Preface

The objective of this book is to introduce a particular class of fuzzy numbers, the fuzzy dual numbers, which present comparatively to classical fuzzy numbers additional attractive properties either from the point of view of theory as from the point for view of applications in the field of engineering and decision theory.

This work is the result of a collaboration between Labfuzzy Laboratosry of COPPE, Universidade Federal do Rio de Janeiro, Brazil, and MAIAA, the Applied Mathematics, Computation and Automation Laboratory of ENAC, the French Civil Aviation Institute in Toulouse, France.

This book introduces fuzzy dual numbers which are a special class of fuzzy numbers and are described in a minimal way by two real-valued parameters. This book shows that using this formalism, uncertainty can be taken explicitly into account in quantitative planning problems without implying an unacceptable computational burden. The first three chapters are devoted to introduce in a progressive way fuzzy dual numbers. Then, the next four chapters extend classical deterministic and probabilistic concepts associated with quantitative planning problems to the case in which uncertainty is represented by fuzzy dual numbers.

Chapter 1 introduces briefly fuzzy sets and their relation with real intervals, giving way to fuzzy intervals and fuzzy numbers.

Chapter 2 is about dual numbers which have been introduced in the ninetieth century by William Clifford when dealing with the theory of engines using a nilpotent operator. They have been introduced initially to study the kinematics of rigid articulated bodies, and more recently, computer tools have been made available for dual numbers calculus.

Chapter 3 is about fuzzy dual numbers which is a special class of dual numbers, associated with symmetrical triangular fuzzy numbers. Fuzzy dual vectors and fuzzy dual matrices are also introduced. Fuzzy dual numbers, vectors and matrices are introduced to handle explicitly using an extension of dual calculus, the uncertainty on the value of parameters or variables in the formalization and solution of decision problems.

Chapter 4 is devoted to fuzzy dual linear matrix inequalities (LMI). LMI formalism has received an increasing acceptance for the formulation of feasible sets for

crisp optimization problems. The new concepts proposed in this chapter are applied to the representation of fuzzy LMI domains using semi-positive definite fuzzy dual matrices.

Chapter 5 considers the fuzzy estimation of distribution matrices. Origin–destination matrices play a central role in transportation and logistics planning while many uncertainties should be taken into account when considering their estimation. An approach is proposed to combine the entropy maximization approach with fuzzy modelling to get coherent intervals for trip distribution estimates based on structured uncertainties.

In Chap. 6, fuzzy dual numbers and probabilities as well as fuzzy dual entropy are introduced. The classical entropy maximization approach for trip distribution prediction in transportation networks is reviewed, and a new formulation is proposed using the fuzzy dual formalism.

Chapter 7 considers general optimization problems with uncertain parameters and variables. The formulation of optimization problems using this new formalism is discussed. It is shown that each fuzzy dual programming problem generates a finite set of classical optimization problems, even in the case in which the feasible set is defined using fuzzy dual LMI constraints. Then, fuzzy dual dynamic programming is introduced and discussed.

Toulouse, France Felix Mora-Camino
Rio de Janeiro, Brazil Carlos Alberto Nunes Cosenza

Springer

http://www.springer.com/978-3-319-65417-1

Fuzzy Dual Numbers
Theory and Applications

Mora-Camino, F.; Nunes Cosenza, C.A.

2018, XIII, 62 p. 21 illus., Hardcover
ISBN: 978-3-319-65417-1