

Online Appendix

```
// Fit PSDH FPM
do dataimport.do

// stset data with all-causes
stset survmm, failure(cause == 1, 2, 3) scale(12) id(id) exit(time 180)
stpm2cr [colrec_cancer: stage2, scale(hazard) df(5)] ///
[other_causes: stage2, scale(hazard) df(5)] ///
[heart_disease: stage2, scale(hazard) df(5)] ///
, events(cause) cause(1 2 3) cens(0) eform mlmethod(lf2) old
range _t1 `=1/12' 15 1000

// Make out-of-sample cause-specific cif predictions for each covariate pattern
predict direct_cif_loc, cif at(stage1 1 stage2 0) timevar(_t1)
predict direct_cif_reg, cif at(stage1 0 stage2 1) timevar(_t1)

// Fit PSDH FPM2
do dataimport.do

stset survmm, failure(cause == 1, 2, 3) scale(12) id(id) exit(time 180)
// Fit 3 separate models for each cause assuming proportionality, and time dependent effects
// for the competing causes.
*Cancer
stpm2cr [colrec_cancer: stage2, scale(hazard) df(5)] ///
[other_causes: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
[heart_disease: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
, events(cause) cause(1 2 3) cens(0) eform mlmethod(lf2) old
. range _t2 `=1/12' 15 1000
predict direct_cif_adj_loc, cif at(stage1 1 stage2 0) cause(1) timevar(_t2)
predict direct_cif_adj_reg, cif at(stage1 0 stage2 1) cause(1) timevar(_t2)

*Other Causes
stpm2cr [other_causes: stage2, scale(hazard) df(5)] ///
[colrec_cancer: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
```

```

[heart_disease: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
, events(cause) cause(2 1 3) cens(0) eform mlmethod(lf2) old
predict direct_cif_adj_loc, cif at(stage1 1 stage2 0) cause(2) timevar(_t2)
predict direct_cif_adj_reg, cif at(stage1 0 stage2 1) cause(2) timevar(_t2)

*Heart Disease
stpm2cr [heart_disease: stage2, scale(hazard) df(5)] ///
[colrec_cancer: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
[other_causes: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
, events(cause) cause(3 1 2) cens(0) eform mlmethod(lf2) old
predict direct_cif_adj_loc, cif at(stage1 1 stage2 0) cause(3) timevar(_t2)
predict direct_cif_adj_reg, cif at(stage1 0 stage2 1) cause(3) timevar(_t2)

// Fit Non-PSDH FPM
do dataimport.do

stset survmm, failure(cause == 1, 2, 3) scale(12) id(id) exit(time 180)

stpm2cr [colrec_cancer: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
[other_causes: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
[heart_disease: stage2, scale(hazard) df(5) tvc(stage2) dftvc(3)] ///
, events(cause) cause(1 2 3) cens(0) eform mlmethod(lf2) old

range _t3 `=1/12' 15 1000

predict directtvc_cif_loc, cif at(stage1 1 stage2 0) timevar(_t3)
predict directtvc_cif_reg, cif at(stage1 0 stage2 1) timevar(_t3)

/* Direct Model for each of the 3 causes adjusted for stage and age */
do dataimport.do

stset survmm, failure(cause == 1, 2, 3) scale(12) id(id) exit(time 180)

// Generate RCS with 3 df to allow for non-linear effects on age at diagnosis
rcsgen age, gen(rcsage) df(3) orthog

global knots `r(knots)`

matrix Rage = r(R)

// Fit the log-cumulative subdistribution hazard FPM
stpm2cr [colrec_cancer: stage2 rcsage1-rcsage3, scale(hazard) df(5) tvc(rcsage1-rcsage3 stage2) dftvc(3)] ///
[other_causes: stage2 rcsage1-rcsage3, scale(hazard) df(5) tvc(rcsage1-rcsage3 stage2) dftvc(3)] ///
[heart_disease: stage2 rcsage1-rcsage3, scale(hazard) df(5) tvc(rcsage1-rcsage3 stage2) dftvc(3)] ///
, events(cause) cause(1 2 3) cens(0) eform mlmethod(lf2) old

range _t2 `=1/12' 15 1000

// Obtain out-of-sample predictions at individual ages for patients
forvalues age = 60(10)80 {
// Generate and store splines for a particular age for use in predict
rcsgen , scalar(`age`) knots($knots) rmatrix(Rage) gen(c)

// Predict cause-specific cumulative incidence functions
predict cif_loc`age`, cif at(stage1 1 stage2 0 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) timevar(_t2)
predict cif_reg`age`, cif at(stage1 0 stage2 1 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) timevar(_t2)

// Predict subdistribution hazards
predict sdh_loc`age`, sub at(stage1 1 stage2 0 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) timevar(_t2)
predict sdh_reg`age`, sub at(stage1 0 stage2 1 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) timevar(_t2)

// Predict cause-specific hazards
predict csh_loc`age`, csh at(stage1 1 stage2 0 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) timevar(_t2)
predict csh_reg`age`, csh at(stage1 0 stage2 1 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) timevar(_t2)

// Predict subdistribution hazard ratios
predict shr_reg`age`, shrn(stage1 0 stage2 1 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) ///
shrd(stage1 1 stage2 0 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) timevar(_t2)

// Predict cause-specific hazard ratios
predict chr_reg`age`, chrn(stage1 0 stage2 1 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) ///
chr(stage1 1 stage2 0 rcsage1 `=c1` rcsage2 `=c2` rcsage3 `=c3`) timevar(_t2)
}

```