



On the equivalence and stochastic dominance of systems of different sizes

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The signature of a coherent, or more generally, mixed, system with independent and identically distributed component lifetimes has been found to be a useful tool in the study and comparison of lifetimes of engineered systems. A key result is the representation of a system's survival distribution in terms of its signature vector, which leads to several results on stochastic comparison of system lifetimes. In order to compare two systems of different sizes by using signatures, the smaller system needs to be represented by an equivalent system of the same size as the larger system. Here equivalence between systems means that their lifetime distributions are identical for any component distribution. One may also consider the opposite problem, whether, for a given mixed system, there can be found equivalent systems of smaller sizes. While there is always an equivalent mixed system of larger size, there need not be equivalent systems of smaller sizes. Still, for any given system, there may be reasons to look for interesting systems of lower size, for example due to the possible lower cost of building a smaller system. In the case that there are no equivalent systems of lower size, one may instead look for smaller systems which in some sense perform approximately as well as the given one. More precisely, we shall consider the class of mixed n -systems with signature vector which stochastically dominates the signature of a given coherent or mixed $(n + 1)$ -system. For this class it may, for example, be of interest to optimize certain cost criterions. An interesting subtask of all this will be to restrict the studies to purely coherent systems. In particular we will be interested in characterizing pairs of equivalent systems of different sizes.

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