J. Opl Res. Soc. Vol. 31, pp. 955 to 958
Pergamon Press Ltd 1980. Printed in Great Britain
Operational Research Society Ltd

Book Selection

Edited by JOHN HOUGH

Reversibility and Stochastic Networks

F. P. KELLY

Wiley, New York, 1979. 230 pp. £14.50
ISBN 0 471 27601 4

It is pleasant to review a book of pure academic research which is directly relevant to O.R. A large number of articles have been published in recent years describing the applications of queueing network models, particularly in computer and communications systems modelling. The underlying theory has developed in a typically higgledy-piggledy fashion where there are far too many special results and not enough general ones. Kelly has now rectified this, providing a unified mathematical framework based on the property of reversibility and variations of it.

The first chapter describes reversibility in Markov processes. The following chapters develop the theory through applications: migration processes, queueing networks (including spare part and machine interference models as well as computer networks), social grouping models, the neutral allele model in population genetics, polymerisation processes and spatial processes (such as a plant infection model).

The idea of reversibility is a simple one. If a stochastic process in equilibrium looks the same whether time moves forwards or backwards the process is reversible. The power of this property is best illustrated by the proof Kelly gives of the result that the output from an $M/M/1$ queue is a Poisson process. No algebra is needed, just a discussion of what reversibility means in this case.

Kelly introduces the concept of quasi-reversibility which enables him to get results for a much wider range of models than reversibility would. These results are the product—from solutions, much trumpeted in computer science applications, which enable you to write the probabilities of a complicated model as the product of the probabilities of the components of the model.

It is obviously useful for an O.R. worker to know whether his model will have a product-form solution or not, but he will also be very interested in whether he has to assume negative exponential distributions everywhere. Chapter 9 covers the distributional assumption in most detail and shows that for many models, or at least for parts of them, any distributions will do. This naturally improves the applicability of the models tremendously.

Although this book is at the forefront of research in a particular area, it is an accessible book written in a discursive style with many illustrative examples. The mathematics required to follow the proofs may be high but the main points of the book will be readily grasped by anyone with a knowledge of Markov Chains and processes. There are exercises at the end of each chapter and the book is clearly printed and well organised. It is a good buy for anyone interested in network modelling.

ANTONY UNWIN