

Bayesian solutions for handling uncertainty in survival extrapolation

Miguel A. Negrín Hernández (Dpto. Métodos Cuantitativos en Economía y Gestión, ULPGC).

Abstract

Objective. Survival extrapolation using a single, best-fit model ignores two sources of model uncertainty: uncertainty in the true underlying distribution and uncertainty about the stability of the model parameters over time. Bayesian model averaging (BMA) has been used to account for the former but it can also account for the latter. We investigated BMA using a published comparison of the Charnley and Spectron hip prostheses using the original 8-year follow-up registry data.

Methods. A wide variety of alternative distributions were fitted. Two additional distributions were used to address uncertainty about parameter stability: optimistic and sceptical. The optimistic (sceptical) model represented the model distribution with the highest (lowest) estimated probabilities of survival but re-estimated using, as prior information, the most optimistic (sceptical) parameter estimated for intermediate follow-up periods. Distributions were then averaged assuming the same posterior probabilities for the optimistic, sceptical and non-informative models. Cost-effectiveness are compared using both the original 8-year and extended 16-year follow-up data.

Results. We found all models obtain similar revision-free years during the observed period. In contrast, there was variability over the decision time horizon. Over the observed period, we detected considerable uncertainty in the shape parameter for Spectron. After BMA, Spectron is cost-effectiveness at a threshold of £20,000 with 93% probability whereas the best-fit model found 100%; by contrast, with 16-years follow-up it was 0%.

Conclusions. This case study casts doubt on the ability of the single best fit model selected by information criteria statistics to adequately capture model uncertainty. Under this scenario, BMA weighted by posterior probabilities better addressed model uncertainty. However, there still be value in regularly updating health economic models, even where decision uncertainty is low.