

## INEQUALITIES OF THE JENSEN AND EDMUNDSON-LAH-RIBARIČ TYPE FOR 3-CONVEX FUNCTIONS WITH APPLICATIONS

ROZARIJA MIKIĆ, ĐILDA PEČARIĆ AND JOSIP PEČARIĆ

**Abstract.** In this paper we derive some Jensen and Edmundson-Lah-Ribarič type inequalities for positive linear functionals and 3-convex functions. Obtained results are then applied to generalized means and power means, as well as to the generalized  $f$ -divergence functional. Examples with Zipf-Mandelbrot law are given.

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### REFERENCES

- [1] S. ABRAMOVICH, *Quasi-arithmetic means and subquadracity*, J. Math. Inequal. **9**, 4 (2015), 1157–1168.
- [2] P. R. BEESACK AND J. E. PEČARIĆ, *On the Jessen's inequality for convex functions*, J. Math. Anal. Appl. **110**, 2 (1985), 536–552.
- [3] M. BEN BASSAT,  *$f$ -entropies, probability of error, and feature selection*, Inform. Contr. **39**, 3 (1978), 227–242.
- [4] P. S. BULLEN, D. S. MITRINOVIĆ AND P. M. VASIĆ, *Means and their inequalities*, D. Reidel Publishing Co., Dordrecht, Boston, Lancaster and Tokyo.
- [5] C. H. CHEN, *Statistical Pattern Recognition*, Hayden Book Co., Rochelle Park, NJ.
- [6] D. CHOI, M. KRNIĆ AND J. PEČARIĆ, *Improved Jensen-type inequalities via linear interpolation and applications*, J. Math. Inequal. **11**, 2 (2017), 301–322.
- [7] C. K. CHOW AND C. N. LIU, *Approximating discrete probability distributions with dependence trees*, IEEE Trans. Inform. Theory **14**, 3 (1968), 462–467.
- [8] I. CSISZÁR, *Information measures: A critical survey*, Trans. 7th Prague Conf. on Info. Th. Statist. Decis. Funct., Random Processes and 8th European Meeting of Statist. **B**, (1978), 73–86.
- [9] I. CSISZÁR, *Information-type measures of difference of probability functions and indirect observations*, Studia Sci. Math. Hungar. **2**, (1967), 299–318.
- [10] L. EGGHE AND R. ROUSSEAU, *Introduction to Informetrics. Quantitative Methods in Library, Documentation and Information Science*, Elsevier Science Publishers, New York.
- [11] D. V. GOKHALE AND S. KULLBACK, *Information in Contingency Tables*, Marcel Dekker, New York.
- [12] L. HORVÁTH, *Weighted form of a recent refinement of the discrete Jensen's inequality*, Math. Inequal. Appl. **17**, 3 (2014), 947–961.
- [13] L. HORVÁTH AND J. PEČARIĆ, *A refinement of the discrete Jensen's inequality*, Math. Inequal. Appl. **14**, 4 (2011), 777–791.
- [14] S. IVELIĆ AND J. PEČARIĆ, *Generalizations of converse Jensen's inequality and related results*, J. Math. Inequal. **5**, 1 (2011), 43–60.
- [15] R. JAKŠIĆ, M. KRNIĆ AND J. PEČARIĆ, *More precise estimates for the Jensen operator inequality obtained via the Lah-Ribarič inequality*, Appl. Math. Comp. **249** (2014), 346–355.
- [16] R. JAKŠIĆ AND J. PEČARIĆ, *New converses of the Jessen and Lah-Ribarič inequalities II*, J. Math. Inequal. **7**, 4 (2013), 617–645.
- [17] B. JESSEN, *Bemaerkinger om konvekse Funktioner og Uligheder imellem Middelveerdier I*, Mat. Tidsskrift. **B**, (1931), 17–28.

- [18] T. KAILATH, *The divergence and Bhattacharyya distance measures in signal selection*, IEEE Transactions Commun. Technol. **15**, 1 (1967), 52–60.
- [19] M. KRNIĆ, R. MIKIĆ AND J. PEČARIĆ, *Strengthened converses of the Jensen and Edmundson-Lah-Ribarič inequalities*, Advances in Operator Theory **1**, 1 (2016), 104–122.
- [20] K. KRULIĆ HIMMELREICH, J. PEČARIĆ AND D. POKAZ, *Inequalities of Hardy and Jensen / New Hardy type inequalities with general kernels*, Monographs in inequalities 6, Element, Zagreb.
- [21] J. LIANG AND G. SHI, *Comparison of differences among power means  $Q_{r,\alpha}(a,b,\mathbf{x})_s$* , J. Math. Inequal. **9**, 2 (2015), 351–360.
- [22] J. LIN AND S. K. M. WONG, *Approximation of discrete probability distributions based on a new divergence measure*, Congressus. Numerantiitm. **61**, (1988), 75–80.
- [23] B. MANARIS, D. VAUGHAN, C. S. WAGNER, J. ROMERO AND R. B. DAVIS, *Evolutionary Music and the Zipf-Mandelbrot Law: Developing Fitness Functions for Pleasant Music*, Proceedings of 1st European Workshop on Evolutionary Music and Art (EvoMUSART2003) (2003), 522–534.
- [24] D. MOUILLOT AND A. LEPRETRE, *Introduction of relative abundance distribution (RAD) indices, estimated from the rank-frequency diagrams (RFD), to assess changes in community diversity*, Environmental Monitoring and Assessment, Springer **63**, 2 (2000), 279–295.
- [25] J. E. PEČARIĆ, F. PROSCHAN AND Y. L. TONG, *Convex functions, Partial orderings and statistical applications*, Academic Press. Inc., San Diego.
- [26] M. SABABHEH, *Improved Jensen's inequality*, Math. Inequal. Appl. **20**, 2 (2017), 389–403.
- [27] Z. K. SILAGADZE, *Citations and the Zipf-Mandelbrot Law*, Complex Systems **11**, 6 (1997), 487–499.