Supplementary Material

In a situation with independent censoring (Table I), the FO analysis, which is the gold standard method, targets the true values in all situations and produces the coverage rates comparable to the nominal level, 95%. The PO analysis, which does not use the information from the prognostic covariates, targets the true values and produces the coverage rates comparable to the nominal level but yields higher estimates of standard errors compared to the FO analysis. The ECS_5 method targets the true values but yields much lower estimates of standard errors (SE) compared to the empirical standard error (SD). As a result, the coverage rates are slightly off from the nominal level. The KMIB, $IPCW_5$ method and all of the $WKM_{I,J}$ methods also target the true values, give coverage rates comparable to the nominal level and yield lower estimates of standard errors compared to the PO analysis, except for the KMIB method when the working failure time model is misspecified. The KMIB method yields higher estimates of standard errors compared to the $IPCW_5$ and WKM methods, especially when the working failure time model is misspecified. The maximum possible gain of efficiency is 34% derived from the FO results based on SD at the median survival time, i.e. $S(t) = 0.5$. The $WKM_{8,1}$ method gains efficiency ranging from 5% to 8% and the IPCW method gains 5% in efficiency. This indicates that the $WKM_{I,J}$, which categorizes the two risk scores through the use of the principal component method, recovers between 15% and 24% of information lost due to censoring while estimating the marginal survival and the IPCW method recovers about 14% of the lost information. The ECS_3 method, which only incorporates the first three covariates in the PH model, also targets the true values and yields lower estimates of standard errors and the coverage rate is slightly lower than the nominal level. The $IPCW_3$ method, which only incorporates the first three covariates in the model, targets the true values and the coverage rates are comparable to the nominal level.

In a situation with dependent censoring and the link functions correctly specified (Table II),

the PO method is associated with bias, which does not decrease with sample size. In contrast, the bias for the WKM method decreases with sample size. In a situation with dependent censoring and the link functions incorrectly specified (Table III), the ECS method is associated with bias but the bias does not increase with sample size. In addition, the SE is lower than the SD. Although the ECS method is associated with bias, the MSE is slightly lower compared to the KMIB and WKM methods. The IPCW method is also associated with bias, and the bias increases with sample size. In addition, the SD is much higher than the SE. As a result, the coverage rate for the IPCW method is off from the nominal level and the MSE is much higher than the ECS, KMIB and WKM methods. For the WKM method, we observe similar results to a situation with dependent censoring and the link functions correctly specified, except the magnitude of the bias is slightly larger. The bias decreases with sample size. This indicates that the WKM method could produce reasonable survival estimates even if the link functions for the working models are incorrectly specified. For the KMIB method, we observe similar results to Table IV in which the magnitude of bias for the KMIB method is slightly higher than for the WKM method. The bias does not decrease with sample size. The KMIB and WKM methods produce similar MSE.

Table I. Monte Carlo results for five time-independent covariates with independent censoring (censoring rate=40%) and the link functions correctly specified. n=200. Spearman's $\rho = 0.00$

	True Value: 0.5				True Value: 0.35			
Method	Est[a]	SD[b]	SE[c]	CR[d]	Est	SD	SE	CR
FO	0.500	0.0350	0.0353	94.7	0.350	0.0338	0.0336	94.1
PO	0.499	0.0430	0.0430	93.7	0.349	0.0425	0.0425	94.5
ECS_3	0.499	0.0431	0.0380	91.9	0.350	0.0418	0.0370	90.3
ECS_5	0.504	0.0425	0.0320	86.4	0.353	0.0412	0.0310	85.5
$IPCW_3$	0.499	0.0414	0.0417	94.5	0.350	0.0428	0.0408	93.9
$IPCW_5$	0.500	0.0420	0.0406	94.6	0.351	0.0416	0.0396	94.3
Both working PH models correctly specified								
KMIB	0.500	0.0425	0.0412	93.3	0.351	0.0407	0.0404	94.1
$WKM_{4,1}$	0.500	0.0410	0.0409	94.3	0.350	0.0402	0.0400	94.4
$WKM_{4,2}$	0.500	0.0412	0.0409	93.9	0.351	0.0405	0.0401	94.6
$WKM_{4,4}$	0.500	0.0413	0.0407	94.5	0.353	0.0408	0.0398	94.4
$WKM_{8,1}$	0.500	0.0413	0.0407	94.4	0.350	0.0404	0.0398	94.8
$WKM_{8,2}$	0.501	0.0416	0.0405	93.6	0.353	0.0413	0.0396	94.3
$WKM_{16,1}$	0.500	0.0418	0.0405	93.8	0.352	0.0412	0.0395	93.8
Only working failure PH model mis-specified								
KMIB	0.500	0.0432	0.0422	94.5	0.351	0.0414	0.0418	94.9
$WKM_{4,1}$	0.499	0.0418	0.0421	94.3	0.349	0.0411	0.0414	94.7
$WKM_{4,2}$	0.500	0.0411	0.0420	94.7	0.350	0.0408	0.0412	94.5
$WKM_{4,4}$	0.500	0.0416	0.0416	93.9	0.351	0.0416	0.0407	93.6
$WKM_{8,1}$	0.499	0.0419	0.0420	94.4	0.350	0.0413	0.0413	94.2
$WKM_{8,2}$	0.500	0.0417	0.0415	93.9	0.352	0.0411	0.0407	93.9
$WKM_{16,1}$	0.500	0.0428	0.0417	93.5	0.351	0.0423	0.0408	93.4
Only working censoring PH model mis-specified								
KMIB	0.500	0.0427	0.0412	93.3	0.351	0.0406	0.0406	94.1
$WKM_{4,1}$	0.499	0.0409	0.0409	94.4	0.350	0.0402	0.0400	94.5
$WKM_{4,2}$	0.500	0.0412	0.0409	94.2	0.350	0.0405	0.0400	94.0
$WKM_{4,4}$	0.500	0.0415	0.0407	94.0	0.352	0.0412	0.0397	93.5
$WKM_{8,1}$	0.500	0.0412	0.0407	94.0	0.350	0.0405	0.0398	94.6
$WKM_{8,2}$	0.500	0.0415	0.0405	93.7	0.352	0.0411	0.0396	93.8
$WKM_{16,1}$	0.500	0.0419	0.0405	93.6	0.352	0.0414	0.0395	94.1

[a]Average of 1000 point estimates.

[b]Empirical standard deviation.

[c]Average estimated standard error.

[d]Coverage rate of 1000 95% confidence intervals.

Table II. Monte Carlo results for five time-independent covariates with dependent censoring (censoring rate=35%) and the link functions correctly specified: the effects of sample size on survival estimates when only the working failure time model is mis-specified. Spearman's $\rho = 0.48$

		True Value: 0.5				True Value: 0.35			
Method	N	Est	SD	SE	CR	Est	SD	SE	CR
FO	200	0.501	0.0352	0.0353	94.6	0.350	0.0343	0.0336	94.0
PO	200	0.568	0.0383	0.0394	58.6	0.426	0.0404	0.0411	53.7
$WKM_{8,1}$	200	0.511	0.0420	0.0401	92.6	0.366	0.0419	0.0391	93.1
FO	400	0.500	0.0244	0.0250	94.9	0.350	0.0242	0.0238	95.1
PO	400	0.567	0.0272	0.0279	32.4	0.427	0.0294	0.0291	25.5
$WKM_{8,1}$	400	0.507	0.0291	0.0288	94.0	0.362	0.0293	0.0280	91.8
FO	800	0.500	0.0176	0.0177	94.6	0.350	0.0171	0.0169	94.1
PO	800	0.567	0.0199	0.0198	7.3	0.426	0.0206	0.0206	3.5
$WKM_{8,1}$	800	0.506	0.0208	0.0205	93.4	0.357	0.0204	0.0199	93.3
FO	2000	0.500	0.0113	0.0112	95.2	0.350	0.0103	0.0107	95.6
PO	2000	0.567	0.0125	0.0125	0.0	0.426	0.0127	0.0130	0.0
$WKM_{8,1}$	2000	0.505	0.0132	0.0131	93.0	0.355	0.0126	0.0126	93.5

Table III. Monte Carlo results for five time-independent covariates with dependent censoring (censoring rate: 51%) and the link functions incorrectly specified as PH when true model is AFT. Spearman's $\rho = 0.59$

	True Value: 0.5					True Value: 0.35				
Method	Est	SD	MSE[a]	SE	CR	Est	SD	MSE	SE	CR
N=200										
FO	0.500	0.0343	0.0012	0.0353	94.5	0.350	0.0335	0.0011	0.0336	94.8
PO	0.605	0.0389	0.0125	0.0404	27.3	0.472	0.0437	0.0168	0.0447	22.0
Only mis-specified link functions										
ECS_5	0.487	0.0412	0.0019	0.0330	85.2	0.337	0.0409	0.0018	0.0320	84.6
$IPCW_5$	0.489	0.0789	0.0063	0.0443	79.6	0.334	0.0842	0.0073	0.0426	72.2
KMIB	0.522	0.0430	0.0023	0.0440	92.8	0.377	0.0455	0.0028	0.0448	91.5
$WKM_{4,1}$	0.514	0.0463	0.0023	0.0441	91.7	0.374	0.0492	0.0030	0.0445	90.1
$WKM_{4,2}$	0.525	0.0454	0.0027	0.0428	88.8	0.391	0.0487	0.0041	0.0432	82.3
$WKM_{4,4}$	0.538	0.0452	0.0035	0.0408	82.8	0.412	0.0480	0.0061	0.0413	64.6
$WKM_{8,1}$	0.519	0.0462	0.0025	0.0425	90.7	0.383	0.0493	0.0035	0.0429	84.8
$WKM_{8,2}$	0.535	0.0451	0.0033	0.0409	82.9	0.408	0.0489	0.0058	0.0412	68.8
$WKM_{16,1}$	0.532	0.0454	0.0031	0.0408	84.2	0.405	0.0486	0.0054	0.0411	72.1
N=400										
FO	0.501	0.0247	0.0006	0.0250	95.7	0.350	0.0240	0.0006	0.0238	95.7
PO	0.604	0.0277	0.0116	0.0286	3.5	0.471	0.0312	0.0156	0.0316	3.3
Only mis-specified link functions										
ECS_5	0.486	0.0303	0.0011	0.0230	84.2	0.334	0.0287	0.0011	0.0230	81.4
$IPCW_5$	0.479	0.0827	0.0073	0.0351	76.3	0.317	0.0823	0.0079	0.0340	66.8
KMIB	0.523	0.0329	0.0016	0.0314	86.6	0.378	0.0334	0.0019	0.0320	84.1
$WKM_{4,1}$	0.511	0.0344	0.0013	0.0320	91.2	0.366	0.0361	0.0016	0.0322	88.4
$WKM_{4,2}$	0.516	0.0342	0.0014	0.0312	90.2	0.375	0.0363	0.0019	0.0316	84.3
$WKM_{4,4}$	0.524	0.0335	0.0017	0.0302	85.3	0.390	0.0357	0.0029	0.0306	73.4
$WKM_{8,1}$	0.511	0.0338	0.0013	0.0312	91.4	0.369	0.0357	0.0016	0.0315	88.0
$WKM_{8,2}$	0.520	0.0337	0.0015	0.0303	86.5	0.385	0.0357	0.0025	0.0306	76.3
$WKM_{16,1}$	0.518	0.0331	0.0014	0.0302	88.4	0.383	0.0348	0.0023	0.0305	79.2

[a]Mean square error: $\text{bias}^2+\text{SD}^2$.