A Hierarchical Bayesian Approach to Robust Parameter Design
Yuri Goegebeur - Peter Goos - Martina Vandebroek

Robust Parameter Design:
"products and processes should have high-level performance despite being subjected to a wide range of changing client and manufacturing conditions..."

⇒ use DOE to find among the control factors:

⇒ complicated in case of unreplicated observations

⇒ Hierarchical Bayesian Approach

\[ y_i = \beta' x_i + \sigma_i \epsilon_i \quad \text{with} \quad \epsilon_i \sim iid N(0, 1) \]

\[ \log(\sigma_i^2) = \phi' z_i + w_i \quad \text{with} \quad w_i \sim iid N(0, \kappa^2) \]

with priors:

\[ \beta \sim N_p (\beta_0, \Sigma_\beta) \]
\[ \phi \sim N_q (\phi_0, \Sigma_\phi) \]

• use Gibbs sampling and Metropolis algorithm to obtain posterior distributions of the model parameters

• use data based choice of hyperparameters \( \beta_0, \Sigma_\beta, \phi_0, \Sigma_\phi, \kappa^2 \)

• illustrated by simulations and by analysis of real life data