JOURNAL OF THE
INDIAN STATISTICAL ASSOCIATION

Special issue in honour of H. L. Koul
on his seventieth birthday

Edited by
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Editor’s Note

It is a great pleasure to present our readers this special volume in honor of Professor H. L Koul on his 70th birth anniversary. This volume contains invited papers written by his Ph.D. students, collaborators and close friends. It contains articles by some leading researchers in areas of interest of Professor Koul: efficient estimation, time series analysis, reliability theory, long memory processes, regression models and survival analysis among others. A brief biographical sketch of Professor Koul and a conversation with him are also included.

Mueller, Schick and Wefelmeyer consider time series described by Markov chains that alternate periodically between different transition distributions, with conditional constraints involving unknown parameters. They obtain efficient and better estimators for these unknown parameters. Li and Johnson obtain asymptotic properties of Crosier’s cumulative sum statistic (CUSUM) which do not follow from classical approach. They establish the limiting distribution of one variant of the statistic and conclude that Crosier’s CUSUM statistic converges weakly to a multivariate diffusion process. Balakrishna and K. Shiji propose a stochastic volatility (SV) model generated by first order extreme value autoregressive process as an alternative to normal-lognormal SV model. They analyze the daily stock price index returns using the proposed model and show that it is capable of capturing the salient features of the financial time series. Kochar gives some reminiscences of the early developments of some partial orders to compare various aspects of probability distributions. Leipus, Philippe, Puplinskaite and Surgailis present recent review work on contemporaneous aggregation of random-coefficient AR(1) and related models, with particular focus on various long memory properties of the aggregated process. Vellaisamy and Pathak investigate copulas corresponding to both simple linear regression and multiple linear
models. They explain quantile regression coefficient and quantile regression
curves in terms of copulas and also the dependence structure between the
random variables.

Dhar and Lahiri introduce an extension of negative multinomial log-
linear model. The parameters of their proposed model are estimated by the
quasi-likelihood method and the corresponding score function, which gives
closed form estimates of the regression parameters. They also demonstrate
the effectiveness of the method for cancer incidence data under generalized
inverse sampling scheme. Verma, Singh, Pandey and Joorel suggest a sample
allocation procedure which can be used for the evaluation of the impact of the
development programmes under the exponential phase effect. They provide
the utility of the proposed method by empirical study. Sankaran and An-
jana develop a martingale based test procedure for comparing cause-specific
reversed hazard rates. The asymptotic distribution of the test statistic is
chi-square. The proposed test is applied to Australian twin data set and
they show that cause-specific reversed hazard rates are significantly differ-
ent. Deshpande, Lam, Naik-Nimbalkar and Xu propose three tests to inves-
tigate the difference in the progress of an epidemic in two groups, where one
group can be considered as the reference group. The procedure consists of
applying two tests based on measures related to the real-time fatality rate.
They apply these tests to SARS data in Beijing and Taiwan.

We are grateful to all these scholars for accepting our invitation to write
for this issue and thank them for their articles. We also thank the referees
for reviewing the articles.

The authors, the editor, office bearers, governing council members of
the Indian Statistical Association join us in wishing Professor Hira Lal Koul
continued years of active research and happy and healthy life.

David D. Hanagal
Professor Hira Lal Koul was born on May 27, 1943 at Srinagar, in the state of Jammu and Kashmir. He is an alumnus of the Department of Statistics and Mathematics, University of Pune. He did his M.A. in statistics with first position in the Faculty of Arts from the University of Pune in 1964. He moved to U.S.A. to pursue his Ph.D. at University of California, Berkeley and completed his Ph.D. in 1967 under the supervision of Professor Peter Bickel. He pioneered the approach of *Asymptotic Uniform Linearity* (AUL) as a powerful tool for studying properties of the empirical process based
on residuals from semiparametric models. This approach has been widely employed by several authors in studying the asymptotic properties of tests of composite hypotheses, and has been a particularly powerful tool for deriving limit laws of goodness-of-fit tests. He has also pioneered work on weighted empirical processes and minimum distance estimation methodology based on weighted residual empirical processes in regression and autoregressive models. He, together with Susarla and van Ryzin, introduced the celebrated Koul-Susarla-van Ryzin estimator of the regression parameter in his 1981 Annals of Statistics paper. This estimator is easy to compute, explicitly defined and has become a popular choice for practitioners. In the late 1980’s, Professor Koul developed interests in time series analysis and econometrics. He has made fundamental contributions in these areas that include several goodness-of-fit tests for fitting an error distribution and lack-of-fit tests for fitting a parametric model to the conditional mean function.

He started his distinguished career in statistics from Michigan State University since 1968 first as an Assistant Professor. Subsequently, he was appointed as Associate Professor, Professor and now he is the Chair of the Department of Statistics and Probability. He has been a visiting professor at several universities all over the world. He has guided 27 Ph.D. students to date and has published 125 research papers in well-known international statistics journals. Professor Koul worked in several areas of statistics, namely, Nonparametric and Semiparametric Inference, Efficient and Adoptive Estimation, Reliability Theory, Survival Analysis, Long Memory Processes, Time Series Analysis, Inference in Stochastic Processes, Measurement Error Models, Robustness, Sequential Analysis, among others. Many of Professor Koul’s publications appeared in top-tier statistics journals. He has written several monographs, lecture notes series and edited special proceedings and books.

He was a Co-Editor-in-Chief of Statistics and Probability Letters from 2007 - 2013. He got several awards and honors during his distinguished career namely, he is a Fellow of American Statistical Association, Fellow of Institute of Mathematical Science, Elected member of the International Sta-
Professor Koul contributed a lot to the Indian Statistical Association (ISA) during his distinguished career as a statistician. He was the President of the ISA during 2009-2013. He was the guest editor of the Journal of the Indian Statistical Association for the golden jubilee volume during 2012. This golden jubilee volume received much appreciation throughout the world. Professor Koul’s guidance and sound advise to ISA have been very helpful in the activities of ISA. We are indeed happy to bring this special volume in the honor of Professor Koul on his 70th birth anniversary.

David D. Hanagal
A Conversation with Professor Hira Lal Koul
by David D. Hanagal

David: It is my privilege to talk to you regarding your distinguished career in Statistics. Let me start with your family background during your school and college life.

Hira: I was the youngest among four brothers and one sister. My father was a forest officer who was often transferred from district to district within the state of Jammu and Kashmir. Till 8th grade I studied in various schools in the Kashmir valley. From 9th grade onwards till B.A., I studied in Sri Pratap High School and Sri Pratap College in Srinagar. I secured B.A. from the Jammu and Kashmir University in 1962.

David: Who were your teachers at University of Poona during your M.A. course?

Hira: I joined the Department of Statistics and Mathematics, University of Poona, in July 1962 for doing M.A. in statistics. I remember Professors Adke, Bhapkar, Kamat, Gokhale (one semester), and B. Raja Rao taught several of my courses during 1962-1964. There might have been one or two more, whom I do not remember. Professor V.S. Hazurbazar, who admitted me to the program, was on leave to the Iowa State University during this time.

David: What made you to move to the U.S.A. for your Ph.D.?

Hira: Because of the Bhapkar’s teaching of statistical inference and non-parametric statistics and because of Lehmann’s work with Hodges, I wanted to do Ph.D. in nonparametric inference. At the time of my completing the M.A. in statistics from the University of Poona in June 1964, there were only 4 people in India whom I could work with. They were B.V. Sukhatme, V.P. Bhapkar, A.R. Kamat and P.K. Sen. But Bhapkar and Sen were going to Chapel Hill and Berkeley, respectively. Both Sukhatme and Kamat were willing to guide me. Because I had read several works of Lehmann, I also wrote to him indicating that I would like to do Ph.D. under his supervision. I still remember the date I wrote this letter- June 15, 1964. I received a
telegram around September 9, 1964 from Professor Le Cam, the then Chair of the Department of Statistics at Berkeley, offering me an admission to their Ph.D. program along with a teaching/research assistantship. I was asked to join immediately, but those days securing passport and other travel documents would take some time. So I joined U.C. Berkeley only in January 1965, and secured the Ph.D. degree in December 1967.

David: What are your experiences with your Ph.D. courses and your Ph.D. supervisor at University of California, Berkeley?

Hira: Over all my experience was very positive. Just like the faculty at the University of Poona, most of the professors in Berkeley were easily accessible, willing to help students at all the times. My advisor Peter Bickel was extremely accessible, willing to listen at any time. I learnt a lot from the courses from Michael Loève and Lucien Le Cam. One of the most beneficial courses for me was the course on theory of rank statistics from Jaroslav Hájek in the Spring Quarter 1966, who was visiting from the Charles University, Prague. He was writing his 1968 *Annals of Mathematical Statistics*, Vol. 39, p 325–346, paper during this time. One main result in this paper was an inequality on the variance of linear rank statistics under general independent alternatives. The proof of this inequality extended over the period of four or five lectures. Every day the constant in the upper bound would be different. This was a tremendous learning experience and exciting at the same time. It was a learning experience as it taught me not to be afraid to make mistakes in the pursuit of the truth. It was exciting as brand new results were being presented in the class. We were in the forefront of the research on this topic.

More than from courses, we learnt a lot from numerous colloquia and seminars. It was fortunate that during my stay at Berkeley, the 5th Berkeley Symposium was held in 1965. This was a life time experience. I remember listening to Feller speak where a large lecture hall was full and people were standing to listen to him. During this time I also met Professor C.R. Rao for the first time.

I was the first president of the Graduate Students Association of the Department of Statistics in 1966-1967. During this period we ran a seminar
series on Bayesian versus Frequentists, in which several faculty members including Neyman, Blackwell, Thomasian, and Le Cam spoke. It was exciting to listen to these world renowned leaders’ opinions.

**David:** What is the key secret of your successful career as a Statistician?

**Hira:** It is hard to identify one thing. I guess if there is any one reason, it has to be the desire to be curious about science, and perseverance. Perhaps having right opportunities and making use of them appropriately are also important.

**David:** You might have been inspired by some people in your distinguished career in statistics. Can you name a few?

**Hira:** Bahadur, Bhapkar, Bickel, Billingsley, Doksum, Hájek, Le Cam, Lehmann, Susarla, and Taqqu. Their way of teaching and the originality in their research have been main inspirational sources. Bahadur was an excellent lecturer and his work on large deviations was fascinating. His papers are also very elegant and well written.

Hájek was a unique scholar, all self trained. His papers show his deep insight about the problem he is solving. In several of his papers one finds unique originality. In the 1950’s one of the very actively researched problem was to prove the asymptotic normality of linear rank statistics under the hypothesis of randomness and under some alternatives. Several people had attempted this. But the most satisfactory and elegant solution to this problem was provided by Hájek in his four papers.


All of these papers developed unique method of establishing the desired result. The first paper proves the asymptotic normality under the null hypothesis of randomness, while the 1962 paper does the same under the local alternatives in linear regression set up. This paper is the first one that uses the theory of contiguity, developed by Le Cam and Hájek independently around the same time, elegantly. It provided a great inspiration during my graduate student days. The other two papers establish asymptotic normality of simple linear rank statistics under general independent alternatives. All of these papers have directly or indirectly influenced my own research.

As you know, I used weak convergence methodology in my thesis. During 1965-1967, there was no course on the weak convergence of stochastic processes given at Berkeley. Fortunately around 1966-1967, Peter Bickel loaned me a copy of a preliminary version of the book on *Convergence of Probability Measures* by Patrick Billingsley. I learnt weak convergence methodology from this book. The book was later published in 1968 by Wiley, and has had a big impact on our subject. Billingsley was an excellent teacher. His papers are also extremely well written and clear.

My students also have had impact on my research and teaching. I have been fortunate in that I have had numerous excellent students, who have become renowned scholars on their own.

**David:** On the personal front, what has been the contribution of your family, parents, wife and children in your pursuit of excellence?

**Hira:** My parents were very supportive all my life. They provided for healthy living and good education right from the beginning. Their dedication for me to be successful was tremendous. My wife Shama Koul has been a tremendous support throughout my career. Without her unconditional support it would have been hard to tread this academic life. She took care of the family matters and social aspects of the professional matters in a tremendous way, hosting numerous events throughout in the past 44+ years. From our two sons I have learnt a lot about life.

**David:** What are your future plans in your academic field?
Hira: I plan to continue to work for the next few years. Nothing definite yet.

David: What would be your advice to young statisticians?

Hira: It is hard to advise any one. Much depends on a person’s ambition. But one thing I tell all young people is decide what you want and pursue it with all you have. Be perseverant. Do not be afraid to ask questions. Professor Loève used to say ‘no question is a stupid question, only answers can be stupid’. I believe in this maxim. Get out there and be inquisitive. Professor Neyman would force all graduate students in Berkeley to ‘rub shoulders’ with famous people, which you can do only if you are out there.

David: Please highlight important events in the last 50 years of your life as a statistician.

Hira: It is difficult to identify these events, but I shall try. In my professional life, the first two important events were being admitted to the M.A. program at the University of Poona and to the Ph.D. program at UC Berkeley. In my personal life being married to my lovely wife Shama and being father of two great sons have been important events.

Then, there are other important events in my research career. My thesis was the first work where the weak convergence of the weighted residual empirical processes was studied. From the work of Hájek in the 1965 Berkeley Symposium, it was clear that weighted empirical processes had an important role to play in regression models. Fine (1966: Annals of Math. Statist. vol. 37, pp 1814–1818) had shown that, in the two sample location model, the Cramér-von Mises minimum distance estimator of the two sample location parameter was the median of pairwise differences, the so called Hodges–Lehmann estimator. The difference of the two empirical processes in the two sample problem is an example of weighted empirical process. From the mid 1970’s, I was struggling with the idea of how to extend this methodology to linear and general regression model. I finally got a break through in 1978 and the first variant of the work was published in the article “Weighted empirical processes and the regression model” (1979), J. of the Indian Statist.
Additional papers appeared later in the *Annals of Statistics*, *Sankhya*, and *Statistic & Probability Letters*. I felt this was a big achievement at the time. It put these weighted empirical processes at the same level as the ordinary empirical processes in the literature. My monograph on *Weighted Empirical Processes and Linear Models*, *IMS Lecture Notes*, vol. 21, 1992, contains many of the achievements here. By the way, the first version of this monograph was typed during my sabbatical at the University of Poona in 1982–1983!

The second exciting stage of my research was the collaboration with V. Susarla and John van Ryzin. In one of our papers we solved the then hot problem of estimating the regression parameter vector in multiple linear regression models when data is randomly censored on the right. I recall the paper submitted to the *Annals of Statistics* was 35 pages long and we got about 16 pages long referee reports. Each of the referees including the Associate Editor was excited about the paper.

The third area of my research activity includes the long memory processes. I heard about these processes for the first time in 1979 when I was visiting Iswar Basawa in Cornell University in the Fall 1979, where I gave a talk on some estimation procedures in regression models with strongly mixing errors. At the end of the talk Murad Taqqu said ‘you should work on long memory processes’, and explained to me what these processes were about. A second order stationary process is said to have long memory if its auto-covariance tends to zero slowly so that their sum diverges. This is an indication that the dependence between any two observations that are far apart persists. In contrast, for short memory processes the correlations tends to zero fast enough so that they are summable and the observations that are far apart become uncorrelated or may be even independent. Taqqu’s suggestion kept nagging me for the next 10 years. In 1987-1988, I read somewhere that one of the areas of the future research in statistics was the development
of inference procedures for long memory processes. So, in January 1989, when I was spending my sabbatical at the University of North Carolina, Chapel Hill, I started working on establishing the large sample behavior of a class of M estimators in linear regression models where the errors were subordinated to a long memory Gaussian process, and where the covariate process may also have long memory. This paper appeared in *Statistic & Probability Letters*, 1992. A surprising result here is that in the linear regression models with Gaussian long memory errors, the difference between a large class of M estimators and the least squares estimator divided by the standard deviation of the least square estimator tends to zero, in probability. This was a surprise, because in the iid case or in the weakly dependent case this standardized difference has an asymptotically normal distribution. This result was later extended to include L and R estimator in the joint work with Kanchan Mukherjee. The same phenomenon continues to hold when errors are long memory moving average as was later established in the work with Giraitis and Surgailis in 1996. One exciting and somewhat self rewarding point of all these works is that the weak convergence methodology for weighted empirical processes provided a unified method of proving these results. A significant portion of this research is included in the monograph on *Large sample inference in long memory processes*, written jointly with Liudas Giraitis and Donatas Surgailis, published by Imperial College Press, 2012.

My work with Anton Schick on adaptive and efficient estimation in semiparametric time series models, with Winfried Stute on model checks for autoregressive time series models, and with Estate Khmaladze on goodness-of-fit testing in parametric and nonparametric regression models are some of the other exciting moments of my research career in statistics.

**David:** What are your satisfying moments in life?

**Hira:** There are several. Every time a hard problem was solved and then gotten published. Every time a student completed a quality thesis. The time I received the Humboldt award for Senior Researchers, which resulted in a quality collaboration with Winfried Stute. The times I was elected to
be President of the International Indian Statistical Association, and of the Indian Statistical Association. Above all, what I have found most satisfying and rewarding has been meeting a variety of people worldwide and developing friendship with many of them. Some of them have resulted in a long time collaborations, like Giraitis, Khmaladze, Surgailis, Schick, and Stute. An interesting statistics about my collaborators is that the majority of their names begin with the letter S—Staudte, Jr., Susarla, Schick, Saleh, Sen, Song, Stute, and Surgailis.

**David:** Thank you for the valuable time to share your experience as a statistician. We wish you many more years of active research.

**Hira:** Allow me to say thank you for your hard work on this issue of the *JISA* and your general dedication to the profession. At this time I would also like to express my gratitude to the Michigan State University. I have benefitted greatly from the working atmosphere at this university. Being able to take sabbatical leaves in particular has been very helpful.