MONITORING and COST OPTIMISATION in HEALTHCARE by MARKOV CHAIN METHODS

CHALLENGES: Monitoring and cost optimisation

PRODUCTIVE SECTOR: Healthcare and health-economics

PROBLEM DESCRIPTION

Consulting companies in healthcare and health-economics have to find cost-efficient therapies and therapeutic regimens and compare them. These challenges also emerge and need to be solved at Healthware Consulting Ltd., Budapest.

CHALLENGES AND GOALS

- To develop cost-optimization methods applicable to medical processes
- To incorporate random degradation, random treatment effectiveness and patient incompliance
- To model and simulate chronic disease progression
- To correct the lead-time bias

MATHEMATICAL AND COMPUTATIONAL METHODS

The main methods and related problems are as follows:

- Incorporation of transition probabilities into a Markov chain's transition matrix which represents the state of the patient at the sampling times (i.e., control visits)
- Calculation and optimization of costs using the stationary distribution of the Markov chain
- Modelling disease progression using gamma deterioration processes, which leads to cost optimizing inspection (screening).
- Development of an accurate simulator of disease progression along with more accurate methods for parameter estimation.

Developing these methods requires new theoretical results (such as the estimation of costs between control visits) and extensive programming in C++ and R. This means creating new, purpose-built functions.


Disease progression-treatment cycles
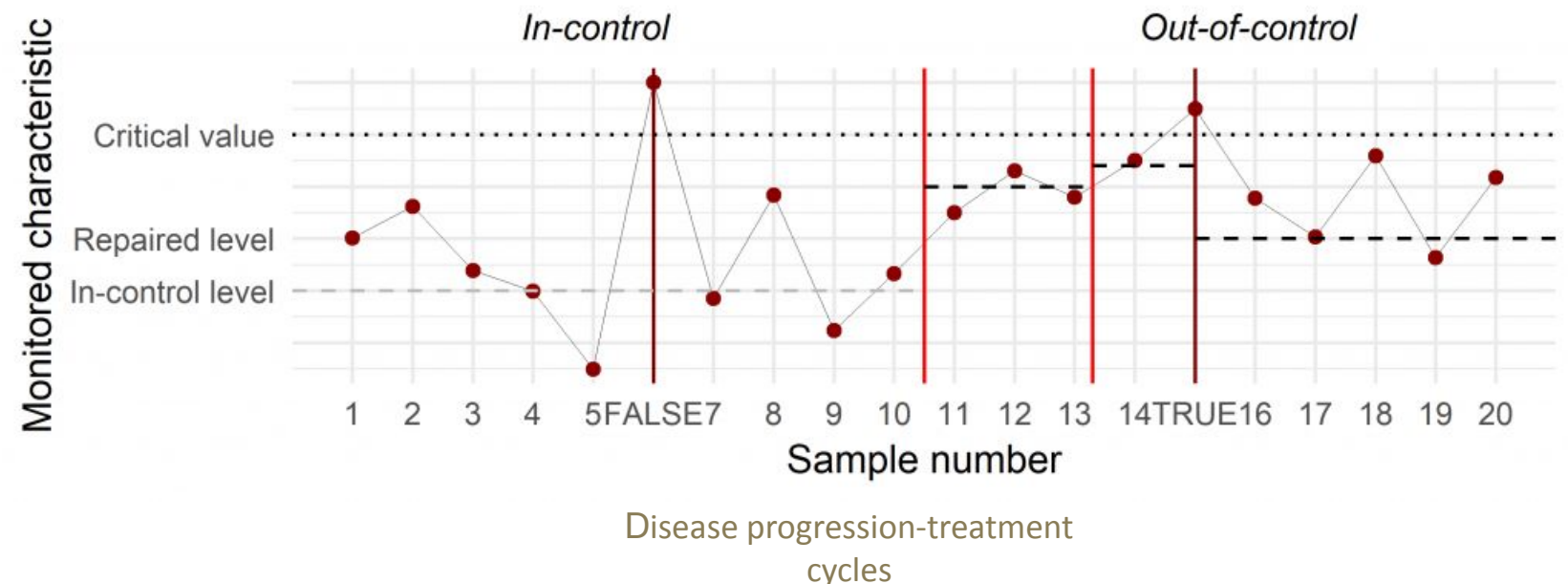
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Results and Benefits

The most important practical results include the cost estimation in different treatment regimens and a more accurate estimation of the lead-time bias. The results were presented at several conferences, a webinar, and in two published papers. Another two papers have also been submitted. The control chart method was successfully applied to real-world medical data at Healthware Consulting Ltd. A preliminary analysis using the method was sent to a client, and it may be followed by further research applying the model.

The company has R programs to estimate and optimise costs related to illness progression and treatment
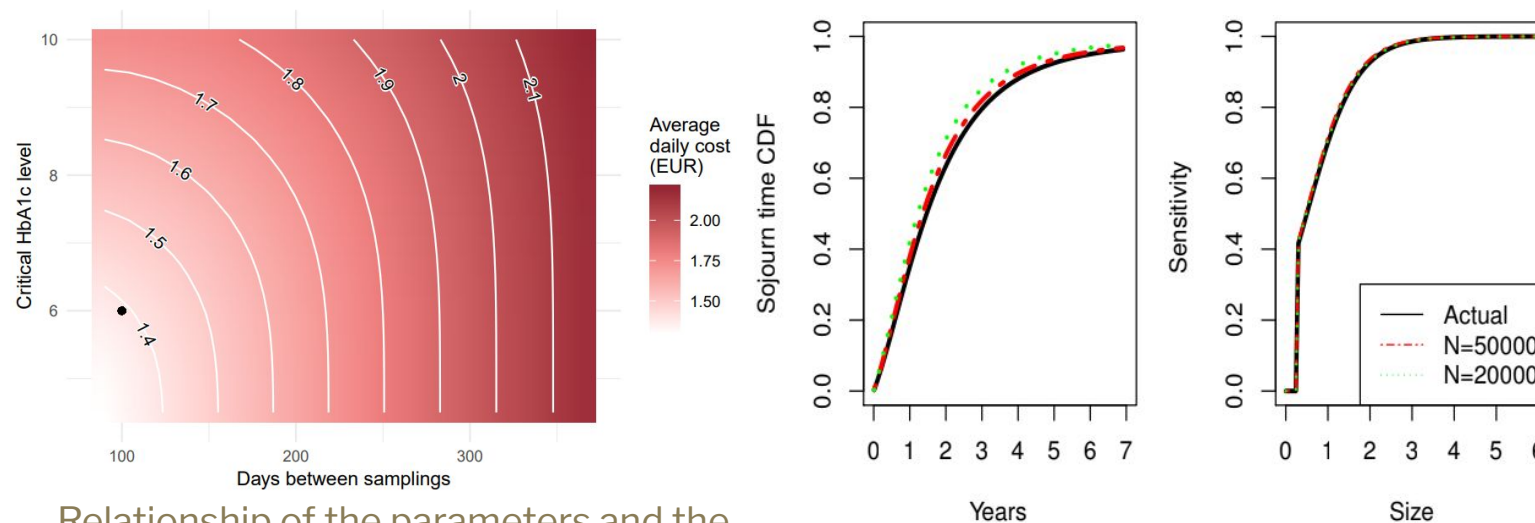
Relationship of the parameters and the daily average costs. (The dot corresponds to the parameters fitted to the empirical data).

Our approach leads to more accurate estimators for process parameters, even if based on a much smaller sample size.

HEALTHWARE

Healthware Consulting Ltd.