

	coef	exp(coef)	se(coef)	z	p
rxLev	-0.0423	0.959	0.1103	-0.384	0.70000
rxLev+5FU	-0.3787	0.685	0.1189	-3.186	0.00140
extent	0.4930	1.637	0.1117	4.412	0.00001
node4	0.9154	2.498	0.0968		

1) These are data from one of the first successful trials of adjuvant chemotherapy for colon cancer. Levamisole is a low-toxicity compound, 5-FU is a moderately toxic chemotherapy agent. The treatment was nothing, levamisole, or levamisole and 5-FU. Y is time until death. The 4 predictors are $x_1 = 1$ if treatment was levamisole, $x_2 = 1$ if the treatment was levamisole and 5-FU, $extent$ of local spread (treated as a variate with 1=submucosa, 2=muscle, 3=serosa, 4=contiguous structures), and $node_4 = 1$ for more than 4 positive lymph nodes. (Two indicators x_1 and x_2 were used for the treatment.)

a) Find the ESP and $\hat{h}_i(t)$ if $\mathbf{x} = (0, 1, 2, 1)$.

$$ESP = \hat{\beta}'\mathbf{x} = -0.0423(0) - 0.3787(1) + 0.4930(2) + 0.9154(1) = 1.5227$$

$$\hat{h}_i(t) = e^{\hat{\beta}'\mathbf{x}} \hat{h}_0(t) = e^{1.5227} \hat{h}_0(t) = 4.5846 \hat{h}_0(t)$$

b) Find a 95% CI for β_1 . $\hat{\beta}_1 \pm 1.96 SE(\hat{\beta}_1) =$

$$-0.0423 \pm 1.96(0.1103) = -0.0423 \pm 0.2162 = (-0.2585, 0.1739)$$

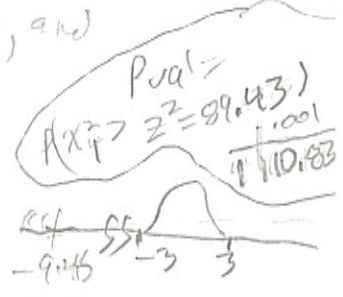
c) Do a 4 step test for $H_0: \beta_1 = 0$. $H_A: \beta_1 \neq 0$

- ii) $z_{01} = -0.384$
- iii) $p_{val} = 0.70$

10) fail to reject H_0 , rxLev is not needed in the PH survival model given $x_2 = rxLev+5FU$, extent, and node4 are in the model

→ d) Do a 4 step test for $H_0: \beta_4 = 0$. $H_A: \beta_4 \neq 0$

- ii) $z_{04} = \frac{0.9154}{0.0968} = 9.4566 \approx 9.46$
- iii) $p_{val} = 2 P(Z < -9.46) = 0$



10) reject H_0 , node 4 is needed in the PH survival model given $x_1 = rxLev$, $x_2 = rxLev+5FU$ and extent are in the model

2) For the same data as in 1), R output says Likelihood ratio test=122.

Do a 4 step test for $H_0: \beta = 0$.

$$H_0: \beta = 0 \quad H_A: \beta \neq 0$$

$$\chi^2(N/F) = 122$$

$$\frac{df \quad .001}{4 \quad 18.47}$$

$$pval = P(\chi_4^2 > \chi^2(N/F)) = P(\chi_4^2 > 122) = 0 (< 0.001)$$

reject H_0 there is a PH survival relationship between times Y and the predictors

$x_1 = rxlev, x_2 = rxlev + sfu$, extent and node 4.

	coef	exp(coef)	se(coef)	z	p
age	0.00147	1.00148	0.00402	0.37	0.714
perfor	0.05396	1.05544	0.26656	0.20	0.840
adhere	0.30843	1.36129	0.12592	2.45	0.014

Likelihood ratio test=6.2 on 3 df, p=0.102

n= 929, number of events= 452

3) The above output is for the same data as 1), but now the model uses the predictors *age* and *perfor* = perforation of the colon (0 or 1), and *adhere* = adherence to nearby organs (0 or 1).

Do a 4 step test for $H_0: \beta = 0$. $H_A: \beta \neq 0$

$$(i) \chi^2(N/F) = 6.2$$

$$(ii) pval = 0.102$$

(iv) fail to reject H_0

there is not a PH survival relationship between times Y

and the predictors *age*, *perfor* and *adhere*.