

## **J.-E. Martínez-Legaz - Curriculum Vitae**

Date and place of birth:     March 26, 1951; Barcelona, Spain

### Qualifications

1973     B. Sc. (Mathematics), Universitat de Barcelona

1981     Ph. D. (Mathematics), Universitat de Barcelona

1986     Associate Professor (Applied Mathematics), Universitat de Barcelona

1992     Associate Professor (Foundations of Economic Analysis), Universitat Autònoma de Barcelona

1993     Full Professor (Foundations of Economic Analysis), Universitat Autònoma de Barcelona

### Employment history and current appointment

1977-1986     Universitat de Barcelona, Departament d'Equacions Funcionals (changed to Departament de Matemàtica Aplicada i Anàlisi), assistant professor

1986-1990     Universitat de Barcelona, Departament de Matemàtica Aplicada i Anàlisi, associate professor

1990-1993     Universitat Autònoma de Barcelona, Departament d'Economia i d'Història Econòmica, associate professor

1993- .....     Universitat Autònoma de Barcelona, Departament d'Economia i d'Història Econòmica, full professor

### Supervision

Supervised 3 PhD students in Mathematics (Universitat de Barcelona) and 1 PhD student in Economics (Universitat Autònoma de Barcelona)

## Research Grants

- 1990-1993 DGICYT Grant, Optimization in Economic Models (main researcher: M. S. Santos)
- 1993-1996 DGICYT Grant, Supermodular Functions in Economic Analysis: Indivisibilities and Nonconvexity (main researcher: J.E. Martínez-Legaz)
- 1996-1999 DGES Grant, Convexity and Indivisibilities in Cooperative Games: Theory and Economic Applications (main researcher: J.E. Martínez-Legaz)
- 1999-2002 CICYT Grant, Cooperative Games and Economic Structures: Convexity, Monotonicity and Generalizations (main researcher: J.E. Martínez-Legaz)
- 2002-2005 MCYT Grant, Convexity and indivisibilities in exchange, assignment, demand and production problems (main researcher: J.E. Martínez-Legaz)
- 2005-2008 MEC Grant, Convexity and monotonicity. Applications to Optimization Theory (main researcher: J.E. Martínez-Legaz)

## Memberships

- 2006- ... Editor-in-Chief of Optimization (Taylor & Francis Ltd)
- 1991-2005 Editorial Board of Optimization (Taylor & Francis Ltd)
- 1994- ... Editorial Board of the Journal of Convex Analysis (Heldermann Verlag)
- 2000- ... Editorial Board of the Journal of Global Optimization (Springer)
- 2001-2005 Editorial Board of the Journal of Systems Science and Complexity (Science Press and Allerton Press)
- 2001- ... Editorial Board of TOP (Sociedad Española de Estadística e Investigación Operativa)
- 2001- ... Editorial Board of Cuadernos Aragoneses de Economía (Facultad de Ciencias Económicas y Empresariales de la Universidad de Zaragoza)
- 2000-2002 Chairman of the international Working Group on Generalized Convexity
- 1994-2006 International Scientific Committee of the international Working Group on Generalized Convexity

### Conference Programme Committees

Third Franco-Latinamerican Conference in Applied Mathematics and First Chile-CEE School on Optimization (Santiago, Chile, 1992)

5th International Symposium on Generalized Convexity (Marseille-Luminy, France, 1996)

6th International Symposium on Generalized Convexity/Monotonicity (Karlovasi, Greece, 1999)

7th International Symposium on Generalized Convexity/Monotonicity (Hanoi, Vietnam, 2002)

VI Seminario Internacional de Optimización y Áreas Afines (Lima, Peru, 2003)

Sixth International Conference of the Association of Asia-Pacific Operational Research Societies within IFORS (New Delhi, India, 2003)

12th French-German-Spanish Conference on Optimization (Avignon, France, 2004)

Jornada Economía y Matemáticas (Alicante, Spain, 2005)

8th Symposium on Generalized Convexity and Generalized Monotonicity (Varese, Italy, 2005)

VII Seminario Internacional en Optimización y Áreas Afines (Lima, Peru, 2005)

CODE 2007: Conférence de la SMAI sur l'optimisation et la décision (Paris, France, 2007)

The Second International Conference on Optimization and Optimal Control (Ulaanbaatar, Mongolia, 2007)

VIII Seminario Internacional en Optimización y Áreas Afines (Lima, Peru, 2007)

The International Conference on Nonconvex Programming: Local and Global Approaches (Rouen, France, 2007)

## Organization of conferences and workshops

Jornades Catalanes de Matemàtica Aplicada (Gerona, Spain, 1994), jointly with D. Azé, G. Gómez, Ch. Horvath and M. Sainz

Cluster of 11 sessions on Generalized Convexity at the 16th International Symposium on Mathematical Programming (Lausanne, Switzerland, 1997)

CODE Workshop on Generalized Convexity and Monotonicity in Economic Modeling (Bellaterra, Spain, 1998), jointly with I. Fradera

Workshop on Mathematical Programming, Games and Networks (Aix-en-Provence, France, 2000), jointly with F. Bloch and A. Soubeyran

Workshop on Mathematical Programming, Games and Networks (Aix-en-Provence, France, 2001), jointly with F. Bloch and A. Soubeyran

II Conference on "Behavioral Learning and Bounded Rationality" (Aix-en-Provence, France, 2002), jointly with B. Sinclair-Desgagné, B. McLeod and A. Soubeyran

LEA Workshop on "Optimization, Games and Economic Applications" (Bellaterra, Spain, 2002), jointly with A. Soubeyran

VI Workshop on "Optimisation-Games-Networks and Applications" (Aix-en-Provence, France, 2003), jointly with B. Cornet and A. Soubeyran

LEA Workshop on "Optimization, Games and Economic Applications" (Bellaterra, Spain, 2005), jointly with A. Soubeyran and H. Stahn

Workshop on "Behavioral Economics in the Light of Mathematics, Psychology, Cognition and Bio Informatics" (Aix-en-Provence, France, 2006), jointly with A. Soubeyran and H. Stahn

International Conference on Nonsmooth and Variational Analysis in Sciences and Engineering (Limoges, France, 2007), jointly with S. Adly, J. Guillerme and J.-B. Hiriart-Urruty

## Talks presented at conferences and workshops:

*1981*

Optimization. Theory and Algorithms (Confolant, France)

*1982*

IX Jornadas Matemáticas Hispano-Lusas (Salamanca, Spain)

XI International Symposium on Mathematical Programming (Bonn, Germany)

*1983*

XI IFIP Conference on System Modelling and Optimization (Copenhagen, Denmark)

VIII Symposium on Operations Research (Karlsruhe, Germany)

*1984*

IX Symposium on Operations Research (Osnabrück, Germany)

*1985*

Journées Fermat 85 (Toulouse, France)

X Symposium on Operations Research (Munich, Germany)

*1986*

4th French-German Conference on Optimization (Irsee, Germany) International Conference on Vector Optimization (Darmstadt, Germany)

Journées Montpellier-Perpignan (Seminaire d'Analyse Convexe) (Montpellier, France)

XII International Conference on Mathematical Optimization-Theory and Applications (Eisenach, German Democratic Republic)

*1987*

29th Annual Conference of the Operational Research Society (Edinburgh, United Kingdom)

XIII International Conference on Mathematical Optimization-Theory and Applications (Eisenach, German Democratic Republic)

*1988*

International Workshop on Generalized Concavity, Fractional Programming and Economic Applications (Pisa, Italy)

33 Internationales Wissenschaftliches Kolloquium (Ilmenau, German Democratic Republic)

*1989*

Colloque International Théorie du Point Fixe et Applications (Marseille-Luminy, France)

XIV International Conference on Mathematical Optimization-Theory and Applications (Eisenach, German Democratic Republic)

*1990*

3rd ECCO Meeting (Barcelona, Spain)

The Fourth Annual Meeting of the International Workshop in Analysis and Its Applications (Kupari, Yugoslavia)

IX International Conference on Multiple Criteria Decision Making (Fairfax, U.S.A.)

*1991*

NATO Advanced Study Institute "Approximation Theory, Spline Functions and Applications" (Maratea, Italy)

Nonsmooth Optimization. Methods and Applications (Erice, Italy)

XVI Simposio de Análisis Económico (Bellaterra, Spain)

*1992*

Seminar on Nonconventional Preference Modelling (Alicante, Spain)

1st Meeting of the Society for Social Choice and Welfare (Caen, France)

Convergences en Analyse Multivoque et Unilatérale (Marseille-Luminy, France)

3rd Franco-Latinamerican Conference in Applied Mathematics and First Chile-CEE School on Optimization (Santiago, Chile)

1st MODE Meeting (Perpignan, France)

XVII Simposio de Análisis Económico (Bellaterra, Spain)

*1993*

Journées Inter-Universitaires Analyse Convexe et Probabilités (Marrakech, Morocco)

XIII World Conference on Operations Research (Lisbon, Portugal)

International Conference on Applied Analysis (Hanoi, Vietnam)

ASSET Meeting 1993 (Barcelona, Spain)

XVIII Simposio de Análisis Económico (Bellaterra, Spain)

*1994*

15th International Symposium on Mathematical Programming (Ann Arbor, U.S.A.)

XIX Simposio de Análisis Económico (Bellaterra, Spain)

*1995*

3èmes Journées d'Analyse Non Linéaire de l'Université Cadi Ayyad (Marrakech, Morocco)

Workshop on Nonsmooth Analysis and Its Applications (Pau, France)

Workshop on New Directions in the Theory of Markets and Games (Toronto, Canada)

Spanish-Russian Meetings on Games and Decisions (Bellaterra, Spain)

2nd Catalan Days on Applied Mathematics (Font Romeu - Odeillo, France)

XX Simposio de Análisis Económico (Bellaterra, Spain)

*1996*

Journées d'Analyse Numérique et Optimisation (Meknès, Morocco)

5th International Symposium on Generalized Convexity (Marseille-Luminy, France)

III Catalan Days on Applied Mathematics (Lérida, Spain)

XXI Simposio de Análisis Económico (Bellaterra, Spain)

*1997*

INFORMS San Diego Spring (San Diego, U.S.A.)

Workshop on Scheduling & Heuristic Search (Riverside, U.S.A.)

16th International Symposium on Mathematical Programming (Lausanne, Switzerland)

XXII Simposio de Análisis Económico (Bellaterra, Spain)

*1998*

Workshop on Game Theory (Bilbao, Spain)

IV Catalan Days of Applied Mathematics (Tarragona, Spain)

International Conference on Public Economic Theory (Tuscaloosa, U.S.A.)

3rd Spanish Meeting on Game Theory and Applications (Barcelona, Spain)

INFORMS International Israel (Tel Aviv, Israel)

*1999*

XIV International Conference on Mathematical Programming (Mátraháza, Hungary)

6th International Symposium on Generalized Convexity/Monotonicity (Karlovasi, Greece)

Conference on Duality and Games (Aix-en-Provence, France)

XXIV Simposio de Análisis Económico (Bellaterra, Spain)

*2000*

INFORMS Spring 2000 (Salt Lake City, U.S.A.)

The Ninth International Colloquium on Numerical Analysis and Computer Science with Applications (Plovdiv, Bulgaria)

Workshop on Mathematical Programming, Games and Networks (Aix-en-Provence, France)

*2001*

Journée Limoges - Barcelone (Limoges, France)

Seminario Internacional en Optimización y Áreas Afines (Lima, Peru)

*2002*

Dixièmes Journées du Groupe MODE (Montpellier, France)

XX Coloquio de la Sociedad Matemática Peruana (Lima, Peru)

*2003*

Mini-symposium Convexité généralisée (Perpignan, France)

12th European Workshop on General Equilibrium Theory (Bielefeld, Germany)

IX Workshop on Well-Posedness in Optimization (Marseille, France)

Seminario Internacional de Optimización y Áreas Afines (Lima, Peru)

XXI Coloquio de la Sociedad Matemática Peruana (Arequipa, Peru)

V Encuentro Nacional en Educación Matemática (Pucallpa, Peru)

VI Workshop on "Optimisation-Games-Networks and Applications" (Aix-en-Provence, France)

*2004*

I Jornadas SEIO - RSME sobre Programación Matemática (Elche, Spain)  
12th French-German-Spanish Conference on Optimization (Avignon, France)

*2005*

Journée Thématique Quasiconvexité (Montpellier, France)  
8th International Symposium on Generalized Convexity and Generalized Monotonicity (Varese, Italy)  
VII Seminario Internacional en Optimización y Áreas Afines (Lima, Peru)  
Jornadas de Trabajo - Optimización, Noviembre 2005 (Madrid, Spain)  
Function Theory on Infinite Dimensional Spaces IX (Madrid, Spain)

*2006*

The International Conference on Nonlinear Programming with Applications (NPA2006) (Shanghai, China)  
INTAS Summer School Nonlinear analysis with applications in Economics, Energy and Transportation (Bergamo, Italy)  
GREQAM Summer School Rationality, Social Learning and Complexity (Aix-en-Provence, France)  
Workshop “Días de Optimización” (Cholula, Mexico)  
Iberian Conference in Optimization (Coimbra, Portugal)  
5th Ballarat Workshop on Global and Non-Smooth Optimization: Theory, Methods and Applications (Ballarat, Australia)  
International Conference on Mathematics - IMCA 2006 (Lima, Peru)

2007

International Conference on Nonlinear Analysis and Optimization (Isfahan, Iran)

15th International Scientific Conference on Mathematical Methods in Economics and Industry (Herľany, Slovakia)

The Second International Conference on Optimization and Optimal Control (Ulaanbaatar, Mongolia)

11-th Workshop on Well-Posedness of Optimization Problems and Related Topics (Alicante, Spain)

VIII Seminario Internacional en Optimizaci3n y reas Afines (Lima, Peru)

XXV Coloquio de la Sociedad Matematica Peruana (Lima, Peru)

Seminario de Optimizaci3n y Anlisis Variacional (Elche, Spain)

2008

International Conference on Modeling, Computation and Optimization (Delhi, India)

Seminario Taller "Avances en Matemticas Aplicadas (Cali, Colombia)

Ninth International Conference "Approximation and Optimization in the Caribbean" (San Andres Island, Colombia)

The Second International Conference on Nonlinear Programming with Applications 2008 (Beijing, China)

48th Workshop: Nonsmooth Analysis Optimization and Applications (Erice, Italy)

5th Workshop on Vector Optimization and Related Topics (Madrid, Spain)

9th International Symposium on Generalized Convexity and Generalized Monotonicity (Kaohsiung, Taiwan)

39th Annual Iranian Mathematics Conference (Kerman, Iran)

### Publications

Martnez-Legaz, J.E.; Singer, I.: Comparing Fenchel-Moreau Conjugates with Level Set Conjugates. *J. Convex Anal.* 15 (2008), no. 2, 285–297.

Martnez-Legaz, J.-E.; Svaiter, B.F.: Minimal convex functions bounded below by the duality product. *Proc. Amer. Math. Soc.* 136 (2008), no. 3, 873–878.

Martínez-Legaz, J.-E.; Soubeyran, A.: A tabu search scheme for abstract problems, with applications to the computation of fixed points. *J. Math. Anal. Appl.* 338 (2008), no. 1, 620–627.

Martínez-Legaz, J.-E.: Convex conjugation and duality for the solutions of a functional equation. *Vietnam J. Math.* 35 (2007), no. 4, 481-494.

Martínez-Legaz, J.-E.; Martínón, A.: Boundedly connected sets and the distance to the intersection of two sets. *J. Math. Anal. Appl.* 332 (2007), no. 1, 400–406.

Hiriart-Urruty, J.-B.; Martínez-Legaz, J.-E.: Convex solutions of a functional equation arising in information theory. *J. Math. Anal. Appl.* 328 (2007), no. 2, 1309–1320.

Martínez-Legaz, J.-E.; Quah, John K.-H.: A contribution to duality theory, applied to the measurement of risk aversion. *Econom. Theory* 30 (2007), no. 2, 337–362.

Martínez-Legaz, J.E.; Sosa, W.: Duality for equilibrium problems. *J. Global Optim.* 35 (2006), no. 2, 311–319.

Martínez-Legaz, J.E.; Penot, J.-P.: Regularization by erasement. *Math. Scand.* 98 (2006), no. 1, 97–124.

Martínez-Legaz, J.E.; Singer, I.: Some conjugation formulas and subdifferential formulas of convex analysis revisited. *J. Math. Anal. Appl.* 313 (2006), no. 2, 717–729.

Martínez-Legaz, J.E.: Some characterizations of convex games. *Recent Advances in Optimization*, 293–303, Springer, Berlin, 2006.

López, M. A.; Martínez-Legaz, J.E.: Farkas-type theorems for positively homogeneous semi-infinite systems. *Optimization* 54 (2005), no. 4-5, 421–431.

Martínez-Legaz, J.E.; Rubinov, A.M.; Schaible, S.: Increasing quasiconcave co-radiant functions with applications in mathematical economics. *Math. Methods Oper. Res.* 61 (2005), no. 2, 261–280.

Martínez-Legaz, J. E.: On Brickman's theorem. *J. Convex Anal.* 12 (2005), no. 1, 139–143.

Martínez-Legaz, J. E.; Svaiter, B.F.: Monotone operators representable by l.s.c. convex functions. *Set-Valued Anal.* 13 (2005), no. 1, 21–46.

Martínez-Legaz, J. E.: Generalized convex duality and its economic applications. *Handbook of generalized convexity and generalized monotonicity*, 237–292, Springer, New York, 2005.

Dutta, J.; Martínez-Legaz, J. E.; Rubinov, A. M.: Monotonic analysis over cones. II. *Optimization* 53 (2004), no. 5-6, 529–547.

Dutta, J.; Martínez-Legaz, J. E.; Rubinov, A. M.: Monotonic analysis over cones. I. *Optimization* 53 (2004), no. 2, 129–146.

Hiriart-Urruty, J.-B.; Martínez-Legaz, J. E.: New formulas for the Legendre-Fenchel transform. *J. Math. Anal. Appl.* 288 (2003), no. 2, 544–555.

Martínez-Legaz, J. E.; Meseguer, A.: The indirect function of an NTU game. *Optimization and related topics*, 3. *J. Math. Sci. (N. Y.)* 116 (2003), no. 3, 3253–3265.

Getán, J.; Martínez-Legaz, J. E.; Singer, I.:  $(*, s)$ -dualities. *Optimization and related topics*, 1. *J. Math. Sci. (N. Y.)* 115 (2003), no. 4, 2506–2541

Bilbao, J. M.; Martínez-Legaz, J. E.: Some applications of convex analysis to cooperative game theory. Generalized convexity, generalized monotonicity, optimality conditions and duality in scalar and vector optimization. *J. Stat. Manag. Syst.* 5 (2002), no. 1-3, 39–61.

Daniilidis, A.; Martínez-Legaz, J. E.: Characterizations of evenly convex sets and evenly quasiconvex functions. *J. Math. Anal. Appl.* 273 (2002), no. 1, 58-66.

Martínez-Legaz, J. E.; Rubinov, A. M.; Singer, I.: Downward sets and their separation and approximation properties. *J. Global Optim.* 23 (2002), no. 2, 111-137.

Daniilidis, A.; Hadjisavvas, N.; Martínez-Legaz, J. E.: An appropriate sub-differential for quasiconvex functions. *SIAM J. Optim.* 12 (2001/02), no. 2, 407-420.

Martínez-Legaz, J. E.; Rubinov, A. M.: Increasing positively homogeneous functions defined on  $\mathbb{R}^n$ . *Acta Math. Vietnam.* 26 (2001), no. 3, 313-331.

Martínez-Legaz, J. E.; Volle, M.: Duality for d.c. optimization over compact sets. *Optimization theory (Mátraháza, 1999)*, 139-146, *Appl. Optim.*, 59, Kluwer Acad. Publ., Dordrecht, 2001.

Dragan, I.; Martínez-Legaz, J. E.: On the semivalues and the power core of cooperative TU games. *Int. Game Theory Rev.* 3 (2001), no. 2-3, 127-139.

Martínez-Legaz, J. E.; Théra, M.: A convex representation of maximal monotone operators. *J. Nonlinear Convex Anal.* 2 (2001), no. 2, 243-247.

Martínez-Legaz, J. E.; Singer, I.: Semi-spaces and bases of convexity systems in complete lattices. *Constructive, experimental, and nonlinear analysis (Limoges, 1999)*, 235-243, *CMS Conf. Proc.*, 27, Amer. Math. Soc., Providence, RI, 2000.

Martínez-Legaz, J. E.: Optimización matemática y sus aplicaciones económicas. *Varia Mathematica* 1 (2000), 97-153.

Martínez-Legaz, J. E.: A new characterization of totally balanced games. *Topics in mathematical economics and game theory (Toronto, ON, 1995)*, 83-88, *Fields Inst. Commun.*, 23, Amer. Math. Soc., Providence, RI, 1999.

Martínez-Legaz, J. E.; Volle, M.: Duality in d.c. programming: The Case of Several D.C. Constraints. *J. Math. Anal. Appl.* 237 (1999), no. 1, 657-671.

Luc, D. T.; Martínez-Legaz, J. E.; Seeger, A.: Least deviation decomposition with respect to a pair of convex sets. *J. Convex Anal.* 6 (1999), no. 1, 115-140.

Martínez-Legaz, J. E.; Sach, P. H.: A new subdifferential in quasiconvex analysis. *J. Convex Anal.* 6 (1999), no. 1, 1-11.

Bajona-Xandri, C.; Martínez-Legaz, J. E.: Lower subdifferentiability in min-max fractional programming. *Optimization* 45 (1999), no. 1, 1-12.

Martínez-Legaz, J. E.: Lexicographic utility and orderings. *Handbook of Utility Theory. Volume 1. Principles*, 345-369, Kluwer Acad. Publ., Dordrecht, 1998.

Flores-Bazán, F.; Martínez-Legaz, J. E.: Simplified global optimality conditions in generalized conjugation theory. *Generalized convexity, generalized monotonicity: recent results (Luminy, 1996)*, 305-329, *Nonconvex Optim. Appl.*, 27, Kluwer Acad. Publ., Dordrecht, 1998.

Martínez-Legaz, J. E.; Singer, I.: On  $\Phi$ -convexity of convex functions. *Linear Algebra Appl.* 278 (1998), no. 1-3, 163-181.

Martínez-Legaz, J. E.: A duality theory for totally balanced games. *Proceedings of the IV Catalan Days of Applied Mathematics (Tarragona, 1998)*, 151-161, Univ. Rovira Virgili, Tarragona, 1998

Martínez-Legaz, J. E.; Singer, I.: On conjugations for functions with values in extensions of ordered groups. *Positivity* 1 (1997), no. 3, 193-218.

Martínez-Legaz, J. E.: Lexicographical characterization of the faces of convex sets. *Acta Math. Vietnam.* 22 (1997), no. 1, 207-211.

Martínez-Legaz, J. E.; Singer, I.: An extension of d.c. duality theory, with an appendix on  $*$ -subdifferentials. *Optimization* 42 (1997), no. 1, 9-37.

Martínez-Legaz, J. E.: Characterization of  $R$ -evenly quasiconvex functions. *J. Optim. Theory Appl.* 95 (1997), no. 3, 717-722.

Martínez-Legaz, J. E.: Dual representation of cooperative games based on Fenchel-Moreau conjugation. *Optimization* 36 (1996), no. 4, 291-319.

Martínez-Legaz, J. E.; Théra, M.:  $\varepsilon$ -subdifferentials in terms of subdifferentials. *Set-Valued Anal.* 4 (1996), no. 4, 327-332.

Martínez-Legaz, J. E.: On the uniqueness of perfect matchings in bipartite graphs. *Exposition. Math.* 14 (1996), no. 5, 473-480.

Martínez-Legaz, J. E.; Santos, M. S.: On expenditure functions. *J. Math. Econom.* 25 (1996), no. 2, 143-163.

Coutat, P.; Volle, M.; Martínez-Legaz, J. E.: Convex functions with continuous epigraph or continuous level sets. *J. Optim. Theory Appl.* 88 (1996), no. 2, 365-379.

Martínez-Legaz, J. E.: On convex and quasiconvex spectral functions. *Proceedings of the 2nd Catalan Days on Applied Mathematics (Odeillo, 1995)*, 199-208, *Collect. Études*, Presses Univ. Perpignan, Perpignan, 1995.

Martínez-Legaz, J. E.; Singer, I.: Dualities associated to binary operations on  $\overline{\mathbb{R}}$ . *J. Convex Anal.* 2 (1995), no. 1-2, 185-209.

Martínez-Legaz, J. E.: Fenchel duality and related properties in generalized conjugation theory. *International Conference in Applied Analysis (Hanoi, 1993)*. *Southeast Asian Bull. Math.* 19 (1995), no. 2, 99-106.

Martínez-Legaz, J. E.; Singer, I.: Subdifferentials with respect to dualities. *ZOR-Math. Methods Oper. Res.* 42 (1995), no. 1, 109-125.

Crouzeix, J.-P.; Martínez-Legaz, J. E.; Seeger, A.: An alternative theorem for quadratic forms and extensions. *Linear Algebra Appl.* 215 (1995), 121-134.

Martínez-Legaz, J. E.; Singer, I.: \*-dualities. *Optimization* 30 (1994), no. 4, 295-315.

Martínez-Legaz, J. E.; Seeger, A.: A general cone decomposition theory based on efficiency. *Math. Programming* 65 (1994), no. 1, Ser. A, 1-20.

Martínez-Legaz, J. E.; Seeger, A.: Yuan's alternative theorem and the maximization of the minimum eigenvalue function. *J. Optim. Theory Appl.* 82 (1994), no. 1, 159-167.

Boncompte, M.; Martínez-Legaz, J. E.: Weak lower subdifferentiability in fractional programming. *Int. Trans. Oper. Res.* 1 (1994), no. 2, 265-270.

Martínez-Legaz, J. E.; Singer, I.: Some characterizations of perturbational dual problems. *Optimization* 29 (1994), no. 2, 97-130.

Martínez-Legaz, J. E.; Romano-Rodríguez, S.:  $\alpha$ -lower subdifferentiable functions. *SIAM J. Optim.* 3 (1993), no. 4, 800-825.

Marchi, E.; Martínez-Legaz, J. E.: A generalization of Fan-Browder's fixed point theorem and its applications. *Topol. Methods Nonlinear Anal.* 2 (1993), no. 2, 277-291.

Martínez-Legaz, J. E.; Santos, M. S.: Duality between direct and indirect preferences. *Econom. Theory* 3 (1993), no. 2, 335-351.

Martínez-Legaz, J. E.; Singer, I.: Some further characterizations of unperturbational dual problems. *Parametric optimization and related topics, III* (Güstrow, 1991), 407-436, *Approx. Optim.*, 3, Lang, Frankfurt am Main, 1993.

Martínez-Legaz, J. E.; Romano-Rodríguez, S.: Lower subdifferentiability of quadratic functions. *Math. Programming* 60 (1993), no. 1, Ser. A, 93-113.

Martínez-Legaz, J. E.: Axiomatic characterizations of the duality correspondence in consumer theory. *J. Math. Econom.* 22 (1993), no. 6, 509-522.

Martínez-Legaz, J. E.; Singer, I.: Some characterizations of surrogate dual problems. *Optimization* 24 (1992), no. 1-2, 1-11.

Crouzeix, J.-P.; Martínez-Legaz, J. E.; Seeger, A.: Un théorème de l'alternative pour des formes quadratiques et quelques extensions. (French) [An alternative theorem for quadratic forms and extensions] *C. R. Acad. Sci. Paris Sér. I Math.* 314 (1992), no. 7, 505-506.

Martínez-Legaz, J. E.; Seeger, A.: A formula on the approximate subdifferential of the difference of convex functions. *Bull. Austral. Math. Soc.* 45 (1992), no. 1, 37-41.

Marchi, E.; Martínez-Legaz, J. E.: Some results on approximate continuous selections, fixed points and minimax inequalities. *Fixed point theory and applications* (Marseille, 1989), 327-343, *Pitman Res. Notes Math. Ser.*, 252, Longman Sci. Tech., Harlow, 1991.

Martínez-Legaz, J. E.: Characterizations of efficient solutions under polyhedrality assumptions. *Z. Oper. Res.* 35 (1991), no. 3, 221-230.

Martínez-Legaz, J. E.; Singer, I.: Some characterizations of  $\varphi$ -Lagrangian dual problems. *Optimization* 22 (1991), no. 6, 835-843.

Martínez-Legaz, J. E.; Singer, I.: Multi-order convexity. *Applied geometry and discrete mathematics*, 471-488, *DIMACS Ser. Discrete Math. Theoret. Comput. Sci.*, 4, Amer. Math. Soc., Providence, RI, 1991.

Boncompte, M.; Martínez-Legaz, J. E.: Fractional programming by lower subdifferentiability techniques. *J. Optim. Theory Appl.* 68 (1991), no. 1, 95-116.

Martínez-Legaz, J. E.; Singer, I.: Compatible preorders and linear operators on  $\mathbb{R}^n$ . *Linear Algebra Appl.* 153 (1991), 53-66. Erratum: *Linear Algebra Appl.* 220 (1995), 5-6.

Martínez-Legaz, J. E.; Singer, I.:  $\vee$ -dualities and  $\perp$ -dualities. *Optimization* 22 (1991), no. 4, 483-511. Errata corrige: *Optimization* 24 (1992), no. 1-2, 13.

Martínez-Legaz, J. E.: Duality between direct and indirect utility functions under minimal hypotheses. *J. Math. Econom.* 20 (1991), no. 2, 199-209.

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