MODELING HEALTH AND ECONOMIC OUTCOMES USING DISCRETE EVENT SIMULATION IN R

A FOUR-DAY ONLINE PRACTICAL COURSE PROVIDING ALL KNOWLEDGE AND TOOLS REQUIRED TO IMPLEMENT DISCRETE EVENT SIMULATION MODELS IN R

> **" During the course complex analyses are very well explained and because they are placed in the right context everything falls into place."**
> *Tim Govers, PhD, Senior Scientist and Advisor Medical Technology, Radboudumc, the Netherlands*

> **" It was a very clear overview of DES and the mixture of presentations and practical sessions with code improved my understanding considerably."**
> *Robert Smith, PhD Candidate, School of Health and Related Research (ScHARR), University of Sheffield, UK*

> **" Everything you need to know about DES. Excellent combination of theory and practice whether you are a beginner or advanced modeller."**
> *William Hall, PhD Candidate, School of Population and Public Health, University of British Columbia, Canada*

Online in January/February 2026

UNIVERSITY OF TWENTE.

MODELING HEALTH AND ECONOMIC OUTCOMES USING DES IN R

There is an increasing need for patient-level simulation modeling methods to perform health economic evaluations or translational research on, for example, the optimization of treatment sequences. Discrete event simulation is an individual-level simulation modeling method suitable for modeling clinical pathways, allowing for patient and disease characteristics and resource constraints to be reflected. It offers much more flexibility of model structure than traditionally used cohort modeling techniques. However, it is often thought that this increase in flexibility comes at the expense of increased complexity compared to cohort models and compared to other individual-level modeling methods, such as individual-level state-transition modeling. This perceived complexity mainly originates from a stronger body of guidance on, and broader experience with, state-transition modeling. In fact, modelers familiar with discrete event simulation typically argue that using discrete event simulation results in models that are more transparent and also easier to interpret when reflecting personalized clinical pathways. This course aims to bridge the knowledge and experience gap on the use of discrete event simulation by providing participants with all theory and hands-on experience required to utilize the full potential of discrete event simulation to model health and economic outcomes.

The 'Modeling health and economic outcomes using discrete event simulation in R' course in brief:

- Four-day course with materials on 'Learning R for Simulation Analyses' to prepare
- Focus on using discrete event simulation for modeling health and economic outcomes
- More than half of the course time is spent on *guided hands-on practical sessions* in R
- Pre-recorded lectures and tutorial walkthroughs to watch on demand
- Lectures, tutorials, Q&A sessions and extensive *live* tutorial support sessions (12 hours)

Course days are January 27 & 30, and February 3 & 6, 2026.

Discrete event simulation for modeling health and economic outcomes

This course focuses on using discrete event simulation for modeling health and economic outcomes of personalized clinical pathways, for example, pathways including multiple treatment lines and biomarker-driven decisions on treatment switching. Based on state-of-the-art methodological guidance, all theoretical background required for implementing discrete event simulation will be discussed, starting from conceptualizing the model structure through analysis of the final model.

More specifically, the following aspects of discrete event simulation for modeling health and economic outcomes will be discussed:

- Conceptualization of the model structure
- Implementing competing events
- Individual patient data analysis
- Discounting in discrete event simulation models
- Reflecting stochastic and parameter uncertainty

Hands-on practical sessions with expert coaches

Although a good theoretical understanding of discrete event simulation is essential and will be provided, more than half of the course time is spent on practical sessions in which participants will learn to implement discrete event simulation models in R. During these practical sessions, participants will be coached by experts to allow each participant to successfully complete all assignments. Four practical sessions covering six tutorials will empower participants to implement any type of discrete event simulation model in R using the `simmer` package. The same case study on modeling health and economic outcomes will be used throughout all practical sessions, resulting in an oncology treatment sequencing model including biomarker-based treatment decisions for multiple lines of treatment and follow up. Throughout the development of this simulation model, all previously mentioned aspects to implementing a discrete event simulation will be covered. Participants will be provided with answers and source codes throughout practical sessions and each tutorial will include optional, more advanced assignments for those progressing through the assignments fast, for example, because they are already familiar a specific concept.

Required knowledge of health economics, simulation modeling, and R

Focus during the course is on the use of discrete event simulation to model health and economic outcomes, so only a very brief recap of health technology assessment (HTA) and health economic modeling (HEM) in general will be provided to set the context. It is helpful for participants to have some experience with building health economic models or simulation models in general. For example, experience with developing cohort-level state-transition models (i.e., Markov models), will be beneficial. Similarly, any experience with R prior to the course will be valuable when learning to use R for simulation purposes. All practical sessions will concern programming discrete event simulation models in R using the `simmer` package. Therefore, materials will be provided for participants to prepare and ensure they have appropriate knowledge about the basic concepts required to perform simulation-based analyses in R, which is crucial to the successful completion of the course. A Question & Answer session will be planned at the start of the course (Q&A tutorial 1, day 1) to address any remaining questions relating to R that participants may have.

Course delivery and structure

The course will be provided through the Moodle online education platform, which provides a central environment for information and document sharing, interaction, and video conferencing. Lectures will be pre-recorded and available on demand to accommodate the schedules and time zones of the participants. Live Q&A Sessions are scheduled for all lectures to discuss remaining questions that participants may have after watching the pre-recorded lectures. Live Tutorial Supports Sessions are scheduled for all practical sessions. Furthermore, although answer code for all tutorials will be provided, pre-recorded walkthroughs of all tutorials will be made available to watch on demand, and Live Q&A Sessions are scheduled to answer any remaining questions regarding the tutorials. During the practical sessions, the course instructors will use Break-out Rooms to provide one-on-one support to participants when needed. Although a single health economic model developed throughout multiple practical sessions, each practical session starts with new R script that provides the foundation for that practical session.

A detailed program is available at the end of this brochure.

Course instructors

Prof.dr.ir. Erik Koffijberg (course leader)

Erik Koffijberg has a background in Technical Computer Science and over 20 years of experience as health economist and modeler. He is Full Professor in the field of Health Technology Assessment and chair of the Health Technology & Services Research department at the University of Twente. He develops and teaches educational modules on the development and interpretation of health economic models in several post-graduate master courses and international workshops. He has published >150 scientific papers related foremost to simulation model-based impact assessment of new healthcare technologies.

E-mail: h.koffijberg@utwente.nl

Dr. Koen Degeling

Koen Degeling is an Industrial Engineer by training and specialized in the use of simulation modeling for health economic and health services research. He is Senior Market Access Manager at GSK and serves on the Editorial Board of the Medical Decision Making journals and Value & Outcomes Spotlight. He previously was Scientific Director and Decision-Analytic Modeling Lead at Healthcare Consultancy Group, and Research Fellow at the Cancer Health Services Research department of the University of Melbourne in Australia. Koen obtained the degree of doctor for his thesis “Simulation Modeling to Optimize Personalized Oncology”. He has developed several introductory and advanced courses and workshops on simulation modeling in health care.

E-mail: info@koendegeling.nl

Dr. Freek van Delft

Freek van Delft has a background in medical technology and health sciences. He is currently a postdoctoral researcher specializing in health technology assessment at the Health Technology & Services Research department at the University of Twente. He also holds a postdoctoral research position at the Netherlands Cancer Institute, where he focuses on informing clinical decision-making based on sequential liquid biopsy measurements. He is also a member of the Young NVTAG board, the Dutch society for technology assessment in healthcare.

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Course fee

To stimulate an interactive environment and to allow for substantial coaching during the practical sessions, there is a maximum of 30 participants. The course fee is as follows

- Private sector € 1199,- for employees of commercial companies;
- Public sector € 799,- a discounted fee for employees of non-commercial research organisations, such as universities and university medical centres;
- Students € 599,- a discounted fee for master students and PhD students.

To obtain a discount for the course fee a request should be sent to the course leader by email, *prior to registration for the course*. PhD students should include an official certificate of enrolment including their name in the corresponding Graduate School with their request.
The full or discounted course fee is to be paid *directly when registering for the course* (see below) which means that paying by invoice or purchase order unfortunately is not possible.

Registration

Registration for the course is processed through an online system that is available through the link below. As soon as the maximum number of 30 participants is reached, registration will no longer be possible, but subscription to a waiting list is possible by contacting the course leader. Cancellation of registrations is possible with full refund until January 4, 2026. Cancellation of registrations between January 4 and January 18, 2026 will result in a 50% refund. Please note that a refund will be paid on the bank account used to perform the original payment and selecting another bank account for the refund is not possible. After January 18, 2026 no refund is provided.

REGISTRATION DEADLINE JANUARY 6, 2026

Register here to participate in this course
https://eventix.shop/cryd29ww

Minimum number of participants

For this course a minimum number of 12 participants is required to allow for sufficient interaction and group discussions. If this minimum number of participants is not reached you will be informed that the course will be cancelled, at the latest on January 7, 2026. Should the course be cancelled due to an insufficient number of participants, all registered participants will receive a full refund of the course fee paid. Please note that a refund will be paid on the bank account used to perform the original payment and selecting another bank account for the refund is not possible. Should the minimum number of participants be reached prior to the registration deadline you will be informed directly that the course will go ahead as planned.

Please contact the course instructors for questions or enquiries (see contact details above).

DETAILED COURSE PROGRAM

Although start times are provided in Eastern Time (ET, UTC -4) and Central European Time (CET, UTC +2), the CET will be leading in case of any inconsistencies.

Day 1 – Tuesday January 27, 2026

START			
ET	**CET**	**DURATION**	**CONTENT**
2am	8am	-	*Deadline for submitting questions for the Q&A Sessions on Lecture 1 and Tutorial 1*
7am	1pm	3 hours	Course Welcome & Introductions Q&A Lecture 1 - Health Economic Modeling - Advanced Modeling Methods - Discrete Event Simulation Q&A Tutorial 1 - Using `R` for Simulation Analyses Live Support Tutorial 2 - Learning the `simmer` Package

Day 2 – Friday January 30, 2026

START			
ET	**CET**	**DURATION**	**CONTENT**
2am	8am	-	*Deadline for submitting questions for the Q&A Sessions on Lecture 2 and Tutorial 2*
7am	1pm	3 hour	Q&A Lecture 2 - Competing Events Q&A Tutorial 2 - Learning the `simmer` Package Live Support Tutorial 3 - Implementing the Basic Model Structure

Day 3 – Tuesday February 3, 2026

START ET	START CET	DURATION	CONTENT
2am	8am	-	*Deadline for submitting questions for the Q&A Sessions on Lecture 3 and Tutorial 3*
7am	1pm	3 hour	Q&A Lecture 3 - Discounting in Discrete Event Simulations - Stochastic and Parameter Uncertainty Q&A Tutorial 3 - Implementing the Basic Model Structure Live Support Tutorial 4 - Implementing the Health Economic Impact

Day 4 – Friday February 6, 2026

START ET	START CET	DURATION	CONTENT
2am	8am	-	*Deadline for submitting questions for the Q&A Sessions on Tutorial 4*
7am	1pm	3 hours	Q&A Tutorial 4 - Implementing the Health Economic Impact Live Support Tutorials 5 & 6 - Performing a Probabilistic Analysis - Visualization of the Results Q&A Tutorials 5 & 6 - Performing a Probabilistic Analysis - Visualization of the Results Closing Remarks

R AND RSTUDIO EXPERIENCE CHECKLIST

To be able to complete this course successfully, it is crucial that participants take the following steps *prior to the course start:*

- install both `R` and `RStudio` on their computer
- get familiar with `RStudio` as environment for using `R`
- master the specific aspects of `R` as listed below.

To support participants in taking these preparation steps a tutorial on Using `R` for Simulation Analyses will be provided on the Moodle platform around two weeks prior to the first course day.

If you are an experienced `R` and `RStudio` user and are confident in your ability to perform the listed tasks, you may not need to complete this tutorial provided before the course start. At the start of the course, there will be a single live Q&A session (Q&A tutorial 1, day 1) to discuss any questions you may have relating to this Using `R` for Simulation Analyses tutorial. All other Q&A and live support sessions during the course will focus on `simmer` and DES aspects and choices, assuming participants have sufficient knowledge of `R` and `RStudio`.

The following aspects of `R` should be learned *prior to the course start* and are covered by the Using `R` for Simulation Analyses tutorial:

- `RStudio` and its different windows
- Loading source codes and data files
- Installing and loading packages/libraries
- Defining and working with variables, vectors, matrices, data.frames, and lists
- Sub-setting/selecting from vectors, matrices, data.frames, and lists
- Basic calculations and transformations on variables, vectors, matrices, data.frames, and lists
- Working with functions (incl. using functions to define arguments to other functions)
- Defining custom functions
- Making basic plots
- Efficient vector and matrix-based calculations using the “apply” functions
- Parallelization of computational tasks
- Defining and working with formulas
- Fitting (logistic) regression models
- Fitting parametric survival models
- Simulating random numbers from parametric distributions