Cox Regression Models: Inference for β and HR

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STAT 417

OUTLINE

Discussion

Recall the one predictor CR model:

$$h(t|X) = h_0(t)e^{\beta X}$$

Suppose that the true ratio of hazards for two values of X is $e^{\beta c} = 1$.

1. What does this imply about the true of β?

2. What does this imply about the variable X?

Hypotheses

What hypotheses should we use to determine if a single predictor X is associated with the hazard of event occurrence?

H_0:

H_a:

Wald test

The Wald test statistic is given by:

NELS college graduation data

R Output

```
                          coef exp(coef) se(coef)     z Pr(>|z|)
as.factor(Gender)1 0.20862   1.23197  0.08141 2.563   0.0104 *
```

R Output

- State the hypotheses.
- Show the computation of the test statistic.
- State a conclusion about the relationship between gender and the hazard of graduating at $\alpha = 0.05$ level of significance.

CI for β

- The $100(1-\alpha)\%$ CI for β is given by:
- Interpretation:

NELS college graduation data

R Output

```
                          coef exp(coef) se(coef)     z Pr(>|z|)
as.factor(Gender)1 0.20862   1.23197  0.08141 2.563   0.0104 *
```

R Output

Construct and interpret a 95% CI for β.

CI for *HR*

- Categorical predictor (X=0/1): the hazard ratio for subjects with $X = 1$ to subjects with $X = 0$ is:
- Quantitative predictor: the hazard ratio corresponding to a c unit change in X is:
- Generally, a $100(1 - \alpha)\%$ confidence interval for *HR* is:

Discussion

What value should we see if a confidence interval for the hazard ratio contains in order to determine if X is associated with hazard?

A. 0
B. 0.5
C. 1
D. none of these

NELS college graduation data

R Output

```
                        coef exp(coef) se(coef)     z Pr(>|z|)
as.factor(Gender)1 0.20862   1.23197  0.08141 2.563   0.0104 *
```

R Output

Construct and interpret a 95% confidence interval for the hazard ratio of female to male students.

NELS college graduation data

R Output

```
Call:
coxph(formula = Surv(Years, Censor) ~ as.factor(Gender), data = grad

  n= 1000, number of events= 614

                        coef exp(coef) se(coef)     z Pr(>|z|)
as.factor(Gender)1 0.20862   1.23197  0.08141 2.563   0.0104 *
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1

                    exp(coef) exp(-coef) lower .95 upper .95
as.factor(Gender)1      1.232     0.8117      1.05     1.445

Concordance= 0.53  (se = 0.012 )
Rsquare= 0.007   (max possible= 0.999 )
Likelihood ratio test= 6.61  on 1 df,   p=0.01016
Wald test            = 6.57  on 1 df,   p=0.01039
Score (logrank) test = 6.59  on 1 df,   p=0.01025
```

VALCG lung cancer study

R Output

```
             coef exp(coef)  se(coef)      z Pr(>|z|)
karno -0.033424  0.967129  0.005075 -6.586 4.51e-11 ***
```

R Output

Construct and interpret a 95% confidence interval for the hazard ratio for a 10 unit increase in Karnofsky score.

VALCG lung cancer study

R Output

```
Call:
coxph(formula = Surv(time, status) ~ karno, data = veteran)

  n= 137, number of events= 128

          coef exp(coef)  se(coef)      z Pr(>|z|)
karno -0.033424  0.967129  0.005075 -6.586 4.51e-11 ***
---
Signif. codes:  0 *** 0.001 ** 0.01 * 0.05 . 0.1   1

      exp(coef) exp(-coef) lower .95 upper .95
karno    0.9671      1.034    0.9576    0.9768

Concordance= 0.709  (se = 0.03 )
Rsquare= 0.264   (max possible= 0.999 )
Likelihood ratio test= 42.03  on 1 df,   p=8.983e-11
Wald test            = 43.38  on 1 df,   p=4.513e-11
Score (logrank) test = 45.32  on 1 df,   p=1.674e-11
```


VALCG lung cancer study

1. Provide the 95% confidence interval for both β and HR corresponding to a 1 point increase in Karnofsky score.

2. Construct a 95% confidence interval for both β and HR corresponding to a 10 point increase in Karnofsky score.

VALCG lung cancer study

3. How would you respond to a claim that the risk of dying from lung cancer decreases by more than 25% for a 10 point increase in Karnofsky score?