Non-standard model building examplified by fish stock assessment

Anders Nielsen
DTU-Aqua

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Researchers in most scientific disciplines sometimes need to express statistical models that are incompatible with the formula interfaces found in standard statistical packages. Such models could for instance contain: non-trivial non-linearities, complex covariance structures, complicated couplings between fixed and random effects, or different sources of observations needing different likelihood types.

Fish stock assessment (the science of "counting fish") is a field where the combination of large non-linear mixed models and the need to provide answers has always forced the model developers to push the limits of existing statistical methods and develop exciting new ones.

Fish stock assessment will motivate the presentation of efficient tools to draw inference from such non-standard models. Many non-standard models can be estimated by a combination of automatic differentiation and Laplace approximation. Finally, options for model validation in these models will be summarized.

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