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Variation of Gini and Kolkata indices with saving propensity in the kinetic exchange model of wealth distribution: an analytical study.

Summary: We study analytically the change in the wealth \( x \) distribution \( P(x) \) against saving propensity \( \lambda \) in a closed economy, using the Kinetic theory. We estimate the Gini \( g \) and Kolkata \( k \) indices by deriving (using \( P(x) \)) the Lorenz function \( L(f) \), giving the cumulative fraction \( L \) of wealth possessed by fraction \( f \) of the people ordered in ascending order of wealth. First, using the exact result for \( P(x) \) when \( \lambda = 0 \) we derive \( L(f) \), and from there the index values \( g \) and \( k \). We then proceed with an approximate gamma distribution form of \( P(x) \) for non-zero values of \( \lambda \). Then we derive the results for \( g \) and \( k \) at \( \lambda = 0.25 \) and as \( \lambda \to 1 \). We note that for \( \lambda \to 1 \) the wealth distribution \( P(x) \) becomes a Dirac \( \delta \)-function. Using this and assuming that form for larger values of \( \lambda \) we proceed for an approximate estimate for \( P(x) \) centered around the most probable wealth (a function of \( \lambda \)). We utilize this approximate form to evaluate \( L(f) \), and using this along with the known analytical expression for \( g \), we derive an analytical expression for \( k(\lambda) \). These analytical results for \( g \) and \( k \) at different \( \lambda \) are compared with numerical (Monte Carlo) results from the study of the Chakraborti-Chakrabarti model. Next we derive analytically a relation between \( g \) and \( k \). From the analytical expressions of \( g \) and \( k \), we proceed for a thermodynamic mapping to show that the former corresponds to entropy and the latter corresponds to the inverse temperature.

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References:


Mező, I.; Baricz, Á., On the generalization of the lambert \( \lambda(W) \) function, Trans. Amer. Math. Soc., 369, 7917 (2017) - Zbl 1375.33034


Koutsogiannis, D.; Sargenti, G., Entropy and wealth, Entropy, 23, 1356 (2021)

Ghosh, A.; Chakrabarti, B. K., Limiting value of the Kolkata index for social inequality and a possible social constant, Physica A, 573, Article 125944 pp. (2021)


Sen, P.; Chakrabarti, B. K., Sociophysics: An Introduction (2021), Oxford University Press


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