EE436

# General-Purpose Methods for Simulating Survival Data for Expected Value of Sample Information Calculations

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## Introduction

Expected value of sample information (EVSI) quantifies the expected value to a decision maker of reducing uncertainty by collecting additional data. EVSI calculations require simulating plausible datasets, typically achieved by sampling from parametric distributions. This can be challenging for survival data as these are often subject to model rules that are difficult to parameterize, such as waning of treatment effects and other long-term survival assumptions. In addition, the increasing prevalence of immature survival data in decision making, particularly for new cancer treatments, has been accompanied by the introduction of sophisticated extrapolation techniques that go beyond standard parametric models.

### Objective

- To develop general-purpose methods that simplify the EVSI data-simulation step for survival data.

## Methods

We developed a discrete sampling method and an interpolated inverse transform (ITS) sampling method for simulating survival data from a probabilistic sample of discrete survival curve probabilities. We compared the general-purpose methods with the standard parametric method using an illustrative partitioned survival model with and without adjustment for treatment effect waning.

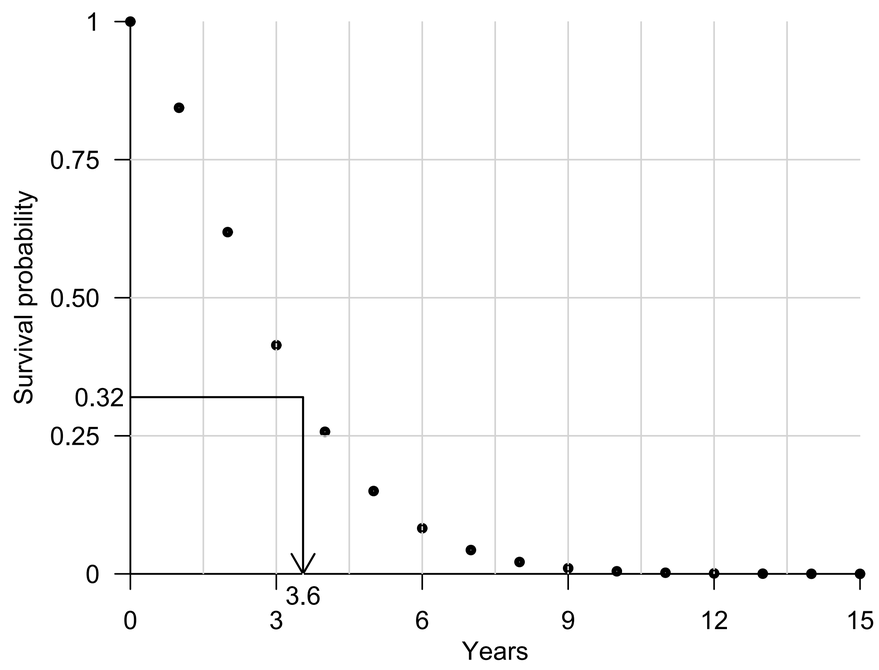



*Figure 1: Illustration of the interpolated inverse transform sampling method for simulating time-to-event data. A survival time of 3.6 years has been simulated by first sampling a value of 0.32 from a uniform distribution between 0 and 1, and then interpolating the discrete survival curve probabilities using monotone cubic splines at 0.32 and recording the interpolated cycle time of 3.6 years.*

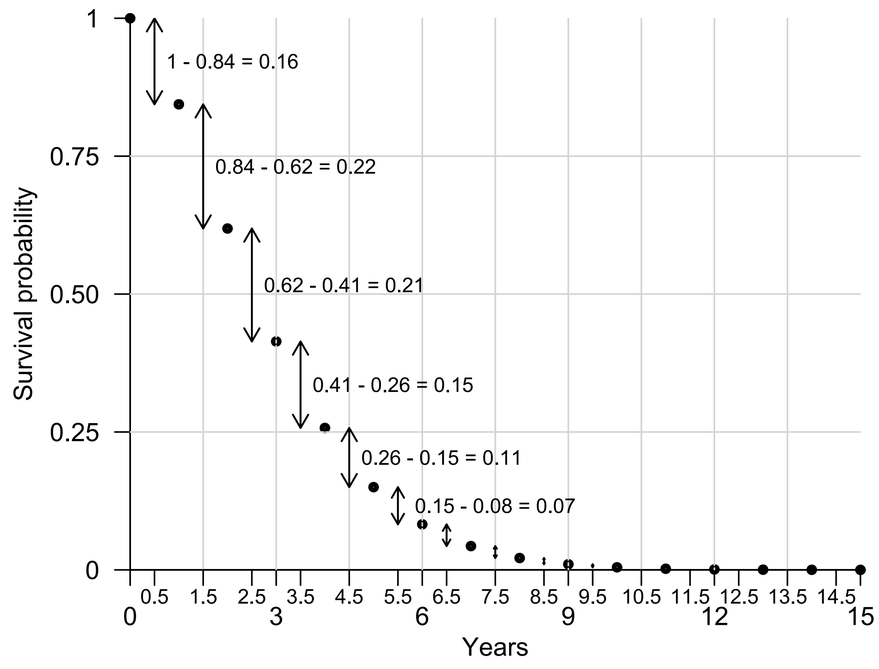



*Figure 2: Illustration of the discrete sampling method for simulating time-to-event data. Survival times can be simulated by sampling from the half-cycle times on the x-axis with probability derived from the discrete survival curve probabilities as indicated by the arrows.*

## Results

There is excellent agreement between the standard parametric, discrete sampling and interpolated ITS methods in the scenario without adjustment for treatment effect waning. The EVSI estimates for the standard parametric method are biased in the scenario with adjustment for treatment effect waning.

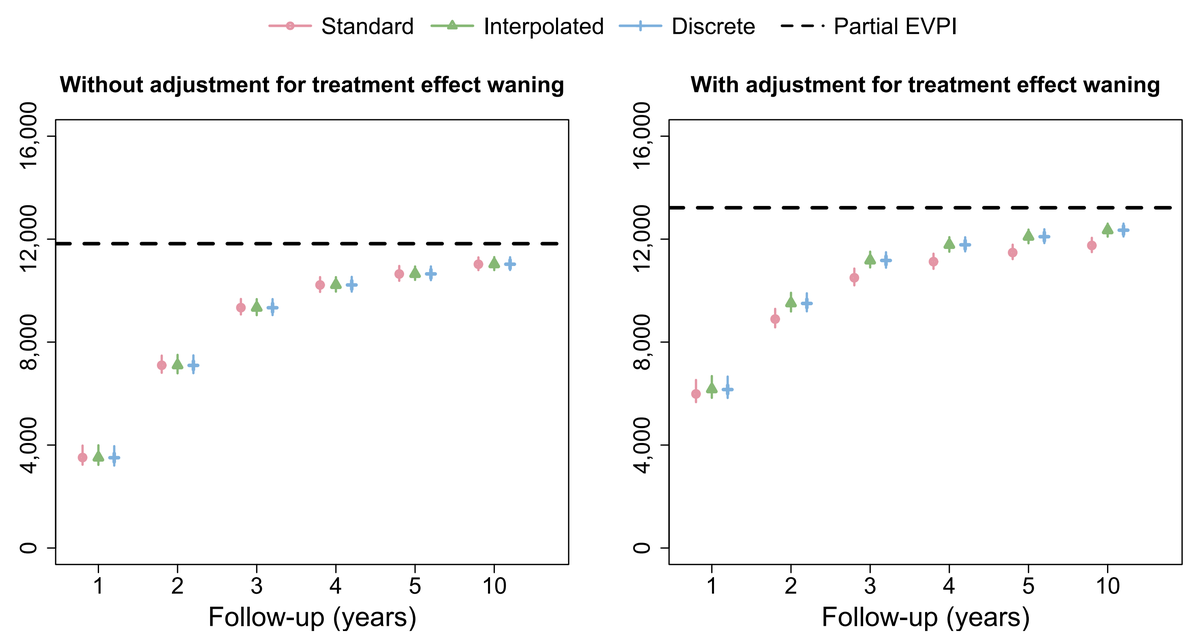



*Figure 3: EVSI values for overall survival and progression-free survival for the synthetic case study.*

## Conclusions

- Our general-purpose data-simulation methods are straightforward to implement and can easily be automated from standard probabilistic decision analyses.
- Our methods allow EVSI calculations in situations where assumptions about treatment effect waning and similar constraints are imposed on survival curves and transition probabilities.