

# Signature conditions for distributional properties of system lifetimes if component lifetimes are iid (exponential)

Tomasz Rychlik<sup>1</sup> and Magdalena Szymkowiak<sup>2</sup>

<sup>1</sup>*Institute of Mathematics, Polish Academy of Sciences*

<sup>2</sup>*Institute of Automation and Robotics, Poznan University of Technology*

## Abstract

First we consider coherent and mixed systems built of components with independent identically exponentially distributed lifetimes. We establish various sufficient conditions on the system signatures for asserting strong unimodality of the system lifetime as well as the monotonicity of its failure rate and mean residual life. Later on we show that the assumption of exponentiality of the component lifetimes by the increasing (decreasing) failure rate condition can be relaxed.

## Keywords

Coherent and mixed system, Signature, Strong unimodality, Failure rate, Mean residual life, Convex transform order.

## Acknowledgements

The second author was partially supported by PUT under grant 0211/SBAD/0121.

## References

- [1] Arnold, B.C., Rychlik, T., Szymkowiak, M. (2021c). Preservation of distributional properties of component lifetimes by system lifetimes, submitted.
- [2] Rychlik, T., Szymkowiak, M. (2021a). Properties of system lifetime in the classical model with i.i.d. exponential component lifetimes. In: *Advances in Statistics – Theory and Applications. Honoring the Contributions of Barry C. Arnold in Statistical Science* (I. Ghosh, N. Balakrishnan, H.K.T. Ng, eds.). Springer, Cham, Switzerland, 4–66.
- [3] Rychlik, T., Szymkowiak, M. (2021b). Signature conditions for distributional properties of system lifetimes if component lifetimes are iid exponential, submitted.
- [4] Samaniego, F.J. (1985). On closure of the IFR class under formation of coherent systems. *IEEE Trans. Reliab.* **34**, 69–72.