

Series on Advances in Mathematics for Applied Sciences – Vol. 29

THE METHOD OF MAXIMUM ENTROPY

Henryk Gzyl

Facultad de Ciencias
Universidad Central de Venezuela



World Scientific

Singapore • New Jersey • London • Hong Kong

Published by

World Scientific Publishing Co. Pte. Ltd.

P O Box 128, Farrer Road, Singapore 9128

USA office: Suite 1B, 1060 Main Street, River Edge, NJ 07661

UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

Library of Congress Cataloging-in-Publication Data

Gzyl, Henryk, 1946–

The method of maximum entropy / Henryk Gzyl.

p. cm. -- (Series on advances in mathematics for applied sciences; vol. 29)

ISBN 9810218125

1. Maximum entropy method. I. Title. II. Series.

Q370.G97 1995

511'.42--dc20

94-23122

CIP

Copyright © 1995 by World Scientific Publishing Co. Pte. Ltd.

All rights reserved. This book, or parts thereof, may not be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording or any information storage and retrieval system now known or to be invented, without written permission from the Publisher.

For photocopying of material in this volume, please pay a copying fee through the Copyright Clearance Center, Inc., 27 Congress Street, Salem, MA 01970, USA.

Printed in Singapore by Uto-Print

Table of Contents

PREFACE	v
CHAPTER 0	
Introduction	1
CHAPTER 1	
Basic Concepts from Probability Theory	7
CHAPTER 2	
Equilibrium Distributions in Statistical Mechanics	17
CHAPTER 3	
Some Heuristics	23
CHAPTER 4	
Entropy Functionals	27
1. <i>Basics</i>	27
2. <i>Entropy inequalities</i>	35
3. <i>Axiomatic characterization of entropies</i>	39
CHAPTER 5	
The Method of Maximum Entropy	41
1. <i>Kullback's and Jaynes' reconstruction methods</i>	41
2. <i>Czizar's results</i>	44
3. <i>Borwein and Lewis' extensions</i>	49
4. <i>Dacunha–Castelle and Gamboa's approach to level 2 M.E.M.</i>	49
CHAPTER 6	
Applications and Extensions	61
1. <i>Entropy maximization under quadratic constraints, or constraint relaxation</i>	61
2. <i>Failure of maximum entropy methods for reconstruction in infinite systems</i>	63
3. <i>Some finite dimensional, linear reconstruction problems</i>	67
4. <i>Maxentropic approach to linear programming</i>	72
5. <i>Entropy as Lyapunov functional. Further comments</i>	75
6. <i>Solving matrix equations</i>	78
7. <i>Estimation of transition probabilities</i>	80
8. <i>Maxentropic reconstruction of velocity profiles</i>	83

9. Fragmentation in a nuclear reaction	86
10. Maxentropic inversion of Laplace transforms	88
11. Maxentropic inversion of Fourier transforms	90
12. Maxentropic spectral estimation	93
13. Maxentropic solution of integral equations	100
14. Maxentropic image reconstruction	103
15. An application in systems analysis	105
16. Distributions with preassigned marginals and related problems	107
17. Maxentropic approach to the moment problem	110
18. Maxentropic taxation policies	113
19. The Stieltjes moment problem	115
20. The Hamburger moment problem	119
21. Applications to data analysis	121
CHAPTER 7	
Entropy and Large Deviations	127
CHAPTER 8	
Maximum Entropy and Conditional Probabilities	135
CHAPTER 9	
Maximum Entropy and Statistics	139
1. Gauss principle and minimum discrimination	139
2. Sufficiency	142
3. Some very elementary Bayesian statistics	144