Assignment 3 for Survival Analysis

Course STAT229

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Date 4/06/2017

1.

(a)

```
                                                LR chi2(1)      =        7.59
Log likelihood  =   -1223.7851                  Prob > chi2     =      0.0059
```

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	1.464118	.2014392	2.77	0.006	1.118058	1.91729

_t	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	.3812532	.137584	2.77	0.006	.1115935	.6509128

Figure 1.1 The hazard model with the coefficient of gender

The hazard model containing gender is shown above and the βgender=0.3813, the 95% confident interval is (0.1116, 0.6509). The hazard ratio of gender is 1.4641 and 95% confident interval is (1.1181, 1.9173).

For gender "1" is female, which means: in this model, the rate of heart attack among female is 46.41% higher than male, and this could be from 11.80% to 91.73% higher with 95% confidence.

(b)

_t	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	.3812532	.137584	2.77	0.006	.1115935	.6509128

_t	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	.2188656	.1414031	1.55	0.122	-.0582795	.4960106
bmi	-.0928799	.0149069	-6.23	0.000	-.1220968	-.063663

_t	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	-.8033496	.7650499	-1.05	0.294	-2.30282	.6961205
bmi	-.1170119	.0234591	-4.99	0.000	-.1629908	-.071033
genderxbmi	.0410099	.0301929	1.36	0.174	-.0181671	.1001869

Figure 1.2 The hazard model with the coefficient of gender, bmi and their interaction

```
. di (.3812532-.2188656)/(.2188656)*100
74.195122
```

From fig 1.2 we have the change of gender; the change is 74.20%. It is larger than 20%. We consider that the BMI is a confounder of gender.

(c)

The adjusted hazard model with gender and bmi is shown in the figure 1.2 The hazard ratio of gender is 1.4641 and 95% confident interval is (1.1181, 1.9173).

(d)

According to the figure 1.2, the WALD test shows the p-value of the interaction is 0.174, which is larger than 0.10. We consider that the interaction is not significant.

(f)

Consider the effect of modifier, from the figure 1.2 we know that the interaction change the coefficient of gender is large (from part (b)), the results for interaction model show that the p-value for Wald test is not significant, p=0.174 (in 90% significance).

(g)

Gender	BMI	Hazard Ratio	95% CI
Male	20	.0963047	.0383955 .2415546
Female	20	.0449332	.0048181 .4190396
Male	25	.0536487	.0169961 .1693437
Female	25	.0669775	.0201469 .2226635
Male	30	.0298862	.0075235 .1187197
Female	30	.0458029	.013503 .1553653

Table 2 Hazard ratio estimation for 1(g)

2.

(a)

Log likelihood =	-1128.987	LR chi2(8) =	197.18
		Prob > chi2 =	0.0000

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	9.291733	9.186587	2.25	0.024	1.33822	64.51579
age	1.074137	.009176	8.37	0.000	1.056302	1.092273
miord	1.072418	.1660183	0.45	0.652	.7917565	1.452568
mitype	.7912096	.1623408	-1.14	0.254	.5292265	1.182882
genderxage	.9696224	.0120855	-2.47	0.013	.9462221	.9936013
mitypexmiord	1.249924	.5068383	0.55	0.582	.5645799	2.767208
hr	1.008324	.0029103	2.87	0.004	1.002636	1.014044
chf	2.187101	.3192416	5.36	0.000	1.642944	2.911488

Figure 2.1 the proportional hazards model with eight variables

and the risk score is:

R = 2.229 * Gender + 0.072 * Age + 0.070 * Miord – 0.234 * Mitype – 0.31 * Gender * Age + 0.223 * Mitype * Miord + 0.008 * Hr + 0.783 * Chf

From the hazards model we know that miord, mitype, mitype* miord are not significant.

Thus, we have to eliminate these variables. Then we have the new model as figure 2.2:

Log likelihood =	-1130.1462	LR chi2(5) =	194.87
		Prob > chi2 =	0.0000

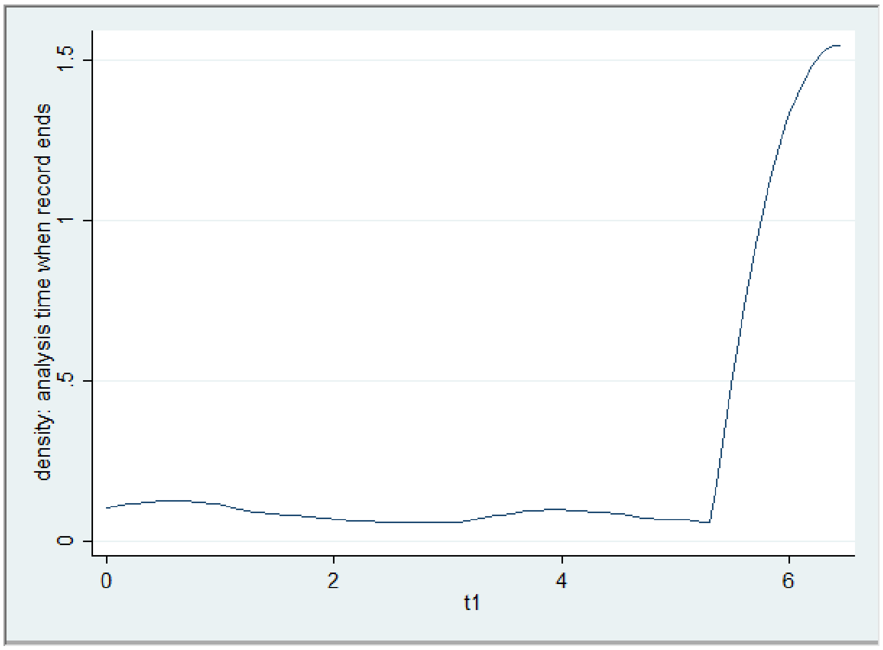
_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	9.758308	9.537314	2.33	0.020	1.436977	66.26727
age	1.076442	.0089161	8.89	0.000	1.059108	1.09406
genderxage	.9690341	.0119631	-2.55	0.011	.9458682	.9927674
hr	1.008903	.0028706	3.12	0.002	1.003292	1.014545
chf	2.173622	.3163306	5.33	0.000	1.634208	2.891084

_t	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
gender	2.278119	.9773532	2.33	0.020	.3625419	4.193696
age	.0736609	.0082829	8.89	0.000	.0574267	.0898952
genderxage	-.0314555	.0123454	-2.55	0.011	-.0556521	-.0072589
hr	.0088634	.0028453	3.12	0.002	.0032868	.01444
chf	.7763947	.1455316	5.33	0.000	.491158	1.061631

Figure 2.2 the proportional hazards model with five variables

And the Risk score is:

$$R = 2.278 * Gender + 0.0737 * Age - 0.315 * Gender * Age + 0.009 * Hr + 0.776 * Chf$$



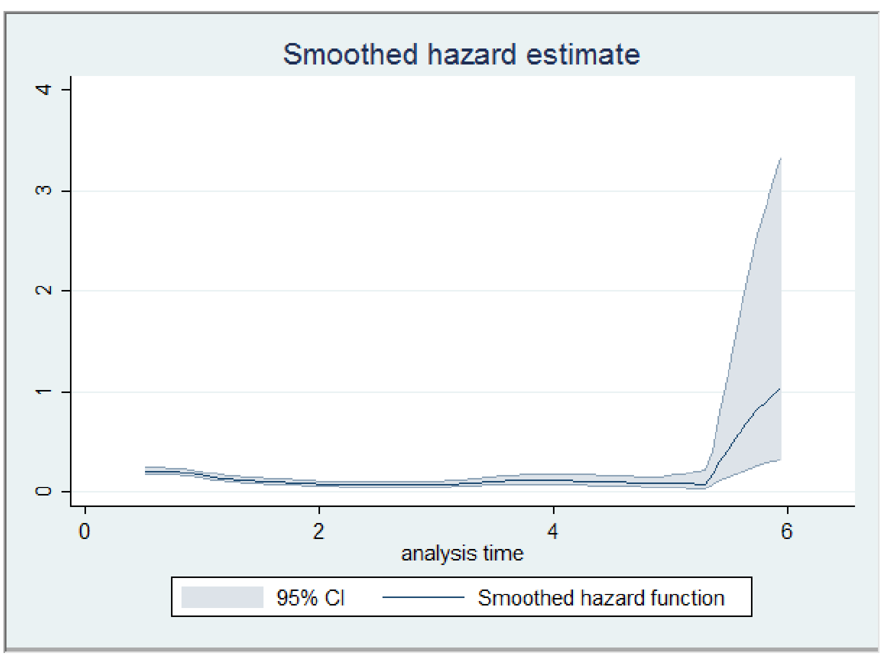


Figure 2.3 Baseline survival function estimate

The baseline survival function is shown above.

Let’s substitute age=65, hr=85 into the risk score function:

R = 2.278 * Gender + 0.0737 * Age – 0.315 * Gender * Age + 0.009 * Hr + 0.776 * Chf

For chf = 0, the risk score for male is 5.541, for female is 5.775;

For chf = 1, the risk score for male is 6.318, for female is 6.551.

(b)

Then we focus on two levels of CHF:

_t	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
chf	**1.198303**	**.1380289**	**8.68**	**0.000**	**.9277713**	**1.468835**

Thus, we will have the covariate adjusted survival functions:

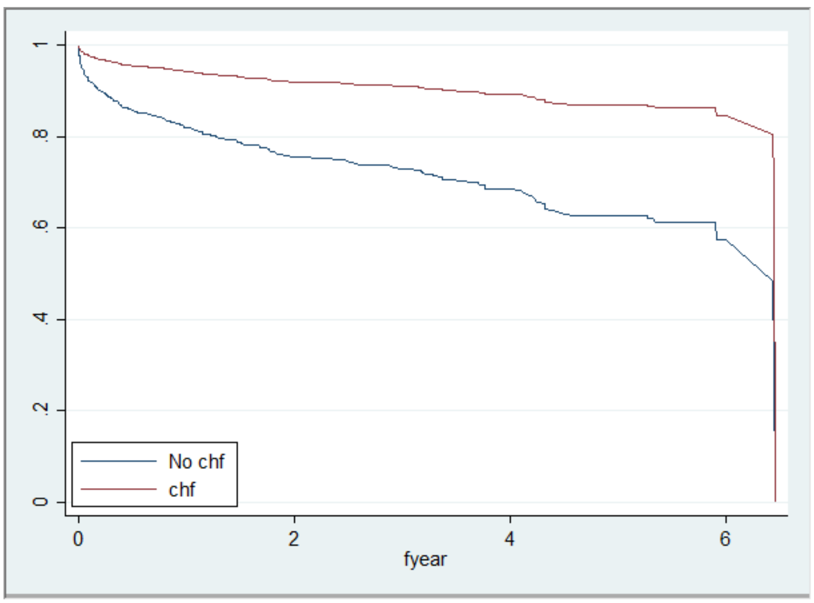


Figure 2.4 Covariate adjusted survival functions at two levels of CHF

Appendix

1.

(a)

gen fyear= lenfol/365.25

stset fyear, fail(fstat)

stcox gender

(b)

di (.3812532-.2188656)/(.2188656)*100

gen genderxbmi=gender*bmi

(g)

```
. lincom _b[gender]*0+_b[bmi]*20+_b[genderxbmi]*0, hr

 ( 1)  20*bmi = 0
```

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
(1)	.0963047	.0451844	-4.99	0.000	.0383955	.2415546

```
. lincom _b[gender]*1+_b[bmi]*20+_b[genderxbmi]*1, hr

 ( 1)  gender + 20*bmi + genderxbmi = 0
```

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf. Interval]	
(1)	.0449332	.0511879	-2.72	0.006	.0048181	.4190396

```
. lincom _b[gender]*1+_b[bmi]*25+_b[genderxbmi]*25, hr

 ( 1)  gender + 25*bmi + 25*genderxbmi = 0
```

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
(1)	.0669775	.041052	-4.41	0.000	.0201469	.2226635

```
. lincom _b[gender]*0+_b[bmi]*25+_b[genderxbmi]*0, hr

 ( 1)  25*bmi = 0
```

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
(1)	.0536487	.0314637	-4.99	0.000	.0169961	.1693437

```
. lincom _b[gender]*0+_b[bmi]*30+_b[genderxbmi]*0, hr

 ( 1)  30*bmi = 0
```

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
(1)	.0298862	.0210331	-4.99	0.000	.0075235	.1187197

```
. lincom _b[gender]*1+_b[bmi]*30+_b[genderxbmi]*30, hr

 ( 1)  gender + 30*bmi + 30*genderxbmi = 0
```

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
(1)	.0458029	.0285439	-4.95	0.000	.013503	.1553653

2.

gen genderxage=gender*age

gen mitypexmiord= mitype* miord

stset fyear, fail(fstat)

stcox gender age miord mitype genderxage mitypexmiord hr chf

predict hc0, basehc

```
replace age=65
replace hr=85
predict double xb, xb
gen double hcmean = (1-(1-hc0)^exp(xb))
drop if hc0==.
sort _t
by _t: keep if _n==1
summ _t, meanonly
local tmin = r(min)
local tmax = r(max)
local N = _N
local N1 = `N' + 1
local obs = `N'+101
set obs `obs'
gen t0 = `tmin' + (`tmax'-`tmin')*(_n-`N1')/100 in `N1'/l
gen t1= t0
kdensity _t [iweight=hcmean] if _d, at(t1) generate(hmean) nograph
twoway line hmean t1
```

(b)

```
gen genderxage=gender*age
stcox chf, nohr basesurv(hw1)
gen hw1_c0= hw1^(exp(-1.198))
sort fyear
twoway line hw1 hw1_c0 fyear, legend(row(2) col(1) pos(7) order(1 "No chf"  2 "chf")
ring(0) size(medsmall))  ylabel(0(0.2)1)
```