Simfit

Tutorials and worked examples for simulation, curve fitting, statistical analysis, and plotting.
https://simfit.org.uk
https://simfit.silverfrost.com

Survival analysis attempts to develop a statistical model for situations where a group is observed from time $t = 0$ onwards until a number of the subjects in the original group no longer survive. It can be used to model numerous situations ranging from the failure of machinery by wear and tear to the death of individuals due to disease or old age.

SIMFIT provides several techniques to analyze the following types of survival data.

1. Estimates of proportions of a population surviving as a function of time are available by some technique which does not directly estimate the number surviving in a populations of known initial size, rather, proportions surviving are inferred by indirect techniques such as light scattering for bacterial density or enzyme assay for viable organisms. In such instances the estimated proportions are not binomial variables so fitting survival models directly by weighted least squares is justified, especially where destructive sampling has to be used so that autocorrelations are less problematical. Program **gcfit** is used in mode 2 for this type of fitting.

2. A population of individuals is observed and information on the times of censoring (i.e. leaving the group) or failure are recorded, but no covariates are measured. In this case, survival density functions, such as the Weibull model, can be fitted by maximum likelihood, and there are numerous statistical and graphical techniques to test for goodness of fit. Program **gcfit** is used in mode 3 for this type of fitting.

3. When there are covariates as well as survival times and censored data, then survival models can be fitted as generalized linear models. The SIMFIT GLM simplified interface module is used for this type of analysis.

4. The Cox proportional hazards model does not attempt to fit a complete model, but a partial model can be fitted by the method of partial likelihood as long as the proportional hazards assumption is justified independently. Actually, after fitting by partial likelihood, a piece-wise hazard function can be estimated and residuals can then be calculated. The SIMFIT GLM simplified interface module is also used for this type of analysis.

To summarize, in the context of survival analysis, the random survival time T with density $f(t)$, cumulative distribution function $F(t)$, survivor function $S(t)$, hazard function $h(t)$, and cumulative hazard function $H(t)$ are defined for $t \geq 0$ by

$$
\begin{aligned}
f(t) &\geq 0 \\
F(t) &= \int_0^t f(u)\,du \\
S(t) &= 1 - F(t) \\
h(t) &= f(t)/S(t) \\
H(t) &= \int_0^t h(u)\,du \\
f(t) &= h(t)\exp\{-H(t)\}.
\end{aligned}
$$

Clearly, the survivor function $S(t) = \exp\{-H(t)\}$ is the probability of surviving up to time t, which decreases monotonically from 1 to zero as t increases, while the hazard function is the probability of failure at t given survival up to this time. However, analysis is often complicated by left censoring when new individuals join the group at some $t > 0$, or right censoring when individuals leave the original group without failing. The alternative methods used to quantify the behavior of any particular group simply depend on the model assumed, while any predictions made from estimated parameters also depend on the size and homogeneity of the group under investigation in terms of covariates.