Population-level modelling of fleets and assets

CSIC Cambridge Centre for Smart Infrastructure & Construction

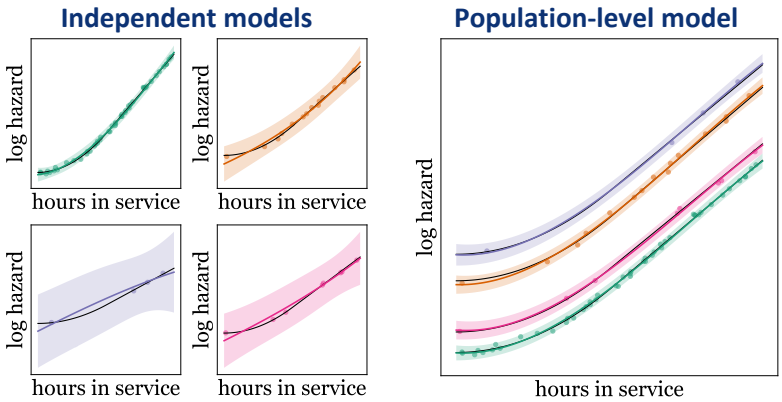
Why share information between assets?

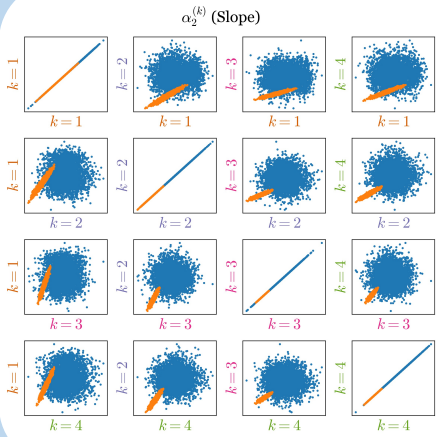
Data sparsity issues can be significant in engineering applications – especially for systems recently in operation. Typically, there is little information *a priori*, since the data arrive incrementally throughout use. This issue motivates the idea of sharing information within *fleets* of assets; specifically, can domains with comprehensive data (or established models) support those with incomplete data. Importantly, *fleets* can include various systems: e.g. fleets of aircraft engines, farms of wind turbines, fleets of rail stock, or collections of bridges.

A truck fleet is considered here for (simulated) prognosis data – though the data could represent a variety of systems. Via hierarchical Bayes, a population-level model shares information between correlated subgroups of vehicles.

Hazard curves for truck fleet prognosis

Hazard curves are essential when predicting the estimated time to failure for truck fleets.
The figures show that *data-rich* vehicle groups (green) support function estimation in groups with sparse data (purple, pink) via population modelling.





What a population model tells us

The figure to the left is insightful since it indicates that the slope parameters *transfer* or *share* information in the hierarchy.
That is, correlations between the four parameters allow for sparse domains (purple, pink) to borrow statistical strength from data-rich domains (green).

Concluding remarks

The method builds on engineering intuition, as correlations in the hierarchy can determine which vehicle groups are similar for which effects. For example, mining and forestry vehicles might be more correlated than retail vehicles, concerning the (linear) rate in change of the (log) hazard over time in service.

L.A. Bull, M. Dhada, O. Steinert, T. Lindgren, A.K Parlikad, M. Girolami lab99@cam.ac.uk

@CSIC-IKC www.smartinfrastructure.eng.cam.ac.uk

UNIVERSITY OF CAMBRIDGE

UKRI Innovate UK

UKRI Engineering and Physical Sciences Research Council