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Entropy and F-divergence construction using the Einstein sum

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The Einstein sum was defined by the formula [1]:

$$\forall x, y \in (-1,1), x \oplus y = \frac{x+y}{1+xy} \tag{1}$$

Starting from the Einstein sum and considering the real parameter $a \in (1, \infty)$, we define the function $f : [0, \infty) \to (-\infty, \infty)$ with the formula:

$$f(x) = \ln\left(\frac{x+a}{1+ax}\right) \tag{2}$$

Using the function f, the following formulas for entropy H_f and f-divergence D_f are constructed [??,??] .

$$H_f(P) = \sum_{i=1}^{n} p_i \ln\left(\frac{p_i + a}{1 + ap_i}\right) \tag{3}$$

$$D_f(P||Q) = \sum_{i=1}^{n} p_i \ln\left(\frac{q_i + ap_i}{p_i + aq_i}\right) \tag{4}$$

where $P = (p_1, p_2, \ldots, p_n)$ and $Q = (q_1, p_2, \ldots, q_n)$ are two discrete probabilities distributions.

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