

## STA 6934 – Fall 2003 – Exam 5

Print Name: \_\_\_\_\_ UFID: \_\_\_\_\_

1) A study is conducted to compare the effects of a new test drug versus a standard drug in terms of reducing blood pressure. The dependent variable,  $Y$ , is the blood pressure after 4 weeks of therapy, and the predictor variables are:  $X_1$ , the patient's pre-treatment blood pressure, and  $X_2$  which takes on the value 1 if (s)he received the new drug and 0 if (s)he received the standard drug.

a) The Analysis of Covariance is conducted here in order to:

- i) Compare pre- and post-treatment scores among patients.
- ii) Test for differences between the two drugs after adjusting for pre-treatment differences among patients' blood pressures

b) The model being fit is:  $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon$ . The regression coefficients and standard errors are given below, based on a trial with  $n = 20$  patients. Test whether there's a difference between the effects of the new drug and the standard drug, after adjusting for pre-treatment blood pressure.

Variable	$\hat{\beta}_i$	$\hat{\sigma}_{\hat{\beta}_i}$
Intercept	20.0	4.0
$X_1$	0.70	0.20
$X_2$	-10.0	2.0

i)  $H_0$  :

ii)  $H_A$  :

iii) Test Statistic:

iv) Rejection Region:

v) Is the  $P$ -value **larger** or **smaller** than 0.05?

2) A study is conducted to determine whether there is an association between incidence of a particular adverse event and the dose of a nicotine patch. A sample of  $n = 100$  smokers is obtained and each is randomly assigned to one of 5 doses (20 smokers per dose). The outcome observed is whether the subject suffered the adverse event during the 3 day period (s)he wore the patch.

a) This is an example of logistic regression because:

- i) The independent variable is nominal with two levels and the dependent variable is numeric.
- ii) The dependent variable is nominal with two levels and the independent variable is numeric.
- iii) Both the independent and dependent variables are nominal with 2 levels.

b) The fitted equation and standard error for the dose coefficient are below. Test whether there is an association between dose and the presence of adverse event at the  $\alpha = 0.05$  significance level.

$$\hat{\pi}(x) = \frac{e^{-5.0+0.5x}}{1 + e^{-5.0+0.5x}} \quad \hat{\sigma}_{\hat{\beta}} = 0.125$$

i)  $H_0$  :

ii)  $H_A$  :

iii) Test Statistic:

iv) Rejection Region:

v) Is the  $P$ -value **larger** or **smaller** than 0.05?

c) Give the estimated probability of an adverse event when the dose is 10.

d) Give the estimate of the ratio of the odds of an adverse event for a dose of  $x + 1$  to the odds of an adverse event for a dose of  $x$ .

3) On *Temptation Island*, a CDC epidemiologist is studying the time it takes until inhabitants contract a sexually transmitted disease. Every day, she tests each inhabitant (except for the known carriers (one male and one female), who have been placed on the island in her experiment). Besides the carriers, there are 10 men and 10 women. The following table gives the dates of occurrences of diagnosed STD's for males and females.

Males						Females					
$i$	$t_{(i)}$	$n_i$	$d_i$	$\hat{\lambda}_i$	$\hat{S}(t_{(i)})$	$i$	$t_{(i)}$	$n_i$	$d_i$	$\hat{\lambda}_i$	$\hat{S}(t_{(i)})$
1	4	10	1	.100	.900	1	9	10	1	.100	.900
2	7	9	2	.222	.700	2	15	9	1	.111	.800
3	10	7	2			3	18	8	1		
4	12	5	1			4	20	7	2		

a) Complete the table, obtaining the Kaplan–Meier estimates of the survival functions.

b) On the following plot, identify the survival functions for males and females.

4) A model is fit to estimate the relative risk of catching a particular disease for patients receiving a new drug ( $x_1 = 1$ ) versus patients receiving a placebo ( $x_1 = 0$ ), after controlling for age ( $x_2$ ), body mass index ( $x_3$ ), and smoking status ( $x_4 = 1$  if smoker, 0 if nonsmoker). The following statistics are obtained from fitting the proportional hazards model.

Variable	$\hat{\beta}_i$	$e^{\hat{\beta}_i}$	95% CI for $e^{\beta_i}$
$x_1$	-0.70	0.50	(0.41,0.61)
$x_2$	0.05	1.05	(1.01,1.09)
$x_3$	-0.01	0.99	(0.93,1.05)
$x_4$	0.45	1.57	(1.16,2.12)

a) Is the risk of catching the disease **higher**, **lower**, or **equal** for the new drug group relative to the placebo group at the  $\alpha = 0.05$  significance level? Briefly explain why you conclude this.

b) Which individual would have the higher estimated risk of catching the disease?

i) Received Placebo, age=50, BMI=22, nonsmoker

ii) Received New Drug, age=60, BMI=18, smoker

5) A nonlinear regression model is fit, relating therapeutic response ( $Y$ ) to dose of a drug ( $X$ ). The fitted model is:

$$\hat{y} = \frac{30x}{15 + x}$$

a) What is the maximum effect predicted by this model?

b) Give the predicted responses at doses  $x = 0, 30, 60$

**Have a Safe and Relaxing Semester Break !!!**