not linear, other types of partial orders are considered, in particular lattices. In the paper we consider in general Hasse diagrams of relations and then, case when they are upper semi-lattices. The relations of the decision makers quantified by semi-metrics in such diagrams are presented in the form of a decision matrix, on the basis of which the selection of allocation is made as a solution to the Multiple Criteria Decision Making problem.

Keywords: multiple criteria decision making, decisive matrix, allocation problem, preferences

JEL classification: C02

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Using a copula estimated with a neural network in risk aggregation in Solvency II

One of the basic aspects of the Solvency II Directive introduced in 2016 is the protection of the insured against the insolvency of insurance companies. For this purpose, by aggregating the Capital Requirements for individual types of risk to which the insurer is exposed, the Solvency Capital Requirement (SCR) and the diversification effect (ED) are determined. The SCR may be determined by insurance companies using the Standard Formula (SF) given by the authors of the Directive or using internal models developed independently (by the companies). The aim of our present research is to use copulas estimated with the use of neural networks (ANN) in modeling dependencies in the premium and reserve risk sub-module. In the research, we analyze indicators for the segments of non-life insurers. The conducted research indicates significant differences in the ED obtained for the copula estimated with the use of ANN, parametric copula and the approach SF. The obtained results can be used in internal models.

Keywords: Solvency II, Solvency Capital Requirement, diversification effect, copula cascades, neural copulas, dependency structure

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The demographic process of society ageing

Developments in medical technology and improvements in healthy lifestyles are having an impact on human life expectancy is increasing. Recent population censuses carried out in many countries have confirmed that the number of elderly people is also increasing as a result. The growth rate of the elderly population in Korea is the highest in the world.

The aim of this paper is to attempt to describe the changes in the boundaries initiating an individual's old age. An indication of the structural changes taking place in the senior group, including double ageing in Europe and Poland. The attempt to describe the changes in the boundaries initiating the old age of an individual are in particular the following boundaries: economic - cessation of professional activity; legal - acquisition of pension rights, and additionally biological - loss of psychophysical fitness and sociological theories of life phases.

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Cantelli's inequality and its improvement for non-negative random variables in assessing Value-at-Risk

Cantelli's inequality, also known as one-sided Chebyshev's inequality, finds application in assessing values of risk measures such as Value-at-Risk (VaR) and Expected Shortfall (ES).

In the paper we provide a probability inequality which, for some classes of univariate distributions, improves on Cantelli's inequality. The results obtained are used in finding bounds for Value-at-Risk. In particular, they are applied to assess bounds on the Solvency Capital Requirement for non-life premium and reserve risk.

Keywords: : Cantelli's inequality, Value-at-Risk, Solvency II

JEL classification: C02, C18, G22

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Technical efficiency of commercial banks in Central and Eastern European countries

The main topic of my presentation will be an analysis of the determinants of technical efficiency of commercial banks from seven Central and Eastern European countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland and Slovakia) during a ten-year period from 2011 to 2020. The estimation will be conducted through the translog function which is commonly used for such analysis, see Kosak et al. (2009), Andries and Capraru (2012), Gallizo et al. (2018), Kozak and Wierzbowska (2019). As potential determinants of the inefficiency I have considered three set of determinants: 1) macroeconomic variables (e.g. GDP, inflation rate, unemployment rate and central bank policy rate), 2) variables representing country-level market structure (level of concentration and Herfindahl-Hirschman index), and 3) bank-specific variables (e.g. return on asset indicator or quotient of granted loans and deposits held). The full list of potential determinants includes 61 variables (the list includes raw variables and their transformations).

Keywords: Banking technical efficiency, stochastic frontier models, CEE

JEL classification: C23, D24, G21

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On some construction of the design of experiments for multiple responses

Technological development of manufacturing enterprises contributes to the search for methods and tools to produce high-quality products. The use of statistical quality control methods enables effective improvement of the results of the production process. In particular, the design of experiments makes it possible to establish or modify the parameters of the production process accordingly.

Usually, full and fractional factorial designs of experiments are used in the practice of manufacturing enterprises. These designs lead to the determination of the influence of factors on a single response variable. In practice, the quality of the results of the production process can be assessed on the basis of several variables. Then, conducting experiments that consider a single response variable is unjustified.

The aim of the paper is to propose an alternative construction of response surface function, which will allow the setting of factor levels to be determined so that the response variables achieve the desired values. The proposed method will be used to set the parameters of the wood pellet production process.

Keywords: design of experiments, response surface function, multiple responses, wood pellet.

JEL classification: C99

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On bootstrap algorithms in survey sampling

There are two main approaches in survey sampling and small area estimation allowing for estimation or prediction of the population and subpopulation characteristics. The first approach is design-based, where the inference is based on a random sample, usually obtained using a complex sampling design, such as stratified multi-stage sampling or probability-proportional-to-size sampling. In this approach, the values of the variable of interest are treated as fixed (non-random) and the sampling design is typically considered as the only source of randomness of estimates. In the model-based approach, the values of the variable of interest are treated as realizations of random variables, and their distribution is usually assumed to be the only source of randomness. Different bootstrap algorithms for estimating the accuracy of estimation and prediction in these two approaches as well as the appropriate software will be presented, including some author's proposals and Monte Carlo simulation studies of their properties.

Keywords: survey sampling, small area estimation, bootstrap, MSE

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