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On the Homogeneous Functions with Two Parameters and Its Monotonicity

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Abstract:

Suppose $f(x,y)$ is a positive homogeneous function defined on $\mathbb{U}(\mathbb{R}_+ \times \mathbb{R}_+)$, call $H_f(a,b;p,q) = \left[\frac{f(a^p,b^p)}{f(a^q,b^q)}\right]^{\frac{1}{p-q}}$ homogeneous function with two parameters. If $f(x,y)$ is 2nd differentiable, then the monotonicity in parameters p and q of $H_f(a,b;p,q)$ depend on the signs of $I_1 = (\ln f)_{xy}$, for variable a and b depend on the sign of $I_{2a} = [(\ln f)_x \ln(y/x)]_y$ and $I_{2b} = [(\ln f)_y \ln(x/y)]_x$ respectively. As applications of these results, a serial of inequalities for arithmetic mean, geometric mean, exponential mean, logarithmic mean, power-Exponential mean and exponential-geometric mean are deduced.

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