Math 473 Exam 3 Spring 2021 Name_____

	Without	With	Reduced Model
Criterion	Covariates	Covariates	
-2 LOG L	372.483	362.819	

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	9.6645	3	0.0216

Parameter Variable	DF	Estimate	Standard Error	Chi-Square	Pr > ChiSq
treat	1	-0.51757	0.31576	2.6868	0.1012
init	1	0.23605	0.07607	9.6287	0.0019
size	1	0.06790	0.10125	0.4498	0.5024

	Without	With	Full Model
Criterion	Covariates	Covariates	
-2 LOG L	372.483	361.946	

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	10.5372	6	0.1038

Parameter Variable	DF	Estimate	Standard Error	Chi-Square	Pr > ChiSq
treat	1	-0.05019	0.62245	0.0065	0.9357
init	1	0.24563	0.14600	2.8304	0.0925
size	1	0.08920	0.20394	0.1913	0.6618
treatlt	1	-0.26254	0.30704	0.7311	0.3925
initlt	1	-0.00742	0.07958	0.0087	0.9257
sizelt	1	-0.00973	0.10392	0.0088	0.9254

1) The bladder cancer data is from Collett (2003, p. 364). The PH model is the reduced model and has predictors *treat* (placebo = 1, thiotepa = 2), *init* (initial number of tumours) and *size* (diameter of largest initial tumour in cm). The GCR model is the full model and adds *treatlt* = treat*log(time), *initlt* = init*log(time) and *sizelt* = size*log(time) interactions to test whether the PH assumption is reasonable. A death time of 0 was changed to 0.001.

a) Test whether the reduced model is good.

b) Is the PH assumption reasonable?

```
              Value Std. Error      z        p
(Intercept) 15.1449    16.0795  0.942 3.46e-01
age         -0.1291     0.2186 -0.590 5.55e-01
quant       -0.0455     0.0583 -0.782 4.34e-01
Log(scale)   1.7179     0.3103  5.536 3.10e-08

Scale= 5.57   n =20
Loglik(model)= -28.9   Loglik(intercept only)= -29.5
        Chisq= 1.1 on 2 degrees of freedom, p= 0.58
```

2) The *R* data set Tobin Data uses a lognormal AFT. (Handled like a WPH or Weibull AFT except use "lognormal AFT" instead of WPH in the appropriate conclusion.) The predictors are *age*, and *quant*.

a) Test $\boldsymbol{\beta} = 0$.

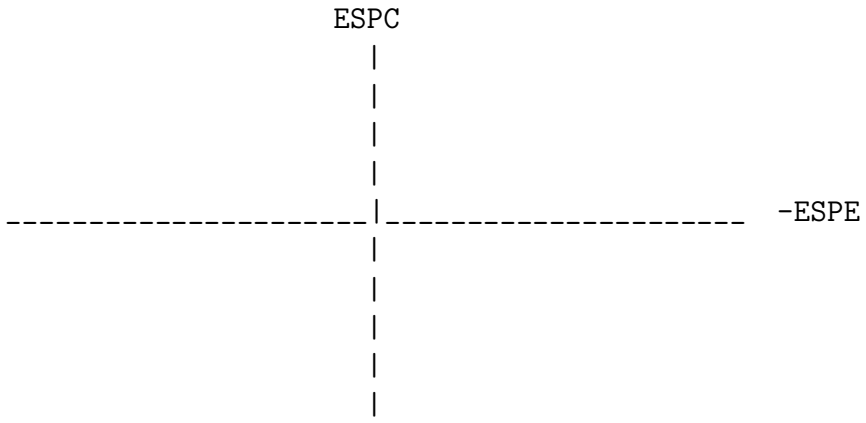
b) Test $\beta_2 = 0$.

c) Find the ESP $= \hat{\boldsymbol{\beta}}^T \boldsymbol{x}$ if $x_1 = age = 50$ and $x_2 = quant = 270$.

3) Does the `cox.zph` function output below suggest that the proportional hazards assumption is reasonable?

```
out <- coxph(Surv(X2,X3)~X4+X5+X6,data=blad)
cox.zph(out)
           rho   chisq     p
X4     -0.1234 0.72870 0.393
X5      0.0136 0.00824 0.928
X6     -0.0278 0.04551 0.831
GLOBAL      NA 0.81479 0.846
```

4) Sketch the EE plot for an exponential PH regression if this model is bad and a Weibull PH model should be used instead.



5) Leemis (1995, p. 190, 205-6) gives data on $n = 21$ leukemia patients taking the drug 6-MP. Suppose that the remission times given below follow an exponential (λ) distribution.

6, 6, 6, 6+, 7, 9+, 10, 10+, 11+, 13, 16, 17+,
19+, 20+, 22, 23, 25+, 32+, 32+, 34+, 35+

a) Find $\hat{\lambda}$.

b) Find a 95% CI for λ.

6) The data below is a sorted iid sample from an EXP(0.5) distribution where $n = 100$. Find shorth(97).

number	1	2	3	4	...	97	98	99	100
value	0.03	0.06	0.07	0.08	...	6.10	6.29	9.56	12.86

```
               Without           With
Criterion      Covariates     Covariates
-2 LOG L        1338.624       1291.465

Test              Chi-Square       DF     Pr > ChiSq
Likelihood Ratio   47.1590         8         <.0001

Parameter                Standard
Variable   DF Estimate   Error    Chi-Square Pr > ChiSq
fin         1  -0.35129  0.19181   3.3541        0.0670
age         1  -0.04977  0.02189   5.1697        0.0230
race        1   0.32149  0.30912   1.0816        0.2983
wexp        1  -0.04765  0.21323   0.0499        0.8232
mar         1  -0.34477  0.38322   0.8094        0.3683
paro        1  -0.04709  0.19630   0.0576        0.8104
prio        1   0.09201  0.02880   10.2085       0.0014
employed    1  -0.78689  0.21808   13.0195       0.0003
```

7) The recid data is from Allison (1995, p. 145). The response variable Y is time in weeks until arrest. The first 7 predictors are fixed but the time dependent variable $x_8(t) = employed = 1$ if the subject was employed in the week previous to t and is 0, otherwise.

a) Test whether $\boldsymbol{\beta} = \mathbf{0}$.

b) Test whether $\beta_1 = 0$.

c) Test whether $\beta_8 = 0$.