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Łukasiewicz Logic and Tsallis Entropy Connected with Free Projections in the Free and Conditionally Free Probability

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In my talk, we consider the following topics:

1. Free and C-free probability and completely positive maps.

2. Free independent projections as a model of Jozef Łukasiewicz n-valued logic, $n > 2$, and also a model of continuous logic of Łukasiewicz–Tarski.

3. Main Theorem: If q is a real number and x, y are from interval $(0, 1)$, then the Tsallis entropy is defined as
$\mathrm{T}_q(x, y) = (x_1 - q + y_1 - q - 1)^{\frac{1}{1-q}}$ $Then we have: If P and Q are free independent in some probability space$ (A, tr) $with trace$ tr $state on$ A, and tr(P) = x, tr(yQ) = y, then tr(P^Q) = $T_0(x, y)$. If P and Q are Boolean independent, then $tr(PQ) = T_2(x, y)$ and relations with Dagum distributions, which are called log-logistic distributions in many statistics models.

   If P and Q are classically independent then $tr(P^Q) = T_1(x, y) = lim_{q \to 1} T_S(x, y)$, as t tends to 1.

   Here the projection P^Q is the smallest projection on the closed linear span of $Im(P)$ and $Im(Q)$.

   The generalizations of cases of Tsallis entropy T_q, for q in $(0, 1)$, we will use conditionally free independent projections.

4. Remarks on the free product of quantum channels.

References:

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4. M. Bożejko, Projections in free and Boolean probability with applications to J. Lukasiewicz logic, Conference on Quantum Statistics and Related Topics, Lodz, 10 pp., 2018.

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