SKF proposal: “Statistical modelling of mechanical bearing life testing”

SKF is the world leading supplier of products and solutions in the rolling bearing business. In addition, we are one of the leading players in seals, mechatronics, lubrication systems, and services which include technical support, maintenance services, condition monitoring and training. The inherent skills and competence of our, around 45.000 employees, help us to fulfill our objective of creating more intelligent, sustainable and innovative customer solutions. SKF is a truly global company with presence in more than 130 countries, serving an extensive range of industries and customers worldwide.

SKF’s commitment to innovation and technology development is essential in maintaining and strengthening the company’s technological leadership. The organization has a number of Research facilities all around the world. The two biggest facilities are located in The Netherlands and Sweden. Here, scientists and engineers continuously generate ideas for developing new products and sub-systems including the integration of electronics and software.

As a knowledge engineering company, SKF derives more information from tests and applications to lead rather than follow industrial standards. The SKF Engineering & Research Centre plays a crucial role in developing test methodologies and performing tests for SKF solutions. The main focus areas are: testing methodology, validation testing, life testing, seal testing.
Summary of the proposal

The goal is to model and optimize bearing life testing time under constraints. The constraints are from various kinds:

- Number of available test machines (each machine has 2 test positions): $K$
- Number of life tests to be run: $N$
- Statistical distribution assumed for individual bearing life: Weibull ($L_{10}, \beta$)
- Assessed precision: expected maximum ratio between confidence bounds on life parameters

The parameters that need to be optimized are:

- The number of samples / machines per each test (can differ from one test to another)
- The order of the tests
- The individual test strategy (censoring, replacement...)
- Bias correction method for the Maximum Likelihood Estimation used for the confidence bounds calculation (when deviating from the type II censoring scheme)

In order to assess the last point, Monte Carlo simulations are needed, where random test data following specific test scenarios should be generated. The impact on the final result of the bias due to the generated test data should be quantified as well as a feasible strategy to minimize this effect.