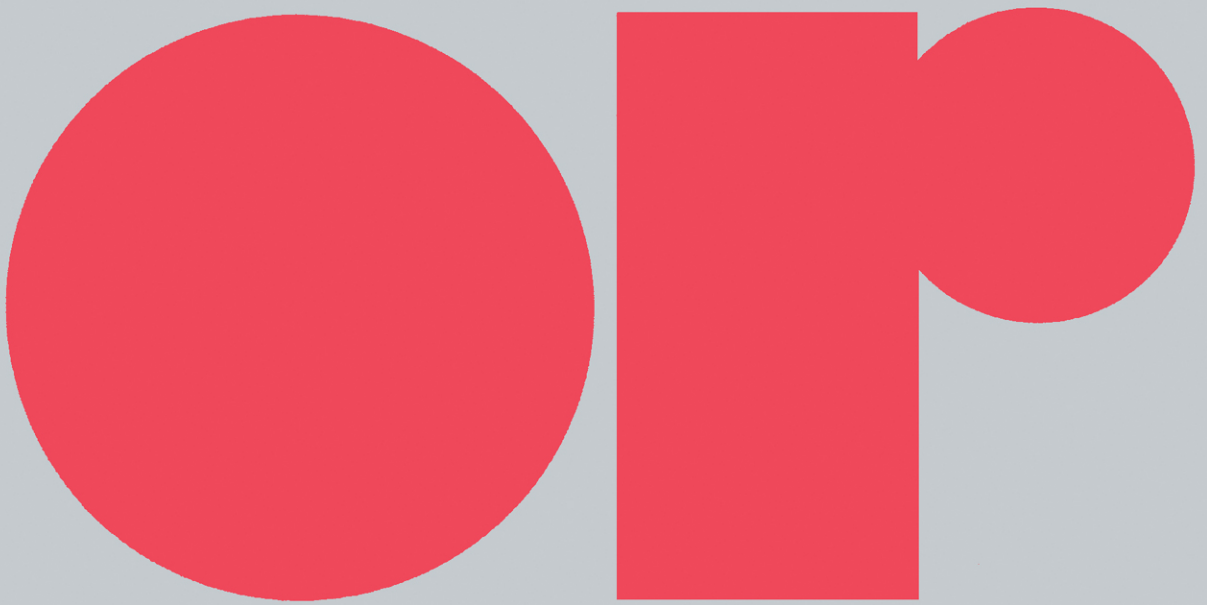


# **Developments in Operational Research**



EDITED BY  
**R W EGGLESE & G K RAND**

PERGAMON PRESS

# DEVELOPMENTS IN OPERATIONAL RESEARCH

## **Other Titles of Interest**

### **FRONTIERS OF OPERATIONAL RESEARCH AND APPLIED SYSTEMS ANALYSIS**

*General Editor:* Rolfe Tomlinson

The series is aimed at helping practitioners to broaden their subject base and to advise managers and specialists in related areas of important new developments in the field.

The scope of the books will be broad and their authorship international. The subject is interpreted widely to include any scientific, applied, interdisciplinary and systems-oriented approach to the study of real life decision problems.

Rolfe Tomlinson is Professor of Systems and Operational Research at the School of Industrial and Business Studies at the University of Warwick, and is President of the European Association of OR Societies. He was for many years the Director of Operational Research at the National Coal Board and was then Area Chairman for Management and Technology at the International Institute for Applied Systems Analysis. The series reflects his deep belief that scientific systems-oriented research can be of direct practical use over a much wider range of topics than at present, but only if the work is problem-oriented and seen as a collaborative effort with the problem owner.

Volume 1

EDEN, C, JONES, S and SIMS D

Messing about in Problems: An Informal Structured Approach to their Identification and Management

Volume 2

TOMLINSON, R and KISS, I

Rethinking the Process of Operational Research and Systems Analysis

Volume 3

STAHL, I

Operational Gaming: An International Approach

Volume 4

KINGSMAN, B G

Raw Materials Purchasing: An Operational Research Approach

## **A Related Journal**

### **JOURNAL OF THE OPERATIONAL RESEARCH SOCIETY\***

Published on behalf of the Operational Research Society Limited, London

*Editor:* Peter Amiry, Department of Engineering Production, University of Birmingham, P.O. Box 363, Birmingham B15 2TT, England

This journal publishes contributions on any matter relevant to the theory, practice, history, or methodology of Operational Research or the affairs of the Society. It is aimed at applications in any field and encourages the submission of accounts of good, practical case studies illustrating OR in action; of reviews of the state of development of fields of knowledge relevant to OR; and of controversial articles on methodology, technique or professional policy.

\*Free specimen copy sent on request.

# DEVELOPMENTS IN OPERATIONAL RESEARCH

edited by

R. W. EGGLESE and G. K. RAND

University of Lancaster, UK



PERGAMON PRESS

OXFORD · NEW YORK · TORONTO · SYDNEY · PARIS · FRANKFURT

U.K.	Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 0BW, England
U.S.A.	Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, New York 10523, U.S.A.
CANADA	Pergamon Press Canada Ltd., Suite 104, 150 Consumers Road, Willowdale, Ontario M2J 1P9, Canada
AUSTRALIA	Pergamon Press (Aust.) Pty. Ltd., P.O. Box 544, Potts Point, N.S.W. 2011, Australia
FRANCE	Pergamon Press SARL, 24 rue des Ecoles, 75240 Paris, Cedex 05, France
FEDERAL REPUBLIC OF GERMANY	Pergamon Press GmbH, Hammerweg 6, D-6242 Kronberg-Taunus, Federal Republic of Germany

Copyright © 1984 Operational Research Society

*All Rights Reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means: electronic, electrostatic, magnetic tape, mechanical, photocopying, recording or otherwise, without permission in writing from the copyright holders.*

First edition 1984

**British Library Cataloguing in Publication Data**

Developments in operational research.

1. Operations research

I. Eglese, R. W. II. Rand, G. K.

001.4'24 T57.6

ISBN 0-08-031829-0

**Library of Congress Catalog Card No. — 84-16641**

## PREFACE

At an early stage of planning the Operational Research Society Annual Conference, to be held at the University of Lancaster in September 1984, it was suggested that one stream should give greater emphasis to teaching. The idea of a "tutorial stream" was born. Contributions were invited from those whom we felt knew their subject well, and also had the ability to put this knowledge across to others. We asked each of them to contribute a session to bring practitioners up to date on recent developments in their subject and to enable the applicability of these developments in practice to be assessed. Small numerical examples to illustrate techniques were encouraged, as well as examples of applications.

Each of the contributors was asked to produce a paper to accompany their session, and these papers form the content of this volume. We have learned a lot from reading these papers, and knowing the authors as we do, we look forward to their presentations at the Conference.

The topics covered include some of the most widely used O.R. "techniques", such as Mathematical Programming and Simulation, together with the contribution of O.R. methodology to specific application areas, such as Capital Investment Appraisal and Purchasing. We are, of course, conscious that the range of subjects is far from comprehensive, and we hope that other subjects may be covered in a similar way at future conferences.

Although originally produced to accompany a conference session, each of these papers stands on its own as an excellent introduction to the subject area and review of recent developments. Whether you are attending the conference or not, we hope that you find these papers useful in bringing you up to date in some significant areas of Operational Research.

R.W. Eglese  
G.K. Rand

Department of Operational Research  
University of Lancaster.

May 1984