Czechoslovak Mathematical Journal

Zbyněk Šidák

News and Notices. Jaroslav Hájek, 1926–1974

Czechoslovak Mathematical Journal, Vol. 25 (1975), No. 3, 491–502

Persistent URL: http://dml.cz/dmlcz/101343

Czechoslovak Mathematical Journal, 25 (100) 1975, Praha

NEWS and NOTICES

JAROSLAV HÁJEK, 1926—1974

ZBYNĚK ŠIDÁK, Praha

The readers of this Journal may remember a recent article (Czech. Math. J. *24* (*99*) (1974), 167–169) relating the award of Klement Gottwald State Prize for 1973 to Prof. ing. dr. JAROSLAV HÁJEK, and the wish expressed there that Prof. Hájek's poor health should improve. Unfortunately, this wish did not come true and on June 10, 1974, Prof. Hájek died, aged only 48 years. His death means an irreparable loss to mathematical statistics on the world scale and particularly in Czechoslovakia where he was founder and the most distinguished representative of our modern scientific mathematico-statistical school in post-war time.

Jaroslav Hájek was born in Poděbrady on February 4, 1926, as son of a hairdresser and a dressmaker. He lost his father at an early age and the family was rather badly off then. At that time and also in subsequent years, he found a second father in his uncle. Some five years later his mother remarried but in 1944 she became a widow again. Nevertheless, in spite of her slender resources she let her son study because as early as a boy he showed much talent for mathematics.

After his studies at the grammar school, J. Hájek studied statistical engineering at the College of Special Sciences at the Czech Technical University and graduated in 1950 as Doctor of Statistical Engineering (in the sense of the word of that time). After his military service he spent the years from 1951 to 1954 as graduate student in the Institute of Mathematics of the Czechoslovak Academy of Sciences and obtained his CSc. degree there in 1955. From 1954 to 1966 he served as a research worker in that Institute. In 1963 he got his Doctor of Physico-Mathematical Sciences degree for his thesis on statistical problems in stochastic processes.

He started his teaching activity as early as in 1948–49 as Assistant Lecturer in the College of Special Sciences. He also lectured at the Economical University in Prague. In 1963 he habilitated at the Faculty of Mathematics and Physics of the Charles University and started teaching there. In 1964 be became external head of the Department of Mathematical Statistics at the above Faculty, and since then led that Department for many years. Finally, in 1966, he was appointed full Professor at the Faculty and joined it for good. In 1973 he got the highest recognition of his scientific work – he was awarded Klement Gottwald State Prize for having built up the asymptotic theory of statistical rank tests.

With much enthusiasm for progress in science, he worked in a number of positions in the organization of both Czechoslovak and international scientific life. He was member of the Scientific Council of the Faculty of Mathematics and Physics of the University and chairman of the Commission for both CSc. and DrSc. degrees in the field of probability theory and mathematical statistics, earlier also member of the Scientific Board of Mathematics and of the Committee for the applications of mathematical methods to Economics at the Institute of Economics of the Czechoslovak Academy of Sciences. He served on the Editorial Boards of the following international Journals: Annals of Mathematical Statistics (after dividing the Journal in Annals of Statistics), Advances in Applied Probability, Zeitschrift für Wahrscheinlichkeitstheorie und verwandte Gebiete, Mathematische Operationsforschung und Statistik, Czechoslovak Mathematical Journal and earlier also Aplikace matematiky. As to international learned societies, he was Fellow of Institute of Mathematical Statistics and member of International Statistical Institute and Econometric Society.

Thanks to his scientific renown Prof. Hájek was many times invited to foreign countries to work and lecture there; he often had so many invitations that it was beyond his power to accept all of them. Le tus mention only his four longer visits to the U.S.A. He was invited three times to the University of California in Berkeley, to the Michigan State University in East Lansing and to the Florida State University in Tallahassee; to complete the picture let us mention that e.g. during his last stay in the U.S.A. he got invitations to lectures from 45 universities on the American continent.

In his scientific work Prof. Hájek dealt mainly with the following areas of mathematical statistics: theory of sample surveys, theory of rank tests, and statistical methods in stochastic processes. A characteristic feature of his work was the evidence of his first engineering training (in the best sense of the word), which enabled him to see into the real essence of the problems. Such an "engineer's approach" and understanding of the needs of practice, combined with deep, ingenious and modern mathematical methods resulted in his numerous important and inspiring achievements and ideas. At the moment of their appearance, his publications always meant a considerable step forward in the development of the field treated, and have many times become a starting point for foreign and Czechoslovak authors. Certain fundamental results are cited under Hájek's name. A number of his papers and books have been translated and republished in English and Russian in the U.S.A. and the Soviet Union respectively. (The list of publications at the end of the present article includes only translations of books and not of papers). In the following let us recall some of his most important publications.

Among Hájek's favourite areas, the theory of probability sampling from finite populations was chronologically the first (cf. [2], [46]); but he did not abandon it until the end of his life (cf. [45], [57]). In [8] he investigates the estimates in

Professor Jaroslav Hájek

stratified sampling, and the optimal and random allocations of samples to strata. The paper [15] contributes to the asymptotic theory of ratio estimates by applying the regression approach and the normal theory approach. In [17] the sampling designs and the estimation methods are found which (under bayesian approach) solve in an optimal way the conflict between the cost of the experiment and the accuracy of the estimates; this work is also related to Hájek's third field of interest – stochastic processes, because the solution is given not only for uncorrelated random variables but also for stationary random sequences with a convex correlation function. Another optimization problem is solved in [28], namely that arising in estimation of many parameters. In [20] a necessary and sufficient condition is established for the asymptotic normality (or the asymptotic Poisson distribution) of the estimates in a simple random sampling without replacement; the method of proof is based on approximating simple random sampling by Poisson (binomial) sampling which is defined as independent sampling of units with certain probabilities, so that it is theoretically easier to study. This idea is further refined and used in the paper [29] on rejective sampling, i.e. on sampling such that n units are selected independently with possibly different probabilities and with replacement, but if all the units selected are not distinct, the whole sample is rejected and a new sample is taken; here again the approximation by Poisson (binomial) sampling is used for finding the results on asymptotic normality. An entirely different problem, important e.g. in geology – namely, probability sampling of points in the plane – is studied in [21] and [24].

Prof. J. Hájek published the book [47] on the theory of probability sampling; its first part is essentially a basic text-book, while its second part is a monograph including also some of his original results. Further, not long before his death he completed the manuscript of a new monograph [57], but he intended to work over it once again.

The second field of Hájek's intensive interest was the theory of rank tests, especially their asymptotic theory. His works are literally landmarks in the development of this theory, and Prof. Hájek himself was considered to be one of the foremost specialists – or may be the first specialist at all – in this field in the whole world. Already at the time when only the first papers on rank tests started timidly to appear, J. Hájek foresaw their future importance and studied them in his thesis in 1949; in its part, published later as [3], he derived the generating functions, and proved the asymptotic normality, of the distributions of statistics which are now known as the Wilcoxon two-sample and one-sample statistics, and the Kendall rank correlation coefficient.

To be more precise let us now suppose that we are given a random sample $X_1, \ldots, X_N$, where X_i has a continuous distribution function F_i. First of all, prof. Hájek investigated the asymptotic distributions of simple linear rank statistics, i.e. statistics of the form $S_N = \sum_{i=1}^{N} c_i\, a(R_i)$, where c_i are known regression constants, $a(i)$ are scores, and R_i is the rank of X_i in the ordered sample (all symbols depending on N in general). In [22] Hájek found necessary and sufficient conditions of Lindeberg type for the asymptotic normality of S_N under the null hypothesis $F_1 = \ldots = F_N$; the original method of the paper was based on the proof that S_N is asymptotically equivalent to a suitable sum T_N of independent variables (in the sense $\lim_{N \to \infty} E(S_N - - T_N)^2/\text{var } T_N = 0$). This theorem is now commonly quoted under Hájek's name, or under the names Wald-Wolfowitz-Noether-Hájek. In the paper [27] he proved the asymptotic normality of the statistics S_N for testing the regression coefficient β in the model $X_i = \alpha + \beta c_i + \sigma Y_i$ under contiguous alternatives (i.e. alternatives approaching at a certain rate the null hypothesis), investigated the asymptotic efficiency of the respective tests, found the form of the asymptotically most powerful rank test, and constructed a universally asymptotically most powerful rank test, whose existence was then a surprise for specialists; a remarkable novelty of the paper was the use of contiguity in the theory of rank tests, which had been originally introduced by LeCam for another purpose. Later on, this line of research continued by the papers [35] and [36], where the asymptotic normality of S_N is proved under very general non-contiguous regression alternatives, and by the paper [37], where similar but still stronger results are given for the Wilcoxon statistic; all these results are far-going generalizations of the well-known Chernoff-Savage theorem, and the ingenious method of proofs is based on a new remarkable inequality for the variances of S_N and on an approximation of S_N by means of their projections on the sums of independent variables.

Moreover, Prof. Hájek dealt with a number of further problems in the theory of rank tests. One of his original ideas was e.g. a representation of the well-known Kolmogorov-Smirnov statistic in a different equivalent form by means of so called antiranks $D_1, \ldots, D_N$ (i.e. $D_1, \ldots, D_N$ is the inverse permutation of the permutation $R_1, \ldots, R_N$), which enabled him then in [30] to generalize this statistic in a natural way for regression alternatives, and to prove its convergence in distribution to the Brownian bridge. In [33] he found the locally most powerful rank test of independence of (X_i, Y_i) in the model $X_i = X_i^* + \Delta Z_i$, $Y_i = Y_i^* + \Delta Z_i$, X_i^*, Y_i^*, Z_i independent. In the paper [39], besides several other topics, he proposed three methods of estimation of the density, which may be used in choosing proper scores for rank tests. In [43] he investigated the efficiency in the Bahadur sense, and proved that, in testing randomness, against the alternative of two samples, the rank tests attain the best possible exact slope.

The results of Prof. Hájek on rank tests until approximately 1965 have been then gathered, systematized and completed by a number of further results in a three-hundred-pages monograph [53]; in addition to the mentioned statistics S_N for testing two samples and regression, also the rank statistics for testing symmetry in one sample, the statistics of the χ^2-type for k samples and for random blocks, the statistics for testing independence, and the statistics of the Kolmogorov-Smirnov and Cramér-von Mises types are investigated here in a similar way. After publishing this thorough scientific treatise, prof. Hájek has written another book [54] in this field at a more accessible level, since he intended it as a text-book for students.

The third major field of Hájek's work were statistical problems in stochastic processes. First, he paid attention to stationary processes with a convex correlation function: in [7] he found the lower bound for the variance of a linear estimate of the mean value of such processes, and showed that the variance of the usual estimate based on the average attains this lower bound; similarly, in [11] he found the lower bound for the residual variance of a linear prediction in such processes. An important result in a quite different line of research was published in [13]: leaning on some limit properties of J-divergences from [12] it was proved in [13] that the probability measures of any two Gaussian processes are either equivalent or mutually singular; the same result was published in the same year by J. Feldman, and therefore it is now commonly quoted as Feldman-Hájek theorem on dichotomy, but Hájek's method of proof is more constructive and therefore more applicable for investigating special cases.

Further group of papers [19], [23], [25] is characterized by the use of Hilbert space methods for solving statistical problems. In [19] the Gaussian process x_t is studied for which $\int x_t \, \mathrm{d}P_\alpha = \alpha\varphi_t$, where φ_t is a known function, α an unknown parameter; the existence of a sufficient statistic for this model is proved, and this statistic found in the regular case. In [23] the preceding model is generalized, namely, an arbitrary stochastic process x_t is investigated for which $\int x_t \, \mathrm{d}P_\alpha = \sum_{i=1}^{m} \alpha_i \varphi_{it}$, where φ_{it} are known functions, α_i unknown parameters; it is shown that classical theorems on the method of least squares and on Markov estimates remain essentially true also here for estimating linear functionals $\Theta = \sum_{i=1}^{m} c_i \alpha_i$. A long paper [25] is again of fundamental importance, since here a unified theoretical approach is developed for the solution of a number of problems such as prediction, filtration, estimation of regression parameters etc. in stochastic processes; the method is based on the correspondence of linear manifolds generated on one side by the random variables x_t, on the other side by their covariances R_{ts}. (Approximately at the same time or somewhat later other authors, e.g. E. Parzen, elaborated a similar approach to these problems based on the so called reproducing kernel Hilbert spaces.) Further in [25] the conditions are analyzed under which the solutions of these problems may be interpreted in terms of individual trajectories (i.e. not only as limits in the mean), strong equivalence of distributions of Gaussian processes is defined, and the density of such a distribution with respect to another one is studied; various general results of the paper are explicitly worked out for stationary processes with a rational spectral density. In the last paper [44] from the field of processes experimental designs (i.e. systems of points) are found that are asymptotically optimal for estimating β in the model $Y(t) = \beta f(t) + X(t)$, where $f(t)$ is known and $X(t)$ is an autoregressive process.

In addition to the three mentioned areas of a long-lasting and intensive interest of Prof. Hájek, he contributed also to certain other areas. Although these contributions are somewhat isolated, many of them contain very important results; let us mention only briefly some of them. E.g. in [4] an interesting inequality (generalizing that of Kolmogorov) was proved for the probabilities concerning the maxima of sums of independent variables; this inequality was often utilized, generalized and quoted even in textbooks, and is now commonly known as the Hájek-Rényi inequality. Further, we may recall two papers in the parametric theory of estimation: in [40] Hájek proved a remarkable result that in a wide class of cases the asymptotic distribution of estimates is a convolution of a certain normal distribution depending only on the underlying distribution, and of a further distribution depending only on the choice of the estimate; under analogous assumptions he found in [42] the lower bound for the local asymptotic minimax risk of estimates assuming very general form of a loss function.

As we have said before, prof. J. Hájek had an admirable gift of a certain "engineer's insight" into the essence of statistical problems. Therefore he was also much interested in various basic questions of statistical inference. He often used to discuss these problems enthusiastically, some remarks on them may be found in some of his publications, but unfortunately he devoted only three papers [5], [31], [32] to them. The last of them, the lecture [32] at the Berkeley symposium, is the most important one, and the concepts of sufficiency, invariance, similarity, conditionality, and likelihood are analyzed in it.

All Hájek's scientific activity was closely associated with applications of mathematical statistics. The results obtained by him are of considerable importance in this respect and are taken advantage of in practice (sample surveys, application of rank tests, stationary processes etc.). Moreover, Prof. Hájek himself cooperated in many problems of practice in various fields. Let us mention e.g. his extensive cooperation in sample surveys concerned with the condition of teeth of the population, with food, in certain anthropometric surveys etc. It is now hardly possible to give a survey of this equally intensive Hájek's activity, because his name, except for one case (publication [18]), usually remained hidden in the background.

Prof. Hájek was an ardent supporter of mathematico-statistical methods because "statistics increases the culture and productivity of human thinking, for it is able to distinguish between justified judgements and the hasty ones, to fix the border beyond which simpler models should be replaced by more complex ones, and to determine the size of data necessary for an appropriate decision" (Hájek's own quotation of 1970). That is also why for a further growth and propagation of this field he devoted himself with much zeal and devotion to pedagogical activity. In his position as the head of the Department of Mathematical Statistics at the Faculty of Mathematics and Physics of the Charles University he educated and trained graduate students and young research workers, lectured to students and wrote texts for them (see [52], [55], [56]). As teacher he was rather strict and demanding but those who have gone through his training possess thorough scientific foundations indeed. Itshould also be noted that to those who had proved gifted and hard-working Hájek gave all possible advice and encouragement and sometimes he even put his own original ideas at their disposal. This has given rise to a number of further papers by his students many of whom obtained their CSc. degrees under his guidance (e.g. J. Anděl, M. Hušková, J. Jurečková, D. Vorlíčková, J. Štěpán and the Vietnamese Nguyen-van Ho). Through his activity Hájek set a high standard of the work done in the Department and as a matter of fact founded his own scientific school in the field of asymptotic problems of mathematical statistics.

In the sense of the above quotation Hájek also paid attention to the teaching of mathematical statistics and probability theory at a lower grade, for he was convinced that statistical thinking would become more and more a part of general education. For this reason he gladly participated in writing text-books [48] and [51] for grammar schools (see also the paper of methodological character [38]) and a popular book [49].

From what has just been said on the previous pages a clear picture of Professor Hájek as an outstanding scientist serving his field of interest with devotion appears. It does not, however, mean that he was a dry and boring man – the very contrary is true: Hájek was cheerful and sociable, had much sense of humour and a particular liking for jokes based on puns, which he devised himself; I also remember that he used to write little humoristic scenes for the parties organized in the Institute of Mathematics of the Czechoslovak Academy of Sciences. He was greatly interested in culture, in modern painting and in music; he particularly liked concert guitar and played this instrument quite well. He visited many countries on his trips but he used to return to Poděbrady, his birth-place, for relaxation and rest. There he devoted himself either to fishing or gardening in his little garden.

His scientific achievements and positive attitude towards life were obtained at a high price from fate: a large part of his life he suffered from a serious kidney disease. One must particularly admire his courage and strength of will with which he fought against his illness in the last years and months. Regardless of his deteriotating health condition he kept working in research and organization of science and maintained his vitality and understanding of the needs of others. Till the last weeks of his life he had many plans for further scientific activity, which he unfortunately could no more carry into effect.

In the person of Prof. J. Hájek we have lost our most important, world famous specialist in mathematical statistics. If we speak about an irreparable loss, we really mean it, as evidently there will not be anybody for a long time to fill in the void in scientific life caused by death of such an outstanding personality.

LIST OF PUBLICATIONS OF JAROSLAV HÁJEK

I. Papers

[1] Užití komplexní methody a intervalu spolehlivosti při vážení. (An application of factorial design and of the confidence interval to weighing.) Statistický obzor *29* (1949), 258—273.

[2] Representativní výběr skupin methodou dvou fází. (The cluster sampling by the two-stage method.) a) Statistický obzor *29* (1949), 384—394.
b) (Summary) Čas. pěst. mat. fys. *74* (1949), 282—283.

[3] Některá pořadová rozdělení a jejich použití. (Some rank distributions and their applications.) Čas. pěst. mat. *80* (1955), 17—31.

[4] Generalization of an inequality of Kolmogorov. Acta Math. Acad. Sci. Hung. *6* (1955), 281—283. (Jointly with *A. Rényi.*)

[5] K některým základním otázkám matematické statistiky. (On some fundamental questions of mathematical statistics.) Čas. pěst. mat. *80* (1955), 387—399. (Jointly with *F. Fabian.*)

[6] Асимптотическая эффективность одной последовательности тестов. (The asymptotic efficiency of some sequence of tests.) Чехослов. мат. ж. *6* (*81*) (1956), 26—30.

[7] Линейная оценка средней стационарного случайного процесса с выпуклой корреляционной функцией. (Linear estimation of the mean value of a stationary random process with convex correlation function.) Чехослов. мат. ж. *6* (*81*) (1956), 94—117.

[8] Oblastní výběr. (Stratified sampling.) Aplikace matematiky *1* (1956), 149—161.

[9] Poznámka k článku „O jistých posloupnostech skupin bodů na kružnici". (A note on the paper "On certain sequences of point sets on a circle".) Čas. pěst. mat. *81* (1956), 77—78.

[10] Nerovnosti pro zobecněné Studentovo rozdělení a jejich použití. (Inequalities for the generalized Student's distribution and their applications.) Čas. pěst. mat. *82* (1957), 182—194.

[11] Predicting a stationary process when the correlation function is convex. Czechoslovak Math. J. *8* (*83*) (1958), 150—154.

[12] A property of *J*-divergences of marginal probability distributions. Czechoslovak Math. J. *8* (*83*) (1958), 460—463.

[13] Об одном свойстве нормальных распределений произвольного стохастического процесса. (On a property of normal distributions of any stochastic process.) Czechoslovak Math. J. *8* (*83*) (1958), 610—618.

[14] O rozdělení některých statistik za přítomnosti vnitrotřídní korelace. (On the distribution of some statistics in the presence of intraclass correlation.) Čas. pěst. mat. *83* (1958), 327—329.

[15] On the theory of ratio estimates. a) Aplikace matematiky *3* (1958), 384—398.
b) (Summary) Bull. Inst. Internat. Statist. *37* (1960), Part 2, 3—10.

[16] Some contributions to the theory of probability sampling. Bull. Inst. Internat. Statist. *36* (1958), Part 3, 127—134.

[17] Optimum strategy and other problems in probability sampling. Čas. pěst. mat. *84* (1959), 387—423.

[18] Věk při prořezávání 2. dentice u dětí ČSSR. (The age of eruption of permanent teeth in children in Czechoslovakia.) Československá stomatologie *59* — 2 (1959), 104—113. (Jointly with *V. Poncová.*)

[19] On a simple linear model in Gaussian processes. Trans. 2nd Prague Conf. Inf. Theory, Stat. Dec. Functions, Random Proc. 1959, Publ. House Czech. Acad. Sci., Praha 1960, 185—197.

[20] Limiting distributions in simple random sampling from a finite population. Publ. Math. Inst. Hung. Acad. Sci. *5* (1960), 361—374.

[21] On plane sampling and related geometrical problems. Proc. 4th Berkeley Symp. Math. Statist. Prob. 1960, Univ. of Calif. Press 1961, vol. I, 125—150. (Jointly with *T. Dalenius* and *S. Zubrzycki.*)

[22] Some extensions of the Wald-Wolfowitz-Noether theorem. Ann. Math. Statist. *32* (1961), 506—523.
[23] On linear estimation theory for an infinite number of observations. Теория вероятностей и применения *6* (1961), 182—193.
[24] Concerning relative accuracy of stratified and systematic sampling in a plane. Colloquium math. *8* (1961), 133—134.
[25] On linear statistical problems in stochastic processes. Czechoslovak Math. J. *12* (*87*) (1962), 404—444.
[26] An inequality concerning random linear functionals on a linear space with a random norm and its statistical application. Czechoslovak Math. J. *12* (*87*) (1962), 486—491.
[27] Asymptotically most powerful rank-order tests. Ann. Math. Statist. *33* (1962), 1124—1147.
[28] Minimalisace nákladů při dosažení předepsané přesnosti současně u několika odhadů. (Cost minimization in multiparameter estimation.) Aplikace matematiky *7* (1962), 405—425.
[29] Asymptotic theory of rejective sampling with varying probabilities from a finite population. Ann. Math. Statist. *35* (1964), 1491—1523.
[30] Extension of the Kolmogorov-Smirnov test to regression alternatives. Bernoulli-Bayes-Laplace Anniversary Volume, Springer Verlag, Berlin 1965, 45—60.
[31] On the foundations of statistics. Conf. on Math. Methods in Economic Research, Smolenice 1965. Edited by Ekonomicko-matematická laboratoř při Ekonomickém ústavu ČSAV, Praha 1966, 1—17.
[32] On basic concepts of statistics. Proc. 5th Berkeley Symp. Math. Statist. Prob. 1965—1966, Univ. of Calif. Press 1967, vol. *I*, 139—162.
[33] Locally most powerful rank tests of independence. Studies in Math. Statistics, edited by *K. Sarkadi* and *I. Vincze*, Akadémiai Kiadó, Publ. House Hung. Acad. Sci., Budapest 1968, 45—51.
[34] Some new results in the theory of rank tests. Studies in Math. Statistics, edited by *K. Sarkadi* and *I, Vincze*, Akadémiai Kiadó, Publ. House Hung. Acad. Sci., Budapest 1968, 53—55.
[35] Asymptotic normality of simple linear rank statistics under alternatives. a) Ann. Math. Statist. *39* (1968), 325—346.
b) (Preliminary communication) Proc. Nat. Acad. Sci. U.S.A. *57* (1967), 19—20.
[36] Asymptotic normality of simple linear rank statistics under alternatives II. Ann. Math. Statist. *40* (1969), 1992—2017. (Jointly with *V. Dupač.*)
[37] Asymptotic normality of the Wilcoxon statistic under divergent alternatives. Zastosowania matematyki *10* (1969), 171—178. (Jointly with *V. Dupač.*)
[38] K počtu pravděpodobnosti. (On the calculus of probability.) Matematika ve škole *19* (1969), 449—462.
[39] Miscellaneous problems of rank test theory. Nonparametric Techniques in Statistical Inference, edited by M. L. Puri, Cambridge Univ. Press 1970, 3—17.
[40] A characterization of limiting distributions of regular estimates. Z. Wahrscheinlichkeitstheorie verw. Geb. *14* (1970), 323—330.
[41] Limiting properties of likelihood and inference. Foundations of Statistical Inference, edited by V. P. Godambe and D. A. Sprott; Holt, Rinehart and Winston, Toronto 1971.
[42] Local asymptotic minimax and admissibility in estimation. Proc. 6th Berkeley Symp. Math. Statist. Prob. 1970, Univ. of Calif. Press 1972, vol. *I*, 175—194.
[43] Asymptotic sufficiency of the vector of ranks in the Bahadur sense. Ann. Statist. *2* (1974), 75—83.
[44] Regression designs in autoregressive stochastic processes. Ann. Statist. *2* (1974), 520—527. (Jointly with *G. Kimeldorf.*)
[45] Asymptotic theories of sampling with varying probabilities without replacement. Proc. Prague Symp. on Asymptotic Statistics, September 1973, Charles University Praha 1974, vol. *I*, 127—138.

II. Books and texts

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[47] Teorie pravděpodobnostního výběru s aplikacemi na výběrová šetření. (Theory of probability sampling with applications to sample surveys.) NČSAV, Praha 1960.

[48] Algebra pro 3. roč. SVVŠ. (Algebra for 3rd grade of Grammar Schoools.) SPN, Praha 1961; more editions. (Author of chapters on probability and statistics, further joint authors of the book *A. Hyška, A. Robek, A. Hustá.*)

[49] Pravděpodobnost ve vědě a technice. NČSAV, Praha 1962. (Jointly with *V. Dupač.*)
English translation: Probability in Science and Engineering. Academia, Publ. House Czech. Acad. Sci., Praha, and Academic Press, New York 1967.

[50] Přehled užité matematiky. SNTL, Praha 1963; 2nd edition 1968; 3rd edition 1973. (Author of chapters on probability and statistics, joint authorship of the book in a group of 18 members headed by *K. Rektorys.*)
English translation: Survey of Applicable Mathematics. Iliffe Book Ltd., London 1969.

[51] Matematika pro 3. roč. SVVŠ, větev přírodovědná. (Mathematics for 3rd grade of Grammar Schools, Science Branch.) SPN, Praha 1966; more editions. (Author of chapters on probability and statistics, further joint authors of the book *E. Kraemer, F. Veselý, J. Voříšek, M. Zöldy.*)

[52] Neparametrické metody. (Nonparametric methods.) SPN, Praha 1966. (Text for Faculty of Math. and Phys., Charles Univ., jointly with *D. Vorlíčková.*)

[53] Theory of Rank Tests. Academia, Publ. House Czech. Acad. Sci., Praha, and Academic Press, New York, 1967. (Jointly with *Z. Šidák.*) Russian translation: Теория ранговых критериев. Издательство Наука, Москва 1971.

[54] A Course in Nonparametric Statistics. Holden-Day, San Francisco 1969. (Russian translation under preparation.)

[55] Stacionární procesy. (Stationary processes.) SPN, Praha 1969. (Text for Faculty of Math. and Phys., Charles Univ., jointly with *J. Anděl.*)

[56] finished manuscript: Matematická statistika. (Mathematical statistics.) Text for Faculty of Math. and Phys., Charles Univ., jointly with *D. Vorlíčková.*)

[57] almost finished manuscript of a monograph: Theory of Probability Sampling.