CENTRE FOR MATHEMATICAL AND STATISTICAL SCIENCES, INDIA

NEWSLETTER

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Centre for Mathematical and Statistical Sciences
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NEWSLETTER

There are two issues of the Newsletter each year, the first issue appearing in the first half of the year and the second issue in the second half of the year. Volumes 1 to 9 of the Newsletter of CMSS were produced in the years 1988 to 1997. Due to financial problems, the publication of the Newsletter was suspended. Volume 10, Number 1 is the first issue of the revived Newsletter.

The Newsletter is circulated to various universities and colleges in India, to important institutions around the world and to others upon request. A copy is posted on CMSS web page www.cmsintl.org There are columns for news from other campuses and for personal news. The readers may send personal news and other news items of academic interest for these columns. Such items will be published free of charge according to the availability of space. Send the materials to one of the editors or editorial assistants or to the editorial office.

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(Two issues per year)

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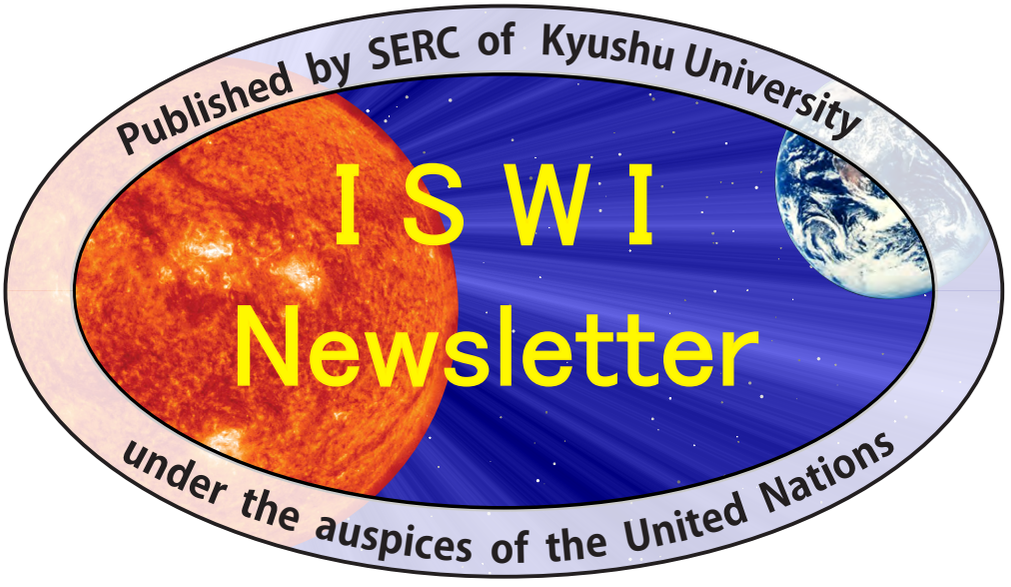

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CMSS NEWS

Dr K.R. Lekha (Head, WSD, KSCSTE),
Dr V.N. Rajasekharan Pillai (Vice-Chairman, KSCSTE)
and Dr A.M. Mathai (Director, CMSS)

Prathibha Scholars

KSCSTE (Kerala State Council for Science, Technology and Environment) has a scholarship scheme called Prathibha Scholarship to encourage talented students who have aptitude for research in science. Higher Secondary School graduates (Kerala State Board, CBSE, or ISC) from Kerala who score 90% or more are eligible to apply. These Prathibha Scholarships are administered under WSD (Women in Science Division) and the person in charge is Dr K.R. Lekha of KSCSTE. There are 100 scholarships of 1000 rupees per month each. These scholars are taken to various research institutes under KSCSTE and top researchers are invited to talk to these scholars about various research areas to motivate them to do research. Recently they were at KFRI on 28-30 November 2013.

Dr A.M. Mathai lecturing to Prathibha Scholars at KFRI

Prathibha Scholars at Krerala Forest Research Institute (KFRI)

Publications from CMSS since the publication of Vol. 16, Number 1, 2013 of the Newsletter

1. M.A. Pathan and M.J.S. Shahwan (2013): Representation theory of the Lie group T_3 and three index Bessel functions. *Kyungpook Math. J.*, **53,** 143-148.

2. Deepa H. Nair and M.A. Pathan (2013): Composition of Saigo fractional integral operators with generalized Voigt function. *Matematicki Vesnik* (to appear).

3. A.M. Mathai (2013): Fractional integral operators in the complex matrix variate case. *Linear Algebra and Its Applications*, **439**, 2901-2913.

4. A.M. Mathai (2013): Ramanujan's hypergeometric function with matrix argument. *Journal of the Indian Mathematical Society* (special issue, to appear).

5. A.M. Mathai (2013): Explicit evaluations of gamma and beta integrals in the matrix variate case. *Journal of the Indian Mathematical Society* (2013, to appear).

6. A.M. Mathai and H.J. Haubold (2013): On a generalized entropy measure leading to pathway model with preliminary application to solar neutrino data. Entropy 2013, Manuscript ID: entropy-41206; doi.10.3390/e15104011.

Research Papers (published/ accepted for publication) by SRFs/JRFs since the publication of Vol.16, Number 1, 2013

7. P. Prajitha (2013): Modeling of discrete HNBUE class with hypothesis testing application. *Communications in Statistics–Simulation and Computation*, (to appear).

8. P. Prajitha (2013) : A new family of discrete distributions associated with Mittag-Leffler functions. *Jounnal of Applied Statistical Science*, (to appear).

9. Deepa H. Nair and Dilip Kumar (2013): Treatise on generalized Krätzel function. *Vietnam Journal of Mathematics* (Springer) (to appear).

10. Naiju M. Thomas (2013) : Distribution of products of independently distributed pathway random variables. *Statistics*, **47 (4)**, 861- 875.

Papers in refereed conference proceedings and parts of books since the publication of Vol .16, Number 1, 2013

11. A.M. Mathai (2013): On Krätzel distribution, reaction rate probability integral and pathway idea. In *Frontiers of Statistics and its Applications*, edited by Tirupati Rao Podi, Proceedings of the Pondicherry Conference 2012, Bonfring Publications, Germany, 2013.

12. H. Kumar, M.A. Pathan and H. Sivatava (2013): A general solution of a space-time fractional anomalous diffusion problem using the series of bilateral eigen-functions. *Communications of Korean Mathematical Society* (to appear).

Conferences attended and lectures given

Dr M.A. Pathan was the chief guest at the *National Conference on Recent Trends in Mathematics* at Mewar University, Chittorgarh, Rajasthan on March 24, 2013. He gave a series of lectures in the Workshop on *A Tribute to S. Ramanujan and Professor S. Chandrasekhar (life and work)* held at T.D.P.G. College, Purvanchal University, Jaunpur during 18-22 April 2013. He delivered an invited talk at the *National Conference* held at Pune University, Pune during April 21-24, 2013 in honor of Professor Thakare and Professor Raghunathan. He delivered an invited talk at the *National Conference on Modern Aspects and Challenges in Mathematics (NCMACM-2013)* during May 18-19, 2013 at the Department of Mathematics, M. A. J. Government College, Deeg, (Bharatpur) Rajasthan, India. He gave a memorial lecture dedicated to Late Professor R.P. Agarwal at the 16th annual conference of Vijanana Parishad of India held at B.R. Ambedkar University, Agra during May 24 to 26, 2013. He was the guest of honor at the *National Conference on Ramanujan Mathematics and Mathematics Eeducation* held at T.D.P.G. College, Purvanchal University, Jaunpur during 1-3 December, 2013.

Dr A.M. Mathai gave the **keynote address** on 10th June 2013 at the national seminar at St Thomas College Thrissur, Kerala, India on 10-11 June 2013 in connection with the

inauguration of the research centre in Statistics at the College. Upon request he gave an additional lecture on 11th June also.

Dr A.M. Mathai was a **judge** and coordinator of the evaluation of the projects executed by the school children in Idukki District under the INSPIRE program of DST Delhi. The evaluation took place on Thursday 4th July 2013 and a dozen toppers were selected for the second stage of State level competition. He was again a **judge** at the State level competition of the INSPIRE program held at Kottayam on 27th August 2013.

Dr A.M. Mathai gave the **keynote address** in connection with the inauguration of the M.Sc program at NSS College Vadakkancherry, Trichur, Kerala, on 8th November 2013 and he gave a technical talk also to the postgraduate students of Physics, Chemistry and Mathematics.

Dr A.M. Mathai will give **R.P. Agarwal Memorial Lecture** in the International Conference of the Society for Special Functions and Their Applications, to be held at Malavya NIT, Jaipur, Rajasthan, India on 13-15 December 2013.

Dr A.M. Mathai was to give an invited talk at the United Nations' conference held on 15-17 September 2013 at Graz, Austria, but due to flight conflicts he could not attend.

Dr A.M. Mathai **inaugurated** the National Conference on Graph Theory and its Applications, held at Amal Jyothi Engineering College, Kanjirappally, on 21-22 November 2013 and gave the **keynote address** also.

P. Prajitha (DST-SRF at CMSS), T. Princy (DST-SRF at CMSS) participated in the conference on "New Directions

Inauguration

Keynote address

Upcoming Activities of the Institute for Basic Sciences, Kerala State Council for Science, Technology and Environment (KSCSTE)

1. 5-7 December 2013 - International Conference on Laser Application and Nano Science, organized jointly with Deutsche Forschungs Gemeinschaft (DFG) and Goethe Zentrum Trivandrum at Trivandrum. There will be 38 invited speakers (including 4 international speakers) and 72 paper presentations including posters. Scientists from various institutes will share their experience and knowledge in the subject area.

2. 29-30 December and 1st January 2014- Macromolecular symposium organized in association with School of Chemical Sciences, Mahatma Gandhi University. Many experts, in the area of macromolecular science, are invited for the symposium. The program is mainly intended for final year M.Sc. students and researchers in the area of Polymers.

in Probability" held at Indian Statistical Institute, Bangalore from May 30 – June 4, 2013.

P. Prajitha, T. Princy participated and presented papers in the International Seminar on Statistical Research organized by the Department of Statistics, St Thomas College, Thrissur from 10-11 June, 2013.

Dilip Kumar gave the **Keynote address** in the inauguration of the Mathematics Association at Union Christian College, Aluva, Kerala on 2nd August 2013.

He attended the National Workshop on Theoretical Physics held at Mascot Hotel, Thiruvananthapuram on 09-11 August 2013.

National seminar and inauguration of the research centre in Statistics, St Thomas College Thrissur

SAD NEWS

Dr B.D. Acharya, visiting Full Professor and Life Member of CMSS passed away on 17th June 2013 due to complications resulting from wrong food items. He was mainly responsible to make CMSS a Department of Science and Technology, Government of India Centre for Mathematical and Statistical Sciences. Activities at CMSS, publication record, the many national level prizes won by CMSS scholars proved that his vision was fulfilled in this case. As a person, he was very humble, always pleasant and continuously working for several hours on any project that he undertook. All of us at CMSS miss him terribly and it is a great loss for the Nation and for CMSS in particular.

Undergraduate Mathematics Training Camps

The 18th and 19th Undergraduate Mathematics Training Camps of CMSS (UG camps) were conducted in September 2013 in collaboration with Assumption College Changanacherry and they were held at Assumption College. Since Dr Mathai was abroad, Dilip Kumar (DST-SRF at CMSS) gave the lectures in the 18th Camp on Vectors, Matrices and Determinants and Dr Seema S. Nair gave the lectures in the 19th Camp on Probability and Random Variables. There were 37 and 33 participants in these camps respectively. Lectures for the 20th Camp on Limits, Continuity and Differential Calculus will be given by Dr A.M. Mathai and the 21st Camp on Vectors, Matrices and Determinants will be given by Dilip Kumar and both these will be held at Peechi on 20th to 29th December 2013.

K.N. Soniya, M.A College, Kothamangalam, first prize 18th UG camp

Dilsha Kujumon, Catholicate College, Pathanamthitta, second prize 18th UG camp

Binduja Menon, St Peter's College, Kolencherry, third prize 18th UG camp

Nimisha Sebastian, Assumption College, Changanacherry, first prize 19th UG camp

Anjali Varghese, St Alberts College, Ernakulam, second prize 19th UG camp

Rose Mary Jacob, Assumption College, Changanacherry, third prize 19th UG camp

18th UG Camp group photo

19th UG Camp group photo

BEST WISHES FROM CMSS FOR SUCCESSFUL PLACEMENTS

Dr Deepa H. Nair of CMSS got a regular Assistant Professor's post at Amal Jyothi Engineering College at Kanjirappally, Kerala, India. Deepa was a visiting scientist at Assistant Professor level at CMSS. She works on function theory. She had written several papers when she was at CMSS.

Miss Linia Anie Sunny, Junior Research Fellow at CMSS, joined IIT Indore after passing GATE. She was doing her Ph.D under the guidance of Professor P.G. Romeo (Adjunct Professor at CMSS) and registered for Ph.D at Anna University, Chennai, through CMSS, in the area of semigroups.

Miss M.V. Dhanyamol, Junior Research Fellow at CMSS, who was doing her Ph.D in graph theory under the guidance of Dr K.A. Germina (Adjunct Professor at CMSS) got registration at the Central University of Kerala, Kasaragod, Kerala, through CMSS, but the fellowship amount was small. She joined NIT Calicut with full fellowship in the light of her passing GATE.

Dr Nicy Sebastian, who received her Ph.D from Banaras Hindu University (BHU) through CMSS under the guidance of Professor A.M. Mathai of CMSS and Professor Umesh Singh of BHU, joined Indian Statistical Institute, Chennai, India.

Dr Seema S. Nair, who received her Ph.D from Banaras Hindu University through CMSS under the guidance of Professor A.M. Mathai of CMSS and Professor Umesh Singh of BHU, joined Bishop Abraham Memorial College, Thuruthicad, Kerala, to get teaching experience.

Dr Dhannya P. Joseph, who received her Ph.D from Banaras Hindu University through CMSS under the guidance of Professor A.M. Mathai of CMSS and Professor Umesh Singh of BHU, joined K.E. College, Mannanam, Kerala as Assistant Professor.

CMSS wish all of them very bright research/ academic careers.

Vacant positions

CMSS has three faculty positions at the Assistant Professor level and 2 JRF positions. For faculty position, a Ph.D degree and strong publication record are needed. For JRF, UGC NET is compulsory. Faculty salaries and JRF fellowships are at UGC scale but DST fellowships. Apply, on plain paper, with all details about degrees, certificates, awards, publications etc to Director, Centre for Mathematical and Statistical Sciences and mail to the address given in this Newsletter. Advance application can be submitted by e-mail. There are no application fees. Selection is done by a national committee periodically when a sufficient number of applications are received. There is no cutoff date for accepting applications.

Current Status of Citation Indices of Haubold and Mathai
(as of 25th November 2013, Google counts)

Author	Citations all	Citations from 2008	h-index all	h-index from 2008	i10-index all	i10-index from 2008
Haubold, H.J.	1780	1262	19	17	37	24
Mathai, A.M.	4708	2554	27	23	65	40

Subject-wise ranks of citations

Special Functions	A.M. Mathai (second rank)	Geometrical Probabilities	A.M. Mathai (first rank)
Applied Analysis	A.M. Mathai (second rank)	Multivariate Analysis	A.M. Mathai (sixth rank)
Statistical Distributions	A.M. Mathai (first rank)		

Note: For Applied Analysis, and Multivariate Analysis, A.M. Mathai had the first rank until a few months back.

NEWS FROM LIFE MEMBERS

List of recent publications of Professor R.K. Saxena

1. R.K. Saxena, J. C. Prajapati, R.K. Jana and A.K. Shukla (2013: Some results on generalized Mittag-Leffler function operator. *Journal of Inequalities and Applications*, 2013.33 , doi: 10. 1186/ 1029-242x-2013-33.

2. R.K. Saxena and T.K. Pogany (2013): Analytic continuation of the extended Hurwitz-Lerch zeta function. *Sarajevo J. Math.*, **9(22)**, 1-9.

3.R.K. Saxena, J. Ram and D. Kumar (2013): On the two-dimensional Saigo-Maeda fractional calculus associated with two-dimensional Aleph transform. *Le Matematiche*, **LXVIII,Fasc. II**, 267-281.

4. R.K. Saxena , J. Ram and D. Kumar (2013): Generalized fractional integration of the product of two N-functions associated with Appell function F_3. *Romai Journal*, **9(1)**,147-158.

5. R.K. Saxena (2013): On a fractional master equation and a fractional diffusion equation. *Mathematics and Statistics*, **1(2),** 59-63.

6. R.K. Saxena, J. Ram and D. Kumar (2013): Alternative derivation of generalized fractional kinetic equations. *Journal of Fractional Calculus and Applications*, **4(2)**, 322-334.

ISWI (International Space Weather Initiative) Newsletter, edited by Professor George Maeda, has a United Nations' link to CMSS Website : www.cmsintl.org. CMSS is thankful to ISWI to UN and to Professor George Maeda.

A Very Successful Development Project

In 1994 the Department of Science and Technology, Government of India, New Delhi (DST) decided to sanction a sequence of five SERC (Science and Engineering Research Council of DST) Schools to Dr A.M. Mathai as the Principal Investigator (PI) to be conducted through the Centre for Mathematical Sciences (CMS) at its Trivandrum (Kerala, India) campus. Dr Mathai had already conducted several projects for DST by that time. Dr B.D. Acharya was in charge of the Mathematical Sciences Division of DST in those days. There were SERC Schools in various subjects but there was none for Mathematics and hence Dr Acharya wanted Dr Mathai to run a sequence of SERC Schools in Mathematical Sciences. A proposal for a sequence of five Schools on the general theme of Special Functions and Their Applications was made in 1994 and it was approved and the first School of 6 weeks was conducted at Trivadrum in 1995. The sanction was for one School each year. But due to lack of time for Dr Mathai, the second School could be held in Trivandrum only in 2000. Since the two Schools were very popular and students were waiting all across India for the next School, Dr Acharya requested the PI to find time to run the School every year. Thus one School every year was conducted starting from 2005. These Schools are well-disciplined and strictly run. The PI lines up the best researchers to give the lectures, usually 2 to 3 from abroad and 3 to 4 from within India for each School. Each lecturer gives, lectures for 3 days or 5 days on a selected topic within the general theme. Lectures are from 08.30 to 10.30 and 14.00 to 16.00 hrs followed by problem-solving sessions from 10.30 to 13.00 and 16.00 to 18.00hrs with short coffee breaks at 10.30 and 16.00 and a lunch break from 13.00 to 14.00. During the valedictory session, a DST representative is requested to come and distribute the certificates and also to interview each and every participant individually and confidentially to get the reaction from him/her about the usefulness of the School. After the first 3 Schools in 1995, 2000 and 2005, Dr Acharya was fully convinced that the SERC Schools run by Dr Mathai was one of the best, if not the best, in India. All the participants in all the Schools went to academic lines, either for teaching or for research. The main theme for the second sequence of five SERC Schools was Multivariable and Matrix Variable Calculus and Applications. The theme for the third sequence is Matrix Methods. The first in the third sequence is scheduled to start in April-May 2014.

After the conclusion of the School in 1995, Dr Acharya said that if Dr Mathai submitted a development plan then it would be given favorable consideration. A development plan to develop research groups and faculty with Dr Mathai as the PI and to create facilities at CMS was submitted in 1995 and it was approved. The PI had made a request for a total five year budget of 3.67 crores rupees only but the program assessment committee approved a budget of 4 crores rupees and the project SR/S4/MS:287/05 started on 1st January 2007. The project was to end on 2nd November 2011 because the sanctioning date was 2nd November 2006. In the proposal, the PI had promised only five research papers in internationally refereed research journals in each year and one to two books in five years. Initially 4 research students were recruited, then more and more and finally the number went up to 17. Four faculty members were also recruited, out of which two were fresh Ph.Ds from IIT Madras, one from IIT Bombay and one established researcher from Lakehead University in Canada. The research students were recruited from among graduates from local colleges and local universities. When the PI started training the students he found that almost all had negative background, not zero but negative, in the sense that in the name of mathematics and statistics a lot of wrong notions, wrong ideas and concepts had gone into their brains. This situation was to be remedied. The PI decided to produce Modules on various basic topics to retrain the youngsters. Modules are self-study materials on basic topics in mathematics and statistics so that a proper foundation is made through these Modules. Eight Modules are produced by 2013. These, as well as other research level books, proceedings of conferences, newsletter etc are printed at CMS Press itself. DST had given the PI a locally manufactured four-color printing unit. All publications from CMS are printed by using this printing unit. Also the PI had started undergraduate mathematics training camps where these Modules are used to train the students up to B.Sc level. After making some basis, research topics are assigned to the students. Also special

training was given by the PI in developing skills for making beautiful slides, presenting materials before large audiences etc. From day one, each student is put on stage to present materials. In these presentations, it was compulsory for each one in the audience to ask at least one sensible question. If the question was not serious enough, as per the PI's evaluation, then the person had to ask another question. Attendance was made strict. All holidays were abolished, except Sundays, Republic Day and Independence Day. Individual personal leaves were granted for personal matters. In Kerala there are holidays in the name of all sorts of things and it is difficult to find 100 working days in a year. One of the Vice-Chancellors in a local university stated that his aim was to find at least 75 working days in a year for his university.

Strict disciplines at CMS produced good results. The PI told all students before they started at CMS that if anyone violated any of the rules then the person would be dismissed right away and there was no second chance since they were all paid from taxpayers' money. Two Ph.D scholars were dismissed for dishonesty, one was dismissed for coming late without acceptable reason, one was dismissed for lack of progress. Progress of each student and faculty was monitored every six months and warnings were issued when there was unsatisfactory progress. With strict disciplines, the scholars brought out the maximum of their own capabilities. Within the short span of five years these scholars, who came from local colleges with negative backgrounds, had won 15 national/international level prizes by competing with the scholars from all the major educational institutions in India. The prizes were for the "best published paper from India", "best paper presentation", "young scientist award" etc. CMS scholars and faculty had published over 150 research papers in refereed journals out of which more than 100 in international journals.

The project officially ended on 2nd November 2011 but due to administrative reasons the project was extended to 31st December 2013 and thus the project will officially end on 31st December 2013. New projects, if sanctioned, will start in January 2014. The following is the summary of the achievements of CMS scholars and faculty during the past five years.

Summary of the achievements of the PI's team at CMS during 2007-2013

Number of National/International Awards won by research scholars in PI's team = 12

Number of research papers published by the team in refereed research journals =152

Number of research papers published in international refereed journals >100

Number of research level books =8 [2 of these are published, third under review, by Springer, New York]

Number of Modules (self-study books at undergraduate-graduate level) = 8

Number of Ph.D students trained = 17 (Four received Ph.Ds, 2 submitted Ph.D theses at MG University, 4 ready to submit their Ph.D theses at Anna University, Chennai).

Number of research level students trained through SERC Schools by the PI > 150

Number of undergraduate students trained through undergraduate mathematics training camps > 700

Number of paper presentations abroad by the research scholars under the PI = 8

Number of paper presentations inside India by research scholars under the PI > 50

Number of invited and keynote addresses by the PI and senior researchers under the PI, including lead keynote addresses at United Nations' Workshops >50

Number of conferences sponsored or co-sponsored by the team under the PI =5

The PI, Dr A.M. Mathai, was honored by several institutions and national societies in India, and thrice by the United Nations, once in Tokyo, Japan, once in Daejon, Korea and once in Quito, Ecuador and he gave keynote addresses also.

CMS, now it is CMSS (Centre for Mathematical and Statistical Sciences), is a recognized research centre of Banaras Hindu University (BHU) in U P, India; Anna University Coimbatore and Chennai in Tamil Nadu, India; Mahatma Gandhi University (MG University) in Kerala, India.

Forthcoming Undergraduate Mathematics Training Camps of CMSS

The 20th and 21st undergraduate mathematics training camps of CMSS (UG Camps) will be sponsored by the Department of Science and Technology, Government of India, New Delhi (DST), co-sponsored by the Kerala State Council for Science, Technology and Environment (KSCSTE), hosted by the Kerala Forest Research Institute (KFRI) and conducted by CMSS. KFRI is situated in the picturesque Peechi Dam area. The theme of the 20th camp is **limits, continuity and differential calculus** and that of the 21st camp is **vectors, matrices and determinants**. Both camps will be held from 20th to 29th December 2013. Instructor of the 20th camp will be Professor Dr A.M. Mathai, Director of CMSS and that of the 21st camp is Dilip Kumar of CMSS.

The UG camps of CMSS are open to all streams of students in the 1st, 2nd and 3rd year of undergraduates (B.Sc level) in all colleges and universities in India. The UG Camps of CMSS are a free service to the youngsters in India. No fee is collected, participants are given free accommodation, food and study materials. Their to and fro travel at the bus/train rate is reimbursed until the budget allotted for travel is finished. UG Camps of CMSS are not tutorials or coaching for any degree program of any university. These camps are aimed at teaching the foundations of the subject matter and basic concepts on each topic. Only 30 seats are there for each camp and the students line up to get in. Up to five motivated students from each college are given admission if the colleges find and nominate such students. These camps are held continuously for 10 days each and no holidays in between. The lectures are from 8.30 to 10.30 and 14.00 to 16.00hrs every day, followed by problem-solving sessions from 10.30 to13.00 and 16.00 to 18.00hrs with short coffee breaks at 10.30 and 16.00hrs.

CMSS does not believe in simply giving lectures on some topics, show some slides or project materials on screens and the participants watch and leave. All programs of CMSS are instructional or teaching programs where every lecture is followed by an equal amount of time spent on problem-solving sessions at the undergraduate level and serious discussions and critical analysis of the lecture material at the graduate/research level. Projection on screen is allowed only on research level materials or for the display of graphs, charts, data etc.

After teaching for the last 55 years at all levels and in various universities in different countries, Professor Mathai came to the conclusion that the best method of teaching students is by using chalk and blackboard. The students have the benefit of watching on the board, listening, writing notes in their notebooks, which also gives a time-lag to absorb the material. When something is projected on the screen the students go into television-watching mode or their minds go into relaxing mode and not into a learning or concentration mode. He found that lecturing by using chalk and blackboard is not sufficient to make the students understand the material properly. Exercises in the form of problem-solving have to follow such lectures. Hence the method adopted at CMSS for UG training camps is to give lectures by using blackboard and chalk where the students must take down notes from the board. Then immediately after the lectures, problem-solving sessions on the same lecture material are conduced. In these problem-solving sessions, students sit around round tables which can seat up to 8 students. Students from the same college or who know each other closely are not allowed to sit at the same table. Students at each table must discuss the problems among themselves first and then solve so that weaker students learn from others at the table also. A supervisor will walk around. Even after discussion, if the students around a table are unable to solve a problem then the supervisor will give hints but not solve the problem fully. With the help of the hints the students will be able to solve the problems. The supervisor is not allowed to go to the board and write anything or explain anything on the board or make public announcements of any sort. This method of conducting UG programs is found to be very effective in making the students to understand the basic concepts properly. Participants' satisfaction level is nearly 10 out of 10 points on all aspects, as revealed by the returned questionnaires. As soon as the camp is announced by CMSS, there is a huge line up to get into the camps. Whenever Professor Mathai is in station, all the lectures in the UG Camps are given by Professor Mathai himself so that his accumulated knowledge of teaching and doing research in one of the top universities in the world, namely McGill University in Canada, will be transferred to the youngsters.

* * * * * *

Recent Visitors to CMSS

Dr P.G. Romeo (CUSAT) and Dr M.A Pathan (Aligharh Muslim University) visiting CMSS

Dr Aloke Dey (ISI Delhi) visiting CMSS

Dr Vincent Jeyakumar (Periyar Mariammai University) visiting CMSS

P. Prajitha presenting her work during INSPIRE evaluation meeting

Dilip Kumar lighting the lamp during the inauguration of the Mathematics Association at Union Christian College, Aluva

Dilip Kumar delivering the Keynote address in the inauguration of the Mathematics Association at Union Christian College, Aluva

CMSS has established a campus in the picturesque Peechi Dam area at the Kerala Forest Research Institute (KFRI). Peechi is easily accessible from Kochi (Cochin) international airport (about 65 kilometers), from Trichur railway station (about 15 KM) and near Kochi-Coimbatore highway. KFRI is one of the premier research institutes under the Kerala State Council for Science, Technology and Environment (KSCSTE). Over 60 research scientists are working there at KFRI, covering various aspects of biological sciences related to forest resources, forest products and forest management. The world centre for Teak wood research, TEAKNET, is situated at KFRI.

CMSS has shifted its library, the best collection of back volumes of research journals and research level books, best in Kerala, to CMSS Peechi Campus. CMSS Peechi Campus is now collaborating with KFRI in the applications of statistical and mathematical techniques in biological sciences. CMSS Director Dr A.M. Mathai had interest in developing mathematical models in biological sciences. The theory of growth and forms proposed by Dr Mathai and the biologist Dr T.A. Davis [Mathai and Davis (1974): Constructing a sunflower head, *Mathematical Biosciences: An International Journal*, Volume **20**, 1974, pp.117-133] is still holding. It is shown how to generate various patterns, and the reason for the emergence of Fibonacci sequences [0,1,1,2,3,5,8,… the sum of the previous two numbers is the next number] in Nature is also explained there. By using the theory of growth and forms, a sunflower head is constructed, which has all the features of the natural sunflower. In 1976 the journal : *Mathematical Biosciences: An International Journal* had adapted the mathematically constructed sunflower head as its cover design, with acknowledgement to the authors [see the inside front cover of Volume 31, Numbers1&2, 1976]. It is still the cover design of the journal.

Mathai and Davis examined the beautiful growing crown of a coconut tree. From many mathematical points of view, it is shown that the coconut crown is an ideal crown and the coconut tree has great survival value. This paper appeared in the Proceedings of the National Science Academy (India) [Volume 39, 1973, pp. 194-202]. Another topic that was taken up for study by Mathai and Davis was the engineering aspects of the egg chamber in Bayya bird's nests. The entrance to the egg chamber is through the bottom tail opening of the nest. The female bird goes into the egg chamber through this opening at the bottom. Hence, naturally, the bottom opening is bigger than the eggs. These nests, hanging on oscillating coconut leaves or other branches of trees are violently oscillating when there is strong wind. The ellipsoidal eggs move around in the egg chamber but none of them comes out of the nest through the bottom opening of the next. No brokern eggs can be found on the ground even though dozens of nests may be there in one colony of nests hanging on coconut leaves in one coconut tree alone. The engineering aspects of the egg chamber are very interesting. While this study was progressing, Professor Davis passed away and thus the collaboration ended. Now, the presence of so many researchers at KFRI, dealing with various aspects of biological sciences, may rekindle the possibility of joint ventures of the applications of statistical ad mathematical techniques in biological sciences, especially in forestry. Some of the geometrical probability problems, especially that of the nearest neighbor problem, will be readily applicable in forestry. Some of such geometrical probability problems may be seen from the book Mathai (1999) [*An Introduction to Geometrical Probability: Distributional Aspects with Applications*, Gordon and Breach, Newark, 1999]. Significant fruitful results can be expected from the collaboration between CMSS and KFRI.

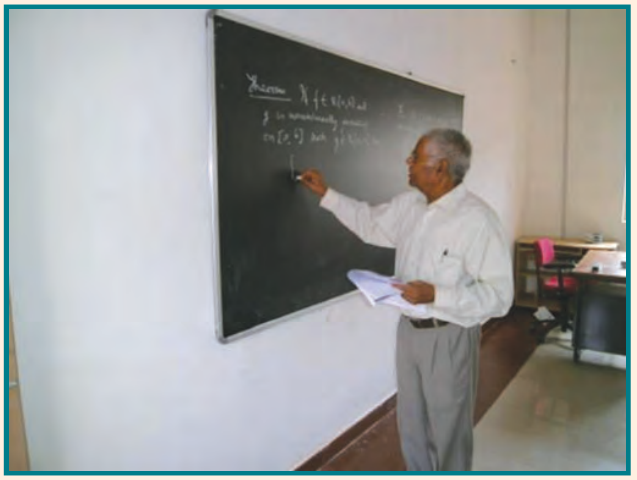
NEWS FROM OTHER CAMPUSES

1a. Department of Mathematics, Central University of Kerala, Kasaragod, Kerala, India (CUK)

The Department organized three National Workshops in 2013.

Workshop on Graph Theory participants, 9-11 January 2013

Workshop on Linear Algebra participants, 11-13 February 2013



Professor M. A. Pathan visited the Department during 15-29 November 2013. He engaged the classes for the First Semester M. Sc. Students of the Department of Mathematics, CUK.

Research Publications
Dr K.A. Germina

1. K.A. Germina and Kumar Abhishek (2013): On outset-magic digraphs. *J. Discrete Math. Sci and Cryptography*, **16 (1),** 45–59.

2. K.A. Germina and Reena Sebastian (2013): Further results on square sum graphs. *International Mathematical Forum* , **8(1),** 47-57.

3. B. D. Acharya and K. A . Germina (2013): Strongly indexable graphs: some new perspectives. *Optimization, An Electronic International Journal-A special issue on Graph Theory and its Applications*, **15(1),** 3-22.

4. K. A. Germina and Reena Sebastian (2013): Maximal square sum subgraph of a complete graph. *International Journal of Algorithms, Computing and Mathematics*, **15 (1).**

Guest Editor to JCISS Vol 34 (2-4) (2012)

B.D. Acharya, K.A. Germina, S.B. Rao and T. Zaslavsky are the guest editors to the special issue of **JCISS, 34 (2-4) (2012)** containing the best part of the technical proceedings of the *International Workshop on Set-valuations, Signed Graphs, Geometry and Applications*, held at Mary Matha Arts and Science College, Mananthavady, Kerala, during 2-6 September 2011.

Invited Talks: Dr K.A. Germina

1. Dr K.A. Germina delivered an invited talk at the *Pre-ICDM-2013 Instructional Workshop on Recent Advances in Spectral Graph Theory*, organized by the Academy of discrete Mathematics and Applications (ADMA) and PiMSci, Karanatak University, Dharwad during 5-9 June 2013 and chaired a session there.

2. She delivered an invited talk in the *FDP Recent Advances in Graph Theory* organized by the Department of Mathematics, National institute of Technology, Calicut, on 26th June 2013.

3. She delivered an invited talk at Assumption College, Changanacherry, Kottayam, on 21st August 2013.

4. She gave an invited talk at the *National Conference on Recent trends in Graph theory*, at SD College, Kanjirappally, Kerala, 21-22 November 2013.

5. She gave an invited talk at the *International Conference on Graph Theory Applied to Social Networking* at Periyar University, Thanchavur, Tamil Nadu during 2-4 December 2013.

Ph. D Thesis Submitted under the Supervision of Dr K.A. Germina

Rency Kurian (FDP) (2013): Title of the Thesis: New Directions in the Theory of Labeling of Graphs.

Forthcoming Events

The Department of Mathematics, Central University of Kerala, plans to conduct a series of workshops for the benefit of M. Sc/Ph. D students and faculty.

* **Workshop on Functional Analysis during 16-18 January 2014.**

* **Workshop on Topology during 30-31 January 2014.**

* **Workshop on Fractional Calculus during 6-7 February 2014.**

Research Publications Dr A.K. Rathie

1. Xiaoxia Wang and A.K. Rathie (2013) : Extension of a quadratic transformation due to Whipple with an application. *Advances Diff. Equ.*, **157**, 1-8.

2. Junesang Choi and A.K.Rathie (2013):Reduction formulas for the Lauricella function in several variables. *J. Inequaalities and Applications*, **312**, 1-7.

3. Y.S. Kim and A.K. Rathie (2013) : Some results for the terminating ${}_3F_2(2)$. *J. Inequalities and Applications*, **365**, 1-12.

Dr A.K. Rathie delivered ninety minutes invited talk titled "Generalized hypergeometric fuinctions with applications in Ramanujan's summations" in the *Annual Conference of Kerala Mathematics Association* held at FISAT, Angamali , Kerala, on July 16, 2013.

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1b. Department of Physics, Central University of Kerala, Kasaragod, Kerala, India (CUK)

Recent Research Activities

Partcipation and Paper Presentation in International Conferences

All faculty members in the department have presented papers in International Conferences held outside India. The details are as follows:

1. Dr Vincent Mathew, Associate Professor, has presented a paper (**invited talk**) in the International Conference *Optics-2013, held at San Antonio, Texas, USA*, during October 6-9, 2013. Title of the paper: "Surface plasmonpolaritons in metal trip waveguides with anisotropic substrate materials".

2. Dr E. Prasad, Assistant Professor, has presented the paper titled "Searching the onset of dissipation in the fusion reactions 16,18O+194Pt via ER measurements presented in *Heavy Ion Accelerator Symposium (HIAS 2013)" at Australian National University, Canberra*, 8-12 April, 2013 (**Invited talk**).

3. Dr Swapna S Nair, Assistant Professor, has presented two papers in the *International Conference on Materials for Advanced Technologies (ICMAT)* at Singapore during June 30 – July 5, 2013.

4. Dr Subasa C Sahoo, Assistant Professor, has presented the paper: M. Chithra, C.N. Anumol, B.N. Sahu, and S. Sahoo, "Magnetic Properties of Cobalt Ferrite Nanoparticles Prepared by Sol-gel Technique", at the *International Conference on Materials for Advanced Technologies (ICMAT 2013)*, June 30 – July 5, (2013), Singapore.

Publications in International Journals

1. Jolly Andrews and Vincent Mathew (20113): Vortex dynamics effects on microwave propagation in high temperature superconducting coplanar waveguides. *Journal of Applied Physics*, **114**, 163914 (1-7).

2. Gishamol Mathew and Vincent Mathew (2013): Nonreciprocal propagation of tunable magnetoplasmons in metal-strip waveguides. *Solid State Communications*, **170**, 58-64.

3. R. Ajith and Vincent Mathew (2013): Dispersion and field distribution of SPP waves at the interface of a metal and nonlinear magnetic material. *Plasmonics*, **8(2),** 449-454.

Publications from team work

4. Rohit Sandal, B. R. Behera, Varinderjit Singh, Maninder Kaur, A. Kumar, G. Singh, K. P. Singh, P. Sugathan, A. Jhingan, K. S. Golda, M. B. Chatterjee, R. K. Bhowmik, Sunil Kalkal, D. Siwal, S. Goyal, S. Mandal, E. Prasad, K. Mahata, A. Saxena, Jhilam Sadhukhan, and Santanu Pal (2013: Effect of N/Z in pre-scission neutron multiplicity for 16,18O + 194,198Pt systems. *Phys. Rev.* **C 87**, 014604.

5. Anju Babu, C. Bhagyaraj, R. Ajith, and Vincent Mathew (2013): Dispersion characteristics of guided plasmonic modes in metallic slot waveguides using method of lines. *Journal of Computational and Theoretical Nanoscience*, **10(9),** 1–6.

6. Jesly Jacob, R. Ajith, P. Arun, and Vincent Mathew (2013): Surface plasmon near field effects in silver nano cylinders arranged in triangular geometry. *Journal of Computational and Theoretical Nanoscience*, **10(6),** 1-7.

7. Seena Mathew, R. Ajith and Vincent Mathew (2013): Tunable wave propagation in superconducting microstrip line based on ferro-electric thin films. *J. Supercond. Nov. Magn.*, **26**, 565–570.

8. Seena Mathew, R. Ajith and Vincent Mathew (2013): Propagation characteristics of superconducting slot line based on ferro-electric substrates. *J. Supercond. Nov. Magn.*, doi: 10.1007/s10948-012-2099-7.

9. Anju Babu, C. Bhagyaraj, Jesly Jacob, Gishamol Mathew and Vincent Mathew (2013): Surface plasmon propagation in a metal-strip waveguide with biaxial substrate. *Opt. Quant. Electron*, **45(6),** 481-490.

10. Jesly Jacob, R. Ajith and Vincent Mathew (2013): Electromagnetic energy transport in a chain waveguide of silver nanoshell cylinder array. *Waves in Random and Complex Media*, (to appear)

11. S. C. Sahoo, D. R. Mohapatra, H. -J. Lee, S. M. Jejurikar, I. Kim, S.-C. Lee, J.-K. Park, Y.-J. Baik, and W.-S. Lee (2013): Carbon nanoflake growth from carbon

nanotubes by hot filament chemical vapor deposition. *Carbon*, **67**, 704-711.

12. B.N. Sahu, S.C. Sahoo, N. Venkataramani, S. Prasad, R. Krishnan, M. Kostylev and R. L. Stamps (2013): Magnetic and FMR study on $CoFe_2O_4$/ $ZnFe_2O_4$ bi-layers. *IEEE Trans. Magn.*, **49**, 4200.

13. M. Bohra, S. Prasad, N. Venkataramani, S.C. Sahoo, N. Kumar and R. Krishnan (2013): Low temperature magnetization studies of nanocrystalline Zn-ferrite thin films. *IEEE Trans. Magn.*, **49**, 4249.

14. Swapna S. Nair, Geetha Pookat, Venkata Saravanan and M. R. Anantharaman (2013): Lead freehet erogeneous multilayers with giant magneto electric coupling for microelectronics /microelectromechanical systems applications. *J. Appl. Phys.*, **114** , 064309.

15. N. Sethulakshmi, V. Sooraj, U. S. Sajeev, Swapna S. Nair, T. N. Narayanan, Lija K. Joy, P. A. Joy, P. M. Ajayan and M. R. Anantharaman (2013): Contact potential induced enhancement of magnetization in polyaniline coated nanomagnetic iron oxides by plasma polymerization. *Appl. Phys. Lett.*, **103**, 162414.

2. Department of Statistics, University of Kerala, Kerala, India

Recent Publications

1. P. Yageen Thomas and K.V. Baiju (2013): Estimation of the scale parameter of a skew-normal distribution using U-statistics based on order statistics. *Calcutta Statistical Association Bulletin*, **64**, 1-20.

2. Jerin Paul and P. Yageen Thomas (2013): On a property of generalized record values arising from exponential distribution. *Indian Association for Productivity, Quality and Reliability*, **38**, 19-27.

3. C. Satheesh Kumar (2013): The bivariate confluent hypergeometric series distribution and some of its properties. *Economical Quality Control*, **28(1)**, 23-30 (available online).

4. C. Satheesh Kumar and M.R. Anusree (2013): Location scale extension of modified skew normal distribution and its application. *Research Journal of Fatima Mata National College – Science Edition*, **4(1),** 48 -57.

5. C. Satheesh Kumar and M.R. Anusree (2013): On a generalized two-piece skew normal distribution and some of its properties. *Statistics: A Journal of Theoretical and Applied Statistics*, **47(6),** 1370-1380 (available online).

6. C. Satheesh Kumar and B. Unnikrishnan Nair (2013): On stuttering hyper-Poisson distribution and its properties. *Sri Lankan Journal of Applied Statistics* , **14(1),** 41-54 (available online).

7. C. Satheesh Kumar and A. Riyaz (2013): On Estimating the parameters of an extended form of logarithmic series distribution. *Communications for Statistical Applications and Methods*, **20(5),** 417- 425 (available online).

8. C. Satheesh Kumar and D.S. Shibu (2012): An extended intervened Poisson distribution. *Research Journal of Fatima Mata National College – Science Edition*, **4(1),** 29-39.

9. C. Satheesh Kumar and D.S. Shibu (2013): On some aspects of intervened generalized Hermite distribution. *Metron*, **71(1),** 9-19 (available online).

10. C. Satheesh Kumar and D.S. Shibu (2013): On intervened stuttering Poisson distribution and its application. *Journal of Statistical Theory and Practice*, **7(3),** 544-557 (available online).

11. C. Satheesh Kumar, Manoj Chacko and E.I. Abdul Sathar (2013): *Collection of Recent Statistical Methods and Applications*. Kerala University Department of Statistics Publishers, Trivandrum.[ISBN 978–93–5104–794–0].

12. G. Rajesh, E.I. Abdul Sathar, K.V. Reshmi and K.R.M. Nair (2013): Bivariate extension of dynamic cumulative residual entropy. Statistical Methodology, **16**, 72–82.

[**Accepted research publications, whose volume numbers and page numbers are not yet available:**

13. Veena, T. G. and P. Yageen Thomas (2013). Application of concomitants of order statistics of independent non-identically distributed random variables in estimation. *Communications in Statistics-Theory and Methods* (accepted for publication).

14. R.S. Priya and P. Yageen Thomas (2013) : A note on use of some functions of spacing in the estimation of common scale parameter of several symmetric distributions. *Communications in Statistics-Theory and Methods* (accepted for publication).

15. S. Minimol and P. Yageen Thomas (2013): On characterization of Gompertz distribution by generalized record values. *Journal of Statistical Theory and Application*, Vol. 12. (accepted for publication).

16. C. Satheesh Kumar and M.R. Anusree (2013): On a extended version of skew generalized normal distribution and some of its properties. *Communications in Statistics-Theory and Methods* (accepted for publication) (available online).

17. C. Satheesh Kumar and S.H.S. Dharmaja (2013): On some properties of Kies distribution *Metron* (accepted for publication) (available online).

18. C. Satheesh Kumar and A. Riyaz (2013): An alternative version of zero-inflated logarithmic series distribution and some of its applications. *Journal of Statistical Computation and Simulation* (accepted for publication).

19. C. Satheesh Kumar and A. Riyaz (2013): A modified version of logarithmic series distribution and its applications. *Communications in Statistics- Theory and Methods* (accepted for publication).

20. C. Satheesh Kumar and A. Riyaz (2012): On a zero-inflated logarithmic series distribution and its properties. Research Journal of Fatima Mata National College – Science Edition, 5 (accepted for publication).

21. C. Satheesh Kumar and A. Riyaz (2013). On zero-inflated logarithmic series distribution and its modification. *STATISTICA, 73* (accepted for publication).

22. C. Satheesh Kumar and A. Riyaz (2013): Logarithmic series distribution of order k. *The Aligarh Journal of Statistics* (accepted for publication).

23. C. Satheesh Kumar and A. Riyaz (2013): On a bivariate version of zero-inflated logarithmic series distribution and its properties. *Journal of Statistics and Applications* (accepted for publication).

24. C. Satheesh Kumar and S. Sreejakumari (2013): Modified intervened geometric distribution and some of its properties. *The Aligarh Journal of Statistics* (accepted for publication).

25. C. Satheesh Kumar and B. Unnikrishnan Nair (2013): On extended alternative hyper-Poisson distribution. *The Aligarh Journal of Statistics*, 33 (accepted for publication).

26. C. Satheesh Kumar and B. Unnikrishnan Nair (2013): A bivariate version of the hyper-Poisson distribution and some of its properties. *Journal of Statistical Research*, 42 (accepted for publication).

27. C. Satheesh Kumar and B. Unnikrishnan Nair (2013): Order *k* version of the alternative hyper-Poisson distribution. *Economical Quality Control*, 28 (accepted for publication).

28. R. Maya, E.I. Abdul Sathar, G. Rajesh and K.R.M. Nair (2013) : Estimation of the Renyi's residual entropy of order alpha with dependent data. *Statistical Papers* (available online).

29. G. Rajesh, E.I. Abdul Sathar, K.V. Reshmi and K.R.M. Nair (2013): Bivariate generalized cumulative residual entropy. *Sankhya* (available online)].

Conferences attended and papers presented by the faculty members

Dr P. Yageen Thomas

Attended the National Statistical Day Celebrations-2013, organized by the Department of Statistics, University of Kerala, Trivandrum, on 29 June 2013 and delivered an invited talk on: "Prof. U. S. Nair's Contributions to Statistics and the Importance of Nair's Estimate of the Scale Parameter of a Distribution".

Dr C. Satheesh Kumar

Delivered invited special lectures on "Research Methodology" to the faculty members and engineering post-graduate students of the T.K.M.M Engineering College, Kollam on 05 October 2013.

Other Activities

1. This department organized several activities with students' participation in connection with the International Statistics Year Celebrations - 2013. Some of them are listed below: (i) All Kerala Post-graduate level Quiz Competition on 28 June 2013, (ii) One day seminar on 29 June 2013 in connection with the Statistics Day-2013 Celebrations, (iii) Graduate level Quiz Competition (Kerala University region) held on 19 October 2013 at the Colleges:

M.S.M. College (Kayamkulam), Fatima Mata National College (Kollam) and University College (Trivandrum), (iv) Lecture Series-1 held on 22-23 October 2013 handled by Professor A.M. Mathai, Director, Centre for Mathematical and Statistical Sciences and Emeritus Professor, McGill University, Canada.

3. Dr C. Satheesh Kumar offered Editorial Services (as a referee) to International Journals in Statistics: *Communications in Statistics-Theory and Methods* (Taylor & Francis journal) published from USA, *Bulletin of Malaysian Mathematical Sciences Society*, *Sri Lankan Journal of Applied Statistics*, *Pakistan Journal of Statistics and Operations Research* and *STAPRO*, and offered Editorial Services (as a reviewer) to *Mathematical Reviews*.

Other noteworthy events

1. Smt. G. Lesitha was awarded Ph. D degree from Kerala University for her thesis titled "On Ranked Set Sampling" completed under the guidance and supervision of Professor P. Yageen Thomas.

2. Mr Vinesh, JRF of this department was selected for Indian Statistical Service.

3. Mr D.S. Shibu, Faculty Research Fellow of this department won "Professor R. N. Pillai Best Paper Award-2013" of the Alumni Association of the Department of Statistics University of Kerala (AADSUK) from among young Alumni Members of the Department of Statistics, University of Kerala.

4. Mr B. Unnikrishnan Nair, Faculty Research Fellow of this department has won Professor Jacob Sundara Raja Best Paper Award-2013 of the Alumni Association of the Department of Statistics, University of Kerala (AADSUK) from among young registered research scholars of the Department of Statistics, University of Kerala.

5. One of the papers of Dr C. Satheesh Kumar published in the Journal: *Journal of Statistical Theory and Practice* (Taylor and Francis) is listed in the group of the most cited article of that journal.

3. Department of Mathematics, Cochin University of Science and Technology (CUSAT)

Dr M. N. N. Namboodiri gave an **invited talk** on Fourier series at the *Instructional Workshop and International Conference on Fractals and Wavelet*, at Rajagiri Engineering College, Kochi, in November 2013.

Dr Namboodiri is **invited** to give a **talk** during *IWOTA, 15-20*, in December 2013 in the Department of Mathematics, IISc, Bangalore.

Dr P.G. Romeo gave lectures as resource person at the AICTE sponsored short term course, in November 2013 in the Department of Mathematics, Government Engineering College, Thrissur.

Research Scholars of the department M.R. Chitra, K.S. Savitha and Seethu Varghese participated at the *Indo-Slovenia Conference on Graph theory and Applications* organized by Department of Futures Study, University of Kerala in February 2013.

Research scholars A.S. Manjunath, S. Jaya and Dhanya Shajin participated and Dhanya Shajin presented a paper at the 23rd Swadeshi Science Congress, 6-8 November2013, at M.G. University, Kottayam.

Fourthcoming Events

1. *Instructional Workshop on Semigroups and Applications*, 22-24, February 2014. The workshop is aimed to benefit research workers in semigroup theory, so it is restricted to those interested in semigroups theory. There is no registration fee for the workshop, accommodation and minimum hospitality will be provided. Professor John Meakin, Nebraska USA, Professor Lazlo Marki, Alfred Renyi Institute,Hungary, Professor K.S.S. Nambooripad and Professor A.R. Rajan (formerly of Kerala University) and Professor M.K. Sen, University of Calcutta will be coordinating the workshop.

2. *International Conference on Semigroups, Algebras and Operator Theory (ICSAOT-2014)*, 26-28 February 2014. Registration details are available in www.cusat.ac.in and http://sites.google.com/site/icsaot2014/

RECENT CONTRIBUTIONS FROM CMSS

Dilip Kumar, CMSS

In the span of past 7 years Centre for Mathematical and Statistical Sciences (CMSS) has published over 152 papers. Significant and new ideas were produced from CMSS during these years. Professor A.M. Mathai's insights on the switching property of the binomial function to the exponential function which was ignited way back in 1970's in connection with population studies gave light to a new mathematical/statistical model called pathway model [Mathai (2005)]. Pathway model which was originally introduced and enlarged to cover rectangular matrix variate case comprises of three forms namely the generalized type-1 beta form, generalized type-2 beta form and the generalized gamma form which in turn covers a spectrum of statistical densities. Thus the pathway idea describes many practical situations or fits into data coming from various situations [Mathai (2005), Mathai and Haubold (2007)]. Tsallis statistics and superstatistics, two very popular topics in the area of non-extensive statistical mechanics in which over 3000 articles were written during the past ten years, are special cases of the scalar version of the pathway model. In the sequel of papers on pathway model Mathai introduced the concept of versatile integrals in 2006. Six different forms of the Mellin convolution of product and six different forms of the Mellin convolution of ratio of two pathway random variables are covered in the paper on versatile integrals. Reaction rate probability integral in reaction rate theory and the many related results, Krätzel integral in applied analysis and the many related results, inverse Gaussian density in Statistics and Stochastic Processes, the unconditional densities in the general Bayesian analysis are all special cases in this versatile integral.

Another idea introduced by Mathai was to study the effect of power transformation and exponentiations. A simple power transformation on an exponential density produces the Weibull density and exponentiation in type-2 beta density produces the generalized logistic density [Mathai (2013)]. Techniques were introduced to produce thicker and thinner tailed models from a given model which was illustrated through a generalized gamma model by appending it with Bessel type series, Mittag-Leffler type series and general hypergeometric series, Wright's series etc. A generalized statistical density is introduced in terms of a 3-parameter Mittag-Leffler function. This density produces thicker-tailed models, its domain of attraction is the power function and connected to Levy and Linnik models, see Mathai (2010). In a series of a papers Haubold, Mathai and Saxena solved a series of fractional differential equations. One of the papers, Haubold et al. (2010), was in the most downloded list. Another vital contribution of Mathai in recent years was to introduce a proper interpretation for a fractional integral, by virtue of the Mellin convolution of product and ratio in the scalar case and M-convolution in the matrix-variate case, which encompass all definitions of fractional integrals available in the literature. It also gives a geometrical interpretation of right-sided and left-sided integrals, see the series of papers on Cornell University Archives [Mathai and Haubold (2013)]. Parallel to the Mellin convolution in the scalar variable case, M-convolution was introduced by Mathai in 1997 [Mathai (1997)]. For the first time, physical interpretations in terms of matrix-variate statistical densities, as densities of products and ratios of real positive definite or hermitian positive definite matrices are given. Fractional calculus of real-valued scalar functions of hermitian positive definite matrices, in matrix-variate case in complex domain is also given in [Mathai (2013)]. Mathai also introduced certain fractional differential operators, applicable in real and complex matrix-variate cases. In 2007, Mathai introduced a generalized entropy [Mathai and Haubold (2007)], which was a slight variation of alpha-generalized entropies discussed in Mathai and Rathie (1975), and it is shown that optimization of this entropy under various restrictions can produce directly Tsallis density, superstatistics, pathway model, multivariate densities including multivariate Gaussian and matrix-variate densities without any intermediate densities, such as escort densities. Other known entropy optimization requires intermediate steps of escort densities to arrive at the final model. Way back from 1984, Haubold and Mathai have produced a larger number of results on energy generation, analytic solar and stellar models etc including two encyclopaedia articles. In continuation of their work, Hans J. Haubold, Alexander Haubold of the team applied diffusion entropy analysis, standard deviation analysis to solar neutrino data available from Super Kamiokande and observed a non-Gaussian behavior or pathway behavior in the data. If this deviation is confirmed then it will be a very significant finding in the near future.

Motivated by the pathway idea a number of results were produced by researchers at CMSS. Pathway model was applied in various fields especially in fractional calculus, applied analysis, statistics and theoretical physics. In 2008, Dilip Kumar of CMSS, in collaboration with Professor Hans J. Haubold made use of the pathway model to extend the non-resonant reaction rates and obtained closed form solutions in each case [Haubold and Kumar (2008)]. Series representations and expressions for fusion yield were also obtained in the following years [Kumar and Haubold (2009), Haubold and Kumar (2011)]. In 2009, Dr Seema S. Nair when she was a senior research student at CMSS applied the idea of pathway model in fractional calculus and obtained a new operator called the pathway fractional integral operator [Nair (2009)]. This operator generalizes the Riemann-Liouville fractional operator and many other integral operators as well. A matrix variate pathway fractional integral operator was also introduced by Nair [Nair (2010)]. In 2009, Kumar in collaboration with Professor A.A. Kilbas of Belarus State

University, Belarus, generalized the Krätzel function. The generalized Krätzel function [Kilbas and Kumar (2009)] thus paved the way to create a new integral transform named P-transform which covers a wide spectrum of integral transforms including the Laplace transform, Meijer transform and Krätzel transform [Kumar (2011, 2013)]. In later years a detailed study of the fractional calculus of P-transform was conducted by Kumar. Dr Dhannya P. Joseph, when she was a senior research student at CMSS, used the pathway idea in 2010 to extend the inverse Gaussian density in statistics and some mixtures of extended inverse Gaussian density were established [Joseph (2009)]. Dr Nicy Sebastian developed a multivariate gamma model associated with Bessel function in 2011 when she was a senior research fellow at CMSS [Sebastian (2011)]. In 2012, Princy introduced a continuous mixture of Weibull and gamma models which in turn lead to the development of a new statistical density called Krätzel density. She applied it to fading channels and ultrasonic backscatter signals modeling [Princy (2012)]. Naiju M. Thomas studied the properties of the product and ratios of pathway random variables [Thomas (2013)]. In 2013, Prajitha introduced a new statistical test procedure to test the discrete HNBUE class of life distributions which is one of the largest aging classes in discrete reliability. In the same year she also developed a discrete probability law using the three parameter Mittag-Leffler function.

References

1. A. Haubold, H.J. Haubold and D. Kumar (2012): Heliosheath: Diffusion entropy analysis and non-extensivity of q-triplet. arXiv:1202.3417v1 [physics.gen-ph].
2. A. Haubold, H.J. Haubold and D. Kumar (2012a): Solar neutrino records: Gauss or non-Gauss is the question. arXiv:1202.1549v1 [physics.gen-ph].
3. H.J. Haubold and D. Kumar (2008): Extensions of thermonuclear functions through the pathway model including Maxwell-Boltzmann and Tsallis distributions. *Astroparticle Physics*, **29**, 70-76.
4. H.J. Haubold and D. Kumar (2011): Fusion Yield: Guderley model and Tsallis statistics. *Journal of Plasma Physics*, **77(1)**, 1-14.
5. H.J. Haubold, A.M. Mathai and R.K. Saxena (2010): Solutions of certain fractional kinetic equations and fractional deffusion equation. *Journal of Mathematical Physics*, **51**, 103506-1,103506-8.
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