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Minimal and nearly minimal measure expansions in connected unimodular groups

Let G be a connected unimodular group equipped with a Haar measure μ, and suppose $A, B \subseteq G$ are nonempty and compact. An inequality by Kemperman gives us

$$\mu(AB) \geq \min\{\mu(A) + \mu(B), \mu(G)\}.$$

We obtain characterizations of G, A, and B such that the equality holds, answering a question asked by Kemperman in 1964. We also get near equality versions of the above results with sharp exponent bound for connected compact groups. This confirms conjectures made by Griesmer and by Tao and can be seen as a Freiman $(3k-4)$-theorem up to a constant factor for this setting. (Joint with Chieu-Minh Tran)