Test

Answer the following true or false questions (circle T or F).

T F 1. The accelerated failure time model and proportional hazards model are both additive models.

T F 2. If the survival function is known then the hazard function can be ascertained (and vice versa).

T F 3. If survival time follows a Weibull distribution then a plot of the ln[−ln S(t)] against ln(t) should be a straight line.

T F 4. If the acceleration failure time (AFT) assumption holds in a log-logistic model then the proportional hazards assumption also holds.

T F 5. If the acceleration factor for the effect of an exposure (exposed vs. unexposed) is greater than one, then the exposure is harmful to survival.

T F 6. Let $S_0(t)$ be the survival function for unexposed subjects ($E = 0$) and let $S_1(t)$ be the survival function for exposed subjects ($E = 1$). If γ is the acceleration factor comparing $E = 1$ vs. $E = 0$ then $S_0(t) = S_1(\gamma t)$.

T F 7. Frailty models are designed to provide an approach to account for unobserved individual-level characteristics.

T F 8. If you include a gamma distributed frailty component to the model, then you will see an additional parameter estimate for the variance of the frailty in the model output.

T F 9. If survival time T follows a Weibull distribution, then ln(T) also follows a Weibull distribution.

T F 10. If a subject is lost to follow-up after five years, then the subject is left-censored.

Questions 11 to 17 refer to a Weibull model run with the "addicts" dataset. The predictor of interest is CLINIC (coded 1 or 2) for two methadone clinics for heroin addicts. Covariates include DOSE (continuous) for methadone dose (mg/day), PRISON (coded 1 if patient has a prison record and 0 if not), and a prison–dose product term (called PRISDOSE). The outcome is time (in days) until the person dropped out of the clinic or was censored. The Weibull survival and hazard functions are, respectively, $S(t) = \exp(-\lambda t^p)$ and $h(t) = \lambda p t^{p-1}$ where $\lambda^{1/p} = \exp[-(\alpha_0 + \alpha_1 \text{CLINIC} + \alpha_2 \text{PRISON} + \alpha_3 \text{DOSE} + \alpha_4 \text{PRISDOSE})]$ for the AFT parameterization and $\lambda = \exp[\beta_0 + \beta_1 \text{CLINIC} + \beta_2 \text{ PRISON} + \beta_3 \text{DOSE} + \beta_4 \text{PRISDOSE}]$ for the PH parameterization. The Stata output for both the AFT and PH forms of the model are presented as follows:

Weibull regression
accelerated failure-time form

Log likelihood = −260.74854

_t	Coef.	Std. Err.	z	p>|z|
clinic	.698	.158	4.42	0.000
prison	.145	.558	0.26	0.795
dose	.027	.006	4.60	0.000
prisdose	−.006	.009	−0.69	0.492
_cons	3.977	.376	10.58	0.000
/ln_p	.315	.068	4.67	0.000
p	1.370467			
1/p	.729678			

Weibull regression
log relative-hazard form

Log likelihood = −260.74854

_t	Coef.	Std. Err.	z	p>|z|
clinic	−.957	.213	−4.49	0.000
prison	−.198	.765	−0.26	0.795
dose	−.037	.008	−4.63	0.000
prisdose	.009	.013	0.69	0.491
_cons	−5.450	.702	−7.76	0.000
/ln_p	.315	.068	4.67	0.000
p	1.370467			
1/p	.729678			

11. Estimate the acceleration factor with a 95% confidence interval comparing CLINIC = 2 vs. CLINIC = 1. Interpret this result.
12. Estimate the hazard ratio with a 95% confidence interval comparing CLINIC = 2 vs. CLINIC = 1. Interpret this result.
13. Estimate the coefficient for CLINIC in the PH Weibull model using the results reported in the output from the AFT form of the model. Hint: the coefficients for a Weibull PH and AFT model are related $\beta_j = -\alpha_j p$ for the jth covariate.
14. Is the product term PRISDOSE included in the model to account for potential interaction or potential confounding of the effect of CLINIC on survival?
15. Use the output to estimate the median survival time for a patient from CLINIC = 2 who has a prison record and receives a methadone dose of 50 mg/day. Hint: use the relationship that $t = [-\ln S(t)]^{1/p} \times (1/\lambda^{1/p})$ for a Weibull model.
16. Use the output to estimate the median survival time for a patient from CLINIC = 1 who has a prison record and receives a methadone dose of 50 mg/day.
17. What is the ratio of your answers from Questions 15 and 16 and how does this ratio relate to the acceleration factor?

Questions 18 and 19 refer to the Weibull model (in AFT form) that was used for the previous set of questions (Questions 11 to 17). The only difference is that a frailty component is now included in the model. A gamma distribution of mean 1 and variance theta is assumed for the frailty. The output shown on in the following contains one additional parameter estimate (for theta).

Weibull regression
accelerated failure-time form
Gamma frailty

Log likelihood = −260.74854

_t	Coef.	Std. Err.	z	p >|z|
clinic	.698	.158	4.42	0.000
prison	.145	.558	0.26	0.795
dose	.027	.006	4.60	0.000
prisdose	−.006	.009	−0.69	0.492
_cons	3.977	.376	10.58	0.000
/ln_p	.315	.068	4.67	0.000
p	1.370467			
1/p	.729678			
theta	.00000002		.0000262	

Likelihood ratio test of theta=0:
chibar2(01) = 0.00
Prob>=chibar2 = 1.000

18. Did the addition of the frailty component change any of the other parameter estimates (besides theta)? Did it change the log likelihood?
19. A likelihood ratio test for the hypothesis H_0: theta = 0 yields a p-value of 1.0 (bottom of the output). The parameter estimate for theta is essentially zero. What does it mean if theta = 0?