Tatra Mt. Math. Publ. **26** (2003), 1–9

TATRA MOUNTAINS
Mathematical Publications

PROFESSOR ANDREJ PÁZMAN

ANATOLIJ DVUREČENSKIJ

Prof. RNDr. A. Pázman, DrSc., one of the leading personalities of the Slovak School of mathematical statistics, member of the Royal Statistical Society (UK) and of the Institute of Mathematical Statistics (USA), was born in Prague on December 6, 1938. He graduated in physics from the Faculty of Sciences, Comenius University, Bratislava in 1961, and in 1961–64 he pursued his PhD study at the Institute of Measurement Theory of the Slovak Academy of Sciences (SAS), Bratislava, and in Prague at the Institute of Information Theory and Automatization. During this study he changed his orientation towards statistics, passing in a certain extent through information theory. In years 1966–69 he worked as a researcher in the international Joint Institute of Nuclear Researches in Dubna, Russia, and in 1976 he made a five-month stay on probability in France, Université Paris VI by prof. J. Neveu. Up to these interruptions, he pursued research in statistics at the Institute of Measurement of SAS in the period 1964–1981, as a leading research worker from 1978. In 1980, he obtained here the scientific degree of DrSc. In years 1981–1991, he worked at the Mathematical Institute of SAS. Here he was a member of the Scientific Board in the International Banach Mathematical Center in Warsaw (1986–90) responsible for Slovakia.

In the years 1969–1990, he was an external teacher of statistics at Comenius University. In 1991, he went to Comenius University, where he was first appointed as an Associated Professor at the Faculty of Mathematics and Physics, and later, in 1992, as a university Professor of probability and statistics. In years 1992–1998, he was the Head of the Department of Probability and Statistics, and in the years 1999–2002 the Head of the Mathematical Section of the Faculty. Since 1992, he is also the head of the commission for defending dissertation for obtaining the DrSc. on probability and statistics.

After 1989 he was invited three times as a Visiting Professor at Wirtschaftsuni. Wien (1994/95), at Uni Augsburg (1998/99), and at TU Wien (2000/01), presenting lectures on analysis and design in regression models. Of course, due to his excellent scientific activity, he has been invited also to several one month research stays at the Imperial College of Science of Technology, London, (1984), City University London and University of Glasgow (1991), CNRS by Université d'Orsay, Paris (1990, 1992), Freie Universität Berlin (1996), Université Bordeaux

II (1993), Université Joseph Fourier, Grenoble (1994, 1995), Unité de Biométrie de INRA, Versailles (several short visits 1997–2002).

Prof. Pázman was or is a member of the editorial boards in journals Mathematica Slovaca (Bratislava, 1988–1990), AMUC (Bratislava), Tatra Mountains Mathematical Publications (Bratislava, since 1998), Statistics (Berlin, 1987––1995), Applications of Mathematics (Prague, 1976–2000), Metrika (Germany, since 2000).

On the occasion of his anniversary, we asked Prof. A. Pázman for a short interview concerning his approach to sciences and on his views on the development of statistics in Slovakia, in particular, on the beginning of Probastats.

Question: Prof. Pázman, please, can you remind the beginning of your activity in statistics?

Answer: My early activities at statistics started in the beginning of Sixties at time, when the subject was not very developed in Slovakia. Therefore contacts with Prague and my experience from Dubna were of basic importance. In Dubna, I pursued some research on the application of Poisson process to data transmission (with G. A. Ososkov), but especially I started here the two topics which are dominating for me until now: optimum experimental design (which we started together with V. V. Fedorov) and nonlinear regression. But being influenced in Dubna also by a significiant development in theoretical physics, after my return to Bratislava I also became interested in the general theory of quantum variables (which we started to investigate simultaneously with S. Pulmannová). In this direction, I oriented also my first two PhD students: A. Dvurečenskij (from my experience in physics I recommended him to investigate the theorem of Gleason, which he developed in an incredibly perfect way), and P. Čerňanský.[1] Here the cooperation with B. Riečan and with a very gifted theoretical physicist P. Bóna from Comenius University was important. These former PhD students are now in high positions in science or university education, and Dvurečenskij and Pulmannová are internationally recognized researchers on the topic. After two years I left the topic and physics, and I focused my interest totally to statistics.

Question: The beginning of the modern Slovak statistics and probability theory is connected with the Institute of Measurement Theory of SAS and with the existence of Statistical Department there. What do you think about this period?

Answer: In the beginning of the Seventies, L. Kubáček built very effectively the Statistical Department at the Institute of Measurement of SAS. The first attempt of L. Kubáček was to organize a mathematical department, but this attemp failed and people left. This happened while I was in Dubna. The second

[1] His other PhD students: J. Mikulecká, M. Tyšler, H. Koutková, E. Horváth.

attempt was in 1969, and was very successful. The start was very modest; we were three: L. Kubáček, F. Štulajter and me, and we were together everywhere. Our group increased quickly, due to good contacts with the university, and also due to the support of the vicedirector of the Institute of Measurement of SAS, J. Bolf. I have been a long time a member of this department, and in the years 1970–1975 I cooperated with L. Kubáček very much (and we wrote together one book in 1971, which, because of different "nonscientific" reasons appeared only in 1979). The atmosphere at the department of L. Kubáček at that not always easy time was very good, with correct relations. As the second oldest in the department I also tried to help effectively younger people in the department: for example I stimulated the important postdoctoral stays of A. Dvurečenskij and I. Bajla in Dubna, and the regular visits of F. Rublík to seminars in Prague. I think that I influenced by discussions the early research orientation not only of A. Dvurečenskij, P. Čerňanský and S. Pulmannová, but also of J. Volaufová, Š. Šujan, F. Štulajter and others.

Question: Is it true that nowadays renowned statistical conferences, Probastat, have their origin at the Institute of Measurement?

Answer: Definitely, yes. To go at the beginning, I must mention early activities in the organization of Probastat, which are starting to become an important part of our statistical history today. In the beginning of 70-ties, L. Kubáček organized a summer school in Bratislava: he invited excellent lecturers from Prague (K. Winkelbauer, O. Hanš, J. Machek) and from Budapest (P. Révész, I. Vincze). After that, in 1974, I proposed to organize regular national conferences on probability and statistics, and proposed the name Probastat (being influenced by the name of a very successful conference Equadiff). The name was accepted, and with S. Pulmannová we organized three or four of the first conferences in Bratislava and Smolenice (one was organized by F. Štulajter with S. Pulmannová when I was in France). Later in 1982–89 several Probastats were organized in Liptovský Mikuláš by B. Riečan, J. Haluška, L. Kubáček, G. Wimmer. After the political changes we started to organize, I think very successfully, international Probastats. In 1991, I was the head of the organizing committee, and in the years 1994, 1998, 2002, I was the head of the program committees. I have also been the coeditor of the proceedings in 1991, 1994 and 1998.

Question: You are the author of many important statistical publications, including monographs. Can you present them?

Answer: In 1979, I published, together with L. Kubáček, a Slovak book on statistics for measurements. In 1980, I published another Slovak book, which appeared (extended) in English in 1986 at the publisher Reidel (Kluwer group) in Netherlands, under the title Foundation of Optimum Experimental Design. Considering citations it is by far my most successful book, and created for me an international position in the community of specialists in experimental design. Another Slovak book on applications of experimental design (written with coauthors) appeared also in 1986. Before of that I got, of course, some research results on the topic: on a Hilbert space approach to design in infinite-dimensional models, on the discontinuity of design criteria and on convergence properties of iterative methods (2 papers in the Annals of Statistics, an invited lecture at the European Meetings of Statisticians in Leuven, Belgium, 1977, etc.). Much later results are on design in nonlinear models, on a method for the design of experiments with correlated observations, results on minimax optimum designs. In the period 1980–89, I supervised two PhD students on experimental design: J. Mikulecká and E. Horváth.

But you cannot pursue research all the time, so in that period I also enjoyed much the stimulating influence of B. Riečan, when I took part in his postgraduate courses and popularization activities in TV and journals for secondary school teachers. As a consequence, in 1987 I obtained the Price of the Slovak Academy of Sciences for popularization of sciences (together with L. Kubáček and J. Bosák), and much later in 1999, partly also for this activity, the honorable membership of the Union of Slovak Mathematicians and Physicists.

Question: How did you find the way from physics to nonlinear statistics?

Answer: Indeed, my first impulse to investigate nonlinear regression came from Dubna, from some problems in experiments of interaction of particles (with F. Lehar). I returned to these problems much later, in 1981, from another point of view. The approach has been differential-geometric, simply, I always liked geometry. And the geometrical approach was fruitful: I derived an "almost exact" distribution of the estimators, found the influence of the Riemannian curvature tensor on this distribution and on other statistical properties of estimators. I also proved the uniqueness of the MLE estimator of the response in nonlinear models, etc. In 1987, I was invited again to present a lecture on the European Meeting of Statisticians (in Thessalonica), this time on nonlinear models. I also summarized this research in a discussion paper in Statistics 1990, and in another book: Nonlinear Statistical Models, published by Kluwer, 1993. (Price of the Slovak Literary Fund in 1994.) On the topic I oriented also the dissertation of another of my PhD students: H. Koutková from the University of Brno (singular models). Recently I am interested in nonlinear models with parameter constraints, the principal paper has been published in the J. Statist. Plann. Inference, in the Rao's Honorary Volume.

Question: In the present moment, you are the head of a very popular seminar on statistics at the University. Please, can you present it for our readers?

Answer: Since 1992 I am leading weekly a seminar on mathematical statistics at the University, which seems to have an important impact on PhD students, and is regularly visited also by statisticians pursuing research at the university and at the SAS. On the department level I am cooperating much with F. Štulajter, who left the SAS for the University earlier than me. Present contacts with the SAS are also on a common research project (a grant from VEGA), on preparing Probastats and their proceedings, on organizing habilitations, etc.

Presently I have three PhD students, working on optimum design or on exact distributions in nonlinear models.

By a look at the list of my publications, one can immediately see that today I am publishing more papers than when I was younger; despite of the fact that now I am more busy with teaching and administrative duties. Now I much enjoy cooperation with younger people here but also abroad, helping them a little with my general experience (because for special new technologies like computers I cannot help them). I try to stimulate their research in general statistics, and I hope that some of them will perhaps once admit that they in fact continue my research work.

Thank you very much, Prof. Pázman, for your interview.

We are glad that the 65th birthday of Prof. A. Pázman encounters him in the full creativity. The author of the present article thanks him in the name of the whole Slovak mathematical society and his friends for his considerable contribution to mathematical statistics, design of experiments and quantum logics in Slovakia, and we wish him good health, happiness and many interesting papers and ideas on statistics.

Monographs

[1] *Nonlinear Satistical Models.*, Kluwer Acad. Publ., Dordrecht, 1993.

[2] *Foundations of Optimum Experimental Design*, Reidel Publ. Comp., Dordrecht, 1986.

[3] *Riešené situácie z navrhovania experimentov.* (*Solved Situations in Experimental Design*), ALFA, Bratislava 1986, with J. Mikulecká, V. Raffaj, M. Tokošová. (In Slovak)

[4] *Základy optimalizácie experimentu* (*Foundations of Optimum Experimental Design*), Veda, Bratislava, 1980. (In Slovak)

[5] *Štatistické metódy v meraní.* (*Statistical Methods in Measurement*), Veda, Bratislava, 1979, with L. Kubáček. (In Slovak)

Scientific papers

[1] *Results on nonlinear least square estimators under nonlinear equality constraints*, (Rao's Honorary Volume), J. Statist. Plann. Inference **103** (2002), 401–420.

[2] *Optimal design of nonlinear experiments with parameter constraints*, Metrika **56** (2002), 113–130.

[3] *Optimum design of nonlinear experiments based on linear Bayesian estimators*, Tatra Mt. Math. Publ. **26** (2003), 69–77, (with K. Hornišová).

[4] *Measures of nonlinearity for biadditive models*, Metrika **55** (2002), 233–245, (with J. B. Denis).

[5] *Measures for designs in experiments with correlated errors*, Biometrika **90** (2003), 423–434, (with W. G. Müller).

[6] *Using densities of estimators to compare pharmacokinetic experiments*, Comp. in Biology Med. **31** (2001), 179–195, (with L. Pronzato).

[7] *Optimal design of experiments subject to correlated errors*, Statist. Probab. Lett. **52** (2001), 29–34, (with W. G. Müller).

[8] *Linearization of nonlinear regression models by smoothing*, Tatra Mt. Math. Publ. **22** (2001), 13–25.

[9] *Concentration sets, Elfving sets and norms in optimum experimental design*, in: Optimum Design 2000 (A. C. Atkinson et al., eds.), Kluwer Acad. Publ., Dordrecht, 2000, 101–102.

[10] *Bias of the M. L. E. in singular nonlinear regression models*, Tatra Mt. Math. Publ. **17** (1999), 55–63.

[11] *Some properties and improvements of the saddlepoint approximation in nonlinear regression*, Ann. Inst. Statist. Math. **51** (1999), 463–478.

[12] *An algorithm for the computation of optimum designs under a given covariance structure*, Comput. Stat. **14** (1999), 197–211, (with W. G. Müller).

[13] *Bias of LS estimators in nonlinear regression models with constraints. Part I: General case. Part II: Biadditive models*, Appl. Math. **44** (1999), 359–374 and 375–403, (with J. B. Denis).

[14] *Some geometrical aspects of the nonlinear least squares method*, Acta Phys. Univ. Comenianae **11** (1999), 69–90.

[15] *Aplications of necessary and sufficient conditions for maximum efficient design*, Metrika **48** (1998), 1–19, (with Ch. H. Müller).

[16] *Design measures and approximate information matrices for experiments without replications*, J. Statist. Plann. Inference **71** (1998), 349–362, (with W. G. Müller).

[17] *A new interpretation of design measures*, in: MODA 5 (A. C. Atkinson, L. Pronzato, H. P. Wynn, eds.), Physica-Verlag, Heildelberg, 1998, pp. 240–245, (with W. G. Müller).

[18] *Approximate densities of two bias-corrected nonlinear LS estimators*, in: MODA 5 (A. C. Atkinson, L. Pronzato, H. P. Wynn, eds.), Physica-Verlag, Heildelberg, 1998. pp.146–151, (with L. Pronzato).

[19] *On modified information matrices in nonlinear regression*, Tatra Mt. Math. Publ. **7** (1996), 215–221.

[20] *A Dirac-function method for densities of nonlinear statistics and for marginal densities in nonlinear regression*, Statist. Probab. Lett. **26** (1996), 159–167, (with L. Pronzato).

[21] *Distribution of estimators and optimal experimental design in nonlinear regression*, Kybernetika **32** (1996), 491–499.

[22] *The density of the parameter estimators when the observations are distributed exponentially*, Metrika **44** (1996), 9–26.

[23] *The geometry of nonlinear inference: accounting of prior and boundaries*, LINSTAT 93 (T. Calinski, R. Kala, eds.), Kluwer Acad. Publ., Dordrecht 1994, pp. 159–170.

[24] *Second order approximation of the entropy in nonlinear least—squares estimation*, Kybernetika **30** (1994), 187–198, (with L. Pronzato).

[25] *Bias correction in nonlinear regression via two—stages least—squares estimation*, in: Proc. 10th IFAC Symp. on Systems Idetification SYSID 94 (H. Blanke, I. Söderström, eds.), Copenhagen (1994), Vol. 1, pp. 137–148, (with L. Pronzato).

[26] *Higher dimensional nonlinear regression—a statistical use of the Riemannian curvature tensor*, Statistics **25** (1993), 17–25.

[27] *Nonlinear experimental design based on the distribution of estimators*, J. Statist. Plann. Inference **33** (1992), 382–407, (with L. Pronzato).

[28] *A classification of nonlinear regression models and parameter confidence regions*, Kybernetika **28** (1992), 444–453.

[29] *Geometry of the nonlinear regression with prior*, Acta Math. Univ. Comenian. **61** (1992), 263–276.

[30] *Curvatures and the distribution of the maximum likelihood estimator in nonlinear exponential models*, REBRAPE (Revista Brasil. Probab. e Estat.) **5** (1991), 43–63.

[31] *Pivotal variables and confidence region in flat nonlinear regression models with unknown sigma*, Statistics **22** (1991), 177–189.

[32] *Almost exact distributions of estimators: I—Low dimensional nonlinear regression, II—Flat nonlinear regression models*, Statistics **21** (1990), 9–19 and 21–33.

[33] *Small sample distributional properties of nonlinear regression estimators (a geometric approach)*, Statistics **21** (1990), 323–367.

[34] *A sufficient statistic and a nonstandard linearization in nonlinear regression*, Kybernetika **25** (1989), 441–452.

[35] *On information matrices in nonlinear experimental design*, J. Statist. Plann. Inference **21** (1989), 253–263.

[36] *Distribution of the weighted L. S. estimates in nonlinear models with symmetrical errors*, Kybernetika **24** (1988), 413–427.

[37] *On the non–asymptotic distribution of the M. L. estimates in curved exponetial families*, in: Trans. 10th Prague Conf. Inform. Theory, Academia Publ. House, Prague, 1988, pp. 117–132.

[38] *Geometrické metódy v matematickej štatistike.*, Pokroky Mat. Fyz. Astron. **33** (1988), 315–326.

[39] *On formulas for the distribution of nonlinear LS estimates*, Statistics **18** (1987), 3–15.

[40] *Discussion to the paper by Dr. Jorgensen*, J. Roy. Statist. Soc. B **49** (1987), 155–156.

[41] *Flat Gaussian nonlinear regression models*, in: Model Oriented Data Analysis (V. Fedorov, H. Läuter, eds.), Springer Lecture Notes in Econom. and Math. Systems, Vol. 297 Springer-Verlag, Berlin, 1987, pp. 120–124.

[42] *On the uniqueness of the M. L. estimates in curved exponential families*, Kybernetika **22** (1986), 124–132.

[43] *Sequential and iterative designs of experiments*, in: Banach Center Publ., Vol. 16, Warsaw, 1985, pp. 443–453.

[44] *Some statistical consequences of the geometry of nonlinear regression*, in: Proc. 5th Pannonian Symp. on Math. Stat., Visegrád/Hung. 1985 (W. Grossman et al., eds.), Physica Verlag, Heildelberg, (1988), pp. 273–283.

[45] *Určovanie parametrov v nelineárnych modeloch pri vysokých úrovniach šumov*, Elektrotech. Čas. **36** (1985), 812–817.

[46] *Nonlinear least squares—uniqueness versus ambiguity*, Math. Operationsforsch. Stat., Ser. Stat. **15** (1984), 323–336.

[47] *Probability distribution of the multivariate nonlinear least squares estimates*, Kybernetika **20** (1984), 209–230.

[48] *Discussion to the paper by P. J. Green.*, J. Roy. Statist. Soc. **46** (1984), 182–183.

[49] *Optimalizácia experimentu pre identifikáciu obvodov*, Elektrotech. Čas. **34** (1983), 406–420.

[50] *Geometry of Gaussian nonlinear regression—parallel curves and confidence intervals*, Kybernetika **18** (1982), 376–396.

[51] *Polynomials of parameters in the regression model—estimation and design*, in: Probability and Statistical Inference (Grossman et al., eds.), D. Reidel Publ. Comp., Dordrecht, 1982. pp. 275–285, (with J. Volaufová).

[52] *Optimal designs for the estimation of polynomial functionals*, Kybernetika **17** (1981), 16–31.

[53] *Predpovedanie pomocou kolmíc v Hilbertových priestoroch I a II.*, Matem. obzory **16** (1980), 61–70; **17** (1981), 65–73.

[54] *Singular experimental designs*, Math. Operationsforsch Stat., Ser. Stat. **11** (1980), 137–149.

[55] *Some features of the optimal design theory—a survey*, Math. Operationsforsch Stat., Ser. Statistics **11** (1980), 415–446.

[56] *Computation of the optimum designs under singular information matrices*, Ann. Statist. **6** (1978), 465–467.

[57] *Hilbert space methods in experimental design*, Kybernetika **14** (1978), 73–84.

[58] *Optimálny experiment*, Pokroky Mat. Fyz. Astron. **23** (1978), 310–317.

[59] *Discussion to the paper by O'Hagan*, J. Roy. Statist. Soc. B **40** (1978), 35.

[60] *Plans d'expérience pour les estimations de fonctionnelles non—linéaires*, Ann. Inst. H. Poincaré Anal. Non Linéaire **13** (1977), 259–267.

[61] *A contribution to the time series design problems*, in: Trans. 7th Prague Conf. 1974, Academia, Praha, 1977, pp. 467–476.

[62] *Statistical research of the probability distribution of streamer track ionization parameters*, Comm. JINR P5–1143, Dubna 1977, (with L. Kuljukina, G. Ososkov, P. Čerňanský). (In Russian)

[63] *Optimum design of experiments for uncorrelated observations on fields*, Kybernetika **12** (1976), 223–247.

[64] *Optimum experimental designs with a lack of a priori information II—Designs for the estimation of the whole response function*, Kybernetika **12** (1976), 7–14.

[65] *Rozhodovanie, hry a experiment*, Matem. obzory (1975), 19–31; (1976), 15–27.

[66] *Optimum experimental designs with a lack of a priori information I—Designs for the estimation of a finite—dimensional set of functionals*, Kybernetika **11** (1975), 355–367.

[67] *A convergence theorem in the theory of D—optimum experimental designs*, Ann. Statist. **2** (1974), 216–218.

[68] *The ordering of experimental designs (A Hilbert space approach)*, Kybernetika **10** (1974), 373–388.

[69] *Optimum nets*, Studia Geoph. Geod. **18** (1974), 91–102, (with L. Kubáček).

[70] *Štatistický prístup k overovaniu analytičnosti komplexnej funkcie*, Acta Metronomica **9** (1973), 26–31.

[71] *Modification of the τ-test and the r^2-test for comparison of hypotheses*, Comm. JINR No P5–7174, Dubna 1973, (with I. Silin). (In Russian)

[72] *Determination of statistical significance in experiments on detection of new resonances*, Comm. JINR No. P1–7155, Dubna 1973, (with V. Vinogradov, M. Dokhmatov, V. Odinsev). (In Russian)

[73] *Testing of analycity of the πN forward scattering amplitude and the determination of the πN coupling constant*, Nuclear Phys. **B46** (1972), 637–643, (with J. Pišút, P. Prešnajder, P. Lichard).

[74] *Mixture sets and convex sets*, Mat. Čas. **22** (1972), 148–155.

[75] *Axiomatická definícia systému pozorovateľných v teórii merania*, Acta Metronomica **7** (1971), zoš. 4, (with S. Pulmannová).

[76] *The problem of the unambiguity of phase—shift analysis I.— Description of a powerful discriminating criterion, II.—NN scattering phase—shift analysis at energies near to 20 MEV*, Czechoslovak. J. Phys. **B 19** (1969), 882–890 and 891–898, (with S. Bilenkaya, J. Bystrický, Z. Janout, F. Lehar).

[77] *Computation of distorsions of the amplitude spectrum coming from supperposition of impulses*, Instr. Techn. Exp. **3** (1969), 112–115. (In Russian)

[78] *Design of Physical experiments* (*Statistical methods*), Fortschr. Phys. **16** (1968), 325–355, (with V. V. Fedorov).

[79] *Sequential design of experiments performed in several measurement points*, Theor. Veroyatn. Primen. **13** (1968), 479–489. (In Russian)

[80] *Planning of regression and discriminating experiments on the NN scattering*, J. Nuclear Phys. **6** (1967), 853–857, (with V. V. Fedorov). (In Russian)

[81] *Design of experiments based on the measure of information*, Comm. JINR, No. E5–3247, Dubna 1967, (with V. V. Fedorov).

[82] *Analysis of errors from linearization in the statistical elaboration of results of measurements*, Avtometriya **3** (1966), 76–84. (In Russian)

[83] *Time minimizing design of an experiment for the specification of a single phase shift*, Comm. JINR, No 2921, Dubna, 1966.

[84] *Zachovanie informácie pri redukcii štatistických modelov merania*, Mat.–Fyz. čas. (1965), 81–89.

[85] *Einige Bemerkungen über den Charakter des systematischen Fehlers bei Längenmessungen*, Vermessungstechnik **6** (1964), 220–222, (with L. Kubáček).