Finite Approximation and Uncertainty - an open problem
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There are two kinds of mathematically rigorous uncertainty relations. On one hand, there is preparation uncertainty, like the inequality usually proved in quantum mechanics lectures, which says that the probability distributions for two given observables cannot both be sharply concentrated. On the other, we have obstructions to joint measurability, which also includes tradeoffs between the accuracy of one measurement and the disturbance of another. We describe how to create a family of quantitative bounds, based on a metric on the outcome sets, or, more generally, on a cost function for "errors". Since the same cost function can be used for preparation as well as measurement uncertainty, it is possible to compare these bounds quantitatively. Equality holds for pairs of observables related by the Fourier transform of any locally compact abelian group with translation invariant cost functions. More generically, we could show for arbitrary n-tuples of projection valued observables in *finite dimension* and arbitrary cost functions, measurement uncertainty is always larger than preparation uncertainty.

Usually in quantum theory, statements valid in arbitrary finite dimension carry over to the general case by standard approximation methods. In this case the problem of extending the result to infinite dimension is open, in spite of techniques allowing the treatment of some special cases of interest. I will prove the finite dimensional result and some easy extensions based on it, and show why straightforward extension does not work. The main aim of the talk is to invite ideas for proving or disproving the general case.