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Can averaging stabilize complex systems?

Averaging (called diversification in some contexts) has the potential to reduce variability. For example, the variance of the average of n independent, identically distributed (i.i.d.) random variables, of variance s2, is s2/n. Averaging can work to reduce the variance below a given threshold of acceptability provided that the variance (and in some cases also higher moments) is small or the system size is large; otherwise, in the case of fat-tailed distributions or effectively small systems, averaging will fail. Here we explore the meaning of this statement in the context in a variety of complex systems.