

Problem. The data set ‘hepatoCelluar’ (in the ‘asaaur’ package) contains 17 clinical and biomarker measurements on 227 patients, as well as overall survival and time to recurrence, both recorded in months. There are three measures of CXCL17 activity, CXCL17T (intratumoral), CXCL17P (peritumoral), and CXCL17N (nontumoral). There is a particular interest in whether they are related to overall and also recurrence-free survival.

- (a) Which of the three is most strongly related for each survival outcome?
- (b) Consider the model you fitted in (a). Check the functional form using martingale residuals, and use case-deletion residuals to identify any outlying points.
- (c) Use Schoenfeld residuals to check the proportional hazard assumption.