

Name Jenny

Student Number _____

STA 312 s2019 Quiz 8

1. (3 points) Consider a Weibull regression model with *exactly two* explanatory variables. If x_1 is increased by one unit, the hazard function at time t is multiplied by _____. That's the *hazard* function. Show your work, starting with a convenient expression on the formula sheet. You have more room than you need. **Circle your answer.**

$$\frac{\frac{1}{\sigma} e^{-\frac{1}{\sigma}(\beta_0 + \beta_1(x_1+1) + \beta_2 x_2)} t^{\frac{1}{\sigma}-1}}{\frac{1}{\sigma} e^{-\frac{1}{\sigma}(\beta_0 + \beta_1 x_1 + \beta_2 x_2)} t^{\frac{1}{\sigma}-1}} = e^{-\beta_1/\sigma}$$

No marks if wrong sign or missing σ

2. (4 points) Still for the Weibull regression model with ~~two~~ ^{a single} explanatory variables, you want to produce a large-sample confidence interval for median failure time. You need to use the delta method.

(a) What is the parameter vector θ ?

$$\theta = (\beta_0, \beta_1, \sigma)$$

(b) What is $\dot{g}(\theta)$? Show your work. The answer will depend on x_1 and x_2 . You may use $\frac{d}{da} a^c = a^c \log(a)$ without proof. **Circle your final answer.**

$$g(\theta) = e^{\beta_0 + \beta_1 x_1} \cdot \log(2)^\sigma$$

$$\dot{g}(\theta) = (e^{\beta_0 + \beta_1 x_1} \log(2)^\sigma, x_1 e^{\beta_0 + \beta_1 x_1} \log(2)^\sigma, e^{\beta_0 + \beta_1 x_1} \log(2)^\sigma \log(\log(2)))$$

3. (3 points) In your analysis of the cancer data, you fit a Weibull regression model with just sex and physician's ECOG rating. You produced an estimate of median survival time for female patients with an ecog rating of 1, together with a 95% confidence interval. Write the following in the spaces provided.

(a) Estimated median survival time.

402.8872

(b) Lower 95% confidence limit.

323.2567

(c) Upper 95% confidence limit.

482.5177

On your printout, circle the three numbers and write "Question 3" beside them.

Please attach your printout. Make sure your name is on it.

R version 3.3.3 (2017-03-06) -- "Another Canoe"
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```
> rm(list=ls()); options(scipen=999)
> # install.packages("survival",dependencies=TRUE) # Only need to do this once
> library(survival) # Do this every time
> # help(cancer)
> attach(cancer)
> summary(cancer)
```

inst	time	status	age	sex
Min. : 1.00	Min. : 5.0	Min. :1.000	Min. :39.00	Min. :1.000
1st Qu.: 3.00	1st Qu.: 166.8	1st Qu.:1.000	1st Qu.:56.00	1st Qu.:1.000
Median :11.00	Median : 255.5	Median :2.000	Median :63.00	Median :1.000
Mean :11.09	Mean : 305.2	Mean :1.724	Mean :62.45	Mean :1.395
3rd Qu.:16.00	3rd Qu.: 396.5	3rd Qu.:2.000	3rd Qu.:69.00	3rd Qu.:2.000
Max. :33.00	Max. :1022.0	Max. :2.000	Max. :82.00	Max. :2.000
NA's :1				

ph.ecog	ph.karno	pat.karno	meal.cal	wt.loss
Min. :0.0000	Min. : 50.00	Min. : 30.00	Min. : 96.0	Min. : -24.000
1st Qu.:0.0000	1st Qu.: 75.00	1st Qu.: 70.00	1st Qu.: 635.0	1st Qu.: 0.000
Median :1.0000	Median : 80.00	Median : 80.00	Median : 975.0	Median : 7.000
Mean :0.9515	Mean : 81.94	Mean : 79.96	Mean : 928.8	Mean : 9.832
3rd Qu.:1.0000	3rd Qu.: 90.00	3rd Qu.: 90.00	3rd Qu.:1150.0	3rd Qu.: 15.750
Max. :3.0000	Max. :100.00	Max. :100.00	Max. :2600.0	Max. : 68.000
NA's :1	NA's :1	NA's :3	NA's :47	NA's :14

```
>
>
> cor(cancer[,2:10],use='pairwise.complete.obs')
```

	time	status	age	sex	ph.ecog	ph.karno
time	1.0000000000	-0.17118329	-0.07804271	0.12961477	-0.20081279	0.13308204
status	-0.171183287	1.00000000	0.14970210	-0.24343282	0.23276393	-0.18226030
age	-0.078042710	0.14970210	1.00000000	-0.12216709	0.19323604	-0.20318207
sex	0.129614767	-0.24343282	-0.12216709	1.00000000	-0.02060379	0.01138505
ph.ecog	-0.200812793	0.23276393	0.19323604	-0.02060379	1.00000000	-0.80726666
ph.karno	0.133082044	-0.18226030	-0.20318207	0.01138505	-0.80726666	1.00000000
pat.karno	0.184323408	-0.17150422	-0.12616688	0.04607145	-0.51122086	0.52029737

[illegible]

	Value	Std. Error	z	p
(Intercept)	6.221	0.1096	56.74	0.000000000
sex	0.401	0.1237	3.24	0.001177501
ph.ecog	-0.356	0.0826	-4.31	0.000016512
Log(scale)	-0.313	0.0613	-5.11	0.000000326

Scale= 0.731

Weibull distribution

Loglik(model)= -1133.1 Loglik(intercept only)= -1147.4

Chisq= 28.73 on 2 degrees of freedom, p= 0.00000058

Number of Newton-Raphson Iterations: 5

n=227 (1 observation deleted due to missingness)

```
>
> patient = data.frame(sex=1,ph.ecog=1)
> predlist = predict(model3,newdata=patient,type='quantile',p=0.5,se=TRUE)
> predlist
$fit
```

1
402.8872

\$se.fit

1
40.62783

Question 3

```
> mhat = predlist$fit; se = predlist$se
> L = mhat - 1.96*se; U = mhat+1.96*se
> c(L,U)
```

1 1
323.2567 482.5177