

#### Problem 4

- (a) The Cox regression model assumes that the hazard for a subject with covariates  $x_i$  is given by

$$\lambda(t; x_i) = \lambda_0(t) \exp(\beta_1 x_{i1} + \beta_2 x_{i2} + \dots + \beta_k x_{ik})$$

The baseline hazard corresponds to the hazard for an individual with  $x_i = (0, 0, \dots, 0)$  and thus  $\beta_1 x_{i1} + \dots + \beta_k x_{ik} = 0$

- (b) The model is called the Cox proportional hazards model because if we compare the hazard for a subject with covariates  $x_i$  and a subject with covariates  $x_j$  we get

$$\frac{\lambda(t; x_i)}{\lambda(t; x_j)} = \frac{\lambda_0(t) \exp(\beta_1 x_{i1} + \dots + \beta_k x_{ik})}{\lambda_0(t) \exp(\beta_1 x_{j1} + \dots + \beta_k x_{jk})}$$

and this does not depend on  $t$ . Thus, the hazards are proportional.

- (c) The coefficient of sex is equal to  $-0.551$ . An approximate confidence interval for the coefficient is

$$(-0.551 \pm 0.394) = (-0.945, -0.157)$$

↑  
 $1.96 \times \text{SE}$

Thus females have a lower hazard and higher survival.



The hazard for females is 0.576  
of the hazard for males.

exp(coef)

An approximate 95% CI for this multiple  
is (0.389, 0.855)

exp of other CI

- (d) The fitted model indicates that sex=female decreases hazard (increases survival) by a factor of 0.576. The higher the ECOG score, the higher the hazard (lower survival) and the hazard increases by ~~2.08~~ 2.08 per unit increase in ECOG. The higher the physician Karnofsky score the higher the hazard (multiplied by 1.02 per unit). No other factors were significant but weight loss has a borderline significant decrease effect on hazard.