Multivariate Markov Chain Methods in Health Care

CHALLENGES: Monitoring and cost optimisation
PRODUCTIVE SECTOR: Healthcare and health-economics

PROBLEM DESCRIPTION

Consulting companies in healthcare and health-economics are often faced with the problem of finding cost efficient therapies and therapeutic regimens and comparing them. These challenges also emerged and need to be solved at the Healthware Consulting Ltd., Budapest.

CHALLENGES AND GOALS

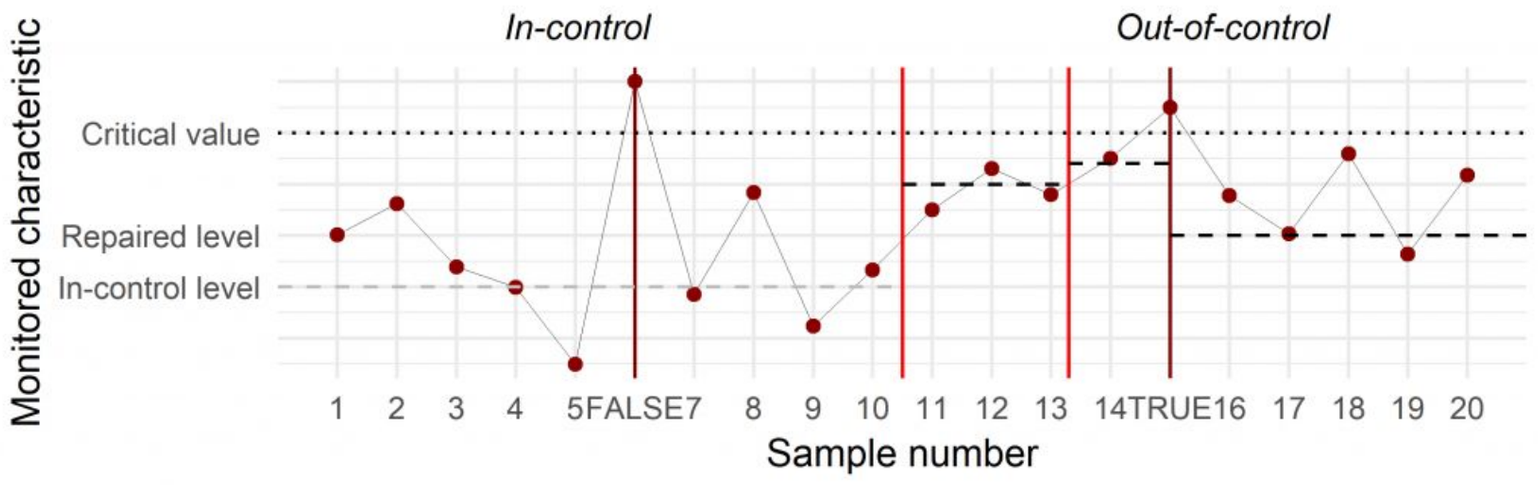
- To develop cost-optimisation methods, which are applicable to different medical processes
- To incorporate the new mathematical methods into the Markovchart R package
- To study the effect of the underlying assumptions on the performance of the convolution bsdrf disease progression model and investigate the identifiability of the parameters

MATHEMATICAL AND COMPUTATIONAL METHODS

The main methods and the connected problems are as follows:

- Simulating natural disease progression and investigating the reasons behind the failure of the convolution based disease progression model
- New Markov chain-based control chart methods for continuous treatment cost modelling by a modified, highly parametrizable cost function

All of these methods required the development of new theoretical results (such as the estimation of costs between control visits) as well as extensive programming in C++ and R. This meant the creation of new, purpose-built functions for theoretical calculations and simulations.



Disease progression-treatment cycles

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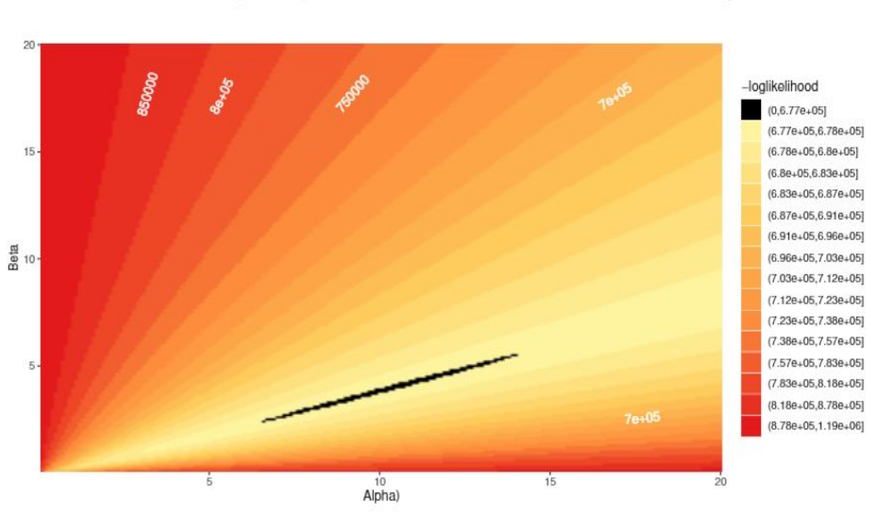
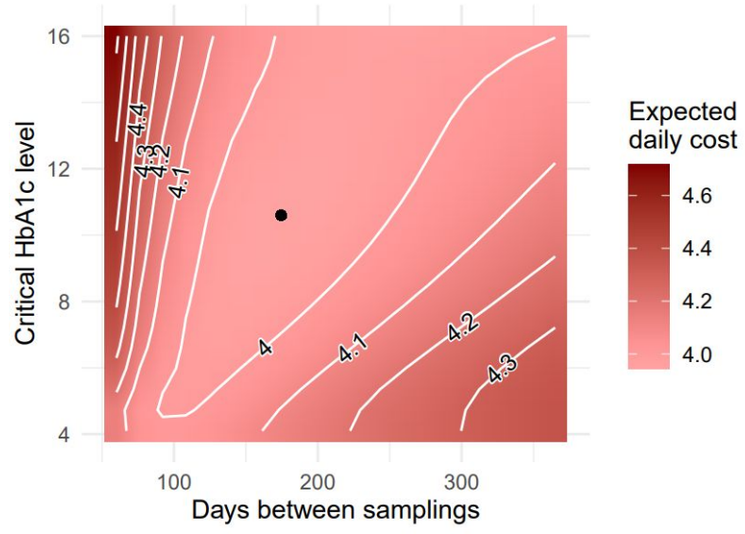
Results and Benefits

We uncovered the reasons behind the discrepancy in the results of the convolution based model and created methods to investigate the identifiability of the parameters in convolution based setups. We also published the updated Markovchart R package on the Comprehensive R Archive Network and applied it to real-world medical data. The results were presented at several conference (together with the Healthware Consulting Ltd.) and as a new publication one submitted manuscript and one completed



Contour plot of the −loglikelihood under the convolution based model for a gamma distributed sojourn time with parameters alpha and beta, the confidence region is in black



Contour plot of expected costs (EUR) related to insulin analogue therapy; HbA1c: glycated haemoglobin (blood sugar) level.

The industry has powerful simulators and R programs to estimate parameters and optimize costs.

HU-MATHS-IN
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Research Group for developing Markov-chain methods in monitoring healthcare processes

SZÉCHENYI 2020

HEALTHWARE

Healthware Consulting Ltd.