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On the misuse of probability theory in economics

The aim of this paper is to give an outline of the sources, arguments and consequences of probabilistic approach to all types of economic data and phenomena. Probability theory is an efficient and useful tool of inductive research in those areas where the conditions of its applications prevail but it leads to illusory results where these conditions are invalid. The first part of the paper deals with the general objective conditions of the applicability of probability theory. Probability theory can be applied to analyse disorganized, non-learning systems with very large numbers of particles if there are no aims and goals of elements and the behaviour of the elements is stochastic and unchanging in time or the change in time is negligible or stochastic, that is, the behaviour of elements of the system can be described by objective probabilistic terms. The second application of probability theory is the sampling theory. There is an important difference between the two applications. In the first case the examined process is itself random. In the second case randomness and independence is not a necessary characteristic of the population from which the sample is derived. Randomness and independence can be introduced by the sampling procedure, therefore in these cases statistics and probability theory can be used for descriptive historical reasons and not as a tool of inductive theoretical research.

The second part of the paper deals with the history of that convention in economics (and first of all in econometrics), which treats population data as a result of a stochastic process or as one actualisation of a repeatable random sample. The very justification of econometrics from Haavelmo's influential paper is the dichotomy between deterministic and stochastic phenomena. However, this dichotomy is invalid in social sciences because there is a third type of phenomenon, the uncertain phenomena, which is typical in economics. The uncertainty stems from the inherent characteristics of the research subject and it is not a deficiency that could be overcome by the development of scientific methods. In this case objective numerical probability of the events cannot be

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counted or observed. The last part of the paper gives theoretical and practical examples of the negative consequences of the misuse of probability theory in economics.

INTRODUCTION

The problems of statistics and probability theory do not mainly concern the mathematical structure of the method; they are generally about the adequate application of mathematical theory to an observed real world phenomenon. The inadequate adoption of the probability theory in the field of non-repeatable, unique phenomena is a highly corrupt practice in the field of economics and many other social and behavioural sciences. The aim of the paper is to give an outline of the sources, arguments and consequences of probabilistic approach to all types of economic data and phenomenon. Probability theory is an efficient and useful tool of inductive research in those areas where the conditions of its applications prevail but it leads to illusory results where these conditions are invalid.

The first part of the paper deals with the general objective conditions of the applicability of probability theory. The second part deals with the history of that convention in economics (and first of all in econometrics) that treats population data as a result of a stochastic process or as one actualisation of a repeatable random sample.

1. THE USE OF STATISTICS AND PROBABILITY THEORY

1.1. THE DIFFERENT INTERPRETATIONS OF STATISTICS AND PROBABILITY

Both terms statistics and probability have many different shades of meaning. The polysomic character of these words is only disturbing in those situations when the different meanings are mixed in the same text. In the older, original sense of the word, statistics was used for any descriptive information about the state of society, and today it is also used for descriptive data, which have a quantitative nature and a numerical form. In this sense statistics is a method of historical research; it is a description in numerical terms of historical events that happened in a definite period of time with definite groups of people in a definite geographical area.

Of course this meaning has nothing in common with its modern natural science meaning. Accordingly, statistics deals with mass phenomena and it enables us to analyse systems with very large numbers of particles. In the field of natural sciences, statistics is a method of inductive research. To take an example: quantum mechanics deals with the fact that we do not know how a particle will behave in an individual instance. Yet we know what pattern of behaviour can possibly occur and the proportion in which these patterns really occur.

The term probability has also many different incompatible meanings. As regards the mathematical theory of probability, its adequate and objective application can be found in the realm of random mass phenomena or random repetitive events. In the first case a great number of uniform elements are involved at the same time, in the second case the same event repeats itself again and again under identical circumstances[2]. The objective, numerical, frequency probability means that we know everything about the behaviour or attribute of a whole class or collective of events, but about the actual singular events we know nothing but that they are elements of this class or collective[3]. In objective sense the word „probability" is a synonym of „relative frequency".

The subjective concept of probability theory applies to single trials and single cases which do not belong to a class of identical cases; therefore there is no sense to talk about objective, verifiable probability of those trials. If someone gives a numerical expression of his subjective belief for something occurring, in spite of the numerical expression of his belief, it remains his personal and subjective feeling. However, there is not a sharp distinction between objective/frequentist and subjective/personalist/epistemic interpretations of probability: beside the clear objective and clear subjective cases an interim zone also exists, where there is a mass phenomenon with random or uncontrollable behaviour but without the condition of perfectly identical circumstances of the single event. Experiences teach us that in some of these cases (see some later examples) the probability theory can also be applied.

1.2. THE CONDITIONS OF USE OF PROBABILITY THEORY

Inductive statistics and probability theory deal with the problem of large numbers by deliberately treating the individual elements of a collective as if they were not systematically connected. In other words, it proceeds on the assumption that information on the numerical frequencies of the different elements of a collective is enough to explain the phenomena and that no information is required on the manner in which the individual elements are related. It deliberately disregards the fact that the relative position of the individual elements in a structure may matter[4]. If relative position does not matter, then statistics is usable. If the relative position of individuals in a system does matter, then statistics is not an adequate method of analysing scientific problems.

[2] Mises, R. von (1980): *Probability, Statistics and Truth.* Dower Publications, New York.
[3] Mises, L. von (1998): *Human Action. A Treatise on Economics.* Ludwig von Mises Institute, Auburn. 107.
[4] Hayek, F. A. (1943): *Scientism and the Study of Society.* Economica. 10. 34–63. 48.

The different conditions of probability theory as a method of explanation or prediction of the functioning of a system can be summarized as follows:

- There are a large number of elements or events,
- The system is disorganized, non-learning,
- There are no aims and goals of elements, there is not conscious choice between the various courses of action
- The behaviour of the elements is stochastic and unchanging in time or the change in time is negligible or stochastic, that is, the behaviour of elements of the system can be described by objective probabilistic terms; by observing the pattern and relative frequency of the past behaviour of element the prediction of the future behaviour is possible

Usability of probability theory can be decided first of all by experts of the scientific area under discussion and not by the statisticians. Experience teaches us where these can be used and where these cannot be used, because there is not always a sharp distinction between the absence and realization of conditions. However, in the case of social systems the last three conditions are clearly not fulfilled. Therefore, in the case of society probability, theory cannot be used as a method of inductive research but an applied part of probability theory, namely sampling theory can be used for descriptive/historical purposes. However, there is an interesting and important difference between the two applications of probability theory. In the first case (probability as a tool of inductive research) the examined process is itself random; therefore, we could say, the application of probability theory to stochastic processes is unrestricted. In the second case, that is, random samples, randomness and independence is not a characteristic of the population of which the sample is derived. Randomness and independence are introduced by the sampling procedure; therefore statistics and probability theory can be used for descriptive historical reasons. Of course, non-random samples are also justified for descriptive purposes, where introduction of randomness is impossible or unpractical (for example collecting price data for measuring the temporal difference of price level).

1.3. SOME EXAMPLES FOR THE VARIOUS USES OF STATISTICS AND PROBABILITY THEORY

Examples of the successful use of statistics and probability theory can be found in those areas where the above mentioned conditions prevail: quantum mechanics and many other fields of physics, insurance, population statistics (e. g. birth rates and death rates), medical statistics, genetics and other biological phenomena, quality control, resource management and so on. Of course, inadequate use of probability theory may occur in these areas also, but dealing with this question would be impossible in a short paper. As regards physical, technical and biological phenomena the behaviour is time invariant, while in the case of social phenomena the change of behaviour in time is negligible. For example, the relative stability of vital statistics enables life insurance; if vital statistics were as volatile as price changes, then life insurance would be not possible, at least in an objective sense.

The data can stem from repeatable experience, repeatable observation and random sample. The difference between experiences and observations is that in the first case we engender actively the observed phenomena and in the second case we register only passively the outcomes of repeatable phenomena. In the case of random samples the repeatability is not a condition, because, as I mentioned earlier, the aim of the sample is a description of some characteristics of society in a definite area and a definite point of time, or in a definite interval of time.

There are many examples of areas where statistics are usable only in the descriptive sense. In linguistics the statistics of words tell us nothing about the structure of a language. The same is true of other systematically connected wholes, which is the subject of ethology, ecology, the investigation of price system and in general the economic system as a whole. The statistics in this field of knowledge can be used in a very limited way: Statistics can provide information about separate parts of the system and thus can give us some „raw material" which helps us to reproduce the structure of the system. And secondly, statistics can help to examine system characteristics if we have information about properties of many languages, many price systems and so on[5]. We have to face two restrictions when using statistics in this way: the number of available instances can be very limited and far from being a mass phenomenon, and secondly, the properties of the systems can only be formed in an indirect way from their parts. Sampling theory is typically not a useful research tool in the investigation of systematically connected wholes, because the elements of the system are heterogeneous, qualitatively different, and they have different weights or importance.

The danger of the axiom systems that are detached from empirics can be illustrated also by the axiomatisation of probability by Kolmogorov: the inadequate adoption of the theory in the field of non-repeatable, unique phenomena. This will later be the basic problem in the case of economic data.

2. THE MISUSE OF PROBABILITY THEORY

2.1. THE FALSE DICHOTOMY BETWEEN DETERMINISTIC AND STOCHASTIC PHENOMENA

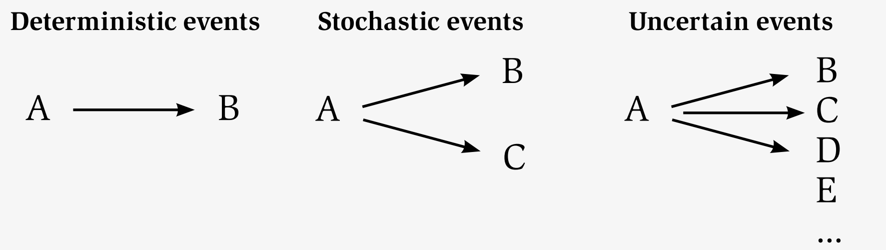
A popular but mistaken belief is that every phenomenon can be divided into deterministic and stochastic phenomena. As regards deterministic phenomena, the determinant elements of a process or events can be known and by knowing

[5] Hayek (1943) 49.

these determinant elements the process can be predicted. In the case of stochastic phenomena the initial circumstances do not determine the result, rather the various results can be predicted by numerical probability only. These two types of phenomena are typical to natural phenomena and it is not necessary to discuss that chaotic phenomena belongs to a third group or it is a subgroup of stochastic phenomena.

In the field of biological sciences and social sciences the deterministic-stochastic dichotomy only seldom prevails, in the case of very simple subsystems with recurrent, standard behaviour of elements. However, in biological and social systems, most phenomena are uncertain, that is, we are able to give neither deterministically nor stochastically predictions about the phenomena (Figure 1). Their uncertainty is epistemologically different from that type of uncertainty that is manageable by the help of probability theory. We are only able to give a subjective probability about the possible course of events; indeed we cannot make a complete list about the possible outcomes of events. This uncertainty stems from the inherent characteristics of the research subject and it is not a deficiency that could be overcome by the development of scientific methods.

Figure 1: **Deterministic, stochastic and uncertain events**



A circumstances is followed by B (It can be dynamic process or some static characteristic)	A circumstances is followed by B in the x % of all cases, and A circumstances is followed by non-B in the 100-x % of all cases	A is followed by B or non-B But: B and non-B may be unknown Or: if B and non-B is known, then they do not have objective numerical probability

The difference between the deterministic and stochastic phenomena is epistemologically by far not as important as the fundamental differences between stochastic and uncertain phenomena. Stochastic and uncertain phenomena have nothing in common apart from the incompleteness of our knowledge.

Let us look at two examples for uncertain phenomena: The result of a sport competition is clearly not deterministic. If it were deterministic, the results would be known in advance. If someone thought objective numerical probability could be given to the various possible results, then she or he could consider the sport competition as a stochastic phenomenon. But I think this would be a metaphysical, mystical and unjustifiable treatment of the point, because the alleged numerical probabilities are not verifiable. Every sport competition is a unique phenomenon; the circumstances are different in each competition. We can also express our subjective opinion about the outcome of events in numerical terms only.

The second example is a more complex one. It can be predicted qualitatively that an increase in money supply leads to an increase in price levels in the unspecified future. Yet it is impossible to predict both the timing of the process in exact numerical terms and the exact effect of the increasing money supply to the structure of the price system, the income distribution, the rate of interest, the change of production structure and so on. If someone still gave a prediction in quantitative form about the process – and this is a common practice of economic policy research institutions ¬– this prediction cannot be treated as a precise and exact numerical result neither deterministic nor stochastic sense, but as an indicator of direction and magnitude of the examined process.

2.2. THE HISTORY OF PROBABILISTIC APPROACH IN ECONOMICS

The most influential paper about the use of probabilistic models in economics is Haavelmo's paper on Econometrica[6]. Mathematical economists and scholars of econometrics before Haavelmo made deterministic mathematical models. Haavelmoo's main argument for probabilistic approach is the following: it is well known that there isn't an exact functional relationship between observable economic variables. Actual observations will deviate more or less from any exact functional relationship. And, according to Haavelmo, if some relationship is not exact, then it is stochastic. This strange opinion became widely and rapidly accepted by the majority of the new generation of economists. The main problem with this statement is that it is not true that if some relationship is not exact or deterministic then it has to be stochastic or probabilistic. It can be also uncertain without any numerical probability. And we can recognize the uncertain character of a relationship not by examining the numbers themselves but by examining the qualitative information about the data generator process.

The law of demand can be used to illustrate the differences between various forms of expressions. According to verbal form, the law of demand states that for a higher price of goods, all other factors being equal, there corresponds a lower (or at any rate not a higher) demand. The mathematical/deterministic form of the law:

[6] Haavelmo, T. (1944): *The Probability Approach in Econometrics.* Econometrica. 12. 1–115.

If p denotes the price of, and q the demand for, goods, then
q=$f(p)$ and dq/dp=$f'(p)\leq 0$.
where $f(p)$ an unspecified deterministic function

The econometrical/stochastic form of the law:
$q=f(p)+e$ and dq/dp=$f'(p)\leq 0$.
where $f(p)$ the deterministic/systematic/theoretical part, e the stochastic part (disturbance or error term) of the function. The deterministic part has to be specified with the help of empirical observations.

For mathematical form it is necessary to introduce a notation system. However, it is interesting that many mathematical economists believe that mathematical forms express more than simple words and, furthermore that they describe the situation more precisely. Far from saying more, in reality mathematical form actually says less than verbal form since it is limited to functions that are differentiable and its graphs, therefore, have tangents. This additional hypothesis is clearly not anchored in economical facts. Therefore the verbal form is more general, but no less precise; it has the same mathematical precision as mathematical expression[7].

We can observe a crucial difference between the mathematical expression of physical and economical laws. In physics not only the theory of mechanics, optics and electrical attraction can be added but there also exist tools for measuring variables used in the mathematical formulation of theories. In economics a law of demand and other theories can also be presented in mathematical form but no instrument exists for an accurate and unambiguous measuring of the variables used in those theories.

In economics the sources of uncertainty are manifold; for example lack of perfect information, lack of perfect foresight, lack of perfect quantitative function between various variables, organized complexity, learning, choosing and so on. A genuinely immeasurable phenomenon was assumed to have a numerical probability either normally distributed or could be analyzed „as if" they were normally distributed or rarely – because it is easy to demonstrate that the assumption of normal distribution do not fit the real data – they have some other distribution. This is a fundamental methodological misconception with various detrimental consequences.

2.3. THE CHANGE OF THE MEANING OF SAMPLE

Not only has the treatment of uncertainty been drastically transformed, but also the meaning of sample. The change of meaning originates at least in Fisher's work for the statistical methods of agricultural experiments. Fisher writes in

[7] Menger, K. (1973): *Austrian Marginalism and Mathematical Economics.* In: Carl Menger and the Austrian School of Economics, Ed. Hicks, J. – Weber, W. Oxford, Clarendon Press.

1925: „Any body of numerical observations, or qualitative data thrown into numerical form as frequencies, may be interpreted as a random sample of some hypothetical population of possible values”[8].

This concept was broadened rapidly to every type of data, not only for experimental data. According to this approach not only the sample is a subset of a population, but that the population is a subset of a hypothetical „super population” or „universe” and the population is also a sample to be drawn from a super population. Population is something that happened and super population is all things that could have happened. According to this approach all data can be interpreted as a sample; moreover, as a random sample. Therefore the probabilistic approach is „justified” with all kinds of data.

Not only has the meaning of sample changed but the meaning of „experiments” in probability theoretical literature. In theoretical literature the word experiment is used for every situation where the probability theory is applied and not only in those cases where test are actively conducted to find out what happens to someone or something in particular conditions. Thus random samples, true experiments and passive observations are deliberately mixed up in a disturbing way.

The conceptual problem of this view is the following: use of inferential statistics, which are designed to make inferences about an unknown population of subjects from a known random sample, on data which is not a sample at all but include the entire population. This strange practice became quite common in many fields of empirical science, not only in economics.

To justify the stochastic approach, we can find both the stochastic process and random sample arguments. Perhaps random sample argument is more common. The following question arises: Can economic data be treated as:

1. Random sample?
2. Repeatable experience under the same conditions?
3. Repeatable observation of a stochastic process?

I think, in regards to macroeconomic data, neither approach can be applied. Otherwise, in some microeconomic problems, stochastic approach can be legitimate. For the sake of simplicity hereafter I will deal with the data of macroeconomics. The events of macroeconomics have unique characteristics. They are not homogeneous members of an identifiable class with known parameters in the distribution of values. They are uncertain, but not random, in the sense of probability theory, that is, they do not have numerical probability.

[8] Fisher, R. A. (1925): *Theory of Statistical Estimation.* Proceedings of the Cambridge Philosophical Society. V. 22. 701.

2.4. ARGUMENT FOR TREATING MACROECONOMIC DATE AS A RANDOM SAMPLE

Beside the original stochastic process argument today the sample argument is perhaps more common in the literature of econometrics. I will examine further arguments for treating macroeconomic data as a random sample (see Table 1), partly based on Summerfield paper[9] and one of my former papers[10]. Neither stems from the strict mathematical theory of probability.

Table 1: **Arguments for treating macroeconomic data as a random sample**

1.	Stochastic process argument
2.	Temporal sample argument
3.	Spatial sample argument
4.	Measurement error argument
5.	Method of measurement argument
6.	Inferential statistics superior to descriptive statistics argument
7.	Sources of data is a sample argument
8.	Significance argument
9.	Randomization argument
10.	It is the usual practice argument

The stochastic process argument stems from the invalid distinction between deterministic and stochastic processes. This argument was discussed in previous sections, with economic data not stochastic but uncertain. According to the temporal sample argument the population can be regarded as sample in time, and the conclusions drawn from the measured population may be inferred to apply to past and future states of that population. However, we know nothing about the length of time over which the initial observations remain valid.

The spatial sample argument is similar: findings from one population can be inferred to apply to other areas for which no observation is available. It is clear that legitimization of such extrapolation cannot arise from the theory of statistics.

According to the measurement error argument population data contains random and independent measurement errors. This argument stems from

[9] Summerfield, M. A. (1983): *Populations, Samples and Statistical Inference in Geography.* Professional Geographers. 35. 143–149.
[10] Dusek Tamás (2006): *Területi statisztika, valószínűségszámítás és statisztikai következtetéselmélet.* Területi Statisztika. 46. 223–239.

measurement of physical sciences, where measurement of something is possible under essentially identical conditions. Measurement error in economy is a totally different and more complex concept than the measurement error in physical measures and in economics and sociology random measurement error is just a minor part of the total measurement error. For example, we know that population censuses have at least a measurement error of 1-2 percent in most developed countries. However, the unrecorded and double-recorded individuals are hardly likely to be a random part of the population.

The fifth argument states that population data represents only one out of the several related but different measures of the examined phenomenon. For example, we know exactly that the notion of unemployment can be operationalized in many different ways. However, methods of particular measurement of unemployment (and other phenomena) are not selected randomly but are determined by research problems and many other practical points of view.

As regards the inferential statistics superior to descriptive statistics argument, it is based only on a preconception concerning the value of scientific research methods. In reality there is not a hierarchy of scientific research methods that is independent from the investigated subject.

Sources of data are a sample argument meaning that in many cases the population data itself stems from a sample of the elementary events. For example, the main source of unemployment data is the labour surveys, which is a quasi-random sample of only about 60 thousand people in each quarter year. According to the argument, due to the sampling, the final results can be treated also as a sample. I think the fact that the source of data is a sample has to be taken into account, but in a different way, namely, the researcher has to be more cautious when interpreting data, because data consist not only non-sampling errors, but sampling errors too.

The significance argument means that testing statistical significance can help to determine the importance of a connection. It is true that testing significance can be treated as one of the many diagnostic methods for detecting inadequacies and unusual characteristics in data analyses. However, there are some problems with this diagnostic method. The most important is that its result is dependent from the number of observations.

According to the randomization argument, randomization does not need random sample. With the help of randomization we can give the results in a standardized scale, therefore we can compare the results of populations better with various variations. This argument, similar to the previous one, can be accepted in some cases. However, this is not an inferential but descriptive statistical way of use.

The most common argument is perhaps that it is the usual practice; everybody does it, every textbook does it; therefore surely it is a very well grounded way of analyzing data. This is, of course, a false argument based on authority, the force of habit and institutional pressure. There are cases, where probability theory can be used very successfully. However, it is not a reason for it to be used uncritically in situations where the conditions of use do not prevail.

2.5. OUTLOOK ON OTHER SOCIAL SCIENCES

Parallel with the expansion of probabilistic approach in various disciplines an intensive critical literature has also emerged on the misuse of the probabilistic method and particularly on the misuse of statistical significance testing. The main counterarguments are the following:

1. Treating populations as a random sample.
2. Concentrating only on statistical significance and not on substantive/subject matter significance.
3. Reporting only p values and disregarding the magnitude of effect.
4. Misinterpreting the meaning of p value.
5. Disregarding the loss function.
6. Disregarding the mathematical statistical conditions of the tests.
7. Disregarding the role of the sample size.
8. Disregarding the non-sampling errors.
9. Mixing up Fisherian significance testing and Neyman-Person hypothesis testing.
10. Interpreting the failure to reject the null hypothesis as a sign of unsuccessful research.
11. The result can be trivial and well known before the test.
12. Lack of meta-analysis.
13. Publication bias.

Without going into detail, I restrict the discussion to presenting some concluding remarks from the critical literature. The first discipline is geography or spatial research. Gould's article is a scintillating exposition of the main problems of treating populations as a random sample. „Very often whole populations can be investigated, yet the results of inferential tests of significance are still conscientiously reported. But having investigated a whole population, to what are we now inferring our results? It is here that we wriggle and turn, trying to justify the use of such tests on a whole populations by noting that we have taken a „sample at one slice in time", or „the sample represents a larger population existing at other places besides the region with which we have dealt." But these arguments sound very weak in the context of the rigorous assumptions of random sampling"[11]. Meyer summarizes his view that "the mistake of applying inferential statistical procedures to population data is not uncommon in geography, as any perusal of journals will reveal. Geographic data frequently comprise

[11] Gould, D. (1970): *Is statistix inferens the Geographical Name for a Wild Goose?* Economic Geography. 46. 439–448, 442.

the entire population of subject rather than a sample of subjects"[12]. „A continuing failure by geographers to appropriately employ inferential procedures only serves to weaken the development of theory"[13]. Summerfield writes similarly: „I suggest that statistical inference in geographical research should be confined to those contexts which are known to satisfy the requirements of statistical theory, and that the ritualized application of such procedures to population data should be abandoned. This situation may focus more attention on descriptive statistics and the explanation of data rather than its artificial and often uninformative statistical categorization into „significant" and „non-significant"[14].

In the field of sociology and educational research an enormous amount of critical literature exists, first of all about the misuse of statistical significance testing. Just one example: „Statistical significance testing has involved more fantasy than fact. The emphasis on statistical significance over scientific significance in educational research represents a corrupt form of the scientific method. Educational research would be better off it stopped testing its results for statistical significance"[15]. „I do not mean to suggest that educational research is more deserving of criticism than other areas of research. This critique applies equally to all fields that use statistical significance testing in conducting research, for example, psychology, sociology, physiology, and biochemistry"[16].

In psychology, epidemiology and medical research the misuse of statistical significance test has also a vast array of literature: „Despite the stranglehold that hypothesis testing has on experimental psychology, I find it difficult to imagine a less insightful means of transmitting from data to conclusions"[17]. „Hypothesis testing is overrated, overused, and practically useless as a means of illuminating what the data in some experiment are trying to tell us"[18]. „Hypothesis testing provides the illusion of scientific objectivity by sanctifying an arbitrary probability (p=.05) of incorrectly rejecting some null hypothesis that almost inevitably is known a priori to be false"[19]. „And we, as teachers, consultants, authors, and otherwise penetrators of quantitative methods, are responsible for the ritualization of null hypothesis significance testing to the point of meaningless and beyond. I argue herein that null hypothesis significance testing has not only

[12] Meyer, D. R. (1972): *Geographical Population Data: Statistical Description Not Statistical Inference.* Professional Geographer. 24. 26–28, 26.
[13] Ibidem 28.
[14] Summerfield (1983): 148.
[15] Carver, R. P. (1978): *The Case Against Statistical Significance Testing.* Harvard Educational Review. 48. 378–399, 378.
[16] Ibidem 379.
[17] Loftus, G. R. (1991): *On the tyranny of hypothesis testing in the social sciences.* Contemporary Psychology. 36. 102–105, 104.
[18] Loftus, G. R. (1993): *A Picture Is Worth a Thousand p Values: On the Irrelevance of Hypothesis Testing in the Microcomputer Age.* Behavior Research Methods, Instruments, & Computers. 25. 250–256, 250.
[19] Ibidem 250.

failed to support the advance of psychology as a science but also has seriously impeded it"[20]. „I believe that the almost universal reliance on merely refuting the null hypothesis as the standard method for corroborating substantive theories in the soft areas is a terrible mistake, basically unsound, poor scientific strategy, and one of the worst things that ever happened in the history of psychology"[21]. „Future historians of psychology will be puzzled by an odd ritual, camouflaged as the sine qua non of scientific method that first appeared in the 1950s and was practiced in the field for the rest of the twentieth century. In psychology and education textbooks of this period they will find this ritual variously referred to as „statistical significance", null hypothesis testing, significance testing"[22]. „I briefly summarize prior research showing that tests of statistical significance are improperly used even in leading scholarly journals. Attempts to educate researchers to avoid pitfalls have had little success. Even when done properly, however, statistical significance tests are of no value. I was unable to find empirical evidence to support the use of significance tests under any conditions"[23].

2.6. THE FORMS OF MISUSE OF PROBABILITY THEORY IN ECONOMICS

There are two main forms of misuse of probability theory in economics. The first form is a general troublemaking during the data analysis; the second form has real costs because of the application of theories based on probability theory in practical economic decisions. Firstly, in a general way, the manipulation with probability distributions and significance tests[24] is an unjustifiable and disturbing part of the results of applied econometrics, while the descriptive part of an econometric analysis can contribute to the grasp of concrete ex post relationships between economic indicators and therefore can be used to illustrate economic laws. It became a common but absurd practice to name the groups of aggregate and historically interesting geographical units (countries, counties, regions and so on) as „sample".

[20] Cohen, J. (1994): *The Earth Is Round (p< .05).* American Psychologist. 49. 997–1003, 997.
[21] Meehl, P.E. (1978): *Theoretical Risks and Tabular Asterisks: Sir Karl, Sir Ronald, and the Slow Progress of Soft Psychology.* Journal of Consuling and Clinical Psychology. 46. 806–834, 817.
[22] Gigerenzer,G. (1998): *We Need Statistical Thinking, Not Statistical Rituals.* Behavioral and Brain Sciences. 21. 199–200, 199.
[23] Armstrong, J. S. (2007): S*ignificance Tests Harm Progress in Forecasting.* International Journal of Forecasting. 23. 321–327, 321.
[24] About the misuse of test of statistical significance in economics see Ziliak, S. T. – McCloskey, D. N. (2008): *The Cult of Statistical Significance.* The University of Michigan Press, Ann Arbor. McCloskey and Ziliak examined the papers published in American Economic Review from the point of view of proper use of test of statistical significance. Their methodology was replicated by Parcell et al. (2000) and Mbatha – Gustafsson (2013) to papers published in agricultural economics. (Parcel, J. L. – Kastens, T. L. – Dhuyvetter, K. C. – Schroeder, T. C. [2000]: *Agricultural economists' effectiveness in reporting and conveying research procedures and results.* Agricultural and Resource Economics Review. 29. 173–182.; Mbatha, C. N. – Gustafsson, M. A. [2013] *The standard error of regressions: a note on new evidence of significance misuse.* Agrekon. 52. 28–39.)

A new part of applied statistics and computer programs came into existence; a huge amount of various methods were developed for treating the lack of standard assumptions of inferences from regression analysis, like homoscedasticity, normal distribution of error term and independence of the observations, which mainly do not prevail in the case of economic data. The emphasis has shifted from metrics of economics to testing of economics, from econometrics to econotesting. The important non-sampling measurement problems fell into the background. This mentality has lead to a concentration on quantitatively measurable surface phenomena and therefore important quantitatively immeasurable phenomena and qualitative information have been disregarded in the explanation of various economic problems. Moreover, it represents an attitude towards data which is positivistic, empiricist, but at the same time anti-positivistic, anti-empiricist and anti-theoretical: during the explanation of real world data there is no possible reference to genuine theory, only ad hoc explanations.

The real cost of misuse of probability theory can be found first of all in application of the modern theory of finance, where the price changes are treated as some form of stochastic process. In a less elementary way the theory of price changes is based on these assumptions: price changes are independent, stationary and normally distributed. These assumptions are clearly contradicted by the real world.[25] The more complicated distributions and assumptions have the same weakness: treating an epistemic uncertainty as a probabilistic process.

CONCLUSIONS

Far from being the most developed type of science, probabilistic approach in economics is only a manifestation of a metaphysical mode of thinking. It is an epistemologically false approach, because the deterministic-stochastic dichotomy typically does not prevail in economics, and, moreover, the analyzed data is mostly not a random sample derived from a well-defined population. Probability theory can be used very successfully in many research areas; however, this success cannot legitimate inadequate use.

[25] See the history of this approach in Mandelbrot, B. – Hudson, R. L. (2004): *The (Mis)Behavior of Markets.* Basic Books, New York.

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HUNGARIAN SUMMARY

A tanulmány a gazdasági jelenségek valószínűségi jellegű megközelítésének kérdéseivel foglalkozik, feltárva ennek a gondolkodásmódnak az eredetét, indokait és következményét. A valószínűségszámítás hatékony és hasznos eszköze az induktív kutatásnak azokon a területeken, ahol alkalmazásának feltételei rendelkezésre állnak. A tanulmány első fele ezekkel az általános és objektív feltételekkel foglalkozik. Az alkalmazás egyik lehetőségét a sztochasztikus folyamatok jelentik, a másikat pedig a véletlen mintavétellel nyert adatok. Az első esetben a véletlenség magának a vizsgált folyamatnak a sajátossága, a második esetben a véletlenség a mintavételi folyamat révén valósul meg. A tanulmány második része azokat a kérdéseket tárgyalja, amikor ezek az objektív feltételek nem adottak, mert bár a jelenség nem determinisztikus, de mégsem véletlen, hanem események nagyobb osztályába nem besorolható egyedi, bizonytalan történések közé tartozik. Ekkor a valószínűségszámítás alkalmazása (például makroökonómiai adatok elemzése során), formálisan bármennyire is tudományosnak és kifinomultnak tűnhet, valójában egy módszer helytelen alkalmazásaként csak illuzórikus és megtévesztő eredményekhez vezethet.

Tibor Rieger: Gergely Czuczor (linguist, poet) and Ányos Jedlik (physicist)