A variance-based approach to study the importance of components and subgroups in a coherent system: the regression importance signature for Workshop SMOD 2026

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The regression importance index of a coherent system evaluates a component's importance, taking into account the system's conditional mean lifetime when the component's failure time is known (see Arriaza et al. [1]). The aim is to extend such importance measure to subgroups of components, introducing the "regression importance signature". This is a tool designed to identify, for any fixed number k of components, the subgroup of size k whose joint state most significantly influences system lifetime variability. Unlike traditional single-component indices, the importance signature captures heterogeneity and interactions, reducing them to intuitive behaviours in series or parallel systems and revealing subsystems or dependencies that cannot be detected by individual measures. In addition, we investigate new properties of the importance index that enhance understanding of how component reliability and structural role jointly affect the system. General results for dependent components are provided, as well as conditions for comparing individual components and subgroups, with a particular attention on system modules. The talk is based on a recent work with A. Di Crescenzo and A. Suárez-Llorens, cf. [2].

References

1. Arriaza A., Navarro J., Sordo M.A., Suárez-Llorens, A. (2023) A variance-based importance index for systems with dependent components. *Fuzzy Set Syst.* **467**, 108482. https://doi.org/10.1016/j.fss.2023.02.003.

2. Di Crescenzo A., Pisano G., Suárez-Llorens, A. (2025) Analysis of systems with dependent components through a variance-based index and regression importance signature. *Currently under revision.*