

FUZZY MEANS AND HGA-TYPE INEQUALITIES

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Abstract. The notion of fuzzy means of fuzzy numbers is introduced. Fuzzy counterparts of the arithmetic, geometric and harmonic means are investigated and inequalities between them are presented.

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REFERENCES

- [1] O. A. ABUAROQB, N. T. SHAWAGFEH, O. A. ABUGHNEIM, *Functions defined on fuzzy real numbers according to Zadeh's extension*, Internat. Math. Forum 3 (2008) 763–776.
- [2] J. ACZÉL, J. DHOMBRES, *Functional Equations in Several Variables with Applications to Mathematics, Information Theory and to the Natural and Social Sciences*, Cambridge University Press, Cambridge, 1989.
- [3] P. S. BULLEN, *Handbook of means and their inequalities*, Kluwer, Dordrecht, 2003.
- [4] G. CHEN, T. T. PHAM, *Introduction to Fuzzy Sets, Fuzzy Logic and Fuzzy Control Systems*, CRC Press LLC, Boca Raton, London, New York, 2001.
- [5] Z. DAROCZY, Z. PÁLES, *Gauss-composition of means and the solution of the Matkowski-Sutô problem*, Publ. Math. Debrecen 61 (1–2) (2002) 157–218.
- [6] M. DHAR, *Arithmetic mean, geometric mean and harmonic mean of fuzzy matrices on the basis of reference function*, Ann. Fuzzy Math. Inform. 14 (2017) 207–214.
- [7] D. DUBOIS, H. PRADE, *Fuzzy Sets and Systems: Theory and Applications*, Acad. Press, vol. 144, New York 1980.
- [8] D. DUBOIS, H. PRADE, *Inverse operations for fuzzy numbers*, IFAC Proceedings Volumes, vol. 16 (issue 13) (1983) 399–404.
- [9] D. DUBOIS, H. PRADE, *The mean value of fuzzy numbers*, Fuzzy sets and Systems 24 (1987) 279–300.
- [10] D. DUBOIS, H. PRADE (Eds), *Fundamentals of Fuzzy Sets*, Kluwer Acad Publ., New York, 2001.
- [11] N. ELEZOVIĆ, *Asymptotic inequalities and comparison of classical means*, J. Math. Inequal. 9 (1) (2015) 177–196.
- [12] L. S. GAO, *The fuzzy arithmetic mean*, Fuzzy Sets and Systems 107 (1999) 335–348.
- [13] J. JARCZYK, W. JARCZYK, *Invariance of means*, Aequat. Math. 92 (2018) 801–872.
- [14] A. KAUFMANN, M. M. GUPTA, *Introduction to Fuzzy Arithmetic: Theory and Applications*, Van Nostrand Reinhold, New York, 1991.
- [15] H. T. NGUYEN, *A note on extension principle for fuzzy sets*, J. Math. Anal. Appl. 64 (1978) 369–380.
- [16] K. NIKODEM, *Set-valued means*, Set-Valued Var. Anal. 28 (2020) 559–568.
- [17] G. TOADER, I. COSTIN, *Means in mathematical analysis. Bivariate means*, Mathematical Analysis and its Applications Series, Academic Press, An imprint of Elsevier, London, 2018.
- [18] L. A. ZADEH, *Fuzzy sets*, Information and Control 8 (1965) 338–353.
- [19] L. A. ZADEH, *The concept of linguistic variable and its applications to approximate reasoning*, Information Sciences 8 (1975) 199–249.
- [20] H. J. ZIMMERMANN, *Fuzzy Set Theory and its Applications*, Kluwer Acad. Press, 1991.