TwoTimeScales

An R-package for smoothing 2D hazards

Try the package:

Carollo et al. (2023) *Smooth hazards with multiple time scales*. arXiv:2305.09342

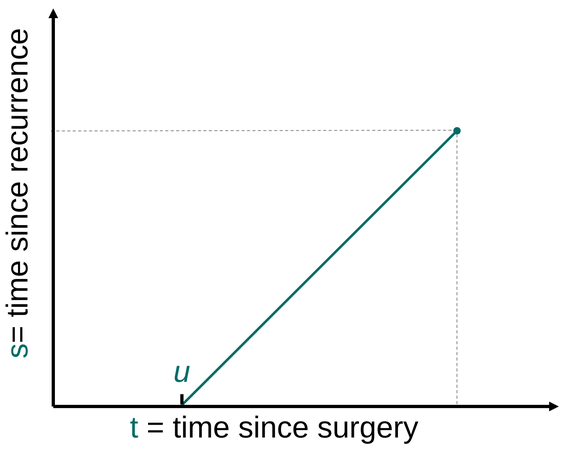
- Hazard is modelled over two time scales by bivariate *P*-splines
- Here: mortality after recurrence of colon cancer
  - *t = time since surgery*
  - *s = time since recurrence*
  - *u = time at recurrence* and *u = t – s*

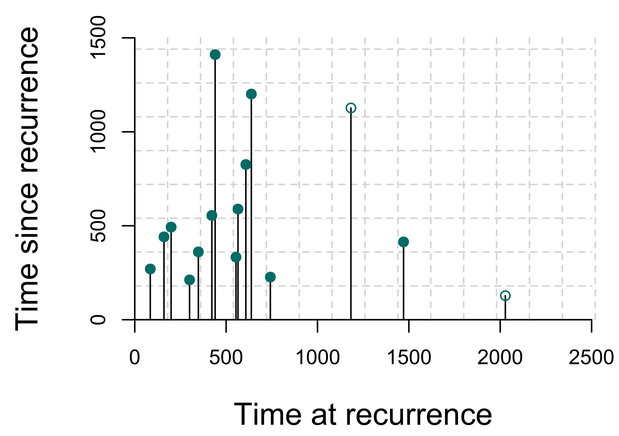
  All measured in days
- The log-hazard is expressed as a linear combination of bivariate *B*-splines
- The coefficients are restricted by roughness penalties in both directions
- The smoothing parameters are chosen by minimizing AIC or BIC

Step 1: `prepare_data()`

- Individuals move along diagonal lines in the Lexis diagram
- Trajectories mapped onto (*u*,*s*)-plane
- Exposures and events binned in small rectangles

From individual to binned data





Step 2: `fit2ts()`

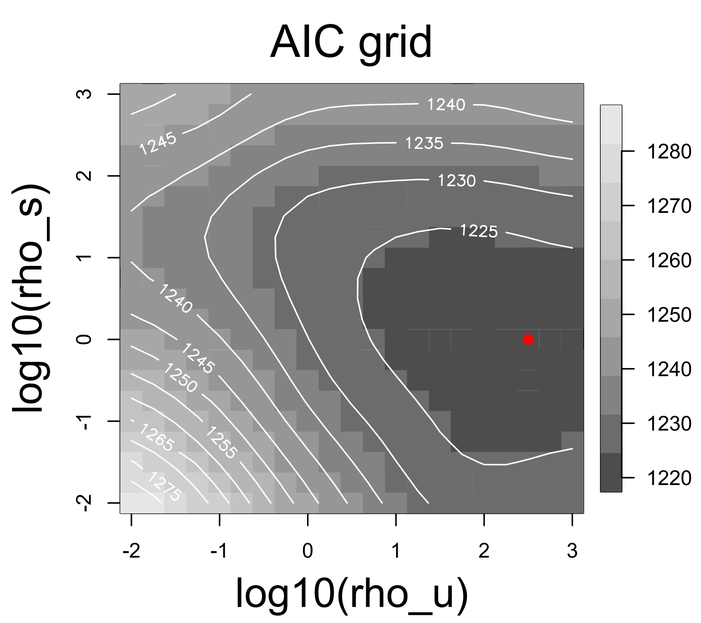
Penalized Poisson regression

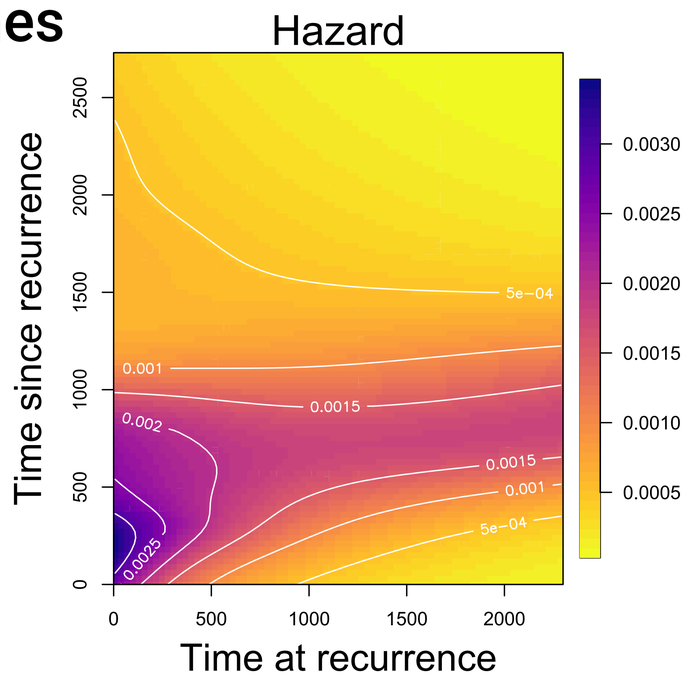
Specify:

- Marginal *B*-splines bases
- Penalty order
- Criterion for optimal smoothing parameter (AIC/BIC)

PH regression also possible

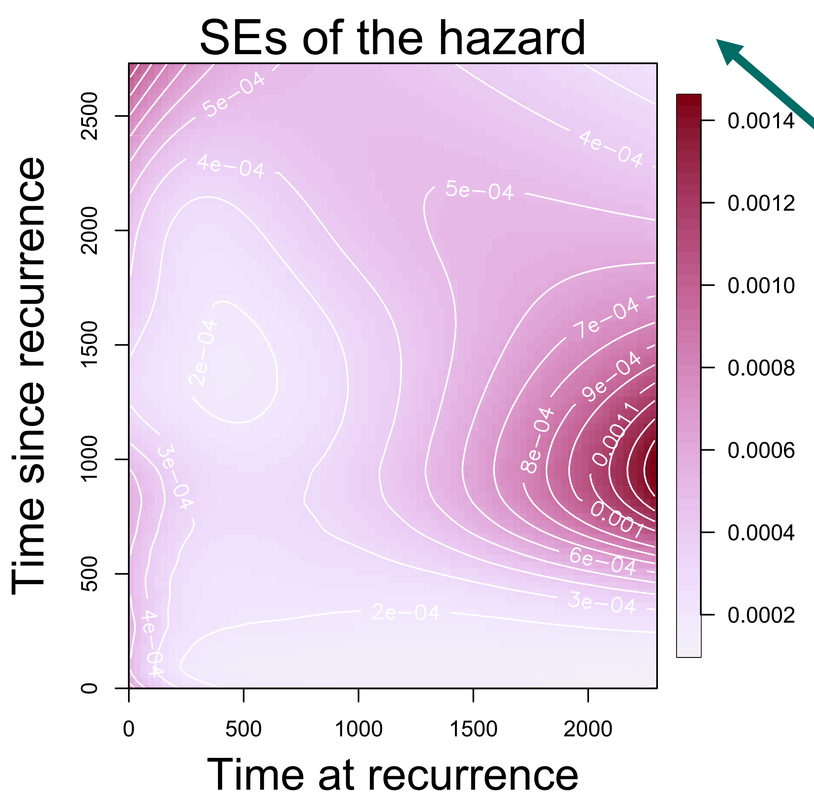
Smooth log-hazard by *P*-splines



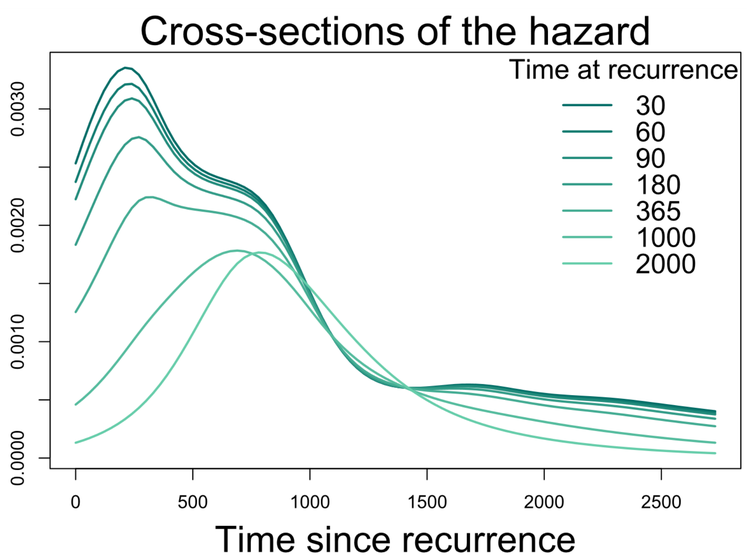


Step 3: `plot_haz2ts()`

Various plots available



- Hazard surface (see above)
- SE surface
- Cross-sections of the hazard along either time scale →
- For PH model: Covariate effects and CI (not shown)



MAX PLANCK INSTITUTE FOR DEMOGRAPHIC RESEARCH

A. Carollo, J. Gampe

Erasmus MC University Medical Center Rotterdam

P. Eilers

LUMC

H. Putter