

Stochastic Models: Analysis and Applications. B. R. Bhat. New Age Int (P) Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002, India. 2000. 395 pp. Price: Rs 520.

The book aims to present a variety of stochastic models and their analysis with more focus on modelling. Beginning with the simplest model of Bernoulli process, the author discusses a variety of stochastic models such as renewal process, Markov chain, Poisson process, finite Markov process, Birth process, Birth–death process, Markov branching process, Semi-Markov process, Martingales, Stationary processes, Time series and Brownian motion. The word ‘analysis’ in the title does not imply data analysis but the mathematical analysis of various models.

Analysis of stochastic models requires many techniques from probability theory. With this view, the opening chapter is devoted to the introductory outline of probability tools. It contains mainly statements of results needed in subsequent chapters. The first chapter is a good summary of the author’s book *Modern Probability Theory – An Introductory Textbook*.

Chapters 2 to 12 cover various stochastic models with increasing order of complexity. The style of exposition of the model is extremely systematic. The model and its various aspects are discussed first, basic theory for the analysis is developed and then generalizations and modifications of the model are studied. Emphasis is more on modelling than mathematical aspects of stochastic processes. Several examples are discussed throughout the book to illustrate important concepts, properties and applications. The author emphasizes the conceptual framework and that too in simple language so that the reader does not get lost in rigorous mathematical details. Each chapter concludes with complements and problems to help the reader to gain familiarity with new concepts, additional properties of the model, extensions of the model and application of the model to different areas. Hints are given to numerous exercises providing guidelines to solution.

The book also includes a chapter on inference for stochastic processes, a topic developed in last three to four decades. Various principles of estimation and testing of hypothesis are compiled for

stochastic processes discussed in previous chapters. This includes likelihood approach of estimation for Markov chain in both parametric and non-parametric set-up, inference for branching process, Markov process, Poisson process, Martingale estimation for non-homogeneous Poisson process, Yule–Furry process, etc. The book also discusses inference for time series models and semi-Markov processes, diffusion processes, curved exponential families and SPRT for stochastic processes. The chapter highlights recent developments in this topic.

It is an extremely well-structured book with a proper balance between mathematical rigour and applications. It explains numerous difficult concepts in an easy manner. The intuitive way in which the topics are ordered makes it very appealing.

Numerous references are given within the text and also in the Bibliography, to guide the reader to the relevant literature. The only disappointing feature of the book is the absence of real-life examples, which makes it less lively. Of course, in spite of this lacuna, it will serve as an excellent textbook for undergraduate students, and that too for a comparatively low price. It is also a good reference book for researchers in applied statistics, but might be difficult for those without sufficient mathematical background.

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Seed and Nursery Technology of Forest Trees. D. G. W. Edwards and S. C. Naithani (eds). New Age International (P) Ltd. 4835/24, Ansari Road, Daryaganj, New Delhi 110 002. 1999. 317 pp. Price not mentioned.

This volume contains papers presented at the symposium on ‘Forest Tree Seed and Nursery Technology’, organized by the School of Life Sciences, Pt. Ravishankar Shukla University, Raipur, India from 22

to 25 November 1997 and supported by the International Union of Forestry Research Organizations (IUFRO). For the faculty and research scholars of this relatively new university, the event must have been catalytic. Over 140 scientists, foresters, planters and seed and nursery traders attended the symposium from 11 countries. The 29 papers included in the volume vary in quality and content. Some are general, based on expertise over a long time; others appear like preliminary research findings, hurriedly put together for the sake of participation in the symposium.

Maithani has critically analysed the problems and prospects of forestry seed in India. Currently 2.5 M ha area is planted in India as against the annual plantation target of 4 M ha. The annual seed requirement is around 9750 MT valued at Rs 500 million. 90% of forests in India are in the government sector. According to Maithani, ‘The concept of seed stands has not been adopted to the desired extent in Indian forestry and seed production areas are a miniscule’. The clonal seed orchards are inadequate and use of certified seed for planting is non-existent. This is an area in which Indian agriculture has made an important headway. There are no facilities to maintain seeds of tropical tree species using the available technology. This is a serious matter for the consideration of the Indian Council of Forestry Research and Education and State Forest Departments.

Besides the traditionally important commercial and industrial species (such as teak, eucalyptus, *Acacia auriculiformis*, *Casuarina*, *Dalbergia sissoo*, *Gmelina arborea*), many secondary timber species and NWFP species (medicinal plants, bamboos, oil-bearing plants, sources of gums, tannins, dyes, etc.) are becoming important. A new clientele for quality seeds of these species is the private sector. The author has recommended that studies be carried out on various aspects of reproductive biology in these species to enable production of field manuals. He has also suggested organizing training programmes for handling forestry seeds.

Ram Prasad has reviewed the aspects of management of tropical forestry seeds for afforestation of wastelands. He has emphasized the production of quality seeds, requirement of seeds in plantation programmes, especially in the central

Indian states and methods of handling forestry seeds. The proceedings for treating seeds of several important species for effective germination have been tabulated. For some reason this paper has not been carefully proof-read.

The role of biotechnology in forest tree gene banks is the theme of M. R. Ahuja's paper. With a vast experience in genetics, tree breeding and plant tissue culture, he has outlined the various parameters of germplasm storage, especially cryopreservation of seeds and buds. He has emphasized the relative values of *in situ* and *ex situ* approaches in genetic conservation.

Two papers which analyse the biochemical mechanisms that confer desiccation tolerance on orthodox seeds and cause desiccation sensitivity in recalcitrant seeds are by Berjak and Pammenter, and Finch-Savage. These are highly instructive and relevant to seeds of tropical forests which are proverbially short-lived and pose severe problems as propagules. The storage physiology of neem and long-term storage of teak seeds are the subject matter of several authors.

Taking the case history of sandalwood—the most valued forest species of India for perfumery industry and carving—Bapat and Rao have discussed the technology of synthetic seeds (synseeds). Essentially, the synthetic seed involves encapsulation of somatic embryos, buds, bulbs or meristems in a suitable gel and plant growth regulators. Ideally, it is enclosed in a synthetic seed coat to prevent loss of moisture and infestation by pests and pathogens. It has taken millions of years for the evolution and perfection of seeds in nature. Despite the various attempts made by scientists in the past two decades, there are still several hurdles to perfect the synseeds. Whenever we attain mastery in this technology, it would open up a significant advance in hightech forestry practice.

The paper by Edwards (one of the editors of the volume) is a review of two newer methods for improving the physical quality of forest tree seeds. The 'Stratification-redry' method of more completely removing seed dormancy and ensuring very rapid and higher percentage of germination was developed by the author for seeds of *Abies* (true firs). He describes the method and explains how it works. The procedure is applied commercially to north American firs and

possibly to *Pinus* and *Pseudotsuga*. Whether it is suitable to seeds of tropical hardwoods is yet to be ascertained. The 'IDS' (Incubator–Dry–Separate) fluid separation technique for removing filled-viable seeds from filled non-viable seeds is also outlined, using seeds of Douglas fir. This enables separation of non-viable from the viable seeds in a mixture by re-immersion in water. The IDS method is commercially used in Sweden. Its utility for tropical seeds has yet to be established.

Seeds of *Casuarina* are best stored at 10°C (Gurudev Singh *et al.*) and those of *Pongamia pinnata* retain 50% germination and vigour potential for 12 months as against loss of viability after 6–7 months at 30–35°C (Sudhir Kumar *et al.*).

Of special interest is the report of the fungal infection of the protein-rich seeds and pods of *Acacia senegal* (the source of gum arabic, fodder and firewood in the semi-arid regions of western India) consumed by the tribals and the rural poor. A survey carried out by Bohra and Purohit has shown that fungi belonging to 8 genera among which *Aspergillus*, (especially *A. flavus*) is the most predominant, are the main sources of infection. Out of the 78 isolates, 38 were toxigenic and produced aflatoxin (especially aflatoxin B1 in an amount higher than the tolerance level set by WHO). In view of the incidents of aflatoxin contamination of bajra and khesari dal, causing severe liver damage, there is need to develop suitable methods for overcoming infection of stored seeds (and pods) of *A. senegal*.

The paper by Puri and Naugraiya on the 'limits and promises of vegetative propagation to ensure clonal forestry – its applications in tropical trees' is partly a primary research communication and partly a review. The sugi (*Cryptomeria japonica*) is a classical example in which vegetative propagation has been practised in Japan for over 400 years. Brazil annually produces over 30 million cuttings of *Eucalyptus grandis* and *E. gradis*, *X. E. urophylla*. Rooting ability of cuttings is controlled by genetic factors, degree of maturation, physiologic status of the cutting and the environment in which it is planted. There is starch breakdown in cuttings and alleviation of moisture stress is critical to rooting. The parameters such as biological safety, feasibility, genetic gains and economic considerations of clonal forestry have been discussed. Of

special benefit to foresters are questions related to gains and risks of clonal forestry from the operational point of view.

In his presentation on the 'Improvement of tree seedlings by rhizosphere microorganisms: current perceptions', B. N. Johri has drawn attention to the *in situ* detection of microbial activities in the rhizosphere through modern analytical techniques and tools. He has suggested a biological software for the management of tree nursery programmes involving cataloguing, conservation and characterization of the gene pools of microbes in the rhizosphere of prioritized species. He has also recommended the need to assess the biopotentiality of the gene pools in respect of release of PGRs, phosphate solubilization, nitrogen fixation, metal chelation and antagonism towards soil-borne pathogens prevalent during nursery establishment.

Neem had been taken for granted and neglected in India despite being used for several centuries for its immense benefits. It has shot to fame on account of the jolt received by Indian scientists through patents filed on neem products abroad. The paper by Solanki and co-workers deals with geographical variation, progeny trials, and reproductive biology of neem in central India. Seeds have been collected from 38 major sites. More than 28 trees were also selected on the basis of straight bole, closed canopy, heavy fruit set and growth vigour. It would have been desirable if azadirachtin content had also been taken as an important parameter. Provenance trials showed that Rewa, Katni, Bhopal, Guna, Shivpuri and Karera were excellent. It is stated that neem may be a self-pollinating species. This conclusion is drawn without sufficient data. Table 3 shows that the flowers were bagged even to test open pollination (probably they were tagged)! Pollen viability cannot be tested by acetocarmine (even pollen form herbarium specimens take up this stain). Acetocarmine indicates pollen fertility. Fluorescein diacetate (FDA) test and germination on stigmas of emasculated flowers (in petri plates) could have given a different picture. No tree improvement programme can be taken up without critically examining the breeding system. Neem is no exception. The attention of authors is drawn to the laboratory manual on pollen biology by Shivanna and Rangaswamy (Springer-Verlag, 1992).

Keshavkant and Naithani have shown that chilling is one of the principal causes of die-back in sal seedlings. This can be reduced by 20% by placing the seedlings in the greenhouse during winter. There are three papers dealing with seedling growth in response to various treatments and spacing in avenue trees. The contribution by Mani *et al.* discusses the role of seed source identification and seed pelletization methods to enhance 'elite seedling production' in *Acacia nilotica*. That pelleted seeds perform well under stressed conditions is useful information for agroforestry and social forestry.

The book is neatly produced. Inclusion of species index and author index has enhanced its utility. Concept papers and reviews by experts in this publication would be useful to foresters, planters, nurserymen, biotechnologists, physiologists, conservationists, NGOs and policy makers. It is hoped that unlike other conference proceedings, that merely sit on a library shelf, this book will stimulate decision-makers in the forestry sector to wake up and put into practice at least some of the major suggestions made by the experts.

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Microbes Minerals and Environment. K. A. Natarajan. Geological Survey of India, A.M.S.E. Wing, 'Vasudha Bhavan', Kumaraswamy Layout, Bangalore 560 078, India. 1998. 162 pp. Price: Rs 200/US \$ 15.00.

Microbes Minerals and Environment is a useful monograph generated from interdisciplinary studies pertaining to ore-forming processes, bio-leaching methods and environmental protection. Technology development today is critically dependent on the synergistic working of scientists from diverse fields. This book is proof of the success resulting from such an effort under the umbrella of IGCP Project-357 Organic and Mineral deposits.

The book contains twelve chapters, which could have been reduced to eight or less with greater elaboration of each chapter. The more general aspects of biotechnology pertaining to minerals and their recovery are covered in chapters 1–3. Specifically, these chapters deal with biomineralization and geomicrobiology (chapter 1), biomineral beneficiation (chapter 2), and biotechnological aspects of metal extraction and leaching bacteria (chapter 3). Chapters 4–6 cover applications of biotechnology, e.g. biohydro-metallurgy and bioleaching to specific minerals such as metal sulphides and ores containing copper, uranium and gold. In particular, integrated biotechnological methods of gold ore processing are nicely presented in chapter 5. Chapter 10 deals with biofouling, biodeterioration and bio-

corrosion of metals, metal alloys and concrete, which is especially relevant in the Indian context in view of prevailing climatic factors. Chapter 11 focuses on recent development and future trends in biomineral technology, while the last chapter concentrates on the Indian scenario which is still in its infancy. Nevertheless, the efforts of a few companies are laudable.

This is a useful college-level book which will be especially beneficial to those who seek to broaden their awareness of biotechnological applications in the above areas and perhaps even work in future on such applied research problems. As emphasized, the treatment of subject matter is rather sketchy and readers will have to refer to primary sources of material for better appreciation of the techniques involved. The editing of the book could have been done better and a more in-depth literature survey would also have been helpful. However, given the increasing role of biology in conventional chemical and metallurgical processes, this book is a timely introduction for popularization of the subject. No doubt, such technologies will be on the rise with future research breakthroughs, heightened awareness of the environment and growing numbers of practitioners of the subject.

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PERSONAL NEWS

Abraham Pais: Physicist and biographer (1918–2000)

An obituary

As the saying goes, 'geography is about maps, while biography is about chaps'. Abraham Pais who died in Copenhagen on 31 July 2000 was not only an award-winning physicist, but also one of the best-known biographers of outstanding physicists. It was Sir Peter Swinnerton-Dyer, a one-time Head of the University Grants Commission in the UK who once pointed out that, 'most scientists reach a moment at which they know they will never have another worthwhile idea'. Once the optimum period is over, the

laws of diminishing returns begin to operate, and a sensible scientist should have the courage to change direction. This is precisely what Abraham Pais did when he switched in his later years from scientific research to chronicling the lives of some of the brilliant physicists and the greatest breakthroughs in physics in the 20th century. It was while he was working at the Institute of Advanced Study in Princeton that Abraham Pais got to know Einstein personally during the last nine years of Einstein's life. In his excellent

biography of Einstein entitled, *Subtle is the Lord* (1982), Abraham Pais opens a window into the life and mind of the greatest scientist of our century. Today it is recognized as the most outstanding and authoritative biography of the great man. It won the American Book Award.

Abraham Pais was born into a Jewish family on 19 May 1918 in Amsterdam, Holland. After finishing his schooling in Amsterdam, he went to the University of Utrecht for his post-graduate studies. It was the time of Nazi occupation of Hol-

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