

In Good Memory of the Academician of the Academy of Sciences of Ukraine, Professor, Doctor of Physics and Mathematics Vladimir Semenovich Korolyuk

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Vladimir Semenovich Korolyuk, an outstanding Ukrainian mathematician, whose main work is related to probability theory, mathematical statistics, approximate and numerical methods, died on June 4, 2020 at the age of 95.

V.S.Korolyuk published about 350 scientific works, including about 20 monographs. Vladimir Semenovich Korolyuk was the Honored Worker of Science and Technology of Ukraine (1998), the laureate of the State Prize of Ukraine in the field of science and technology (1978, 2003), Prizes of the Academy of Sciences of Ukraine named after N. M. Krylov (1976), V. M. Glushkov (1988), N. N. Bogolyubov (1995), M. V. Ostrogradskii (2002).

In 1963, Korolyuk defended his doctoral dissertation becoming Doctor of Physical and Mathematical Sciences in 1964, and then Professor (1965) and corresponding member of the Academy of Sciences of the Ukraine (1967). Korolyuk became the academician of the Academy of Sciences of the Ukraine in 1976, where he served, as a chief research fellow from 1993 to 1999 and from 1999 became the Advisor to the Directorate of the Institute of Mathematics. After defending his candidate dissertation, Vladimir Semyonovich Korolyuk has forever connected his life with the Institute of Mathematics of the Academy of Sciences of the Ukraine, where he first worked as a junior and, since 1956, as a senior researcher. Since 1960, Korolyuk served as a Head of the Department of Probability Theory and Mathematical Statistics, organized by Korolyuk's mentor and teacher B.V. Gnedenko, who has left the Institute of Mathematics in the summer of 1960 to work at Moscow State University, and so Korolyuk has led this department until 1993. In 1966 - 1988, Korolyuk served also as the Deputy Director of the Institute for Scientific Work.

Besides his work at the Institute of Mathematics, Korolyuk was Professor in the Department of Probability Theory and Mathematical Statistics in the Faculty of Mechanics and Mathematics at Kiev State University named after T.G. Shevchenko (1965 - 1993) lecturing and supervising the work of undergraduate and graduate students.

More than 40 of his graduate students defended their Candidate (PhD) theses and 10 received their doctoral degree (equivalent to Full Professor in the US).

Studies and collaboration with Boris V. Gnedenko

Vladimir Semenovich was the first Kiev student of academician Boris Vladimirovich Gnedenko. In September 1949, the Presidium of the Academy of Sciences of the Ukraine decided to transfer B.V. Gnedenko from the city of Lviv to the city of Kiev. Gnedenko was asked to lead the department of probability theory at the Institute of Mathematics of the Academy of Sciences of the Ukraine and to become a Head of the Department of Probability Theory and Algebra in the Faculty of Mechanics and Mathematics at Kiev University. In the spring semester of 1950, Gnedenko organized a special seminar on probability theory and began reading a special course on limit theorems in the theory of probability. At this time, Vladimir Semyovitch Korolyuk was a graduate student at Kiev University (in the USSR educational system, studying in his fifth year), and many years later in his memoirs about his mentor Gnedenko, he wrote that the first time (in the fall of 1949) he saw Gnedenko "at a meeting of the academic council of the faculty, delivering a bright, energetic speech, I decided without hesitation to become a student of Boris Vladimirovich Gnedenko." To begin, V.S. Korolyuk became a participant in Gnedenko's special seminar and enrolled in Gnedenko's special course. Boris Vladimirovich Gnedenko offered him to examine the conditions of attraction to stable laws in terms of characteristic functions as a perspective topic for a master thesis. Korolyuk wrote: "Of course, I understood that B.V. could develop this innovative approach on his own. However, he suggested me to work on this problem because he believed in my creative abilities. **Some remarks on the theory of regions of attraction of stable laws**" became my first scientific work (co-authored with my teacher B.V. Gnedenko), which was published in the journal **«Reports of the Academy of Sciences of the Ukrainian SSR»** (*«Dopovidi AN URSS»* 1950, number 4, 275 - 278) in 1950.

After graduating from the university with the equivalent of the Master degree in 1950, Korolyuk worked one year at the Artyomovsk Teachers Institute (Artyomovsk - a city in the Donetsk region of Ukraine). Moreover, he tried, whenever possible, to come to Kiev to attend Gnedenko's seminar. At this time, Gnedenko was fascinated by the problem associated with the problem of equipment debugging. This means the following: a debugged machine starts to process certain parts, and for some time these parts are produced without defects, i.e. their sizes do not go beyond the permissible limits. Over time, equipment debugging begins (say, the cutter is blunted) and there is a danger of the parameter of interest to us exceeding the permissible limits (the dimensions of the parts fall into a certain range of values preceding the unacceptable). It is necessary, without stopping the production process itself, to determine whether the parameter of interest falls into such an acceptable interval.

In order to do this, the probability distributions of the two samples (the dimensions of the parts measured at the initial stage of the machine's operation and measured after some time passed) would be compared to each other and before 1951 the solution would typically involve two steps: 1. An assumption is made about the specific distribution of the parameter of interest to us and this hypothesis is checked against the sample obtained at the initial stage of the work; 2. After some time, the second sample is collected and a comparison is made with the first. Gnedenko was interested in the question of whether it is possible to solve this problem using methods of nonparametric statistics, i.e., without testing the hypothesis about a specific type of distribution, thereby collapsing the solution to only one-step procedure.

This task enthralled Korolyuk and already in a year, in 1951, collaborative work with Gnedenko has led to the publication of the article describing the new *trajectories method* for a given number of trials (Gnedenko & Korolyuk. 1951. "About the maximum divergence of the two empirical distributions" published in «[Reports of the Academy of Sciences of the USSR](#)» t. 80, number 4, 525 - 528).

In the fall of 1951, Korolyuk starts PhD program continuing working with his Major Advisor Professor Gnedenko on the same problem. In his memoirs, Korolyuk wrote: "I was carried away by the task proposed by B.V., and as a result, the criteria of Kolmogorov and Smirnov became the subject of my PhD thesis, defended at the Institute of Mathematics in 1954." Throughout his life, Korolyuk have organized many scientific and research conferences including the 2002 International Gnedenko Conference in Kiev, dedicated to the memory of his teacher and mentor, B.V. Gnedenko.



Near the building of Kiev University. From left to right: V.S. Korolyuk, V.S. Mikhalevich, V.S. Rodionova, B.V. Gnedenko, A.V. Skorohod (1953)

In November 1953, the USSR Ministry of Higher Education assigned Gnedenko to go for one year to Berlin, Germany, to restore university education destroyed during the WWII there. Anticipating this trip, Gnedenko asked his mentor, Professor Andrei Nikolaevich Kolmogorov to accept three Gnedenko's graduate students (Korolyuk, Mikhalevich and Skorokhod) at Kolmogorov's Department at Moscow State University. Korolyuk has arrived to Moscow in September, while V.S. Mikhalevich and A.V. Skorokhod joined him there in December.

In May 1954, Korolyuk returned from Moscow to Kiev, where he worked under the leadership of Kolmogorov who soon arrived to Kiev to attend the Korolyuk's dissertation defense, which took place on June 29.



Four friends. Top row, from left to right: Vladimir Sergeevich Mikhalevich, Anatoliy Vladimirovich Skorokhod. Bottom row, from left to right: Anatoly Gordeevich Kostyuchenko, Vladimir Semenovich Korolyuk (Moscow University. Spring 1954).

As Doctor of Philosophy, Vladimir Semyonovich Korolyuk became an employee of the department of probability theory, led by Gnedenko. At the end of 1954, Gnedenko returns from Germany and proposes to open a laboratory for special modeling and computer technology at the Kiev Institute of Mathematics, which would be in turn separated into an independent institution - the Computing Center of the Academy of Sciences of Ukraine. The laboratory was the first in continental Europe to use an electronic computer (MESM), created by the laboratory team under the leadership of its previous Head, Lebedev. Various affiliated organizations were utilizing that computer to perform all kinds of tasks.

Well before his trip to Germany in 1953, Gnedenko and his students, V.S. Korolyuk and V.S. Mikhalevich, were formulating and solving various tasks at MESM. Now, Gnedenko decides to attract his former graduate students to the development of the new, wide profile computer "for solving systems of linear algebraic equations with a number of unknowns exceeding seven hundred, to meet the growing demand from customers in geodetic, construction, physical fields that we came across when working with numerous practical applications. Of my students, V.S. Korolyuk and E.L. Rvacheva were the most active participants [of the project]."

As part of the new computer project, V.S. Korolyuk begins to teach a computer programming course to 5th year students (equivalent to master students in the US system of education), and, together with Gnedenko and Rvacheva-Yushchenko, begins working on a programming textbook, the first chapters of which were ready by the end of 1955, and it was entirely written in 1960, becoming the first in the USSR textbook on programming, "Programming elements". It was released by publishing house Fizmatgiz in 1961 (Moscow. Fizmatgiz. 1961, 3-348), with the second edition following in 1963. In 1964, the textbook was published in Germany ("Elementen der

programmierung", Teubner, Leipzig: 1964, 1 - 327), Hungary ("Bevezetes a programozasba." Budapest, 1964, vol.1, 1 - 228 and vol.2, 1 - 204) and, in 1969, in France («Elements de programmation sur ordinateurs». Dunod. Paris. 1969. 1 - 362).

Korolyuk's last joint work with Gnedenko was the preparation of the report on *Asymptotic expansions in probability theory* for the IV Berkeley Symposium in the USA in 1960, in which Skorohod also participated. It was published in the «*Proceedings of the Fourth Berkeley Symposium on Mathematical Statistics and Probability*», 1961, vol. II, 153 -170, University of California Press. From Korolyuk's memoirs: "Although my subsequent research activities have been taking place with my students without the direct participation of Gnedenko, I continued to discuss new problems and new results with Gnedenko, always receiving attention and sympathy from him." Inherently, the scientific interests of the teacher and student continued to directly intersect. This happened, for example, when Gnedenko began to study the reliability of duplicated systems with recovery, when both operating time and recovery time are assumed to have arbitrary distributions, and received the first results, Vladimir Semenovich Korolyuk saw that semi-Markov processes could be used to solve such problems. In addition, as Korolyuk wrote afterwards, "so under the influence of B.V. [Gnedenko], a new direction in the theory of reliability has arisen - an asymptotic analysis of semi-Markov processes in the phase enlargement scheme," to which both, the student and the teacher, have contributed significantly.

Recollections of M. Yastrebenetsky

I dealt with the reliability problems of control systems for various technological processes. For building reliability models in some situations, Markov processes were not enough for me. I drew attention to the new then term – semi-Markov and Markov recovery processes. These processes could be models of the reliability for a number of industrial control systems. The first works that I saw on this subject were the works of V.S. Korolyuk.

Shortly thereafter, a series of portraits of prominent Russian mathematicians – Chebyshev, Kovalevskaya, and others, including Markov – was published. I began with the fact that cut the portrait of Markov lengthwise into two parts and hung a half of portrait of Markov in my office, telling everyone visiting me that this is the Semi - Markov.

Vladimir Semenovich Korolyuk attended one of my research presentations in Kiev. After that, he invited me to give a talk on Markov recovery process rarefaction at a seminar in his department at the Institute Mathematics of the Academy of Sciences of Ukraine. Since then, a warm welcome and help from Vladimir Semenovich Korolyuk have always greeted me in my work on semi-Markov processes. I became a frequent visitor at cozy home of Institute of Mathematics, located on the street, then bearing the name of the Russian painter Repin. No wonder he wrote on his book with A.F. Turbin "Mikhail Yastrebenetsky, a victim of semi-Markov processes."

A lot of attention in my doctoral dissertation devoted to reliability of industrial control systems was paid to semi-Markov processes. V.S. Korolyuk, then a corresponding member of the Academy of Sciences of Ukraine, signed a review from the Institute of Mathematics for my dissertation. On the advice of B.V. Gnedenko, opponents in defense of my doctoral dissertation were A.D. Soloviev and I.A. Ushakov (and Prof. A.A.Larin). The defense went flawlessly, but the newly reformed USSR Government Higher Committee on Dissertations (so-called VAK, Higher Attestation Commission) sent me negative reference of their reviewer. He wrote that my work is not original and merely repeats the results of the article of corresponding member of the Academy of Sciences of Ukraine Anatoly Vladimirovich Skorokhod and Professor I. I. Yezhov in the "Journal of Probability Theory and its Application". The parallel between my results and the results of Skorohod and Yezhov was

a great honor for me, because I have always considered my mathematical level (that of an engineer) and the level of Skorokhod's math incommensurate. However, I wanted to show that my results were by no means a simple replica of the previous researches. To prove my point, I decided that it is best decision is to ask Skorokhod himself to write a letter to the Higher Attestation Commission and confirm that there is nothing in common between our works. A.V. Skorokhod was a colleague of Korolyuk at the Institute of Mathematics and, as I learned later, his close friend. Thus, Vladimir Semenovich Korolyuk introduced me to Skorokhod and explained the situation. Skorokhod and Yezhov have seen my work and immediately wrote a letter to VAK, on the letterhead of the Institute of Mathematics. I still have a copy of this letter: "The process introduced in our article does not contain the model of regenerating semi-Markov process proposed in the dissertation of M. A. Yastrebenetsky as a special case." Further, in this letter, the difference between the article by Skorokhod and Yezhov and my work was described. That letter has become a significant contributor for the final approval of my dissertation. I am forever grateful to Vladimir Semenovich Korolyuk for help in such an important for me situation.



**International conference «Mathematic methods in Reliability» (MMR 2009),
Organized by Vladimir Rykov in Moscow. From left to right: Michael Yastrebenetsky,
Vladimir Semenovich Korolyuk, Dmitry Borisovich Gnedenko.**

Korolyuk's interest to the issues of the theory of reliability persisted throughout his lifetime, including his publication of the "Reference Book on Theory of Probability and Mathematical Statistics."

Always being interested in reliability issues, Korolyuk became one of the first presidents of the international association of specialists in reliability *Gnedenko-Forum*, created by Igor Ushakov and Alexander Bochkov and named after B.V. Gnedenko.

Speaking of Korolyuk, it is important to mention his wife - Nina Ivanovna Korolyuk-Andros. I remember her since my childhood in Kharkov– we have been of the same age and her female school was neighboring with my male school, so that our relationship was always friendly. Then it turned out that Nina became the wife of Vladimir Semenovich Korolyuk. Indeed, the world is small! Nina is - a servant of two muses. One of them - music. Nina is a musicologist, professor at the Kiev Conservatory, the author of scientific papers and textbooks in musical education. Her second muse is literature. Nina is the - author of children's books published in Kiev, Moscow, Riga, as well as the winner of a number of prestigious literary prizes. She has played a very important role in Korolyuk's life.

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