Centre for Mathematical Sciences (CMS)
Apaji Institute of Mathematics
&
Applied Computer Technology
Banasthali University
Banasthali 304022 (Rajasthan)

Report

On

National Workshop on 'Recent Trends in Bio-Mathematics & Statistics'

November 02-05, 2012

Sponsored

by

Department of Science & Technology

Government of India, New Delhi

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About the Workshop

Bio-Mathematics comprises of mathematical models to help understand phenomena in biology. Modern experimental biology is very good at taking biological systems apart (at all levels of organization, from genome to global nutrient cycling), into components simple enough that their structure and function can be studied in isolation. And, Dynamic models are a way to put the pieces back together, with equations that represent the system's components, processes, and the structure of their interactions. Mathematical models are important basic tools in basic scientific research in many areas of biology, including physiology, ecology, evolution, toxicology, immunology, natural resource management, and conservation biology. Mathematical biology may sound like a narrow discipline, but it encompasses all of biology and virtually all of streams of Mathematical Sciences, including Statistics, Operations Research, and Scientific Computing.

This workshop intended to bring together expert researchers from around the India to exchange ideas and share their research results about all aspects of Mathematical Biology and Biostatistics in general and the use of optimal control theory in biology and medicine in particular. The aim of the workshop was to promote and explore new collaborations among the national scientific community.

Eminent Speakers of the Workshop:

1) Prof. Peeyush Chandra, IIT Kanpur
2) Prof. B.V. Rathish Kumar, IIT Kanpur
3) Prof. P.G. Siddheshwar, Bangalore University
4) Prof. Uttam Bandhopadhyay, Calcutta University
5) Prof. Atanu Biswas, ISI Kolkata
6) Prof. Apratim Guha, IIM Ahmadabad
7) Prof. G.N. Purohit, Banasthali University

Participants: Participation was invited from all over the country by sending invitation to the Heads of the Departments of Mathematics/Statistics/Computer Science of various Institutes/Universities and Research Organizations and also announcing the workshop at the website of Banasthali University www.banasthali.org. About fifty candidates from all over India applied for participation in the workshop. The advisory committee scrutinized the applications received and finally forty candidates from these applications were short-listed and invited based on the relevance of the area of specialization with their research interest. Besides these participants, faculty members and research scholars from Banasthali Vidyapith also participated.

Programme: The programme comprised of technical sessions in addition to Inaugural and Valedictory session. The detailed Program Schedule is given below.

Programme Schedule

Nov. 2, 2012

Registration: 9:00-10.00
Inauguration: 10.00 – 10.30
Tea Break…….10.30 – 11.00

Technical Session I: 11.00 – 12.00
Instructor: GNP
Technical Session II: 12.15 – 1.15
Instructor: PGS
Lunch Break….1.15 – 2.45

Technical Session III: 2.45-3.45
Instructor: PGS
Tea Break….3.45 – 4.00

Lab Session I: 4.00-6.00
Introduction to Mathematica with special reference to Bio-Mathematics
Instructors: Dr. Shalini Chandra, Dr. Patanjali Sharma, Dr. Praveen Gupta, Ms. Preeti Jain

Nov. 3, 2012

Technical Session IV: 10.00 - 11.00
Instructor: BVR
Tea Break .....11.00 - 11.15

Technical Session V: 11.15 – 12.15
Instructor: BVR
Technical Session VI: 12.15 – 1.15
Instructor: AG
Lunch Break: 1.15 - 2.45

Technical Session VII: 2.45–3.45
Instructor: AG
Tea Break: 3.45- 4.00

Technical Session VIII: 4.00 - 5.00
Instructor: PGS
Lab Session II: 5.30-7.30
Introduction to R
Instructors: Dr. Shalini Chandra, Ms. Mansi Khurana, Ms Gargi Tyagi

Nov. 4, 2012

Technical Session IX: 10.00 - 11.00
Instructor: PGS
Tea Break .....11.00 - 11.15

Technical Session X: 11.15 –12.15
Instructor: AG
Technical Session XI: 12.15 – 1.15
Instructor: PC
Lunch Break: 1.15 - 2.45

Technical Session XII: 2.45–3.45
Instructor: PC
Tea Break: 3.45- 4.00

Technical Session XIII: 4.00 - 5.00
Instructor: GNP

Technical Session XIV: 5.00-6.00
Instructor: PGS

Lab Session III: 6.00-7.00
Introduction to R (Continued)
Instructors: Dr. Shalini Chandra, Ms. Mansi Khurana, Ms Gargi Tyagi

Nov. 5, 2012

Technical Session XV: 09.30 - 11.30
Instructor: AB
Tea Break .....11.30 - 11.45

Technical Session XVI: 11.45 - 1.45
Instructor: UB

Followed by Valedictory

TOTAL- 19 Sessions

1.	Prof. Peeyush Chandra(PC)	Mathematical Modeling in Epidemiology
2.	Prof. B.V.R. Kumar (BVR)	Modeling &Simulation of Cardiac Electric Activity
3.	Prof. Atanu Biswas(AB)	Clinical Trials
4.	Prof. P.G. Sidheshwar(PGS)	Basic Models of Bio-Fluid Mechanics
5.	Prof. Uttam Badhopadhyay(UB)	Parametric and Non-Parametric Inferences Related to Clinical Trials
6.	Dr. Apratim Guha(AG)	Point Processes and Time Series Modeling
7.	Prof. G.N. Purohit(GNP)	SIR Models

Venue of Lectures: CMS Auditorium and CMS Lab

The Inaugural Ceremony of the National Workshop on "Recent Trends in Bio-Mathematics & Statistics" commenced with the lighting of lamp by a group of dignitaries of Banasthali University- Prof. D. Kishore (Official Secretary, Banasthali University), Prof. G.N. Purohit (Dean, AIM &ACT (Banasthali University) and Convenor of the workshop), Prof. Sarla Pareek (Head, Department of Mathematics and Statistics, Banasthali University and Co-ordinator of the workshop). The program was followed by Saraswati-Vandana.

Prof. Sarla Pareek formally welcomed all the dignitaries present on the dais and participants from various parts of the country, colleagues & students. She mentioned about the significance of CMS and its aims about bringing together a core group of researchers from all over India with a significant participation from our own state Rajasthan.

Prof. G.N. Purohit described the importance of Mathematics & Statistics in Biology and related fields and how they are interconnected from a long time. He informed that this is the 15th workshop organized by CMS. He motivated everyone to actively participate in the workshop to get benefited.

In his address, Prof. D. Kishore briefed about the importance of the topic and our esteemed resource persons. He wished for the success of the workshop and inspired the participants for academically rewarding stay in Banasthali.

In the end, Dr. Piyush Kant Rai (Organizing Secretary of the Workshop) offered a vote of thanks to all including Prof. Aditya Shastri, Director, CMS and Vice Chancellor, Banasthali University. He thanked all the invited guests and participants for gracing the occasion by their solemn presence. He also thanked DST for providing all kind of facilities to conduct such workshops in the centre.

The workshop went for four days and participants were benefited by the lectures of the eminent speakers across the country.

Prof. G.N. Purohit delivered two lectures during the workshop. In his first lecture he gave an introduction on mathematical epidemiology including stochastic epidemic model, deterministic epidemic model and

their generalised versions. New diseases, such as severe acute respiratory syndrome (SARS), avian or bird flu, and historically significant diseases such as diphtheria and polio were also the content of his talks.

Prof. P.G. Siddheshwar delivered five lectures in the workshop. He started with very basic concepts of gradient, curl, divergence of vectors and the fundamental laws of physics such as Gauss's law, Ampere's law, Maxwell's law etc. In his second lecture, he began with the nature of second order partial differential equations and their solutions. He gave an insight about the concept of scaling and non-dimensionalisation of the differential equations using varied examples. In the third lecture, he conversed about the domain of solution of partial differential equations, fundamental equations of fluid dynamics and basic models of bio-fluid mechanics. In the forth lecture, he explained the successive linearization method to solve the nonlinear ordinary differential equations. Modeling of non-newtonian fluid flow with different boundary and initial conditions was also discussed. In the last lecture, he briefed about Fourier series, Fourier transformation and its use in wave propagation.

Prof. Peeyush Chandra gave two lectures consisting of the topics 'Mathematical Models in Epidemiology' and 'Mathematical Modeling of HIV Dynamics: IN VIVO'. In the first lecture, he discussed about the concept of Epidemiology and related models such as, SI model, SIS model and SIR model. In his second and last lecture, he explained about the biology of HIV and AIDS disease and its basic model formulation and their methods of solution.

In his one of the two lectures, **Prof. B.V. Rathish Kumar** discussed the mechanism of heart in details and its mathematical formulation. He described the steps involved in the solution using finite element method. In his second lecture, he continued his previous talk and discussed about the purpose of using pacemaker for maintaining the adequate heart rate and its proper functioning.

Prof. Apratim Guha delivered three lectures during the workshop. In the first lecture, he started with the point process, its properties and mathematical formulation. He also discussed about the Poisson process, its properties, implications and some examples. Compound Poisson process, Non homogeneous Poisson process and Cox process were also discussed in the same lecture. In the second lecture, he began with the basics of time series analysis, its models such as AR, MA and

ARMA for stationary time series and in the concluding session, he lectured on the ARIMA and fractional ARIMA for non stationary time series. He also gave a statistical analysis of EEG type data.

Prof. Atanu Biswas gave an insight about Clinical Trials and discussed its various phases. He mentioned about the use of Statistics in different phases of trials such as sample size determination, methods of treatment allocation (Randomisation and Blinding in trials).

Prof. Uttam Bandhopadhyay talked on the approaches of inference such as naive approach and heuristic approach which he discussed in detail. In heuristic approach, he talked about likelihood ratio test, Rao's U-test and Wald's test. Behren's Fisher problem was also discussed in the lecture. In the end, he also suggested some nice references on non-parametric inference.

In the lab session on **Mathematica Software**, Dr. Shalini Chandra, Dr. Patanjali Sharma and Dr. Praveen Gupta demonstrated about the solutions of linear and non-linear algebraic equations and the system of algebraic equations using Solve, NSolve commands, ordinary and partial differential equations and their solutions by using DSolve, NDSolve commands. Apart from these, 2D, 3D and vector plots, Laplace transform, Bessel's function etc. were the main attractions of this lab session.

In the lab session of **R software**, Ms. Mansi Khurana started with the introduction to R and gave an idea about how the basic commands are used. She demonstrated about construction of a vector, matrix and its basic mathematical operations. She also told about some graphics like line plots, scatter plot, histogram etc. Ms. Gargi Tyagi continued with the graphics and discussed bar plots (vertical, horizontal and sub-divided) and pie diagram. She then told about how to write your own functions and also demonstrated the inbuilt functions available for linear regression and ANOVA. Dr. Shalini Chandra explained how to display a time series data and decompose it in different components. Its analysis and plots of ACF and PACF were also discussed. In the end, she also mentioned about the available packages and how to access them.

In the **Valedictory Session,** the coordinator, Prof. Sarla Pareek thanked all the internal and external participants for showing their keen interest and active participation in the workshop.

Prof. G.N. Purohit expressed his satisfaction on the arrangements of the workshop. He also announced the **15th Annual Conference of Society of Statistics, Computer and Applications** during **February 24 - 26, 2013** and expected a vast participation of candidates in the same. Few participants gave their critical views about the workshop and few of them gave very positive response by thanking the organizers for a great hospitality and all the arrangements. At last, Dr. Shalini Chandra, on behalf of organizing committee thanked the university staff, DST and all others involved in the successful completion of the workshop.

Lecture notes: The soft copy of the lecture notes procured from experts has been provided to the participants. A feedback of the workshop from the participants was also collected.