

Russia's Actuarial Legacy

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The Russia's actuarial legacy (among our goals is to testify to the correctness of that phrasing) has two prerequisites: the famous probability school and the demands from the insurance industry. Both have roots surprisingly deep.

The Russian probability school goes back to Leonhard Euler (1707–1783) and Daniel Bernoulli (1700–1782), members of the St.Petersburg Academy of Science since 1727 and 1725 respectively, who worked long time in Russia and published works in e.g., *Commentarii Academia Petropolitanae*. For lack of space we mention only the far-famed St.Petersburg paradox which name speaks for itself and cite the title of one of the pioneering articles by L. Euler on foundations of mathematical demography: "Investigations concerning mortality and increase of mankind".

The insurance, mostly in the form of governmental pensions for Army and Navy veterans, is known in Russia since Peter I. The conditions of the admission to pension were strictly stipulated¹ but there were no room yet for the market insurance since all the expenses were borne by the Crown.

The industrialization of the middle of the 19-th century was a big push forward for the market insurance which stimulated in its turn the scientific attitude to the problem. The result of cooperation between industrials, governmental officers and scientists (this cooperation was close and scrupulous but lengthy and in each particular branch of insurance deserves separate narrative) among whom V.Ya. Bouniakowsky² contributed a lot, gave birth to the Russian actuarial profession. It benefited of the experience of other national actuarial professions, in particular the British which was 50 years elder in those times, the French and the German.

By the end of 19-th century the actuarial knowledge was codified in the professional monographs by B.Th. Maleshewsky³ ([4],[5],[6]) and by S.E. Savitch⁴ ([7]).

¹Historians take particular interest to archive files concerning admission to pension of the veteran officers for these files contain most detailed record of service.

²Bouniakowsky, Viktor (1804–1889). Prominent Russian mathematician whose achievements are in Mechanics, Mathematical Physics, Calculus and Probability. Since 1864 and until shortly before his death vice-President of the Russian Academy of Science. Author of the probability textbook [3] where actuarial and demographical applications abound and of a range of actuarial papers (e.g., [1],[2]).

³Maleshewsky, Boleslaw (1849–1912). Graduated from the Warsaw University. Mathematician and high ranked civil officer. Since 1894 held the post of director of the Special Credit Office of the Ministry of Finance. Lectured (since 1902) in the St.Petersburg Polytechnic Institute.

⁴Savitch, Sergei (1864–?). Graduated from the St.Petersburg University. Presented theses "On linear ordinary differential equations with regular integrals" and received his Magister degree in mathematics. University professor. On behalf of different government institutions participated

These books are in Russian and their copies are of great rarity. To provide some view of these monographs we cite their contents.

The volume one ([4]) of the book by Maleshewsky is devoted to financial calculus and consists of seven chapters: ch. 1 (§§ 1–24⁵) — Interests and discounting, ch. 2 (§§ 25–53) — Level annuities, ch. 3 (§§ 54–87) — Variable annuities, ch. 4 (§§ 88–122) — Calculation of increments in level annuities, ch. 5 (§§ 123–156) — Theory of borrowing and refunding, ch. 6 (§§ 157–214) — Interest-bearing securities, lottery and premium bonds, ch. 7 (§§ 215–225) — Supplementary tables for financial calculus, addenda (tables).

Volume two, part one ([5]) consists of ten chapters: ch. 1 — Short historical review of life insurance and development of the appropriate institutions: pension funds, sickness insurance funds etc., ch. 2 (§§ 1–20) — Historical review of the development of mortality tables before 19-th century and the mortality tables compiled in the 19-th century on the base of general population data, ch. 3 (§§ 21–76) — Mortality tables compiled on the base of individual observations, ch. 4 (§§ 77–105) — Empirical mortality laws and the mortality coefficient, ch. 5 (§§ 106–133) — Correction of the mortality tables, ch. 6 (§§ 134–154) — Probability of survival and of death of one life; mean of the future lifetime; application of the mortality tables; laws of Grossman and of Bouniakowsky, ch. 7 (§§ 155–182) — Calculation of probabilities related to joint survival of two or more lives; mean duration of future joint survival; extension of the Gompertz and Makeham laws of mortality on the joint survival, ch. 8 (§§ 183–221) — Mathematical theory of disability, ch. 9 (§§ 222–240) — Calculation of the probability of marriage; tables of matrimony, ch. 10 (§§ 241–250) — Morbidity statistics.

Volume two, part two ([6]) consists of ten chapters: ch. 1 (§§ 1–33) — Evaluation of the accumulated value of a pension⁶ for one life at a certain age, ch. 2 (§§ 34–59) — Pure endowment and whole life insurance contracts for one life; relations among the pension and the capital⁷; m -year term and whole life pensions, ch. 3 (§§ 60–106) — Premium calculation; cash refund and insurance with bonus; change of the insurance contract conditions, ch. 4 (§§ 107–135) — Disability and old-age pensions; retirement pension plans, ch. 5 (§§ 136–158) — Pensions for two and more lives, ch. 6 (§§ 159–187) — Benefits payable at the moment of one or several deaths in a group; pensions at the moment of the first death, ch. 7 (§§ 188–216) — Heritor's⁸ pensions, ch. 8 (§§ 217–275) — Price of the insurance contract; reserve evaluation, ch. 9 (§§ 276–280) — Illness insurance, ch. 10 (§§ 281–323) — Mathematical theory of risk.

The monograph by Maleshewsky comprises also the volume three which is composed of a great number of tables.

The book by Savitch ([7]) consists of ten chapters: ch. 1 (§§ 1–38) — Basic notions of the theory of probability, ch. 2 (§§ 39–50) — Basic formulas concerning long-term financial operations, ch. 3 (§§ 51–77) — Mortality tables, ch. 4 (§§ 78–95)

in actuarial evaluation of insurance companies and pension funds. Contributor of the *Bulletin de l'Institut des actuaries français* and of the Proceedings of the first and of the second International Congresses of Actuaries.

⁵The author considers it of great interest to communicate to the actuarial community further details concerning the monographs by Maleshewsky and Savitch. Unfortunately, lack of space renders it impossible here.

⁶In this context annuity payable to insured.

⁷In this content single premium.

⁸Widow's and orphan's.

— Probabilities concerning one or more lives, ch. 5 (§§ 96–106) — Disability tables and probabilities concerning life and employability, ch. 6 (§§ 107–114) — Commutation numbers, ch. 7 (§§ 115–144) — Endowment and life insurance benefits; annuities, ch. 8 (§§ 145–161) — Calculation of net-premiums in main insurance contracts, ch. 9 (§§ 162–183) — Calculation of reserves, ch. 10 (§§ 184–211) — Pension funds, addenda (tables).

Current actuarial problems were discussed in the monthly journal [8] published since 1890.

After this impressive preparatory work the Russian actuaries were becoming swift enough for the race and strong enough for the battle⁹, but . . . nor does food come to the wise or wealth to the brilliant or favor to the learned; but time and chance happen to them all: the Bolshevik coup d'état followed.

The decrees "On establishment of government control over all kinds of insurance except social" (March, 23, 1918), "On organization of insurance in the Russian republic" (November, 28, 1918), "On annulment of life insurance contracts" (November, 18, 1919) and "On annulment of property insurance contracts" (December, 18, 1920) which culmination was the decree "On the governmental property insurance" (October, 6, 1921) eliminated the market insurance. The actuarial profession was deprived of its base. Moreover, to mention the actuarial application of the probability theory became dangerous and was tacitly forbidden¹⁰.

I dare say however that it is wrong to deem that the Russian actuarial school perished. It rather became latent within the probability school¹¹. I testify here that my elder colleagues and teachers and particularly academicians B.V. Gnedenko and Yu.V. Prokhorov did their best to support interest of students to application of theory probability to insurance problems.

⁹In 1915 the International Congress of Actuaries was organized but not held in St.Petersburg, Russia.

¹⁰Reader should bear in mind that literally a danger of death was to work in particular fields of science e.g., genetics (the leader of the Russian genetics Nikolai Vavilov was arrested in 1940 and faced his death in jail alike many of his colleagues; newspapers did not refer to genetics any otherwise than as "harlot of imperialism"), let alone actuarial science whose "capitalist" origin is evident. It is then a peculiar actuarial problem to evaluate the risk accepted by A.N. Kolmogorov who published in 1940 a paper [9] where he applied non-parametric test known presently as the Kolmogorov-Smirnov's to certain empirical data and claimed that "these data . . . turn to be a brilliant new confirmation of the Mendel's laws".

¹¹We consider it appropriate to cite a short excerpt from the article by Harald Cramér [10] whose witness is precise: ". . . In May 1955 the University of Moscow celebrated its bicentennial, and I was invited to attend, representing the Stockholm University. It was a great event, and it gave me an opportunity to make the personal acquaintance of the Soviet mathematicians, whose work had meant so much for the advancement of probability theory. Unfortunately, Khintchine was ill — he died shortly afterwards — but I met Kolmogorov, who gave the impression of being a great scientific personality, and I had some interesting conversations with him. I was also happy to meet other members of their probabilistic group. There was Dynkin, who was beginning his great work on Markov processes, Gnedenko who in collaboration with Kolmogorov had written the book on limit problems referred to above, Linnik who was beginning his work on large deviations so closely connected with my own work of 1937, Yaglom and Rozanov who were to do outstanding work on stationary processes, and many others. They formed a group of wonderful scientific activity, and were preparing to start their new Journal of Probability Theory and its Applications, which soon acquired an internationally leading position in the field." To stimulate the interested reader to address to this memoir which is in no sense an apology we note e.g., that the name of Kolmogorov is cited there 42 times, the name of Khintchine 20 times.

”Perestroika” called forth great hope of quick resurrection of the actuarial profession, mostly among members of the Russian probability community. The Russian actuarial society was established. Unfortunately, contrary to great expectations, things went down and this society collapsed de juro and de facto. The failure was caused indirectly by the troubles of the insurance industry and legislation¹² and directly by administrative and professional incompetence of certain responsible persons¹³.

The past decade was however productive. First of all, the interest of insurers to actuarial expertise increases in direct ratio to their business growth (i.e., acquiring of statistics, increase of insurance portfolios etc.) and to stabilization of inflation. Implying future development (e.g., forthcoming implementation of the compulsory automobile insurance and the development of the life insurance) national insurers supported translations [13],[14],[15] which codified the modern actuarial terminology in Russian and reinforced the educational base. Swiss and British funds contributed to publication of the translations [11],[12]. Among the contributors of the 26-th and the 27-th International Congresses of Actuaries there were Russians, Russian member was admitted to the IAA and ASTIN, Russian researchers in risk theory and in financial mathematics are active.

The narrative of the Russia’s actuarial legacy evokes a legend about a mythical bird called Phoenix. The resurrection of Phoenix to life from death was described by Herodotus, Tacitus and others with varying details. The version that has become popular in modern times has the new Phoenix arising from the funeral pyre which the old Phoenix has made for itself (i.e., arising from the flame or ashes). The Phoenix and its legend have always had a positive role in mythological symbolism and are now almost universally (at least in Western culture) recognized as depicting the indefeatable nature of the Human Spirit.

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¹²The interested reader will be amazed by the rate of inflation in 1990-th in Russia; the Royal Charter seems a big advantage of the UK actuarial profession — the Russian legislation does not stipulate even who is actuary.

¹³The Russian actuarial society collapsed more than two years ago while presided by Mr. Kotlovsky who let this ship sink.

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