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Let  $a_1, \dots, a_n$  be nonnegative numbers and let  $r$  be a positive integer. Show that

$$\left( \sum_{1 \leq i, j \leq n} \frac{i^r j^r a_i a_j}{i + j - 1} \right)^2 \leq \sum_{m=1}^n m^{r-1} a_m \sum_{1 \leq i, j, k \leq n} \frac{i^r j^r k^r a_i a_j a_k}{i + j + k - 2}.$$