

Modeling correlation and dependence among intervals

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Abstract

This note introduces the notion of dependence among intervals to account for observed or theoretical constraints on the relationships among uncertain inputs in mathematical calculations. We define dependence as any restriction on the possible pairings of values within respective intervals and define nondependence as the degenerate case of no restrictions (which we carefully distinguish from independence in probability theory). Traditional interval calculations assume nondependence, but alternative assumptions are possible, including several which might be practical in engineering settings that would lead to tighter enclosures on arithmetic functions intervals. We give best possible formulas for addition of intervals under several of these dependencies. We also suggest some potentially useful models of correlation, which are single-parameter families of dependencies, often from the identity dependence ($u=v$) representing maximal correlation, through nondependence, to opposite dependence ($1-u=v$) representing maximally negative correlation.